THE 'LEARNING BUREAUCRACY': NEW UNITED MOTOR MANUFACTURING, INC.

Paul S. Adler

ABSTRACT

The human aspects of Japanese manufacturing management techniques, in particular those used in repetitive operations such as automobile final assembly, are currently under intense debate. Some observers applaud the Japanese approach's reliance on teamwork, workers' problem-solving and multiskilling. Other observers denounce what they see as work intensification, management by stress, and ultra-Taylorism. This study contributes to the debate through an analysis of New United Motors Manufacturing, Inc. (NUMMI), a joint venture between General Motors and Toyota that began operation in Fremont, California in 1984. The plant appears to have sustained exceptional levels of productivity, quality, and worker motivation. Seeking to understand the determinants of these performance and attitudinal outcomes, this study focuses on the role of the organization of production, and specifically the significance of the high levels of formalization and standardization with which work at NUMMI was regimented. Relying on qualitative evidence from a small number of in-depth interviews, the study develops three key ideas. First, the case suggests that Taylorist principles of "scientific management" can be implemented in despotic or democratic ways, with very different effects on performance and attitudinal outcomes. Second, it suggests that the outcomes of highly bureaucratic organizations depend on whether their workflow procedures are designed to enforce the compliance of a workforce assumed to be irresponsible and recalcitrant or, alternatively, to encourage learning on the part of a workforce assumed to share a common goal of production efficiency and quality. Third, the NUMMI case suggests that organizational outcomes depend not only on the design of these formal systems but also on the characteristics of the informal aspects of the organization. Some implications of these ideas for our understanding of the psychology and the politics of work are also suggested.

Research in Organizational Behavior, Volume 15, pages 111-194.

ISBN: 1-55938-522-7

INTRODUCTION

The human aspects of Japanese manufacturing management techniques are currently under intense debate. This debate has focused in particular on the techniques used by Japanese automobile manufacturers (such as described by Monden, 1983; Schonberger, 1982; Suzaki, 1987; Womack, Jones & Roos, 1990). The significance of these techniques for the quality of worklife has been interpreted in two very contrasting ways. On the one hand, some observers applaud the Japanese approach's reliance on teamwork (Kenney & Florida, 1988), workers' problem-solving and multiskilling (Koike, 1988), and the resulting motivational characteristics of their job designs (Womack, Jones, & Roos, 1990). On the other hand, other observers interpret differently the same facts or focus on different facets of these operations, and denounce what they see as work intensification (Kamata, 1983), management by stress (Parker and Slaughter, 1988), and "ultra-Taylorism" (Dohse, Jürgens & Malsch, 1985). The exceptional productivity and quality of these Japanese plants and the growing wave of overseas investment by Japanese auto manufacturers combine to add urgency to this debate.

Not too far from the surface of this debate is a broad range of more theoretical questions. This study concentrates on some key issues within the orbit of organization theory, in particular the significance of these management practices for our understanding of bureaucratic forms of organization. But a discussion of these issues cannot but implicate issues such as worker motivation that fall more naturally within the orbit of organizational behavior research, and issues surrounding industrial relations that concern political scientists.

This study contributes to these debates through an analysis of New United Motors Manufacturing, Inc. (NUMMI), a joint venture between General Motors (GM) and Toyota that began operation in Fremont, California in 1984. GM has had responsibility for marketing the plant's main products (the Nova, then the Geo Prizm), while Toyota controlled the design of the cars and the plant operations.

The NUMMI case presents a number of particularly interesting features. First, the plant's design and operating philosophy were a very close copy of Toyota's Takaoka plant in Japan. Kamata (1983) has given a harrowing account of his experience of exploitation and alienation as a temporary worker at Toyota City. Observers have thus been eager to learn how U.S. workers would respond to the intense discipline for which Toyota is renown. Second, 85% of the workers hired by the new company were former employees of the GM-Fremont facility that NUMMI took over, and the United Auto Workers (UAW) continued to represent them. The GM-Fremont plant had an abysmal record of productivity, quality and labor strife. When it closed in 1982, there were over 700 outstanding grievances, and absenteeism was running at approximately 25%. Its productivity and quality were among the worst in the

whole GM system (see data below). Observers have thus also been eager to learn how well the plant would perform in terms of productivity and quality.

Within two years of start-up, the new plant had become the most productive auto assembly plant in the United States and the quality of the plant's principal product, the Nova, was ranked by consumers and internal GM audits in the highest category among domestic and foreign cars. Moreover, worker morale seemed high: in the first four years of operation, only some 30 grievances had been filed, of which only three had gone to arbitration; absenteeism averaged 2.5%; personnel turnover averaged between 6% and 8%; and over 70% of the workers annually participated in the suggestion program, contributing on average approximately 6 suggestions per employee. Over the more recent years, the plant has sustained these exceptional levels of business and personnel management performance.

Many possible explanations of NUMMI's performance have been advanced by different observers. This study is lengthy because I present a rich enough tableau to allow the reader to appreciate the plausibility of several of the most popular explanations. However, this study focuses primarily on the role of the organization of production, and specifically the significance of the intense discipline and detail with which jobs at NUMMI are regimented. My interest in this feature was aroused when I first had the opportunity to visit NUMMI in 1987. One of the managers described Toyota's technique of standardized work as "the intelligent interpretation and application of Taylor's time and motion studies." Indeed, NUMMI's system of standardized work was very close to Frederick Taylor's ideals: each gesture was analyzed as scientifically as possible, the optimum sequence was selected, and everyone performing that task had to employ the prescribed sequence (for descriptions of the principles of standardized work, see Monden, 1983; Schonberger, 1982; Suzaki, 1987). NUMMI seemed to fit Cole's (1989) description: "Japanese managers have achieved a more thorough-going implementation of scientific management to an extent that its founder, Frederick Taylor, could not have even imagined" (p. 23).

On the other hand, NUMMI departed from what some consider an important part of the Taylorist tradition, because work teams themselves established their methods. Indeed the plant had no Industrial Engineers responsible for defining methods, whereas the old GM-Fremont plant had 82 IEs. But teams were not in any way autonomous in defining these methods, since methods had to be identical across shifts, and had to be negotiated with teams upstream and downstream. In another departure from classical Taylorism, workers were encouraged to constantly refine these methods so as to improve safety and quality and to reduce waste. But the methods in place at any given time were to be respected down to the second. The work was regimented in its minutest gestures, far more so than at GM-Fremont. Even the process of revising the methods was intensively standardized at NUMMI,

with a detailed procedure for assessing their adequacy and for proposing changes.

This work design was itself part of a broader set of policies governing NUMMI operations, a policy set the organization calls the "NUMMI production system." Apart from job design, this system encompassed inventory and production control, continuous improvement, quality, and work organization. As I will show below, these policies formed a closely interlocking set of disciplines which together created an intensely regimented "workflow bureaucracy" (Pugh & Hickson, 1976). The system certainly helped people "work smarter," but everyone in the plant agreed that they were also working harder than at GM-Fremont.

This system was not without its critics both within and outside the plant (e.g., Parker & Slaughter, 1988). But no one disputed that workers preferred working at NUMMI to GM-Fremont. Moreover, my interviews at NUMMI with enthusiasts as well as with critics associated with the People's Caucus lead me to conclude that even the critics were generally in favor of the system. The criticisms were, with very few exceptions, directed at what workers saw as avoidable flaws in the implementation of the system, not at the system itself.

How can one explain the workers' positive response to such intense standardization and formalization? On this narrower question too, there are several competing explanations. One factor is obviously that NUMMI's approach afforded workers significantly more participation in the design of these procedures than they had in the GM environment. This is clearly an important factor—participation is its own reward (Miller & Monge, 1986). But if the resulting regimentation were the chains that both the critics of Japanese management and much conventional organizational theory assume it is, then the participation-driven enthusiasm would not last for long. Seven years after start-up, however, the NUMMI plant still ranked among the most productive in the world and its products still drew top quality reviews.

Without denying the importance of several other factors that could help explain this apparent paradox of intense regimentation and high morale, my analysis will focus on three interrelated elements of an explanation. First, I will suggest that Taylorist principles of "scientific job design" can be implemented either in despotic or in democratic ways, depending on whether the work standards are imposed on or codeveloped by workers, with very different effects on performance and morale. NUMMI's approach to job design, I will argue, reflected a more democratic version of Taylorism, a version that sustained both performance improvement and worker morale. Second, shifting the level of abstraction up a notch, I will extend this proposition to suggest that highly bureaucratic organizations characterized by high levels of standardization and formalization can design their procedures either to enforce the compliance of a work force assumed to be irresponsible and recalcitrant or, alternatively, to encourage learning on the part of a work force assumed

to share a common goal of production efficiency and quality. I argue that NUMMI had a learning orientation to the design of its bureaucracy, and that this approach, too, contributed to performance and morale. Third, I suggest that NUMMI's performance and morale were sustained by the combination of these learning-oriented characteristics of the organization's "formal" systems with the distinctive characteristics of its "informal" organization—its culture, the fabric of trust between workers and managers, and the balance of power between labor and management. While a single case can neither prove nor disprove a theory, my analysis of NUMMI suggests that this combination of democratic Taylorism, learning bureaucracy, and cooperative culture contributed to NUMMI's exceptional performance and morale.

This study is based primarily on interviews with workers and managers. The next section describes my research methods. This is followed by a sketch of the history and general characteristics of NUMMI's management and a summary of its performance. I then identify several possible explanations of this performance. This leads to a more detailed study of the NUMMI production system, a summary of workers' responses to its various elements, and to a characterization of workers' assessments of NUMMI as a whole. The Discussion section develops the three ideas introduced in the preceding paragraph and explores some of their implications for our understanding of both the psychology and the politics of work. The Conclusion sketches some implications for future research.

RESEARCH METHODS

Following my first 1987 plant visit, I proposed to the senior member of the GM management team at NUMMI that I prepare a case study for classroom use. He agreed to take the idea to NUMMI's management team, and they agreed on the principle and focus of the case. I had insisted that the case would only be worthwhile if it expressed all the competing points of view, and these managers must be thanked for their willingness to support that goal.

The first source of data is publications by NUMMI management and the voluminous literature that has appeared on NUMMI in the business and academic press. This study will use and cite these sources where appropriate.

The second data source is a series of semistructured interviews. The first set of interviews was with managers and employees on site. Each interview lasted one hour, but with two informants (Mark Hogan and Bill Borton) I had several rounds of discussion totalling three and five hours respectively. The interviews followed a common interview guide. The guide covered the following themes: personal background; impressions of NUMMI's start-up; assessment of the NUMMI production system, employment conditions, and

union-management relations; comments on the values that seemed to govern NUMMI operations; assessment of NUMMI results from whatever points of view seemed relevant to the interviewee; lessons learned, again from the point of view of whatever stakeholders seemed relevant to the interviewee; and thoughts on the future of NUMMI.

I tape-recorded, transcribed, and edited these interviews (with the help of a research assistant, Gary Robinson), and submitted them to both the individual interviewees and then to management for release approval. Some minor changes were made by individual interviewees where they felt I had misconstrued their comments; but no changes were requested in the subsequent review by management.

Independently, but with management's assent, I interviewed three union officials, one from the then-majority faction of Local 2244 (the "Administration Caucus"), a second from the minority faction (the "People's Caucus"), and a third from the UAW International. These interviews followed the same format, but sometimes lasted several hours. They were conducted in the union hall across the street.

In order better to understand the dissenting views, I asked union officials from the People's Caucus to arrange a discussion with some of their supporters among the production workers. Two of them, Carlos Romero and Lamar Huntzinger, were interviewed off-site.

These union interviewees were also given the opportunity to correct any errors in my transcript. I explained to them that if the interviewees were going to appear in a case for classroom use, I felt obligated to allow management to review the material. I suggested to Romero and Huntzinger that they could use pseudonyms if they preferred, to which they responded: "Management already knows what we think. We have nothing to hide."

These first and second sets of interviews were subsequently published along with other materials on NUMMI (Adler, 1991). Since then, I have had the opportunity to re-interview several of the original informants, and to interview somewhat less formally several other workers and one engineer. Since these later interviews were not included in the published case material, I will refer to these interviewees only by their initials. The list of interviewees and their job titles at the time of the interviews is given in Table 1.

As compared with a survey, the reliance on interviews had the advantage of depth, allowing me to explore more deeply the ambivalence of the interviewees and the responses that surprised me. But it is not obvious that all the different views have been heard. I confess that I cannot even claim to have reached "theoretical saturation," since each new follow-up interview revealed exciting new issues to be explored. So this case study and my commentary on it must be considered provisional.

Table 1. Interviewees

Bill Borton, Stamping Dept. Manager
Bill Childs, General Manager, Human Relations
Gary Convis, Vice President, Manufacturing
Kan Higashi, NUMMI President and Chief Executive Officer
Mark Hogan, Manager, General Affairs and Comptroller
Ted Holman, Team Leader, Body Shop
Lamar Huntzinger, Team Member, Assembly
Rick Madrid, Team Leader, Quality Control
George Nano, Bargaining Committee Chairman, UAW
Carlos Romero, Team Member, Assembly
Bob Silva, Team Leader, UAW People's Caucus
Joel Smith, UAW West Coast Representative
B, Team Member
S, Team Member
K, Team Leader
D, Engineer

NUMMI: AN OVERVIEW

A Brief History

Discussions between GM and Toyota about a possible joint venture began in early 1982.[1] In February 1983, the two firms reached an agreement in principle to establish an operation that would produce a subcompact car at the former GM assembly plant in Fremont, using the production system developed by Toyota. GM would be responsible for marketing and sales for the new product, the Nova, a renamed Corolla; Toyota would be responsible for product design and engineering, the design and daily operation of the manufacturing system, and the marketing and sales of the Toyota FX; and the new entity, NUMMI, would manufacture and assemble the cars. A timeline of some key events in NUMMI history is given in Table 2.

The objectives of the two partners were complementary. GM wanted to learn about the Toyota production system. GM would also obtain a high-quality subcompact for its Chevrolet division, at a time when GM's market share was eroding rapidly. Toyota's motives, according to a NUMMI Community Relations Department publication (cited in Adler, 1991) were "to gain experience with American unionized labor and with American suppliers. By establishing a manufacturing presence in the United States, Toyota sought to help diffuse the trade issue between the United States and Japan."[2] Some 65% of the value of NUMMI's product was American in origin.

Shortly after the initial agreement was reached, the new venture began discussions with the UAW. A Letter of Intent was signed between the venture

Table 2. A Timeline of NUMMI

February 1983
Toyota Motor Corporation and General Motors Corporation sign an agreement in principle to produce a small car in Fremont.

September 1983
United Auto Workers and Joint Venture sign Letter of Intent.

February 1984
NUMMI officially organized as an independent California corporation.

April 1984
Federal Trade Commission approves Joint Venture.

June 1984
First group of 30 NUMMI trainees arrives at Toyota's Takaoka Plant in Toyota City for training.

December 1984
First Chevrolet Nova produced.

June 1985
First agreement between UAW and NUMMI signed.

December 1986
Full second shift operations begin.

September 1986
First Toyota Corolla FX16 produced.

February 1987
First Corolla FX produced.

May 1987
Production schedule cut by 8% because of lower-than-expected sales.

August 1987
Schedule cut another 8%.

November 1987

Schedule cut another 18%.

September 1988
Last Nova and Corolla FX16 and first Corolla sedan produced.

November 1988
First Prizm produced.

April 1990
Decision to build truck line reached.

August 1991
First truck produced.

and the UAW in September 1983. The Letter of Intent stipulated that the UAW would be recognized as the bargaining agent for the venture's employees; that the company would pay prevailing U.S. auto industry wages and benefits; and that a majority of the work force would be hired from among the workers laid off from GM-Fremont (but seniority would not be a factor). In return, the UAW agreed to support the implementation of a new production system and to negotiate a new contract. A new collective bargaining agreement was signed in June 1985. It gave the UAW a full complement of 15 full-time representatives as well as 67 union coordinators in the plant. The coordinators' role is to help resolve problems through discussion. They are allocated two hours overtime pay per week for this task.

NUMMI took over the old GM-Fremont facility located 35 miles southeast of San Francisco. GM-Fremont opened in 1963 and closed in 1982. It reached its peak employment of 6800 hourly employees in 1978, then progressively shrank and eventually closed in 1982 leaving 5,700 workers laid off. Between 1963 and 1982, the plant's UAW work force acquired a reputation for militant action: the plant shut down four times for unauthorized strikes and sickouts, making it one of the more militant in the GM system.

According to Bill Childs, NUMMI's manager of human resources, "At first, Toyota didn't really want the United Auto Workers in the plant. They'd heard about problems at the GM-Fremont plant and didn't want any part of it. But Toyota realized that the Fremont plant was the best facility for a joint venture with GM and, since the UAW had de facto control of the plant, they'd have to bite the bullet" (quoted in Adler, 1991).[3] In fact, GM did not offer Toyota any alternatives for siting the new venture. GM was concerned about possible union backlash at other plants, and hiring a majority of GM-Fremont workers was necessary if NUMMI was legally to recognize the UAW without a vote.

Because the joint venture involved the world's largest and third largest auto firms, the Federal Trade Commission approved the venture subject to the stipulation that its production of cars for sale to GM should not continue for more than 12 years. The approval was opposed by both Chrysler and Ford, and Chrysler appealed to the FTC in January 1984. GM and Chrysler settled the suit, adding other limitations, in particular, that GM people could only be on its staff for 8 years and that not more than 250,000 units per year could be produced for GM (Ordover & Shapiro, 1985).

The company was formally organized in February 1984. GM and Toyota each contributed $100 million to capitalizing the joint venture. GM's capital contribution was in the form of the Fremont plant, while Toyota's was in cash.[4]

NUMMI began hiring in May 1984. Of 5300 applications sent to former GM-Fremont employees, 3,200 were returned.[5] Over the next 20 months, 2,200 hourly team members were hired, approximately 85% of them from the old GM-Fremont plant, including the entire union hierarchy. Some 300 salaried employees were also hired.

Each applicant for the manager, Group Leader, Team Leader and Team Member positions had to pass the same three-day assessment test. This included production simulations, individual and group discussions, written tests, and interviews. The applicants for hourly jobs—Team Leaders and Team Members—were evaluated jointly by managers and union officials. During the negotiation of the Letter of Intent, the union had insisted that the company offer compelling reasons for rejecting a candidate and that an arbitration procedure be established to handle disputes over selection (Smith & Childs, 1987). The union also played a significant role in selecting the non-GM management personnel (Jacobson, 1986, p. 50). The 16 GM managers who were to spend a three-year sting at NUMMI were selected using novel criteria too. A pool of candidates was created from personnel files, selecting individuals with the appropriate experience, education, work evaluations and age. These candidates were invited to interview in Detroit. Jacobson (1986, p. 47) quotes from two GM managers responsible for conducting these interviews their key selection criteria: "honesty, humility, groupism [group orientation], sensitivity, listening ability, and communication ability."

The composition of the resulting work force reflected its GM-Fremont origins. Since GM-Fremont had not done much hiring in the years preceding its shut-down, NUMMI's work force was unusually old compared to other assembly plants, the average age being 41. Most hourly employees had a high school education. Some 26% were Hispanic, 20% black, and 15% female.

Before starting their new jobs, new hires participated in a four-day orientation program that explained the team concept, production system, quality principles, attendance rules, safety policies, labor-management relations, housekeeping, and competitive conditions in the auto industry.

The first group of 450 Team Leaders and Group Leaders attended a three-week classroom and on-the-job training program at the Takaoka plant. Toyota trainers trained them on the Takaoka assembly line. (The entire NUMMI management team also went through this training program.) These Team Leaders then served as trainers for newly hired Team Members. Team Leaders selected their team's members from among the candidates who had passed the evaluation test.

The Team Leaders and Team Members participated in setting up the plant. New equipment was installed and old equipment reorganized. NUMMI was a fairly conventional auto assembly plant in its overall physical configuration. Overall, it was a relatively "low tech" plant.[6] The one distinctive feature was that it was one the few U.S. final auto assembly plants with its own stamping facility. The manufacturing process is summarized in Table 3.

Actual production of the Nova began in December 1984. Volumes were increased only slowly, to allow the new hires to master the Toyota/NUMMI production system. Full first-shift production was reached in October 1985. Hiring for the second shift began in summer 1985, and the second shift reached full production in April 1986. Production of the Corolla FX-16 began in September 1986.

Table 3. NUMMI Assembly Process

1. Stamping Plant
   - rolled steel
   - 26 presses between 400 tons and 2600 tons
   - stamp 35 major body panels—hoods, doors, fenders
2. Body Shop
   - various metal parts and panels are welded together
   - 170 robots
   - approximately 3800 welds used to form each body
   - each body checked for defects in metal or welds
3. Paint Shop
   - coating
   - sealing
   - painted—9 different colors with 4 combinations of 2-tone paint available
   - oven dried
4. Assembly
   - final assembly line is 1.3 miles long
   - most of the 2000 parts added as body travels along line
5. Inspection

Source: Presentation by M. Hogan, Stanford University, December 4, 1987.

Nova sales were sluggish. NUMMI had still not reached its breakeven point even in 1991. Industry observers were critical of GM's marketing effort ("Little Car That Didn't," 1988. Amongst other problems, "no va" means "it doesn't go" in Spanish. As a result, the assembly line was slowed down in June 1986 and several times in 1987. Even though NUMMI was operating at only 58.6% of its production capacity in 1988 (*San Jose Mercury,* May 31,1989, citing a study by Autofacts, Inc.), management fulfilled its pledge and did not lay anyone off. Team members displaced from direct production jobs were given training or put on other assignments in the plant, most frequently in "kaizen" (continuous improvement) teams.

In 1990, Toyota announced that it would invest a further $350 million to set up an assembly line to produce Toyota trucks for the U.S. market. This would require hiring some 650 hourly workers, in addition to the 2,500 currently employed, and 100 salaried employees.

Strategy, Structure, Policies, and Culture

NUMMI's strategy is summarized in Table 4. In the words of NUMMI's president at the time, Kan Higashi, "Our business strategy is very simple: build cars at the highest quality and lowest possible cost."[7]

Table 4. NUMMI'S Strategy

Fundamental Goal

To produce products with quality as high as anywhere in the world while assuring that product costs are the most competitive of any manufacturer.

Supporting Policies

- Foster stable and cooperative relationship between all team members, particularly labor and management.
- Effectively implement philosophy that "Quality should be assured in the process itself."
- Establish long-term and stable relations with qualified suppliers.
- Maintain cooperative, friendly relationship in community and maintain company image of being a fair employer and neighbor.

Supporting Practices

- Quality is assured in the production process itself.
- Continuous efforts to reduce costs and eliminate waste in all operations.
- Develop team member potential through practice of mutual trust and respect and in addition:
  - recognize worth and dignity of all team members;
  - develop individual and team performance;
  - improve work environment.

Source: Presentation by M. Hogan, Stanford University, December 4, 1987.

This strategy was reflected in NUMMI policies. The labor/management policies reflect a commitment to what Higashi called the "team concept":

> The team concept is not just the small groups on the shop floor. It also applies to the plant as a whole. The bigger team is the workers, managers, engineers and staff all working together to constantly improve our product. This way, the workers see that the company isn't the property of management, but of everyone together. And the key to this team concept is trust and respect.

This policy was embodied in management's commitment to joint union/management investigation of work problems; advance consultations on layoffs, schedule changes, and major investments; and joint union/management review of unusual or mitigating circumstances in advance of discharges or suspensions.

This cooperation was also embodied in NUMMI's no-layoff policy. The collective bargaining agreement of 1985 stated:

> New United Motor Manufacturing, Inc. recognizes that job security is essential to an employee's well being and acknowledges that it has a responsibility, with the cooperation of the Union, to provide stable employment to its workers. The Union's commitments in Article II of this Agreement are a significant step towards the realization of stable employment. Hence, the Company agrees that it will not lay off employees unless compelled to do so by severe economic conditions that threaten the long term viability of the Company. The Company will take affirmative measures before laying off any employees, including such measures as the reduction of salaries of its officers and management, assigning previously subcontracted work to bargaining unit employees capable of performing this work, seeking voluntary layoffs, and other cost saving measures.

The no-layoff policy was not without some sacrifice for workers. Not only did the union have to agree to many changes in operating philosophy, but in exchange for NUMMI's commitment to avoid layoffs, the contract exempted NUMMI from contributing the GM's Supplemental Unemployment Benefits scheme, the scheme that assured GM workers with ten years seniority of 95% of their pay until retirement in case of layoff. Without this Supplemental pay, laid off workers would only get Unemployment Insurance, whose benefits were substantially lower.

Management saw this no-layoff commitment as a crucial part of their overall strategy:

> • *Hogan, Comptroller and General Manager of General Affairs:* There's no question in my mind but that the commitment to no layoffs and the ability of managers to operate on a day-to-day basis in a way that supports this underlying philosophy are absolutely crucial to our success. Team members know that when they contribute ideas for more effective operations they are not jeopardizing anyone's job. And that's fundamental, since they know more than any manager or industrial engineer about how to improve our efficiency and competitiveness.
>
> • *Gary Convis, VP, Manufacturing:* We plan to move heaven and earth to adhere to NUMMI's no-layoff policy. Before anyone got laid off, everyone from top to bottom would take pay cuts, we would take on work like security and janitorial tasks that are currently done by outside contractors—and there's about 200 relatively unskilled outside contractors—and we would probably try to put workers into sales. The idea is the workers and managers take an equal dose of the hardships. If drastic measures like those aren't enough, then at least the workers would see that NUMMI has done all it could to preserve their jobs.

In 1987 and 1988, management's commitment was sorely tested. As explained by Hogan:

> The takt-downs[8] [during 1987] left us with a total of 264 more workers than were warranted by our production level. One hundred of them were assigned to preparing for the 1989 new car introduction and to ongoing kaizen projects. With the other 164 slots, we rotated everyone through 128 hours of training each in quality, safety, kaizen principles, problem-solving and standardized work.
>
> Then, in late December, we had to takt-down yet again. We were really at our limit—these slowdowns hurt morale in the plant. So, after a lot of agonizing and extensive discussions with the union, we decided to do three things: order a mandatory vacation shutdown of 5 production days, cut the scheduled buildout of the 1988 model by 10 days, and ask all the employees to take three nonproduction days. We gave them three options on these three days: (a) they could take their paid vacation time, or (b) they could take unpaid leave, or (c) if they did not have enough vacation time saved they could work that week. For those that did work, we had them doing construction and maintenance work,

> saving over $100,000 we would have otherwise spent on outside contractors. We also had them performing the year-end inventory count, but since our policy is to keep as little inventory as possible so that only saved us $30,000. Others worked on housekeeping or bringing their standardized worksheets up to date.

NUMMI's strategy was also reflected in its organizational structure. There was only one classification for Division 1 personnel, as opposed to over 80 in the GM-Fremont contract. The number of skilled trades classifications had also been reduced from 18 to 2—general maintenance and tool-and-die. Production workers were organized into approximately 350 production teams. Each team was made up of some five to seven people and a Team Leader. Toyota management was philosophically committed to this small team size, arguing that larger teams were ineffective in promoting participative decision making and did little to encourage team bonding (see also Jacobson, 1986, p. 85).

Team Leaders were nonxempt employees. They played a role somewhere between the old-style "utility man" (multi-skilled worker able to fill in for a broad range of positions) and foreman. The Team Leader filled in for absent workers; trained new workers; assisted workers having difficulty in their jobs; recorded attendance; assigned work when the line stopped; assisted team members in minor maintenance and housekeeping; assessed new team members; led Kaizen efforts; and organized social events outside the plant.

Four teams comprised a group, which was led by a Group Leader who constituted the first layer of management personnel. There were about 110 Group Leaders in the plant.

Quality, too, played a key role in NUMMI's strategy. In Higashi's words: "Quality should be built into the process—it should not be possible for anyone to pass along any defects to the next person." NUMMI and Toyota call this the "jidoka" principle. Bill Borton, Manager of the stamping operation, described the quality policies in his department thus:

> NUMMI's stamping operation scrap rate is 0.2 percent versus a typical 3 or 4 percent in a GM plant. Part of the reason is that NUMMI is the only stamping plant in the world in which everybody is allowed to do repairs. And you'll notice that there are no repair areas in the stamping department. That's totally different from what you'd see in an American plant where faulty parts are repaired by a special group. At NUMMI, we repair all the parts as they come off the line. We don't have inspectors on the production line. Although we have nine people who perform periodic inspections, we want to build a culture where inspection is everybody's job.

The suggestion program was a key element of NUMMI's continuous improvement process. The design of the suggestion program reflected and

buttressed several features of NUMMI's strategies and policies. For example, the relatively low rewards for labor savings as compared to materials savings was consistent with NUMMI's no-layoff policy, both reflecting NUMMI's approach to labor as a fixed cost. In Bill Borton's words:

> NUMMI's suggestion program has monetary rewards, but they're mainly small. We want to encourage quantity, the number of suggestions, rather than just focusing on suggestions with big payoffs. So I try to hold the line at least 95% acceptance. Even ideas that we reject are rarely just killed. The Group Leader or manager will go back to the team who made the suggestion and we work with them to find some better alternatives for achieving the same objective.
>
> Suggestions are rewarded at about $1.00 per point, and if you saved the equivalent of a whole person on the line, which saves the company about $50,000 per year, that would earn you a grand total of about 70 points. If you saved that same amount in materials you would earn 1,100 points.
>
> Although the financial rewards are relatively small, having your suggestion approved is a big deal among the workers. We try to give people this kind of peer recognition whenever possible—it creates an environment for continual improvement.
>
> Let me give you a couple of examples of employee innovation at NUMMI—only about one-quarter of the lights are ever on in the inventory holding area. One of the workers suggested that we just didn't need them. Another employee suggested that the lighting switchbox use color-coded circuit breakers: one color for "always on," one color for "only on at night," and a third color for "only on during certain hours of the early morning and late afternoon." GM wouldn't even allow plant workers access to a circuit breaker box—they'd be worried about sabotage.

Compensation at NUMMI followed the national UAW contract. Under the 1985 contract, production workers earned $13.28 per hour plus cost of living and shift premiums. The 1991 contract brought this up to $17.85 an hour. This was some 10 to 30 cents higher than other GM plants, since NUMMI paid for the lunch break.[9] There was a 90-day probation period, beyond which the contract did not allow individual performance appraisals or incentives, nor for any "pay-for-knowledge" type pay increments. New hires reached full pay after 18 months; the 1991 contract extended this to 24 months and lowered the starting rate from 85% to 75%. Team Leaders earned 40 cents an hour more than Team Members which was raised to 60 cents in 1991.

Childs explained the overall philosophy of compensation as follows:

> Hourly workers make the same rate regardless of their job. There used to be 80 hourly worker classifications with varying pay rates under the old system. This caused workers to grumble over why one worker got a 5 cents an hour more

> than someone else for what looked like equally strenuous work. We don't have those kinds of arguments any more. And that makes a big difference to our productivity. We've also decided against giving hourly workers seniority, performance or merit-based bonuses. While it's true that money is important, we found that salary equity is even more important in keeping the work force satisfied.

Attendance is an important policy issue at NUMMI, at least in part because of the traditions established at GM-Fremont. Absences are recorded daily and displayed publicly for all—including managers. As compared to GM, absenteeism penalties were harsh. Childs explained the policy:

> At GM-Fremont, they argued all the time over whether worker absences were excused or not excused. If a dispute dragged on, then a grievance got filed and a lot of time was wasted fighting it out. Things are much simpler at NUMMI. We've eliminated the distinction between excused and unexcused absences. Instead, after three occurrences within a 90-day period, we submit a write-up [a written warning]—automatically. After three more occurrences within 90 days, there's a write-up and a warning; and three more gets you a final warning. The worker is given counseling after the second and third warnings in an attempt to help them solve their attendance problem, but after three more occurrences you're out.
>
> The advantage of this system is that to apply it properly you only need to be able to count to three. The old system allowed for too much disparity of treatment across departments, and disparities like that really poison the atmosphere. But we do have to allow for extenuating circumstances, and we've set up a committees to review cases at each level of severity. To date, we've had to let over 80 employees go for absenteeism problems. There really hasn't been much union opposition to these cases because they were pretty clearly people who weren't going to fit in. We're just now going to have our very first arbitration on one of these cases.

NUMMI's strategy, structure, and policies were buttressed by its culture. Three features of NUMMI's culture were particularly noticeable—consensus, consistency, and communication.

Higashi described Toyota's consensus decision process (*ringi-sho*) and the difficulty of implementing it at NUMMI in these terms:

> It took us almost one full year to work out how to apply the ringi-sho style of management communication and decision-making. In Japan, it's traditional to get as many opinions as possible before taking a decision and to make the decision as much as possible on a consensus basis. It took us a year to translate that into a process that the American managers could understand and begin to feel comfortable with. For example: American managers are used to being free to use their own department's budget however they think is appropriate, while for

> us, even if you have the budget, you should still get consensus from other department managers on specific nonrepetitive projects that you want to spend it on. We think it's a good system because your colleagues might have some valuable suggestions or important concerns, and also, when it comes to implementing your decision, the other department will be more cooperative. But American managers were used to another way, and it took a long time for them to become comfortable with our way.

Hogan described his own reactions to the *ringi-sho* system in these terms:

> [It] has been a common stumbling block for many incoming GM managers here at NUMMI. I stubbed my toe and damn near broke it a few times getting used to it. One of my biggest problems as a manager here was knowing when consensus is supposed to be consensus and when I'm just supposed to agree with the decision.

Consistency in employee relations was a key feature of the NUMMI culture. This dedication to consistency was not lost on NUMMI workers. Even supporters of the People's Caucus such as Carlos Romero were impressed:

> Japanese managers are really smart and cool under fire—I've never yet seen a Japanese manager get excited. On the other hand, an American manager will cuss you out at the drop of a hat! The Japanese managers also take their jobs a lot more seriously. For example: I had oil dripping from above my station and onto my head for over a year and our American management did nothing about it even though I complained regularly. One day a Japanese visitor walked by and I pointed out the leak to him. About 1/2 hour later he came back with a few workers to lay down some canvas to catch the dripping. The next day, more people came by and blocked the leak with a metal plate, sealing the leak for good. That's what I call results!

Hogan described the challenges created by this commitment to consistency:

> At GM, it's easy to slip into the mentality of: "Just do it—I've got a production schedule to meet." The biggest challenge for managers coming into NUMMI is the absolute commitment to consistency to all our principles, not just to a production schedule set by Marketing. At NUMMI, we've got to walk like we talk. In time, this should even win over the skeptics [among the workers].

Communication was a third outstanding feature of NUMMI culture. Borton described the extensive communication effort in his department:

> We have monthly department meetings of all the team members. Typically, I give the teams the same report I give our managers. We first discuss the previous month's sales of the Nova and FX; next we discuss plant safety and encourage

people to remain vigilant. Then we talk about quality as reported to us by GM's quarterly quality control audit. Next we go into job attendance—right now, we're on target for our 95% objective (and that 5% includes vacations). Then we'll discuss the suggestion rate and report back on the status of employee suggestions. We then give some data on line performance that month, die change times per shift, scrap, and energy costs. The remainder of the meeting is opened for general questions—and the questions often put me on the hot seat. At the end of the meeting we often spend some time discussing the status of the various kaizen teams.

Plant Performance

The productivity of the NUMMI plant has been extensively analyzed by Krafcik (1986).[10] Some key indicators of NUMMI's performance are summarized in Table 5.

The key conclusions are first, that labor productivity, both corrected and uncorrected for differences in product and technology, was much higher at NUMMI than at the old GM-Fremont plant in 1978 and at the GM-Framingham plant. (Krafcik chose Framingham because it was a GM plant

Table 5. NUMMI Productivity Comparisons

	Framingham	*GM-Fremont*	*NUMMI*	*Takaoka*
Uncorrected Productivity (hrs/unit)				
Hourly*	36.1	38.2	17.5	15.5
Salaried	4.6	4.9	3.3	2.5
Total	40.7	43.1	20.8	18.0
Corrected Productivity** (hrs/unit)				
Hourly*	26.2	24.2	16.3	15.5
Salaried	4.6	4.9	3./3	2.5
Total	30.8	48.5	19.6	18.0
Product Quality (*Consumer Report* Reliability Index)	2.1-3.0	2.6-3.0	3.6-3.8	3.8-4.0
Space Utilization (sq. ft/unit/year)	8.1	7.9	7.0	4.8

Notes: *Excluding stamping, molding, and seat assembly personnel.
**Corrected for number of welds, welding automation, product size, relief time, and option content.
Source: Krafcik (1986).

somewhat comparable in product and technology mix to NUMMI.) By 1986, NUMMI was almost as productive as its sister plant in Takaoka and more productive than any other GM plant. This performance is all the more impressive when it is recalled that the NUMMI work force was on average some 10 years older than Takaoka's, and younger workers are in general better equipped to deal with the pressures of assembly line work.

Second, the quality of the vehicle as rated by the *Consumer Report* reliability index, was much higher than at GM-Fremont or Framingham, and almost as good as Takaoka's Corolla/Tercel lines sold in the United States during 1984-86. Krafcik also cites internal GM quality data on end-of-the-line inspections (Corporate Quality Audit) and owner surveys (CAMIP) that mirror these results.

Finally, space utilization at NUMMI showed a modest improvement over Framingham and GM-Fremont, but was still far from the Takaoka level. This reflects that fact that the GM facilities, including Fremont, were all designed to stock several weeks of parts. NUMMI parts inventories averaged two days. This inventory level was still above the two hour level prevailing in Takaoka, primarily due to difficulties in running true Just-In-Time from Japan and the U.S. Midwest.

These comparisons with the Takaoka plant are particularly useful, because one of the factors contributing to NUMMI's productivity and quality performance was the "producibility" ("manufacturability") of the Nova design. Not only was the design already in production—which meant that most of the produciblity problems that the original design may have had were already ironed out—but Toyota was renowned for its ability to assure a high level of producibility in its original designs.[11] The fact that NUMMI's overall performance had reached a level so close to Takaoka's suggests that this performance level was not due exclusively to the products' producibility.

Turning from technical to human outcomes, various indices suggest that workers' responses have been largely positive. Higashi:

> The change from the Fremont plant conditions has been enormous. Absenteeism is down from 20-25% to 3-4%. When Fremont closed, they had over 700 grievances outstanding. NUMMI has had a total of 30 grievances with only one still pending.

Hogan also cited the suggestion rate and the low frequency of substance abuse:

> One measure of how well NUMMI is doing is participation in the suggestion program. We've got about a 50% participation rate—which is just phenomenal. But then again, Toyota's rate is about 100%. Another pretty impressive thing about NUMMI is that we have a minimal problem with substance abuse. You

could have bought literally anything in the old Fremont plant, and substance abuse was a major concern.

More recent data indicate that these extraordinary technical and human results persisted into 1991. The J.D. Power surveys of the number of problems experienced by customers within 90 days of purchase slipped from 117 per 100 vehicles in 1989 (compared to an industry average of 151 for all cars sold in the United States) to 145 in 1990 (versus an industry average of 142) with the introduction of the Prizm, and then went back down to 117 in 1991 (versus an industry average of 140 with an average of 121 for Asian nameplates and an average of 153 for U.S. nameplates.)[12] Absenteeism held steady at 3%, participation in the suggestion program had increased to over 90%, and internal surveys showed that the overall proportion of people describing themselves as satisfied or very satisfied with work at NUMMI had increased from around 80% to over 90%.

EXPLAINING NUMMI PERFORMANCE

In sum, NUMMI's performance was remarkable in both business and human terms. There are several possible explanations for this success. This study will not attempt to formulate a comprehensive explanation; instead, it will focus on one possible factor, NUMMI's production system. But before turning to discussion of the production system, we should at least review some of the other factors that probably also contributed to NUMMI's performance.

There are, first, some contextual factors that probably contributed to NUMMI's performance. One might argue that NUMMI's success reflected that fact that the workers were cowed by their experience of unemployment and their continuing fear of renewed unemployment. Brown and Reich (1989) cite data from the California Employment Development Department indicating that 40% of the displaced GM-Fremont workers were still unemployed at the end of 1983, and that displaced workers who did find jobs in other industries experienced pay cuts averaging approximately 40%.

Proponents of the view that NUMMI's success is at least partly due to workers' fear of unemployment can be found among workers;

- *Romero:* A lot of us don't have that good of an education. If they close the plant on us, there aren't too many people who will pay us the $13.00 an hour we get here. Management knows that and they play off our fear of getting fired to keep us in line and to overload us with work. They're constantly reminding us, in subtle and not so subtle ways, that if we don't play ball, the whole plant could shut down. So it's still fear tactics that drive this place. Take an example: once a year we have this big meeting where top management explains their goals for the year. At the last one, they made it very clear—one of their key goals was

> to negotiate a contract 'suited to the economic situation.' We may not have that good an education, but we can understand when they're dangling the threat of closing down.
>
> • *S:* A lot of people are still scared. The truth is that NUMMI doesn't make money, and people are really scared of being laid off again. I know that every single day that I come into work I think about the risk of this plant closing down. We never had to think about that with GM. Our only concern was temporary layoffs, and then you used to get paid 95% of your pay. No one imagined that you wouldn't get recalled eventually.

Bargaining Committee Chairman, George Nano, however, presented a powerful argument against the idea that this fear can fully explain NUMMI's performance:

> Sure, having the plant close down made re-hired workers more receptive to NUMMI's approach. But if the old management had come back and managed the plant as they did before, then workers would have gone back to doing things just like we did before. Over the years, plenty of plants have closed down and plenty of workers have been laid off, but they never saw the kind of quality and productivity improvement we got here because they never changed management's approach.

A second contextual factor that could have contributed to NUMMI's performance was the careful selection process. As explained earlier, workers were carefully screened through three days of tests, leading some observers to conjecture that the real troublemakers were weeded out in the process.

But the earlier description also showed the considerable influence wielded by the union in hiring decisions: not only was the entire union hierarchy rehired, but so too were well-known rank-and-file plant militants.[13] The union filed hiring decision grievances in only four cases. It is difficult to disagree with the conclusion reached by Brown and Reich (1989): "What emerges as impressive, then, is not a weeding-out process of hiring, but rather the high rates of rehiring" (32). Moreover, the most plausible assumption is that the 2,500 workers laid off from GM-Fremont who did not apply for jobs at NUMMI probably had on average greater success in finding reasonable alternatives.

If three days of screening tests eliminated so few applicants, what function did they serve? This question leads to a third possible explanation: One might argue that these tests were part of a subtle socialization process designed to instill a new set of values in the new work force. NUMMI's hiring and training process worked to create a sense of collective purpose and to undercut any "we/they" divisions between workers and management. Jacobson's (1986) discussion of NUMMI's early history highlights several powerful socialization processes that plausibly contributed to workers' positive response to their

experience at NUMMI through processes such as commitment, rationalization, shaping the saliency of information, and enactment (as highlighted in Pfeffer and Salancik's [1978] social information processing model):

- "[W]hen NUMMI announced that it would use a similar method of simulation and role playing to screen 3,200 hourly workers applying for jobs, the world was shocked. It was unheard of to expend that much time simply on the selection of an hourly worker" (p. 51). Holman described his experience in these terms: "I'll never forget when I was first hired by GM many years ago. The personnel manager who hired us got the dozen workers who were starting that day into a room and explained: 'You new employees have been hired in the same way we requisition sandpaper: we'll put you back on the street whenever you aren't needed any more.' How in the hell can you expect to foster a loyal and productive work force when you start out hearing stuff like that? At NUMMI, the message when we came aboard was: 'Welcome to the family.' That's the difference."
- "Of the first 3,200 hourly applicants, 78% were initially rejected. Those who were hired were congratulated by managers and union officials as having been selected to a special work force that was going to produce the highest quality vehicle in the U.S." (p. 52). (Most of these 78% would be accepted in later rounds of hiring.)
- Team members were selected by Team Leaders, adding to their sense of importance.
- Team Leaders were only paid 40 cents an hour more than Team Members (this was later increased to 50 then to 60 cents). "Surprisingly, over 95% [of those offered Team Leader positions] took the job" (Jacobson, 1986, p. 54)—the result is surprising, but a policy of minimal pay differentials is consistent with the psychological research on cognitive dissonance and commitment.
- Jacobson (1986) describes the way NUMMI management responded quickly to requests from workers and union officials for items like new gloves and floor mats, a response that surprised workers accustomed to seeing requests such as these turn into battles over management prerogative. "Something very strange has happened," writes Jacobson. "After being given everything they asked for, many of the committeemen found themselves actually feeling a little 'guilty.' They responded by trying to think of ways they might be able to reciprocate. During the first year, union officials approached management and informed them that chrome water fountains were not necessary, and that they had located some plastic ones for half the price. When news of this got to the Japanese Vice President, Higashi, it was said his face broke into a broad smile, and

he said, 'We are progressing very well. Our union leaders are doing their jobs.' A few weeks after that incident, committeemen were given accounts so that they could order supplies for their team members without having to file requests through management" (pp. 68-69).

- "The group and team leaders that would work together in the same departments travelled to Japan together" (p. 62).

The trip to Japan by the first group of employees seemed to have played a powerful role in shaping workers' expectations. Silva presented a darker side of this socialization:

> When we went to Japan, we found that a lot of people weren't put in the areas where they were going to work. It seemed logical to use our time in Japan to actually learn about the jobs we'd be doing. Management could never explain why that wasn't happening. My explanation is that the main reason we were sent there was to see how hard the Japanese workers are forced to work, so that when we got back here and the pressure built up, the Group Leaders would be able to tell us to be grateful that it's not as bad as in Japan.

While these "start-up" conditions clearly contributed to NUMMI's performance, it is difficult to see how workers' morale and performance could have been sustained over the subsequent years without an appropriately designed management system. In Higashi's words:

> Being out of work for two years certainly was a factor in changing the attitudes of a lot of workers. But at the same time, I think our philosophy helped change their attitudes—we treated our employees as human beings. Some workers have told me that in other plants they used to be called by their numbers.

To quote a worker: "The interesting thing about this place is that they never stop making you feel important" (Jacobson, 1986, p. 52).

This suggests that alongside the contextual and start-up conditions, the set of factors explaining NUMMI's performance should include the design of its management system as a whole—its structure, policies, and culture—and the high level of congruence or fit between this management system and the business strategy. The previous section highlighted a number of distinctive features of this management system, and their contribution to worker motivation and to performance would seem hard to underestimate.

While the specific contributions of various components of this management system deserve more attention, the debates concerning Japanese manufacturing management methods require that we clarify in particular the role played by the production management component. The focus of the next section is therefore on what NUMMI calls its "production system." This notion

corresponds to what organization theory refers to as the "technical system," which Berniker (1987, quoted by Weick, 1990) defines as the "specific combination of machines, equipment, and methods used to produce some valued outcome."[14]

As the next section will show, this technical system was tightly linked to the other components, both buttressing and relying on them. The NUMMI case is, I believe, particularly interesting in what it can tell us about how the technical system can be designed to complement the other facets of the organization.

THE NUMMI PRODUCTION SYSTEM

This section describes both NUMMI's production system and workers' evaluations of each of its elements. Several managers and workers argued that this system was the foundation of the superior performance achieved by NUMMI, and their argument is supported by the more general analyses of observers such as Monden (1983), Schonberger (1982), and Suzaki (1987).

This section gives disproportionate attention to NUMMI's standardized work methodology, which in the view of many of my informants was at the heart of the production system. It is this standardized work methodology that raises most acutely the question of Taylorism.

After outlining the concept of a production system, each constituent element of it will be examined in turn. Each subsection will briefly describe the nature of an element and then summarize the diverse views on its significance expressed in the interviews. I leave until the following section the question of workers' overall evaluation and the relative frequency of favorable and unfavorable views.

The Idea of a "Production System"

The idea of a production system is itself something of a novelty in many U.S. manufacturing plants. According to Nano:

> The crazy thing is that for so many years, GM had no real production system—no system for organizing production, at least nothing that people on the floor ever saw. Maybe once upon a time they had a system. But not in my 20 years at GM. At NUMMI, we've got a comprehensive system that ties together in a defined and disciplined way standardized work, just-in-time inventory, preventive maintenance, quality control—a system that everyone on that shop-floor understands and respects.

This definition was echoed by Joel Smith, the West Coast UAW representative who was responsible for the NUMMI plant and instrumental in establishing the Letter of Intent:

> The Toyota production system is an integrated set of concepts. The Japanese believe that stable employment and building a quality product will earn them more market share and a substantial return. So they have a set of policies that reflect that policy. And it goes right down to the details, like how to encourage worker input. But all the concepts form an interlocking whole. Without that integration, you could get a team together but nothing would happen. Everybody would likely ask for the same thing at the same time and clog the system up. I think a lot of people who visit or hear about NUMMI latch onto one particular aspect and think that they've got the key. But unless you get the whole package, there's a good chance none of it will have much impact.

The idea of a "production system," then, implies (a) a fine-grained characterization of the operating policies of the plant's technical system, (b) a high degree of consistency between these policies, and (c) a high level of discipline in respecting these policies in day-to-day functioning. Workers and managers at NUMMI contrasted the plant with their prior auto industry experience along all three dimensions.

The key elements of the NUMMI production system were modelled directly on Toyota's system. They are summarized in Table 6. The following subsections review each of the key techniques in turn.

Kanban

Nummi did not use a computerized scheduling system. Instead, signs—*kanban*—would be passed to the upstream department whenever a pallet or dolly needed to be replaced. When no kanban arrived, the upstream department stopped production because no inventory was allowed to build up.

Behind this innocuous-sounding innovation lies a fundamental shift in management methods, away from the reliance on work-in-progress inventory as a way to buffer tasks from upstream variability, towards a tightly-coupled system in which problems at any point in the process trigger a complete halt (Schonberger, 1982).

Hogan explained the benefits of lower inventory in these terms:

> That saves us inventory carrying costs. Less inventory also improves quality because bad parts are easier to spot and because when there's less inventory around the workers have an incentive to be continually on the look-out for bad parts.

The implications for workers were considerable. Such a Just-In-Time system is at the polar opposite of the system used at Volvo's Kalmar plant, where buffer inventory was a key mechanism for assuring the autonomy of the production teams: "Each work group has its own buffer areas for incoming and outgoing carriers so it can pace itself as it wishes and organize the work

Table 6. The NUMMI Production System

Objectives
- Reduce costs by eliminating waste
- Assure product quality
- Worksites able to change quickly
- Respect, mutual lrust, and support of team members

Concepts
- Thorough rcmoval of waste
- Just-in-Time production
- Quality assurance (Jidoka)
- Full utilization of worker capabilities

Techniques
- Kanban
- Production Leveling
- Kaizen
- Visual Control
- Team Concept
- Standardized Work

Source: Presentation by M. Hogan, Stanford University, December 4,1987.

inside its own area so that its members work individually or in subgroups to suit themselves" (Gyllenhammar, 1977).

If the production process never experienced any interruption, the presence of buffer stock would be unnecessary. But the workers from the People's Caucus were critical of NUMMI's ability to implement this method of inventory management. Romero:

> During training for kanban, they told us that we'd never run out of parts at our stations. But we run out of parts about two or three times a week They have never gotten this system right.

The challenge of the kanban system from the workers' point of view was that it created intense pressure whenever there is the slightest hiccup. Bob Silva highlighted this difficulty:

> As far as we can see, they're screwing up their own system. The ideas sound great. But in practice the pressure is too great. [...] [T]he pressure means that people turn against each other. Even when they're not bickering, when the team's under pressure people try to meet the team's expectations and under peer pressure, they end up pushing themselves too hard and getting hurt. The team concept is a nice idea, but when you put the teams under pressure, it becomes a damn effective way to divide workers. So this is becoming an unhappy place to work. You don't

> see that many people doing the morning exercise routine any more, and even attendance at potlucks is going down. The vehicle quality isn't suffering because people still want to do good job. But morale is dropping.[15]

Production Levelling

The second facet of NUMMI's production system was the effort to assure as stable as possible a production schedule. Quoting Borton:

> At the typical auto assembly plant, managers [...] never know ahead of time how many cars they'll be producing. Their schedules are constantly changing. So what they do is fix the line speed—and that varies between about 50 seconds and 80 seconds a car—and get more or less output by constantly adding or subtracting overtime and taking on and laying off shifts. At Toyota and NUMMI, we stabilize the schedule over several months, and make minor adjustments to the line speed. In the U.S. auto industry they let schedules change and destabilize everything but never touch the line speed.

The logic of the NUMMI approach was that changing production levels meant inevitably that inventory levels would be higher, quality could not be assured, and improvement efforts would be stymied.

There were two challenges in levelling the production schedule. First, agreements had to be made with the marketing organization. Second, the assembly line had to be made sufficiently flexible to handle variations in the product mix, in particular by the reduction of set-up times. But once these challenges had been met, a takt time could be set, and this would serve as the foundation for just-in-time inventory (kanban), the detailed analysis of tasks (standardized work) and continuous improvement (kaizen).

From the workers' point of view, this production levelling had two important advantages. First, it reduced the stress associated with schedule changes in a taut production system. As Silva explained, in a Just-in-time inventory management system, any changes create a lot of stress as workers scramble to reestablish equilibrium. Second, production levelling minimized the risk of temporary layoff by reducing the risk that part of the work force would be temporarily underemployed.

Kaizen

Borton explained the kaizen policy in these terms:

> We have a really intense focus on improving the little things. Take an example: all stamping operations throw away the first and last few sheets from the steel coils because they're usually wavey and tough to run through the stamping process. Our people took the time to redesign the process so we didn't have to

> waste those pieces. We also get some really great, bigger projects as well. For instance, we have two teams working right now on reducing the sheet size and steel gauge—those could save us half a million dollars a year.

All NUMMI workers were given training in problem-solving for continuous improvement kaizen efforts.[16] This training familiarized workers with a formalized six-step process: (1) identify the problem and define the goal, (2) analyze the problem, (3) generate potential solutions, (4) select and plan the solution, (5) implement the solution, and (6) evaluate the solution.

Hogan explained the link between kaizen and the no-layoff policy:

> Team members know that when they contribute ideas for more effective operations they are not jeopardizing anyone's job. And that's fundamental, since they know more than any manager or industrial engineer about how to improve our efficiency and competitiveness.

Kaizen created important challenges for both management and the work force. Borton again:

> In most other plants I've worked in, the issue is not coming up with employee suggestions—workers always have lots of interesting ideas on how things can be done better. The real problem is that the maintenance and engineering people never give workers' suggestions a high enough priority, which means that worker suggestions don't get implemented.
>
> In stamping, we've had some fantastic kaizen efforts. We've got a team working right now on reducing our downtime ratio on the presses. It's amazing to see these workers doing statistical analysis of two hundred or three hundred downtime incidents. Some of these guys didn't finish high school. They've been auto workers for thirty years and no one ever gave them any training before. Now they're putting together Pareto charts. One team member told me recently that he had to do literally a hundred graphs before he managed to get one right—no one had ever taught him to do a graph. He was so proud of what he'd done. So was I—his group has done a damn good analysis and they're coming up with some great improvement ideas.

The challenges were not exclusively technical ones. Huntzinger explained the social problems associated with Kaizen:

> The idea at NUMMI is that if I have a problem with my job, I first take it to my Team Leader, and if they can't solve it we take it to the group, and if together we can't solve it we go to the Group Leader and then the coordinator and the committeeman and then there's other steps. But the problem is that a lot of people are rushing straight to the committeeman. They short-circuit the process. That get's everyone frustrated, and the committeeman usually doesn't know how to handle the problem. People aren't used to this system and it takes a long time to change old habits.

Visual Control

Visual control was set of techniques designed to signal abnormal conditions as rapidly and automatically as possible. Kanban was one form of visual control, signalling the need to replenish an inventory pallet. Another key element of visual control at NUMMI was the "andon"[17] board lights that signalled quality problems on the line. Workers pulled a "line stop" cord when they encountered a quality problem, thus ensuring that it received top priority. As expressed by Convis:

> Workers at NUMMI are supposed to pull the cord every time they see a quality problem. That will stop the line unless the cord is pulled again before the next vehicle is due to enter the team's work-space. So when a team member pulls the cord for a problem, the team leader comes over and if the problem can be solved quickly or off-line, they pull the cord again to resume production. That means that many of the pull-cords don't actually shut the line down, because they operate as a communication system between team members, team leaders and other parts of the plant. But I'd say we have about 100 pull-cords a day on the final assembly line and about 30 minutes line stoppage per shift. And we can measure our quality progress by the gradual reduction over time in the number of pull-cords and line stoppage time.

The commitment to quality implied by this willingness to sacrifice production was appreciated by workers at NUMMI. But the critics pointed out some potentially important failings in the implementation of this quality commitment. Silva:

> The cord pulling routine is the biggest bunch of baloney to hit this plant since we began! At first, workers were told to pull the cord if there was a quality problem at their station. But lately, there's been a lot of pressure to avoid doing it—Group Leaders run right over and immediately re-pull the cord behind them to restart the line and keep things going. Sometimes they don't even stay around to find out why you pulled the cord. My guess is that upper management is on Group Leaders' back—they have people upstairs who calculate who is creating the downtime. They scrutinize it very closely and put pressure on the Group Leader. But it sure tells the workers where the priorities are.

Later interviews reveal that the problems mentioned by Silva appeared to have been temporary. But the effective implementation of the visual control policy clearly requires a very high degree of management discipline.

Team Concept

Under the team concept at NUMMI, workers were organized in small production teams; the other facet of the team concept, the cooperative relations between union and management, will be addressed in the next section.

Workers in each team were cross-trained on each others' tasks and rotated between tasks. Madrid contrasted the rotation principle with the old seniority-based system:

> Rotating jobs means that everyone in the team is contributing as much as everyone else. In the traditional plant, older workers with more seniority would get the easier jobs. There was a kind of justice in that I suppose, because you do slow down as you get older. But it led to a lot of bickering. Now we've eliminated those easy jobs by rotation, and if someone has a harder time on one job because they're older or their hands aren't big enough, the team helps out by rotating faster so that at least the worker isn't killing himself for a whole day at a time on that particularly difficult job.

In practice, the rotation was not as systematic as planned. As described by Huntzinger:

> Every job in this plant is supposed to be rotated. In reality, nearly half the positions end up not rotating. It might be because someone can't lift a heavier part or because a left-handed worker needs the tools on the other side of the job. And often it's because we simply don't have the time to teach the other team members, so they can't rotate. But that leaves a lot of us doing the same lousy job all day.

In the earlier discussion of kanban, Silva was quoted on an important downside of this team organization—the peer pressure that results when teams are put under production pressure. He had a second, distinct criticism of the way the rotation principle was implemented:

> I like the principle of job rotation. But there are some really exhausting jobs out there on the line, and management tries to get around having to change these jobs by rotating people through them, hoping that workers will say: "Since I'm not going to be in this job all day, I won't say anything." When you do that, people get hurt with strained backs and so on.

There were other concerns about the implementation of the production team concept, focussed on favoritism in selecting Team Leaders. These will be discussed in the next section.

Standardized Work

Borton summarized the nature of NUMMI's standardized work methodology in these terms:

> Standardized work is really the intelligent interpretation and application of Taylor's time and motion studies. [...] The first thing you do is teach workers the techniques of work analysis. Next, you get the workers as a group to time each other with a stopwatch. Running between stations is not allowed because the idea is not to do things quickly, but to find a way of doing the job at a pace that can be sustained over the long haul. After everybody has been timed, workers analyze what they think is the best performance and break that process down into little pieces. They take each of these job parts and explore ways of improving them even further. All this leads to a way of doing the job that everybody agrees with. The team leader compares this job definition against the best performance of the team on the other shift. The best way of doing the job is codified and people then do the job as we've specified in the standardized work definition. The point is to get workers to participate in defining the standards and encourage them to constantly make suggestions to improve them.
>
> In Japan, even though everyone is trained and understands standardized work, it's usually the Team Leader that performs the standardized work analysis. And that seems to work out OK because of the level of trust they have with their team members. Here at NUMMI, because of the history of more conflictual relations with supervisors and industrial engineers, it's really important that workers perform the analysis themselves.
>
> In Toyota's Takaoka plant, Team Leaders examine every standardized job every Monday. They are constantly looking for ways to save costs and increase process yields. You might think that this process takes a lot of time, but it really doesn't—it only takes 15-30 minutes, because they understand both the production system and the standardized work procedure. NUMMI employs the same kind of task analysis, but only when problems occur or when the line speed changes.
>
> The production people bought into standardized work very easily. They understood the technique, because it had been done to them for years; and they liked the idea, because now they had a chance to do it for themselves. Their biggest problem was that many of them don't have a lot of education, so some of the math [for statistical quality control, for example] is a bit challenging and maybe threatening. So you have to work on that. A second challenge comes from the fact that you're changing things. At NUMMI, we want people to constantly improve their standardized work and a lot of people just aren't used to that much change. So you have to work with people so they come to see that change not just as a disturbance but as an opportunity to improve things. That's hard sometimes.[18]

To this description should be added a summary of how standardized work fits into whole production system. Hogan explained the multiple interrelations in this way:

> Standardized work is simply the process that workers use to reduce variability in task performance. Every step is planned and thought out so that each person performs the task identically. The basic idea is that reduced variability and

team assessments of the jobs result in a whole series of interconnected improvements.

There are fewer injuries from strains and greater safety since workers get an opportunity to examine all the possible sources of strain and danger in a systematic way and because we rotate jobs within the team—that rotation also adds equity to the operations.

We get improved quality because workers identify the most effective procedure for the job. When you have a good procedure, any problems with equipment very quickly come to the surface. And since every worker becomes a real expert, that means that each workstation becomes an inspection station.

We also get better inventory control because we have a much more finely-tuned and well-balanced process. That saves us inventory carrying costs. Less inventory also improves quality because bad parts are easier to spot and because when there's less inventory around the workers have an incentive to be continually on the look-out for bad parts.

Standardized work also means that each worker in the team can refer to a good procedure for doing the job, so that even if the team isn't rotating for some reason, if one team member is absent, quality doesn't go through the floor. In the old days, absences killed quality because the replacement not only didn't know the job but didn't even have a procedure to refer to for doing it right.

When you've got standardized work, you've got a clear base on which you can build to make continual improvements—you can't improve a process you don't understand.

And standardized work has the major benefit of giving control of the job to the person who knows it best—it empowers our workers.

So you see that standardized work ties together a lot of different elements of the Nummi production system. It's kind of the foundation of the whole thing.

Borton highlighted the interdependence of standardized work and the rotation of production teams:

> The traditional IE designs individual jobs, and the struggle is between the IE or the foreman and the individual worker. Here the entire team rotates through the job. So that if any individual thinks the job is overloaded, the other team members are there to either support that argument or to tell that individual that they feel the job is about right. That increases equitable treatment all around.

Holman highlighted the reliance of the standardized work methodology on cooperative interdepartmental relations:[19]

> With standardized work, the team tries to solve its own problems, and if we can't work it out, then we have engineers and managers we can turn to. In the old system, it you tried to make a suggestion, it was just a brick wall. Now the system is really a support system, instead of an authority system. You make a suggestion

> and the next day the engineer is down there working with you on how to implement it. So people actually feel good about working here.

The contrast with traditional job design practice, the province the Industrial Engineer at GM, was dramatic. Borton characterized the difference in these terms:

> Let's face it—traditional Industrial Engineering methods never had really good results. Industrial Engineers aren't close enough to the work to know what is going on right there on the line. From the worker's point of view, the IE will dump more work on you unless you beat him at his game. "Winning" means slowing down to make the job look harder than it is, especially if an IE is watching.

The workers' view of this contrast was instructive. Ted Holman, a Team Leader in the body shop, argued this way;

> I don't think IEs are dumb. They're just ignorant. Anyone can watch someone else doing a job and come up with improvement suggestions that sound good. But they don't usually take into account all the little things that explain why, from the worker's point of view, they couldn't work. And it's even easier to come up with the ideal procedure if you don't even bother to watch the worker at work, but just do it from your office, on paper. Almost anything can look good that way. Even when we do our own analysis in our teams, some of the silliest ideas can slip through before we actually try it out. There's a lot of things that enter into a good job design. Little things can make a big difference, like how high or low the stock is placed or how the tools are organized or where the hoses are. The person actually doing the job is the only one who can see all those factors. And in the U.S., engineers have never had to work on the floor—not like in Japan. So they don't know what they don't know. In the typical U.S. plant, you never even saw the IE—they stayed in their cozy offices upstairs. They never talked to workers about how to improve their jobs. Today, we drive the process, and if we need their help, the engineer is there the next day to work on it with us.

Smith put this contrast in a broader perspective:

> In most plants, management assumes the "divine right" to design jobs as they see fit. And in the U.S. auto industry, workers have historically agreed to that in exchange for high wages. Management was willing to pay a ton of money to the workers to preserve its prerogative. But in practice, the old way of setting standards was just ridiculous. An Industrial Engineer would shut himself away in an isolated office and consider how long it took for somebody to twist their wrist and move their arm in such and such a way, and calculate times from some manual and try that way to come up with a task design. The IE would take this "properly" designed job to the foreman. The foreman would nod his head, but

> then said "screw you" to the IE's back and redesigned the task to his own liking. Then he'd take his task design to the worker and said "Do it this way or you're out." The worker would nod but would pull the same trick on the foreman. In the end, the job got done however the worker could. When the boss walked by, the worker might pretend to do the job the way the foreman had told him. Everybody involved knew this was going on but no one cared enough to do anything about it.
>
> Multiply that game by the number of shifts and the number of different people involved and you've got a process you can't control. You can't build a quality car like that. You can't even go back and improve the process, because the IE lives in dream world, doesn't have a clue how the job is actually done, and doesn't have any impact. The foreman's impact is also zip. Nobody talks to the worker even though he's the one guy who can do something about the problem. Nobody wants to listen to him. That's basically how most of the auto industry operates even today. So you can see why standardized work is so revolutionary. And why most IEs are pretty uncomfortable with it!

Apart from the quality, productivity, health and motivation benefits, Borton pointed to the advantage of standardized work in increasing line flexibility:

> NUMMI can convert to a new production line speed in four to six weeks and maintain total worker buy-in. In fact, we use those changes as opportunities to redo and improve our standardized work analysis. In traditional IE-dominated shops, it might take anywhere from six months to a year to digest a new line speed. You've got to understand what it's like if you try to change the line speed in a traditional plant—the IEs have to spend thousands of hours recalculating line balance, and they are using data that doesn't have much to do with the way the line actually operates. To top it off, you've got to get the line workers to accept the changes even though they assume that you're trying to screw them any time you try to change anything. That's why in the traditional plant, if orders drop off, you can't slow down the line; you've got to lay off a shift—there isn't any other way to do it.

Childs identified the key challenges in implementing standardized work in these terms:

> There were a lot of things to learn as people started applying standardized work. It takes a lot of training in problem-solving methods and really thorough knowledge of the operations. The toughest thing so far is preventing worker overload. Balancing a team's workload occurs within the team, across shifts and between different teams. Within the team, we rotate team members through assignments. That short-circuits any attempts to protect the jobs of slower, less productive workers. Nobody can hide in our system. Across shifts, the Team Leaders compare notes and agree on a common process. And Group Leaders can reallocate work across the four teams that they are usually responsible for or to other groups that have agreed to take the work.

There is little doubt that workers at NUMMI worked harder than they did at GM-Fremont. Standard IE times at GM-Fremont were set to as to occupy the experienced worker approximately 45 seconds out of a hypothetical cycle time of 60 seconds. NUMMI's norm is closer to 57 seconds out of 60. Management's point of view was expressed by Convis in these terms:

> It is tough to sell working harder to the work force. As a manager, the first thing to understand is that you can't fool the workers. You've got to respect their intelligence by being straight with them. You just have to be very straightforward about the fact that everyone's job security depends on working both smarter and harder. But you've also got to change a lot of environmental factors before workers will buy that argument. For example, here at NUMMI, you almost never see staff people standing in the aisles. The only people you see in the aisles at NUMMI are materials delivering people. And even then, they're moving pretty fast—materials isn't the easy job it usually is in other plants. That sends a subtle but powerful message—that we're all in this together, managers and workers alike. Things like a single parking lot for everyone including executives and a single lunch room reinforce this "togetherness" idea.

The standardized work process elicited mainly positive responses from workers, but some negative ones too. Starting with the positive ones first:

> • *Madrid:* The GM system relied on authority. People with rank—the managers—ruled regardless of their competence or the validity of what they were saying. It was basically a military hierarchy. At NUMMI, rank doesn't mean a damn thing—standardized work means that we all work out objectively the best way to do the job, and everyone does it that way. I might make some minor adjustments because of my height, for example, but I follow the procedure we've laid out because it makes sense. [...] Management has delegated responsibility to the people who do the work and that gives workers a sense of pride in their jobs. [...] The great thing about standardized work is that if everyone is doing the job the same way, and we run into a problem, say a quality problem, we can easily identify where it's coming from and fix it. If everyone is doing the job however they feel like, you can't even begin any serious problem solving. [...] Standardized work does mean that we work a bit harder and we have more responsibility. A lot of people were used to sitting down and reading the newspaper between jobs. But we're competing with people around the world now, and a lot of them are hard-working people. So now we have to earn our money the old-fashioned way.
>
> • *Holman:* The average worker is definitely busier at NUMMI than he was at Fremont. That's the point of the NUMMI production system and the way it ties together standardized work, no inventories, and no quality defects. The work teams at NUMMI aren't like the autonomous teams you read about in other plants. Here, we're not autonomous because we're all tied together really tightly. But it's not like we're just getting squeezed to work harder, because it's

> us, the workers, that are making the whole thing work—we're the ones that make the standardized work and the kaizen suggestions. We run the plant—and if it's not running right, we stop it. At GM-Fremont, we only ran our own little jobs. We'd work really fast to build up a stock cushion so we could take a break for a few minutes to smoke a cigarette or chat with a buddy. That kind of "hurry up and wait" game made work really tiring. There was material and finished parts all over the damn place and half of it was defective anyway. Being consistently busy without being hassled like that and without being overworked takes a lot of the pain out of the job. You work harder at NUMMI, but I swear it, you go home at the end of the day feeling less tired[20]—and feeling a hell of a lot better about yourself!
>
> • *Nano:* Standardized work is such a dramatic change from the old way of doing things. Before, workers never got to make any input into how to set up their jobs. It was like managers used to think that they came from a different gene-pool than workers. At NUMMI, workers aren't just valued for their physical effort but also for their ideas. The workers have got stopwatches to set their own standards now. Before, standards were done by time-and-motion engineers, and the committeeman was the only worker with a stopwatch, and that was so that he could argue with management over the production standards. Standardized work gives workers the right to set up their own jobs and that means that management has to share power and cooperate with us.

Unlike his critique of some other aspects of the production system, where he focused on flaws on implementation, Romero's critique of standardized work went to the heart of the system:

> In our standardized work training, our teachers told us that we should approach our fellow team members and suggest ways to improve their jobs if we can. Hell, do you see me trying that with a team member who's 6 foot 4 and weighs 250 pounds? You'd be picking me up off the floor if I tried that. [...] Standardized work is a joke as far as I can see. We're supposed to go to management and tell them when we have extra seconds to spare. Why would I do that when all that will happen is that they'll take my spare seconds away and work me even harder than before? I'd rather just do the job the way I'm already comfortable with. At GM, we were given a task and if we finished it earlier than we were supposed to we got to rest. At NUMMI, they'll try to shove more work at you. I'm no fool.

Borton's view of this issue formed an instructive contrast:

> Our assumption at NUMMI is that people come to work to do a fair day's work. There are exceptions, and you would be foolish to ignore them. But 90% of people, if you give them a chance to work smarter and improve their jobs, and if they find that by doing that they have created free time for themselves, will spontaneously look for new things to do. I've got hundreds of examples of that.

> In the old system, the big fear was that you would be over-loaded. I don't think that people work harder at NUMMI than in other plants. Not physically anyway. But the mental challenge is much greater. Just to take an example in stamping: when we started in 1985, our best line was running at 240 pieces an hour. Now, two years later, that same line is running at close to 400 an hour, and over 90% of that increase come through training and worker suggestions for improvements.

Silva and Huntzinger also had criticisms of what they saw as flawed implementation:

> • *Silva:* I think standardized work in practice has really created a lot of problems. Even the Industrial Engineers GM used didn't screw things up this badly. Everybody should be able to perform a job at a reasonable pace. But the younger workers don't realize that rushing through their jobs will lead to unrealistic standards. The night shift has a lot of young kids working on the line, and they often set a pace that the older guys can't match. Management uses their standards against us, saying: "If the night shift can do it why can't you guys?" Of course they can, they're all young kids! In Japan, they just throw the guys over thirty years old out, into a supplier's plant and probably a lower-paying job. But this is the U.S., and people have got different values here.
>
> • *Huntzinger:* The concept of analyzing the job and working out the best way to do it is good. It gives us control over our jobs. But the concept is good only if it is applied correctly. That's exactly the problem—it's not. Workers' jobs are overloaded. If I feel that my job is overloaded, they just say that I need to get used to things and that it will get better. That's a bunch of bull. When we complain to the union, the union just says: "learn the system." [...] One of my biggest problems with standardized work is that they often don't include all the tasks I have to do. They don't want to include things like getting parts out of a storage bin or replacing a broken tool. And then I'm forced to bust my butt to keep up with a job. I'm supposed to be able to do it at a reasonable pace."

WORKER'S OVERALL EVALUATIONS OF NUMMI

The previous sections presented quantitative indices of worker morale and qualitative assessments by workers of the different elements of NUMMI's production system. This section reports on workers' global assessments of NUMMI.

Lived Experience

The first and overwhelming fact to emerge from the interviews was that no one at NUMMI wanted to go back to the GM-Fremont days. Whatever their

criticisms of NUMMI, everyone interviewed felt that NUMMI was a far superior work environment.

That does not mean, however, that everyone was happy with the new *modus operandi.* Childs' assessment of the relative frequency of positive and negative evaluations among the workers was sober:

> Some workers, maybe about 20%, are still uncomfortable with involvement in the decision process. Let's face it, not everybody wants to be a participant—they say, "Just tell me what you want me to do and I'll do it." I'd guess that another 10-15% are hopelessly intransigent. They don't like change and they never will.

Among the more positive evaluations, Smith argued that NUMMI's production system had an important impact on workers' self-esteem:

> One of the biggest effects of the change from the Fremont to the NUMMI system was on workers' self-esteem. It's hard to exaggerate how important self-esteem is. Seven or eight people killed themselves when they lost their jobs at Fremont. And lots of other people had serious problems with their spouse or with drinking. It's not the purely economic hardship that pushes people to put a gun in their mouth or drink themselves unconscious. The economic problems are real enough but the lack of self-respect is much more damaging to people. And NUMMI gives our workers a chance to build that self-respect because they're building a car they can be proud of and they're building it in a way they can be proud of. That self-esteem also builds the union's strength: if the workers don't respect themselves individually they can't respect themselves as a union and the community loses respect for the union.

Holman emphasized workers pride:

> Everyone still grumbles a bit, because it's still a production system and you have to produce so many widgets a day, and so tempers get short sometimes. But on the whole, I think everyone is very proud to work at NUMMI. You really see workers bending down to pick up a cigarette butt or a candy wrapper off the floor. In the Fremont days, you'd come in the morning and have to wade through the garbage. The parking lot was like a trash dump. People have a lot more pride now and a lot more feeling of self-worth.

Madrid assessed the impact on workers lives outside the work context:

> I wish you could talk to the guys' wives about the changes they've seen. I was a typical macho horse's ass when I worked at Fremont. When I got home, I'd get a beer, put my feet up and wait for dinner to be served. I'd figure, "I've done my eight, so just leave me alone." Now, I'm part of a team at work, and I take that attitude home with me, rather than dump my work frustrations all over my family. I'm much more of a partner around the house. I help wash

> the dishes and do the shopping and stuff. My job here is to care, and I spend eight hours a day doing that job, so it's kind of natural that I take it home with me. And it's not just the men, either. The other day, one of the women on the safety committee over in the body shop was telling us that she nearly had a fire in her kitchen because she left something on the stove, and she described how afterwards she went through the whole problem-solving process to kaizen her kitchen—she got a fire extinguisher and worked out where to put it and decided to put the pan tops in a cupboard nearer the door so she could use them to smother the flames. It was great to hear her and see how much she'd learned in her job here.

He contrasted his own experience at NUMMI and GM-Fremont:

> When I was with GM I hated management and everything about the plant. Work was just an eight-hour interruption in my day. I couldn't have cared less if somebody had driven a forklift right through a wall just to break the monotony. And sometimes we did.
>
> At NUMMI, I am constantly learning new things. Right now, I'm part of the 1989 Nova model project team. All the homework and extra work is rough, but it's exciting to be constantly tackling new problems. At GM, they left me in the truck tire mounting department for 8 years of mind-numbing repetition. It was degrading!

Madrid argued that workers' attitudes cannot be assessed only by their statements:

> There are people here that will tell you they hate this place. All I say is: actions speak louder than words. If people were disgruntled, there's no way that we'd be building the highest quality vehicle. You wouldn't have a plant that's this clean. You would still have the drug problems we had before. You would still have all the yelling and screaming. You can't force all that. And try this: go into any of the bathrooms, and you'll see there's no graffiti. If people have a problem with their manager, they don't have to tell him on the bathroom wall. They can tell him to his face. And the boss's first words will be: "Why?" Something's happened here at NUMMI. When I was a GM, I remember a few years ago I got an award from my foreman for coming to work for a full 40 hours in one week. A certificate! At NUMMI, I've had perfect attendance for two years.

These indices of a globally positive response should not lead us to ignore the negative reactions; but even critics were unambiguous in their preference for working at NUMMI over GM-Fremont.

Trust and Respect

One of the key positive features of NUMMI from the workers' point of view was the much greater level of trust and respect shown them by management. This trust and respect was evidenced in several ways. First, by management's attitudes:

> • *Smith:* NUMMI's managers are generally pretty good at considering suggestions when workers make them. They respect workers' ideas. NUMMI's managers will always get back to you with: "It's a great idea," or "It's a good idea but..." This is what we like to see. At GM, you were lucky if they wrote the idea down; as soon as you left the room you knew that idea was headed for the garbage can.
>
> • *Holman:* In the old system, it you tried to make a suggestion, it was just a brick wall. Now the system is really a support system, instead of an authority system. You make a suggestion and the next day the engineer is down there working with you on how to implement it. So people actually feel good about working here.

Smith described how management's respect and trust or lack of it conditioned worker motivation:

> In the old days, we fought for job security in various ways:
> • "Slow down, don't work so fast."
> • "Don't show that guy next door how to do your job—management will get one of you to do both of your jobs."
> • "Every now and then, throw a monkey wrench into the whole thing so the equipment breaks down—the repair people will have to come in and we'll be able to sit around and drink coffee. They may even have to hire another guy and that'll put me further up on the seniority list."
>
> Management would respond in kind:
> • "Kick ass and take names. The dumb bastards don't know what they're doing."
> • "Go hire extra people. We need some people, so go get some 100 bodies—I don't care what they look like or what their qualifications are—not for these jobs."
>
> Management was looking for employees who they could bully into doing the job the way they wanted it done. The message was simply: "If you don't do it my way I'll fire you and put somebody in who will. There are ten more guys at the door looking for your job."
>
> You can't build a team effort like that. You end up with workers and unions that only looked out for their own interests. Their attitude toward the company was "Screw them!" But neither management nor the union has the luxury of those games any more. Not with imports.

Most critically for the workers, this new respect and trust was not just a matter of management style, but also reflected in a policy commitment to no-layoffs and to quality:

> • *Smith:* The UAW has always demanded: one, that workers be recognized as knowing more about the job than anyone else; two, long-term stable employment; three, worker involvement in the process; four, that we be treated like adults; five, that we build quality products. We want to be proud of our cars—we don't need to hear any crap about how a neighbor bought one of our cars that was built on Friday or Monday and how it's falling apart. At NUMMI, we finally found a management whose goals were compatible with ours—build a quality product and provide stable employment. The U.S. companies would never say that. They only have one goal—stockholder value. As long as they think that way, industrial relations have to be very adversarial. The Japanese are also committed to financial returns, but they have a clear idea of how stable employment will help them get there—and a commitment to that path.
>
> • *Nano:* At NUMMI, management doesn't have that short-term approach of squeezing every damn thing out of the workers and then taking the money and running to build a plant in Mexico. That makes a big difference.

And management's new attitude was all the more credible because it led to policy changes in matters not directly related to traditional areas of contention. Nano gave the example of NUMMI's automation policy:

> One thing I really like about the Toyota style is that they'll put in a machine to save you from bending down. The Toyota philosophy is that the worker should use the machine and not vice versa. Not like some of these plants you read about where it's automation for automation's sake. I visited a plant a while back—they had robot sealer guns but they also had workers who had to check that the robots had done it right and redo it manually when the robots screwed up. It would be fine if the robots worked perfectly—and the engineers always seem to imagine that they will. But they don't and so the worker ends up being used by the machine. At NUMMI, we just put in a robot for installing the spare tire—that really helps the worker, because it was always a hell of a tiring job. It took a while, and we had to raise it in the safety meetings and argue about it and then do some kaizen. But they knew. They understood. And they came through. Same thing with installing batteries—they put in a machine to help the worker do a better job. That would never happen at GM-Fremont—you never saw automation simply to help the worker.

Favoritism

This trust and respect had limits, however. The interviews suggested that one of the most urgent of workers' criticisms concerned favoritism in selecting personnel for promotions and special assignments:

• *S:* "The main problem that people feel with NUMMI is favoritism. Depending on who you know or whose family you're from, things don't always work out the same. And that doesn't have to happen very often before people lose confidence in the system and become bitter. At GM, favoritism was pretty much impossible, because the contract said that pretty much all the decisions had to be made on the basis of seniority. So management didn't even have the opportunity to try anything. But here, a lot of promotions and opportunities are decided on the basis of someone's subjective judgement. [...] It sounds like a great idea, to decide who gets these opportunities on the basis of merit and not only seniority, but it creates a lot of opportunity for favoritism, and so the union has to stay on top of it much more—much more than they've been doing so far.

• *Romero:* The line jobs are the toughest; so everyone tries to get into other jobs. But there are rules for transfers off the line. So a couple of months ago, when we heard that there might be materials positions open, three of us applied to transfer out of the line. A few days later, the superintendent comes around and tells us that there will be no transfers. A few days after that we notice this new guy driving a forklift working for the materials group that we tried to transfer into. It turns out that he is the superintendent's brother. After that, I said the hell with it. How are you supposed to have a team concept under those conditions? They only promote the team concept when they want something from us—if they don't need anything they ignore you. Favoritism is getting worse here. They do surveys every now and again to see how we feel, and favoritism is the number one complaint of a lot of workers.

Management and the union were both aware of the problem of favoritism and trying to deal with it in their own ways.

• *Childs:* In most U.S. firms, managers evaluate employees in their own department. At NUMMI, the Human Resources department coordinates plant-wide performance evaluations. That avoids favoritism by ensuring that people are judged by the same standards.

• *Nano:* We've found that management sometimes selects Team Leaders on the basis of favoritism. We want these selections to be made on a fair and equitable basis. So the union is probably going to start negotiating an agreement for participating in the selection of Team Leaders. But there are lots of difficult issues involved. How broad should the scope of selection be—from the team, the department or the group? What criteria should be used—seniority, experience or training? Who's going to do the selection? The union is still trying to work out our position on all these issues. My position is that we shouldn't leave promotions solely up to management—Group Leaders will end up choosing their favorites. So I think we should have a joint committee. But the basic thing is that we have to find a way to deal with issues like these, even if they are difficult ones for the union, because we shouldn't leave all the initiative to management.

In March 1988, some months after this interview with George Nano, and after several months of difficult negotiations, the union and the company agreed to a formal mechanism for selecting Team Leaders. A joint union-management committee was established and explicit criteria were defined.[21]

Despite these efforts, favoritism in other areas continued to pose a problem at NUMMI. A confidential survey of plant personnel in 1991 showed that favoritism was the top concern of workers, with only a minority of workers believing that management consistently avoided favoritism in job assignments.

Stress

While it was not a major theme of the interviews, stress and excessive work pressure were real concerns for some. Silva argued thus:

> When we first started up, people were pretty positive about the team concept. But as production ramped up, the pressures increased and discussion dropped off. A lot of times, the team simply isn't involved or even consulted on standardized work. Just yesterday I got a call from a team where the Group Leader had come in telling them that the night shift had done the analysis and that here was the way to do the job. So I tell them that they should analyze it themselves and kaizen it if they have any problems. But the problem is that they have no time to kaizen it. They're too overloaded. The Team Leader is too busy just trying to help get the job done to do a new analysis or to kaizen it. It's really demoralizing for the Team Leaders. Same thing with the suggestion program: after they've broken their backs on the line for eight hours, workers aren't going to stay late to make suggestions.

Holman made a quite different argument about the origins of some of the stress experienced by NUMMI workers:

> A lot of workers expect utopia when they first hear about all the stuff we're trying at NUMMI. They don't realize that they are a part of a process, that it is damn hard to pull that whole process together, and that there's bound to be some degree of pain involved.
>
> Just to take an example: you arrange a team meeting and only 2 of the 5 members bother to show up. What are your options? You either give up then and there or you go ahead and make the decisions you need to make and live with the fact that the other 3 members are going to holler and yell because they don't like what you decided. Or let's say you've got everyone, but then you realize that you don't really have the skills that you need to take all the ideas people have and hammer out an action plan—you've got action lists that are too long or that aren't prioritized. As workers, we never needed those problem-solving and communication skills before. It's a learning process, but some people aren't sure they want to learn. And even if you do want to learn, it takes time and some pain, and some people get discouraged along the way.

The internal survey cited above did not show excessive pressure or stress to be a widespread concern. A skeptic would perhaps argue that if NUMMI did not fall under Parker and Slaughter's (1988) critique of "management by stress," it was only because NUMMI's production schedule had never been aggressive, as witnessed by the sequence of take-downs. The evidence is lacking on how NUMMI would deal with a more demanding production schedule. Silva argued that:

> You can stop the line, but you'll have hell to pay for doing it. Management makes no secret of the fact that they hate to see you stop the line. The cord is a good concept, but in practice it isn't applied very well. [...] The litmus test for how serious the company is regarding standardized work will come when demand for our cars picks up. If worker fatigue, safety and quality considerations suffer in the name of boosting production output, then we'll know that the whole standardized work thing was a hoax.

NUMMI's strict rules on absences have been cited by critics as a key element of "management by stress." Parker and Slaughter (1988) argue that "the most effective measure against absence is the way the jobs are structured. There are no regular replacement workers [unlike in GM plants], so the Team Leader usually fills in for an absent worker. But the Team Leader is supposed to be responsible for other relief and assistance, so one person's absence makes all team members' lives more difficult—because management has organized it that way" (p. 106).

Cole (1989), however, points out that team work can play a quite different role vis-à-vis absenteeism depending on the relative power of workers and managers. Team work in Japan was seen, Cole argues, as a way of reducing absenteeism through peer pressure; but in Sweden, team work was a way of reducing the costs of absenteeism, since group work encouraged multiskilling which in turn reduced the disruption caused by absences (p. 70). It is difficult to tell which effect was the more important at NUMMI, but both were clearly operative.

Moreover, the fact that workers felt restrained by peer pressure was not obviously entirely negative from the point of view of quality of work life. If plant performance suffers with absences, and if workers share an interest in plant performance, peer pressure is a surrogate for self-interest. Team leader Rick Madrid commented on this question in these terms:

> Once you start working as a real team, you're not just work acquaintances any more. When you really have confidence in your co-workers, you trust them, you're proud of what you can do together, then you become loyal to them. That's what keeps the absenteeism rate so low here. When I wake up in the morning, I know there's no one out there to replace me if I'm feeling sick or hung-over

or whatever. Not like in the old Fremont plant where they had 20% more people than they should have needed just to cover absences. At NUMMI, I know my team needs me. They need my loyalty like I need theirs.

Balance of Power

The industrial relations component of the team concept (as distinct from the production system component discussed earlier) was symbolized by NUMMI's collective bargaining agreement: it was some 80 pages long—as compared to the 250 pages in the GM-Fremont agreement. Interviews revealed a variety of views on the significance of the less adversarial, less contractually-constrained approach.

Positive views were expressed in these terms:

- *Holman:* Many people in the plant feel that our union is namby-pamby because we work too closely with management. But if working more closely with management, getting on a first-name basis, spending time in problem-solving meetings and all that are effective ways of increasing worker respect and dignity, then I'm all for it. In the end it makes for a more effective and stronger union. And in any case, either we find a new way to manage industrial relations or the whole U.S. auto industry and our jobs along with it are going to go down the tubes.

- *Madrid:* We've got the strongest union in the GM system because we're functioning as teams and thinking for ourselves. The grunts on the line *are* the union—they sit down with management to resolve their own problems. The union is the stronger for it.

- *Smith:* We're past the historically contentious issues we've fought over before, like wages and benefits. They're real issues alright, but now we've stopped beating up on each other and we've gotten down to the practical part of running a production facility. That's something the UAW has never been involved in before. If you go around the rest of GM's plants, they'll tell you a good story, but the fact remains that workers are not involved in designing and managing the production process.

- *Nano:* Under the old way, management would make their decision and if we didn't like it we'd bitch about it. If we did that here, management would end up making all the decisions just like before. But doing it differently is really hard. We have guys that are really afraid to make decisions because they think that they might upset some of their constituency. But the way I see it, if we can't make decisions on things like promotions and Team Leader selection, how the hell are we ever going to negotiate with management on more important issues like what products to produce or where to add another production line and stuff like that? As far as I'm concerned, this whole thing is just a step toward our larger goal of giving workers more of a say in the important decisions that affect

their lives.[...] I don't know if this kind of team-concept unionism is going to work. There's a lot of things we're going to have to work out as we go. Rome wasn't built in a day. But the one thing that I do feel sure about is that we're dealing with a global economy now. It's not just GM, Ford, and Chrysler now, and the old model of unionism just isn't going to work anymore. I don't see any alternative—we have to try a new approach. Part of the new approach will have to be international cooperation between unions—but that's still a big challenge. And my instincts tell me that another part of the new approach will be some kind of team concept, because it's giving our rank-and-file the means to participate more in the company operations and in the union. It's challenging them to learn and develop. And the majority of our people do rise to the challenge. That creates a fantastic base for the union.

Opposition was expressed in varying ways:

- *Silva:* It's not very hard to figure out why GM would show its strongest competitor how to kick GM's ass. GM wants to use NUMMI to popularize the concept of a collaborative, weakened union. Once they sell this to the rest of the system, they'll have no use for us here in Fremont, GM will pull out and Toyota will take over the place. You can drive trucks through all the holes in our current agreement. Take absences. We have this "no fault" attendance policy which means you don't have any "excused" absences anymore. But the contract also says you have five days sick leave a year. The contract doesn't say anything about whether these five days count as absences or not. The informal understanding was that they wouldn't be counted. But it was only informal, and now, the way Labor Relations interprets it, even these five days count as absences. We don't have any contract languages that says they're wrong, even though it's absurd and unfair. And the union just goes along.

- *Huntzinger:* I don't blame management for the favoritism around here—I blame the union. The union just doesn't protect us from management. The contract is too vague and a lot of committeemen don't understand it. I worked in GM for 20 years and it was always straightforward: seniority decided all these issues. And if management didn't abide by seniority, we knew where we stood. But now they want to make seniority just one factor among many. That's just a way for management to play their games. There's no fairness in that.

- *Romero:* How can our leaders relate to the workers and fight for us when they're working so closely with management? There's a total conflict of interest! They can't identify with us because they're off on their little weekend retreats and speaking engagements with management. The workers don't really have a union. They told us that we'd love work so much that we wouldn't ever want to take time off. We were willing to give it a try. But management isn't following through. For example:
- We can't use our seniority to switch from night shift to day shift. Management gives itself the right to select who they want or don't want to change shifts when there's an opening.[22]

> • Favorite sons get preferential treatment in promotions and they ignore seniority.
> • Management is even trying to force us to take unpaid vacations because the cars are not selling very well."

Between the positive and negative assessments were more nuanced ones such as that expressed by S:

> In the old days, we had to worry about management playing its games, and the union was there to defend us against them. But now, with the union taking on their new role, it's not as simple as before, and we have to worry about both the management games and the union games. I don't want the type of union muscle we used to have. You could get away with almost anything in the old plant, because the union would get you off the hook. It was really crazy. But it wasn't productive. I still want a union that's honest and that can help the people that really need it. I don't think there is anything about the NUMMI system that means that we can't have a union that takes care of the rank-and-file. Why can't a union say, "How the plant is managed is our business too. So we want to be a part of the decision-making process around here. But we're also going to make sure that things are fair across the board. And if we find things that are really unfair, we're going to say, 'Hey, wait a minute.'" We've never seen the union really stop management with that "Hey wait a minute." Maybe they do it, but if they do, it must be behind closed doors, because we never see it. [...] The opposition caucus is also a mixed bag. I've got family and friends on both sides and I vote my conscience. What's sad is that I don't think it would make much difference which caucus was in power. We don't have any choice but to get competitive, and in order to compete, we have to learn new systems, and in the new systems, the union just can't have the kind of power it used to have. One of the best things about labor/management relations at NUMMI is that the workers get so much more of a say than we used to in how to run things. But the scariest thing is that somehow, when we're under this pressure to be competitive, giving workers on the shopfloor more power seems to mean that the union itself ends up weaker. That's scary because I just don't see where it's all headed the next step seems to be no union at all.

Union Leadership

The challenge to the union in this new context was to articulate a vision that spoke to the members' concern that the new labor/management cooperation should not entirely displace the union's commitment to defending those interests of workers that diverge from managements'. Nano admitted his difficulty in making a new vision compelling:

> The union is essential because power corrupts and absolute power corrupts absolutely. The idea that in a plant everything can always be peaches and cream

> is unrealistic, and so you need checks and balances. No matter how good things get at NUMMI, managers are human, and workers need a union to act as a check against management's power. So we still have to police things like fairness, discipline, promotions, and transfers. Even with things like safety, where everyone knows how important it is, there are still some managers who put production before safety. [...]
>
> We've learned that you don't have to have a thousand contract clauses if management makes a real commitment. Just look at the pages and pages in the old Fremont contract on safety and working conditions—things like when the toilets get cleaned and when the floor gets swept. And the plant was still filthy. Cooperation doesn't come from the contract—it has to come from the heart.
>
> Now when I try to explain that concept to old UAW buddies from other plants—especially guys that I fought with against the International's 1982 concessionary contract—they figure that I'm forced to say all this stuff because they shut our plant down and I had no choice. They figure that going along with the team concept and all the rest was just the price we had to pay to get our jobs back. I explain to them that the plant is cleaner, it's safer, we've got more say on important issues, and we have a real opportunity to build our strength as a union. I explain to them that our members can broaden their understanding of the manufacturing system and build their self-esteem, and that the training we've gotten in manufacturing, problem solving, quality, and so on can help them reach their full potential and get more out of their lives. I explain to them that in a system like this workers have got a chance to make a real contribution to society—we don't have to let managers do all the thinking. But these guys just don't see it. Maybe it's because they haven't personally experienced the way NUMMI works. Whatever the reason, they just see it all as weakening the union. Someone like Irving Bluestone probably understands what we're doing. He had the idea a long time ago: if the worker has the right to vote for the President of the United States, he ought to have the right to participate in decisions on the shop floor. Maybe he was just too early.

Earlier quotations showed several workers expressing their frustration with what they saw as the lack of a compelling and consistent union stance. But the People's Caucus appeared to do little better in articulating a compelling alternative vision of the union's role. While the People's Caucus argued for a more assertive posture, one that was more aggressive in defending workers' interests, they articulated no alternative overall strategy beyond getting more explicit guarantees into the contract.[23]

A revealing case highlighting the difficulty of articulating a compelling union strategy was the question of the NUMMI managements refusal to participate in the Supplemental Unemployment Benefits (SUB) fund. As Huntzinger explained: "If this plant ever closes down, all we'll ever get is 26 weeks of Unemployment Insurance—no hospitalization coverage, no nothing."

Nano explained his view of the SUB funding in these terms:

> The supplemental pay scheme was set up back 20 years ago to maintain the living standards of laid-off workers, and it would also give the auto company an incentive not to lay people off. But the whole thing got turned around. First, the auto companies simply passed on the cost of the scheme to the consumers and continued their lay-off and recall cycle just like before. Then you got to a situation where the union was negotiating agreements that would allow older workers to be the first ones laid off instead of the last ones because the supplemental pay brought them up to 95% of their regular pay and they wanted the time off. Then the fight started over the funding, because it ran out in really severe downturns. At NUMMI, we have got a no-layoff commitment instead of supplemental pay. That commitment means that if there were going to be lay-offs at NUMMI, management would have to take strong affirmative measures before they laid anyone off, and they'd have to negotiate those measures with us, and in the event there were layoffs we would demand some type of supplemental pay for those workers.

Silva saw the issue differently:

> Our Caucus still thinks that not having supplemental pay was a bad deal to cut. It's good that management makes a commitment to not laying people off. Of course, it would be a lot more meaningful if they spelled out exactly what they planned to do. If they're going to run out of money, I suppose I'd rather do it by keeping people at work instead of by paying people supplemental pay. But we don't have any guarantee that we'll agree with management's assessment that the viability of NUMMI really is at stake. Supplemental pay would at least give us some protection on that score.

It is not difficult to sympathize with the Local leaders confronted with the need to improvise a new vision, a new language, and a new discourse to deal with such a radically novel situation. Such improvisation is the task of an International, not a Local,[24] but as Smith explained, no help came from this quarter:

> They [the UAW International] know that the GM-Fremont way is outdated and that it's time for something different. But we've been pretty much left to our own devices to try things out. They really haven't been able to give us much guidance.

Moreover, as Smith explained, the resources required of the Local to develop and sustain a new posture are not merely discursive:

> In the future we're going to need union leaders with more technical and management knowledge. We're much more involved now in deciding how the plant operates. That stretches our capabilities. Management is coming to us asking for our input. We really need a union 'production system committee' to study all these issues—people from the plant who understand them and have

the time to work on them. The old approach was much simpler—"you make the damned decision and I'll grieve it if I want." Now we need to understand how the production system works. We need to take the time to analyze things, to formulate much more detailed proposals. This system really allows us to take as much power as we know what to do with. But we don't have the expertise yet.

DISCUSSION

This discussion focuses on the debate outlined in the Introduction: it seeks to draw some lessons from the NUMMI case for our understanding of the implications of Japanese manufacturing management techniques for the quality of worklife. From this point of view, the preceding sections suggest three tentative "findings." While more systematic survey-type data would be needed to buttress these conclusions, the interviews lend support to the following three propositions:

Proposition 1. The evidence strongly suggests that workers' motivation had improved dramatically from GM-Fremont days, and that workers' motivation was a key factor in the exceptional performance of the NUMMI plant.

Proposition 2. While the record on workers' responses to NUMMI's Taylorism—its intensely bureaucratic, standardized and formalized work process—is mixed, there is evidence that for at least some employees, this characteristic was seen not as alienating but as a motivating feature of their work environment.

Proposition 3. To the extent that workers endorsed standardization work and other elements of the production system, the interviews suggest that it was at least in part because they recognized these techniques as the most effective way of doing the job.

While these findings must be considered provisional, it is useful to consider their implications for organizational theory. The key theoretical issues posed by these findings concern the concept of "bureaucracy" in the sociology of organizations—as Clawson (1980) and Littler (1982) argue, Taylorism is a kind of bureaucratization of the labor process. A discussion of these issues leads back from the focus on NUMMI's production system to the broader organizational context and to consideration of related assumptions in the psychological and political study of organizations.

Bureaucracy and Taylorism

The first step in this discussion is to relate the question of NUMMI's Taylorism raised in this study's introduction to the broader conceptual field of the sociology of bureaucracy. Table 7 lays out the key elements of Weber's (1978) conception of bureaucracy (adapting the discussion by Littler, 1982). Table 8 summarizes the key elements of Taylor's "Scientific Management" (relying on the discussion in Kelly, 1982). The specific parallels and the overall consistency are rather striking.[25]

What Table 8 does not reveal is the similarity of the ambiguity in the way the two systems specify their underlying authority structures. As many commentators as noted, Weber appeared to confuse two distinct sources of authority in bureaucracies—"incumbency in a legally defined office" and "the exercise of control on the basis of knowledge" (1947, p. 339). Thus, according to Gouldner, Weber "thought of bureaucracy as a Janus-faced organization, looking two ways at once." On the one hand, "it was administration based on discipline," and on the other, "an individual obeys because the rule or order is felt to be the best known method of realizing some goal" (1954, pp. 22-23).

We find the same ambiguity in Taylor. On the one hand, the assertion that operations will be governed by scientific objectivity has led some to see in Taylorism the opportunity to democratize the firm, allowing workers and managers to pursue a scientific dialogue designed to reach consensus on the "one best way." This interpretation was advanced by Taylorites such as Morris L. Cooke, intellectuals such as J.R. Commons, unionists such as Sidney Hillman, and socialists such as the young Walter Lippmann (for unsympathetic surveys of such interpretations, see Haber, 1964; Merkle, 1980; Hughes, 1989; also see Jacoby, 1983). On the other hand, Taylor's writing allows the interpretation that workers must trust engineers; that collective bargaining should not be allowed to challenge the scientific authority with which engineers determined work standards; and that any such recalcitrance must be met with management sanction.[26] This has led many commentators to assert that Taylorism represented an "expropriation" of worker control and know-how (e.g., Braverman, 1974).

The key ideas suggested by my study of NUMMI concern this ambiguity and how we should resolve it.

Two Logics of Bureaucracy and Taylorism

Theories of bureaucracy have tended to focus on either bureaucracy's technical efficiency or its power to coerce compliance from employees assumed to be recalcitrant. Different authors have focused on one aspect or the other (e.g., Perrow [1979] on efficiency, and Crozier [1964] and Blau & Scott [1962] on compliance). The assumption of recalcitrance is an elementary

Table 7. Weber's Ideal-Type of Bureaucracy

Job Design	*Structure of Control*	*Employment Relationship*	*Values*
1. Systematic division of labour, with the necessary and delimited powers (A2)	1. Continuous organization bound by rules (A1)	1. Separation from means of production and administration (A5, B9)	1. Legal norms have a claim to obediance.
2. Work performance is governed by rules or norms (A4)	2. Hierarchy (A3, B2)	2. Non-appropriation of office (A6, B9)	2. Every body of law consists of a consistent system of abstract rules that have been intentionally established. Administration consists in the application of these rules to particular cases.
3. Specialized training (A4)	3. Unified control system, i.e., monocratic (B10)	3. Formally free labour (B1)	3. Superiors are also subject to impersonal rules.
4. Written records and communications (A7)		4. Appointment on the basis of contract (B4)	4. Subordinates obey authority only in their capacity as "members" of the organization, and they obey only the "law."
		5. Selection based on technical or professional qualification (B5)	
		6. Career system based on either seniority or merit (B8)	
		7. Fixed money salaries and pension rights (B6)	
		8. Full-time commitment, i.e., sole or primary occupation (B7)	

Notes: "A" items are taken from Weber (1978, pp. 218-220).
"B" items are taken from Weber (1978, pp. 220-223).
"Values" are taken from Weber (1978, pp. 217-218).

Source: Adapted from Littler (1982).

Table 8. Key Elements of Taylorism

Job Design	*Structure of Control*	*Employment Relationship*	*Values*
• Determine work standards by objective, detailed analysis—not by traditional management standards nor by workers' customs.	• Raise productivity by determining the physically possible limits then linking pay to these—not by racheting up from current standards.	• Scientific selection of personnel.	• A "cooperative partnership" of workers and management to increase pay and productivity.
• Create "first class" men by specialized training under specialized training department—rather than relying on informal OJT and greater effort.	• Create specialized departments to perform time-and-motion analysis, fix rates, ensure the reliability of machines, materials, and logistics—piece-rates can only provide incentives if the rest of the production system operates smoothly.	• The employment relationship should be viewed as one between the firm and the individual worker—otherwise efficiency improvement efforts will be blocked by reliance on managers' "rules of thumb" and by workers' "soldiering."	• Raise profits and pay by increasing the size of the "pie" through superior efficiency —then conflict over shares will be unncessary.
• The "task idea": workers must be given a detailed daily production goal accompanied by well-defined methods sheets.	• Specialize foremen by function—the multiplication of new functions will overload a single foreman's capacities.	• Differential piece-rates—to reinforce the individual nature of the employment relationship.	• Scientific management as a "mental revolution"—from custom and coercion to scientific objectivity.
	• Motivate workers by the combination of the "task idea" and differential piece-rates (not the customary ineffectual piece-rate systems).	• The employment relationship is esentially a wage relation-ship—rather than a fabric of reciprocal obligations shaped by tradition and custom.	• Individual financial incentives are fundamental to the effective management of the enterprise.

axiom of economics, including the new institutional economics based on transactions costs (e.g., Williamson, 1985) and agency theory (e.g., Fama & Jensen, 1983).

Whatever their views of the *motives* behind bureaucratization, many researchers share the assumption that the *effect* of bureaucratization is a high level of alienation among the organization's employees. Echoing the ambivalence expressed in Weber's (1978) image of an "iron cage," Katz and Kahn (1966, p. 222) expressed this view of bureaucracy in terms that reflect the views of many researchers:

> It is an instrument of great effectiveness; it offers great economies over unorganized effort; it achieves great unity and compliance. We must face up to its deficiencies, however. These include great waste of human potential for innovation and creativity and great psychological cost to the members.

The parallels with discussions of Taylorism are clear. The technical efficiency of time and motion analysis is often acknowledged, but the dehumanizing effect of the resulting job designs is widely decried.

The assumption that bureaucratic organization and Tayloristic job design are necessarily alienating is not easily reconciled with the second of my "provisional findings": there is evidence that at least for some employees, the discipline of NUMMI's production system was not alienating, and was for some a source of motivation. Part of the explanation for this positive response is that this discipline provided an important source of relief from the stresses they experienced at GM-Fremont. But as I argued earlier, the novelty of NUMMI's approach had probably worn off over the subsequent years, and so we need to understand why workers still saw NUMMI's formalized disciplines in such a positive light several years after the plant's start-up.

This result is perhaps less surprising when viewed through the lense of the social-psychological research on role stress. Numerous studies have shown that increasing formalization of procedures and structures tends to reduce role conflict and ambiguity, thereby increasing work satisfaction and reducing alienation and stress (see Rizzo et al., 1970; Podsakoff, Williams, & Todor, 1986; Organ & Greene, 1981; Jackson & Schuler, 1985).[27]

But this interpretation seems to ignore an important theme of the interviews: if workers responded positively to NUMMI's regimentation, this result also seems to reflect some very specific characteristics of NUMMI's formal system. My lengthy discussion of standardized work highlights the way that the goal of learning shaped NUMMI's system, and the interviews showed the striking contrast between this learning logic as reflected in the standardized work process and the compliance-oriented logic of traditional Industrial Engineering standard-setting. The traditional approach to standard-setting did little to reduce role conflict or role ambiguity; if the NUMMI approach did have these

beneficial effects, it was because a different logic presided over the new formalization effort: the *form* of the formalization was different.

This contrast is reminiscent of Gouldner's (1954) thesis that bureaucracy could take several possible forms—punishment-centered, negotiated, or mock. This idea gradually disappeared from view in industrial sociology and organizational theory, as subsequent generations of researchers have tended to focus on the punishment-centered form and the associated compliance logic of bureaucracy. The NUMMI production system reminds us of the pertinence of Gouldner's analysis, by confronting us with a set of procedures that seem to designed not primarily as instruments of domination, but as elements of productive technique recognized by participants as being tools in their own collective interests.

Gouldner's analysis provides a fruitful way to resolve the debates over the nature of authority in bureaucracy: bureaucracies come in different forms, some relying more on management fiat, others more democratic.[28] Support for his analysis can be found in the results of empirical analyses of correlations among variables characterizing various aspects of the structure of organizations. Factor analyses show that the factor "centralization *vs* diffuseness of authority" is orthogonal to a factor that captures the level of formalization and standardization of work processes; correlations between standardization and formalization on the one hand and centralization on the other are generally not significant or even negative (see Pugh & Hickson, 1976, James & Jones, 1976; Blau & Schoenherr, 1971; Child, 1972; Grinyer & Yasai-Ardekani, 1980).[29] In other words, some organizations with high levels of formalization and standardization are highly centralized in their power structure but others are more participative. Pugh and Hickson (1976) call the former "full bureaucracies" and the latter "workflow bureaucracies"; but the use of the term "full" biases the discussion.[30]

The same logic could clarify the debates over the impact of Taylorism on authority relations. The corresponding hypothesis is that the features of Taylorism summarized in Table 8 do not necessarily lead to a "degradation" of the worker (to use Braverman's term). Whether workflow standardization and formalization are associated with more or less centralization of power or alienation depends on a variety of contextual factors: Taylorism can be more democratic or more despotic depending on its form. Lenin argued a form of this thesis, in his plea that the soviets adopt the scientific standardization of Taylorism, and caste aside the negative, exploitative aspects that accompanied its use in capitalist firms.[31] Without going as far as Lenin, we can find some guidance on criteria for judging the fairness of procedures in the literature on organizational justice. Procedures (as distinct from outcomes) are typically judged to be fair when they: are based on accurate information; suppress bias; create consistent outcomes; represent the concerns of all the members; and are based on prevailing moral/ethical standards (Leventhal, 1980).

The NUMMI case suggests that bureaucracy and Taylorism can be oriented towards learning rather than social control if workers participate in the definition of the rules that govern their work, or more generally if the organization has some way of assuring that the rules will reflect a shared understanding of technical requirements of the job. The section below on power will assess how well NUMMI itself fits this new model. Future research might fruitfully return to Gouldner's question and seek to elaborate further the different forms of bureaucracy and Taylorism.[32]

Bureaucracy, Taylorism, and Rigidity

A second common assumption shared by both efficiency and compliance perspectives in the theory of bureaucracy and in discussions of Taylorism has been that while formalization and standardization may be beneficial for efficiency, they have the unintended consequence of rigidifying the organization. If the social control afforded by bureaucratic formalization generates alienation, it follows that the organization's ability to innovate is truncated, since alienated employees will have little motivation to contribute to these complex change processes. Several studies have argued that bureaucratic/mechanistic organizations do well in the implementation of innovations but poorly in the generation of innovations (Pierce & Delbecq, 1977; Zaltman & Duncan, 1977); this is consistent with the thesis that bureaucracy is an ineffective form of organization for dealing with change and complexity (Bennis, 1967). A parallel critique is commonly made of Taylorism: the innovation and flexibility required of firms today is asserted to be incompatible with Taylorist work designs (e.g., Blackburn, Coombs, & Green, 1985).

NUMMI seems to belie this assumption, since the formalization and standardization of its production system seems to facilitate rather than impede innovation. Standardized work, for example, captures learning by codifying best practice; and the relative decentralization of power encourages workers to constantly improve on this best practice. Indeed, Hogan's thesis that "you can't improve a process you don't understand"—a thesis that was echoed by several workers—suggests that proceduralization is the essential precondition for learning. Hogan further suggested that standardized work was not only a *vehicle* and a *precondition* but also a direct *stimulus* for improvement: "When you have a good procedure, any problems with equipment very quickly come to the surface. And since every worker becomes a real expert—that means that each workstation becomes an inspection station."

The learning-stimulation effect was also clearly at work in the kanban and visual control techniques. NUMMI's formalization, standardization, and detailed division of labor encouraged the kaizen process by constantly revealing new opportunities for improvement. Set-up times, for example, were constantly being reduced, thus attacking a key source of rigidity in traditional sequential

processes such as stamping and assembly.[33] (This view of the learning functions of these Japanese techniques echoes Hayes [1981]; for a more general argument along these lines, see Nelson & Winter [1982, pp. 128 ff.] on the role of routines in innovation.)

NUMMI's organizational design thus seems particularly effective at the type of innovation that makes an auto assembly plant "world-class." Clearly, NUMMI's innovativeness was not that of a Research and Development department; but given the relatively routine and stable nature of its core task, NUMMI's specific type of bureaucratic/Taylorist organizational technology—characterized by learning rather than compliance goals and by participative rather than authoritarian processes—proved very effective at sustaining the relevant forms of innovation.

This view contrasts with that advanced by Kenney and Florida (1988), who present the Toyota model as a predominantly "organic" structure, highlighting three features: overlapping work roles, job rotation, and teams. Close examination of NUMMI practices reveals that these features are developed to only a very modest degree, at least compared to plants such as Volvo's Uddevalla plant (see Berggren, 1989). While these features, even in the homeopathic doses applied at NUMMI, certainly contribute to innovation and flexibility, Kenney and Florida's characterization misses what I have argued is an even more novel feature of the Toyota model, at least as it was implemented at NUMMI: the way its basically mechanistic, bureaucratic, and Taylorist form of organization was able so effectively to support learning and innovation.[34]

But I do not want to overstate the argument for the importance of formal procedures and standards in the learning process. The NUMMI case provides ample evidence for the proposition that learning results from the *synergistic combination* of the formal elements such as standardized work and other, more "informal" facets of the organization, in particular (a) the cultivation of broader skills and (b) the values and assumptions that shaped the organization's culture.[35] These two facets deserve a little more discussion.

With respect to skills, NUMMI did not appear to have gone as far as Toyota's Japanese plants in broadening workers' skills, but even the modest movement in this direction may have contributed to NUMMI's performance. The reduction in job classifications among skilled trades reduced the time wasted waiting for the right tradesperson, and the cross-training of production workers within workteams reduced the need for replacement workers. Koike (1988) argues that the key factor in explaining the superior performance of some Japanese firms is their "white-collarization" of manual work through the deliberate cultivation of their skill-base by job rotation and changing work assignments across related departments. As an empirical proposition, Koike's argument does not appear to be sufficient to explain NUMMI's success, given the modest extent of such skill formation at NUMMI. More importantly, as a theoretical proposition, Koike's argument calls for a (friendly) amendment

insofar as the NUMMI case suggests that workers' skills are all the more effectively deployed when their application is guided by a well-designed set of work procedures.

With respect to the role of culture, Blau's (1963) analysis of what he calls the "adjustive development" of bureaucracies provides a pertinent characterization of the key elements. Defining adjustive development in a way that corresponds remarkably closely to Kaizen—namely, the emergence of practices that solve incipient operational problems, practices developed by officials in the course of their work without being deliberately instituted by superiors—Blau identifies five key prerequisites for this kind of innovation:

1. a minimum of employment security;
2. a professional orientation towards the performance of duties;
3. established work groups that command the allegiance of their members;
4. the absence of basic conflict between work group and management;
5. organizational needs that are experienced as disturbing.

It is noteworthy how well the NUMMI case meets Blau's criteria:

1. Management's commitment to employment security was clearly a key factor in establishing and maintaining worker commitment.
2. The NUMMI case supports the crucial role played by workers' "professional" commitment to efficiency goals in facilitating—indeed, encouraging workers to participate in—the design and implementation of superior production methods.
3. Blau sees cohesive work groups' role as helping to socialize new members in professional norms; to encourage feelings of security through confidence in one's place in the group rather than seeking one's security in identification with specific procedures; to help group members identify improvements; and to help diffuse improvements within the organization. While my account of NUMMI has not dwelt on these factors, their echo is noticeable in many of the workers' comments.
4. The NUMMI case suggests that the key condition is not so much the absence of basic conflict as the salience of a space of convergent interests, i.e. that the conflictual component must not overwhelm the cooperative. The "trust and respect" that managers showed NUMMI workers seems to have played a key role in sustaining the improvement momentum.
5. Blau highlights the role of incidents that encourage the organization to seek better solutions. The genius of NUMMI's production system, in particular the Kanban methods and the focus on quality, is that it deliberately orchestrates the appearance of such incidents.

The NUMMI case suggests one other key cultural prerequisite for kaizen: a climate in which the appearance of these "incidents" is welcomed as an opportunity for learning, rather than a sign of failure to be hidden from view (see also Imai, 1987). This is indeed characteristic of NUMMI, as the earlier quotations suggest. A key mechanism for institutionalizing this culture was the presentation by kaizen teams of the results of their improvement efforts. NUMMI conforms to the pattern identified by Cole (1992) in some Japanese firms he studied: Cole argues that these presentations serve simultaneously to diffuse improvements within the organization and to reinforce a culture of learning by recapitulating the "blind alleys and failed solutions." By contrast, many U.S. firms reserve their praise for "results-oriented" managers.[36]

The NUMMI case suggests that these informal, less visible elements—skills and culture—are much more powerful in stimulating learning when buttressed by an appropriately designed system of formal rules and procedures. Much of the research in the intervening years appears to have assumed that organization's formal work systems were designed to substitute for, rather than complement, the informal aspects of organization.

The Psychology of Work

Sociological and macro-organizational theories often rely on psychological models; and the NUMMI case suggests that the psychological model implicit in the theories of bureaucracy and Taylorism as alienating and rigidifying is inadequate. The psychological assumption underlying the expectation that bureaucracy/Taylorism is essentially alienating is that work will be motivating only to the extent that it resembles free play. The NUMMI case suggests that this theory imputes to workers an infantile psychology incapable of delayed gratification. The third "provisional finding" suggests that the NUMMI system taps into three motivation sources hidden from the view by this assumption of an infantile psychology:

- first, the desire for excellence, the instinct of craftsmanship, the desire to do a job well done;
- second, the recognition by psychologically mature workers of the "reality principle" (Freud, 1911)—the understanding that either NUMMI constantly improved its performance or competitors would take its market and its workers' jobs;
- and finally, the respect and trust that management showed workers—behavior that elicited a reciprocal commitment from workers.

The first motivating factor, the desire for excellence, is visible in Madrid's comment:

> The great thing about standardized work is that if everyone is doing the job the same way, and we run into a problem, say a quality problem, we can easily identify where its coming from and fix it. If everyone is doing the job however they feel like, you can't even begin any serious problem-solving. [...] Before, when I saw a Chevy truck I'd chuckle to myself and think, "You deserve that piece of crap if you were stupid enough to buy one." I was ashamed to say that I worked at the Fremont plant. But when I was down at the Monterey Aquarium a few weekends ago, I left my business card the grunts—even have business cards!—on the windshield of a parked Nova with a note that said "I helped build this one." I never felt pride in my job before.

If detailed procedures like standardized work help workers become more effective in their jobs, this enhanced "competence" can be a powerful source of motivation. This is the theme of Bandura's research (1977), although his formulations focus on the subjective feeling of self-efficacy rather than on the objective fact of enhanced competence. The NUMMI production system enhanced both the objective competence of workers—through the more efficient production process—as well as the feeling of competence—through the techniques of visual control.

The motivating role of this desire for excellence could be integrated into Locke's theory of goal-setting (1968), but here we see that workers have strong feelings about the salience of the goal, whereas Locke's formulation leaves this aspect of the goal unspecified. The idea that excellence can be a motivating force also comes close to Hackman and Oldham's (1980) "task significance" variable[37]; but the NUMMI case suggests that task significance and motivation can be high even when the task involved is a very repetitive one performed every 60 seconds—a proposition at variance with the spirit of Hackman and Oldham's argument.

The second element of motivation that emerges from the interviews is related to what Freud (1911) called the "reality principle." Quoting from Rycroft (1973, p. 138):

> According to Freud, mental activity is governed by two principles, the pleasure principle and the reality principle, the former leading to relief of instinctual tension by hallucinatory wish-fulfilment [...] the latter to instinctual gratification by accommodation to the facts of, and the objects existing within, the external world. According to Freud's original formulations, the reality principle is acquired and learned during development, whereas the pleasure principle is innate and primitive.

NUMMI workers' grasp of the reality principle seems to expressed in comments such as Smith's:

> What we have here is not some workers' utopia. It's still a lousy job working on the assembly line in an automobile factory. The bottom line is that it's

> repetitive physical work that is as boring as hell [...] We want to continue to minimize the negative parts of the job by utilizing the new system.

It is visible too in Madrid's comment:

> Standardized work does mean that we work a bit harder and we have more responsibility. A lot of people were used to sitting down and reading the newspaper between jobs. But we're competing with people around the world now, and a lot of them are hard-working people. So now we have to earn our money the old-fashioned way.

Or S's comment about GM-Fremont union/management relations:

> I don't want the type of union muscle we used to have. You could get away with almost anything in the old plant, because the union would get you off the hook. It was really crazy. But it wasn't productive.

It is also visible in workers' responses when I asked them how they would react if business conditions were so bad as to really jeopardize the long-term viability of the business:

> • *Holman:* About 87% percent of our people are ex-GMers. They all understand that layoffs are a part of the auto industry. All they want is an equitable layoff process.
>
> • *Madrid:* They'd have to handle it right—before they laid off workers, they'd have to cut pay for everyone, and they'd have to start the layoffs with the salaried people. But if I saw them being equitable, I'd be willing to meet them half-way. We know that layoffs are a part of the auto industry. You can't avoid the ups and downs in the auto market. And possibly in 1988 we may have to have some layoffs. But I think the team concept would survive the layoffs if management handled it fairly. Of course, not much is going to survive if they do what [GM] did last time and let the executives pay themselves bonuses at the same time they're laying us off.

These two views contrasted with the views of several other interviewees:

> • *Huntzinger:* We don't believe they'll follow through on what they say they'll do in the contract anyway. But layoffs would kill whatever's left of worker morale.
>
> • *Higashi:* NUMMI is a relatively young company and hasn't had a lot of time to build a strong foundation for its policies. Even if workers see that we've done everything within our power to avoid layoffs, layoffs at this point in NUMMI's life would probably be devastating to the atmosphere of trust we're trying to build here. In another five to ten years the results may be different because we would have had a chance to consolidate that trust.

> • *Nano:* If things really got bad and layoffs became unavoidable, I don't know what would happen to labor/management relations at NUMMI. If we couldn't provide some economic support for laid-off workers, then I think there's a pretty good chance that we'd revert to the adversarial relations like you find at GM and Ford. But it's very hard to predict how we would react, because so much would depend on how it went down. In the past, GM showed so little regard for workers that there was no question how we would react. Like in 1982, when our people were decimated. They told us that with transportation deregulation it was cheaper to ship cars from the midwest. And they said that business was so bad they needed concessions—and then GM executives paid themselves big bonuses. Hopefully at NUMMI, things will be very different. But we have an obligation—the union has to fight to maintain workers' economic security. No one else will.

But whatever the validity of any of these views on the likely response of workers to eventual layoffs, the theoretical point seems worth further exploration: whatever psychological theory is needed to undergird organizational sociology, it cannot be one that assumes that workers are so captive of the pleasure principle that high levels of motivation must come from the immediate pleasure of intrinsically meaningful work. The evidence suggests that at least some of the workers at NUMMI were powerfully motivated by the simple recognition that they would now have to "earn their money the old fashioned way." While NUMMI workers' motivation level could perhaps have been even higher had it been possible to redesign their work to make it intrinsically motivating, they appear to have been psychologically mature enough to maintain a high level of commitment to the production system that they thought was more compatible with the demands of the market for high-quality and low-cost products.

Moreover, there seemed to be a subtext running through some of my interviewees' comments: "Why would you academics think that we workers are so stupid that we would find it intrinsically satisfying to do anything as mundane as assembling a car?" Nano pointed in this direction with his comment: "These are people who spend their days on the assembly-line making cars, then go home and do these amazing things—they are expert carpenters or they run restaurants or they're real leaders in the church or in their community. They have so much talent and potential." Work that is intrinsically motivating is better than work that isn't, all other things being equal. But workers at NUMMI recognized that all other things, and in particular life chances, are not equal, and they were realistic in their recognition of having had an unlucky draw. The tone of the interviews suggested that workers saw automobile assembly as work that could never have much intrinsic value; but their motivation levels could nevertheless vary from strongly negative (at GM-Fremont) to sufficiently positive to support world-class performance (at NUMMI).

The Social Information Processing (SIP) model proposed by Salancik and Pfeffer (1978) as an alternative to the Hackman/Oldham Job Characteristics model leaves more space for such realism. In the SIP model, workers assessments of the characteristics of their jobs vary with such social mechanisms as enactment, social construction of reality, commitment processes, rationalization, and information saliency. Unfortunately, in Salancik and Pfeffer's presentation of the SIP model, the only reality that employees seem particularly attentive to is the reality of the social context: the SIP model highlights the way that colleagues' views of the job (and one's own performance) shapes one's view of its motivational characteristics. But the interviews at NUMMI show that workers' attitudes towards their jobs were influenced by both the social and the technical/economic contextual realities. The SIP model should be interpreted as one of social processing of information, not the processing of exclusively social information.

If social information processing encompasses both technical/economic and social realities then the question of motivation has two parts: first, what led NUMMI workers to focus on one aspect of reality versus the other, and second, why did workers see the social reality of the plant in terms of their common interests with management while at GM-Fremont it was their divergent interests that were most salient for them.

Several competing lines of reasoning seem possible, although they might prove to be complementary rather than exclusive, since organizations are complex realities whose dynamics are "overdetermined" and not typically amenable to a mono-causal explanation. One type of explanation might focus on the possibility that NUMMI's socialization process could create a "false consciousness" among workers, leading them to see common interests where none really existed. The interviews also suggest a second type of explanation: greater competitive rivalry in the auto industry made the "old games" counterproductive from the workers' point of view, and now workers really did share some kind of economic interest with management since workers' jobs were at risk. Without denying the potential validity of either of these explanations, I submit that they do not fully capture the variety of views found in the interviews. The interviews suggest a third type of explanation: that the respect and trust that management showed workers in NUMMI's ongoing operations elicited a powerful response in greater motivation, as evidenced by Jacobson's account (1986, pp. 68-69, and quoted above) of how management's responsiveness to workers' requests for things like gloves and mats led spontaneously to efforts by workers to respond to management's concerns.

From this third point of view, if technical/economic realities became more salient, it was because management behaved in such a way as to lead workers to conclude that there was indeed a commonality of goals: when goals become common, attention shifts naturally to the technical/economic issue of how to attain them. The motivational effect of management trust and respect for

workers takes us back to the old Human Relations tradition in organizational behavior research and the "Hawthorne effect" (Roethlisberger & Dickson, 1939). It is a tradition largely ignored by theorists today, but the NUMMI case suggests that some of its central constructs may nevertheless be very powerful elements of motivation.

Autonomy

The notion of autonomy seems responsible for part of these difficulties in the theory of bureaucracy/Taylorism and its underlying psychological model. Autonomy is often asserted to be a key element of motivating job design and it is the lack of autonomy in bureaucratic organizations and in Tayloristic job designs that is often assumed to be the root cause of alienation. Table 9 summarizes the contrast between NUMMI and GM-Fremont in terms of autonomy and the other major variables of the Job Characteristics model.

The interviews at NUMMI, however, suggest that autonomy is not a critical motivating characteristic of jobs. NUMMI's "team concept" had little of the emphasis on team autonomy that characterizes many work-redesign efforts (Hackman & Oldham, 1980) and in particular the Volvo Kalmar and Uddevalla plants: teams at NUMMI were tightly coupled with teams upstream and downstream through the kanban system; their work methods were tightly coupled with the corresponding team on other shifts; and their problem-solving efforts linked them tightly to suppliers and internal staff.

Yet the fact that this coupling was seen by workers as the most effective way of managing operations seemed to ensure its endorsement. This suggests that when workers can establish a feeling of organization-wide responsibility for the effectiveness of their work, they will accept sacrifices of individual autonomy and even sacrifices of work-group autonomy. As long as these sacrifices are seen as effective ways to accomplish necessarily interdependent tasks, low individual autonomy and even low work-group autonomy can coexist with high satisfaction and motivation. (This appears to be the logic implicit in Womack, Jones, and Roos' [1990, pp. 100-103] assessment of what they call the "lean" production system.)

If we push this analysis a step further, two lines of reasoning and future research seem indicated. First, one could hypothesize that it is the notion of autonomy that leads us astray. Autonomy is the absence of external constraint; but the more important factor behind motivation and satisfaction might be the obverse—self-efficacy (Bandura, 1977), or the power to accomplish significant objectives (Sutton & Kahn, 1987). When a job design—even though it may not be intrinsically very motivating by the standard criteria such as those proposed by Hackman and Oldham (1980)—fits well the nature of the task, workers will feel empowered in a productive—as distinct from a socio-political—sense, and this productive empowerment is a real source of

Table 9. Comparing NUMMI and GM-Fremont Along the Jobs Characteristics Dimensions

1. Autonomy
   - Less autonomy in performing work—less freedom to vary methods from work-cycle to work-cycle.
   - More integration of higher level functions such as quality control and standard-setting—but "participation in" rather than "autonomy" since tight interdependence with other actors was the norm.
2. Task variety
   - More, but still very low.
   - *Madrid:* "At NUMMI, I am constantly learning new things. Right now, I'm part of the 1989 Nova model project team. All the homework and extra work is rough, but it's exciting to be constantly tackling new problems. At GM, they left me in the Truck Tire mounting Department for 8 years of mind-numbing repetition. It was degrading!
   - Job rotation within teams—but only about half actually rotated.
   - Higher-level tasks incorporated into job add variety.
3. Task identity
   - same—very low.
4. Task significance
   - Increase in perceived task significance by communication, training, culture, team organization.
   - Some objective increase through "visual control" methods.
5. Feedback from the Job
   - Much higher—through "visual control" methods.
6. Moderators
   - Growth needs strengths seem to have been increased by "transformational leadership" (see Madrid's comments on not caring at GM-Fremont vs. pride and commitment at NUMMI).
   - Knowledge and skill increased to deal with new job challenges.
   - Contextual:
     - work load may have been too high;
     - supervisory style was more supportive;
     - pay: same, relatively high.

satisfaction and motivation.[38] When managers impose an authority perceived by workers as arbitrary and unjustified by common interests, autonomy from such domination appears as an important psychological factor. In other words, when authority is subordinated to common goals, efficacy seems to be more important in determining motivation levels. In this view, autonomy becomes what Herzberg (1966) would call a "hygiene" rather than a "motivating" factor.

The second line of reasoning might be to transform rather than abandon the notion of autonomy. The focus to date has been on individual autonomy and the autonomy of small teams. One might attempt to conceptualize the NUMMI experience as an experiment in plant-wide autonomy (see also Klein,

1991): as Holman expressed, "We run the plant—and if it's not working right, we stop it." It could be argued that the NUMMI system only worked to the extent that the entire work force as a collective actor took charge of production. The following subsection will weigh the evidence for this interpretation, but to the extent that it proves valid, the involvement of the work force and the union in plant-level management decision making might be seen as symptomatic of an emergent form of "industrial democracy."

Power

The question of autonomy thus leads directly to that of power. The evidence suggests that the workers at NUMMI did not have very much individual power over their own work, nor did the production teams exercise much autonomous power. But how should we assess the changes in the overall balance of power between workers and management?

This section's assessment of workers' power focuses exclusively on social power, which, as all the classical definitions suggest, is fundamentally negative—the capacity of one actor to impose their will on another. By contrast, the previous section's discussion of autonomy and motivation combined references to both this social/negative power and what we might call technical or positive power—the ability effectively to pursue salient goals, that is, to dominate things rather than people. Clearly, NUMMI's disciplined production system brought greatly increased technical/positive power for workers; but what of their social power?

Before assessing these *changes* in power, it is important to recall that the *comparison level*—the level of worker and union power in the GM-Fremont plant—was relatively high. As the earlier discussion of NUMMI's history showed, this was one reason for Toyota's initial reticence about taking over the Fremont plant.

It is useful to distinguish two facets of the power issue: workers' shopfloor power and the union's institutional power. Relative to the former, some of the interview comments quoted in the section on workers' overall assessments and other material in their analysis of the NUMMI production system support the argument made by Wilkinson and Oliver (1989) that the Toyota/NUMMI production system increases both managers' power over workers—by making workers' performance immediately visible—and workers' power over management—by increasing workers' capacity to disrupt production. In Tannenbaum's terms (1968), the NUMMI system shifted the "control curve" upwards at both management and worker levels of the organization.

As for the power of the union, the picture is less clear. On the one hand, the NUMMI Local could now participate in decisions relative to a much broader range of issues than at GM-Fremont where decisions such as

promotions and assignments were made on the basis of seniority alone. This represents an important increase in the scope of the union's power. Critics such as Parker and Slaughter (1988) may be unduly minimizing this point, since they are concerned that in the exercise of this power, workers and their unions are drawn into a much more cooperative problem-solving relationship with management, and that this relationship may undermine worker solidarity and the union's independence.

On the other hand, when we examine how the union chose to use its power in this new relationship, we are led to question the effectiveness of the vision and strategy of both the Administration Caucus and the People's Caucus. Neither seemed to have a compelling vision of how to sustain the union's independent capacities for action and analysis in this new context of greater opportunities for participation in plant governance. Without this independent capacity, the union cannot participate as effective partner in the governance task.

My discussions at NUMMI suggested several possible areas in which the union could have advanced a more independent agenda. First, the ergonomic quality of some jobs at NUMMI left much to be desired. The ergonomic benefits of tilting the vehicle during some assembly steps are well established, but I observed workstations at which workers had to reach directly over their heads to attach parts to the underbody. The union could have formulated a strategy for more aggressively pursuing ergonomic improvements. Second, the plant had no overall training plan. Workers were rated according to their level of knowledge of the tasks in their team, but no overall skill development plan taking workers beyond their team duties had been established for the plant. In contrast, Toyota does formulate such plans in its Japanese plants. The union could have pushed for the formulation of such a plan. It would have the important benefit of progressively raising workers' skill levels, thus reducing the disparity between the UAW wage rates and the wages available to workers of comparable skill levels in other industries, and thus increasing NUMMI workers' "employability." Third, the union could perhaps have sought modifications to the absenteeism policy that allowed for a better balance of production and non-work-life priorities. Finally, the union's independence could perhaps have been reinforced by greater attention to the importance of rank-and-file participation in the Local's decision-making. Greater cooperation between union and management leads naturally to a more informal exchange between their respective representatives; this should not come at the expense of rank-and-file involvement, but on the contrary should be used as an opportunity to reinforce the workers' collective self-efficacy.

The case evidence is thus somewhat ambiguous on whether the union has been strengthened or weakened at NUMMI. The uncertainty is increased by the impression that the union's power has not been put to as strong a test as one might imagine, due to the lack of schedule pressure. At Mazda's Flat Rock

plant, by contrast, Fucini and Fucini (1990) describe how local management, under pressure from headquarters to meet a very steep production ramp, created a very stressful environment in which the promised trust and respect were discarded. The local union leadership was ineffective in resisting this degradation, and was replaced in 1990 by a caucus close to the dissident New Directions group in the UAW.

The portrait drawn here nevertheless leads to quite different conclusions than those proposed by Dohse, Jürgens, and Malsch (1985) and Burawoy (1985), who, echoing Kamata (1983), interpret Japanese firms' productivity as resulting primarily from management's domination over workers. Dohse et al. characterize "Toyotism" as "simply the practice of the organizational principles of fordism under conditions in which management prerogatives are largely unlimited"[39] and Burawoy likens these management systems to the "despotic factory regimes" of early capitalism. In the NUMMI case, Toyotism took a significantly less despotic and more democratic form.[40]

Viability of the NUMMI Model

The contrast between my interpretation of work at NUMMI and Kamata's (1983) portrayal of work in a Japanese Toyota plant suggests some intriguing hypotheses concerning the conditions of long-term viability of the NUMMI model.

The technical aspects of the system described by Kamata—the workflow bureaucracy—appears similar to NUMMI's, but there is an considerable difference in the social dimension—the distribution of authority and power. The intense exploitation of the work force and the lack of worker or union power at Toyota city in 1972 contrasts with the work life and the balance of power prevailing at NUMMI in the late 1980s.[41]

Such as Kamata describes it, and his description may be biased by his focus on Toyota's temporary workers (NUMMI had none, except for students during summer break), Toyota's super-exploitation of its workers does not appear to constitute a viable model for the longer term. Kamata documents the turnover, accidents, quality problems and worker frustration that it created. Not only would it be difficult to imagine the transfer of such a system to other industrialized countries where workers have greater institutionalized power and very different expectations of work, but it is not at all clear how the system can succeed for long in Japan.[42] As new generations of more affluent Japanese workers come to work at Toyota, its despotic features will surely meet a growing challenge manifested in increasing turnover and shop-floor opposition.[43]

From this point of view, NUMMI represents a variant on the Toyota system as described by Kamata, a variant whose long-term viability seems considerably enhanced by the greater worker and union power and it reflects. Worker and

union power—"voice"—add to the robustness of the Toyota model by reducing the likelihood that intense discipline turn into exploitation.

The Toyota model's long-term viability depends critically on active worker support: if techniques like kanban and standardized work come to be interpreted as merely means of social control and exploitation, not only would improvements not be forthcoming, but current levels of performance would degrade. The maintenance of workers' active support depends on the trust and respect shown by management. Any exception to this practice anywhere in the plant—such as favoritism in a promotion or an assignment—is rapidly communicated through the work force and becomes a test of management's commitment to the "team concept."[44]

Greater worker and union power adds robustness to the NUMMI variant by its effect on two sources of such risk. First, worker power on the shop-floor level can minimize the risk that managers would be tempted to exploit opportunistically the informational and power asymmetries of the employment relationship.[45] Potential forms of employer opportunism include the distortion or hoarding of information about the product market and relative costs as well as the unilateral introduction of technical or organizational innovations that undercut labor's bargaining position (see the overview in Dow, 1987). Endo (1990) argues that the *satei* system used in Toyota's Japanese plants but not at NUMMI—a system that makes a substantial proportion of the workers' remuneration and their promotion prospects dependent on the foreman's assessment of not only the workers' objective performance but also their subjective attitude—affords management a powerful tool for precisely such opportunism. The institutionalization of the countervailing power of the union and the power of "the grunts on the line" is one way to reduce this risk of management opportunism.

Greater worker and union power at top-management levels can reduce a second risk of management inconsistency: lower-level managers are both agents (subordinates of senior management) and principals (supervisors of hourly workers). If top management asks lower-level managers to both maintain an attitude of trust and respect towards workers and simultaneously increase production output, there is a real risk that lower-level managers will sacrifice the less easily observable variable, the attitude of trust and respect, in order to show improvement in the more measurable goal of output. In a comment that is worth quoting a second time, Hogan put it in these terms:

> At GM, it's easy to slip into the autocratic mentality of: "Just do it, I've got a production schedule to meet." The biggest challenge for managers coming into NUMMI is the absolute commitment to consistency to all our principles, not just to a production schedule set by Marketing. At NUMMI, we've got to walk like we talk.

And Silva was quoted earlier: "The litmus test for how serious the company is regarding standardized work will come when demand for our cars picks up."

The only way to minimize this risk of lower-level opportunism is for top management to show particular commitment to maintaining an orientation of trust and respect. This means that managers who deviate from this norm will need to be dealt with just as severely if not more so than workers who fail to live up to their commitments. Such management discipline would contrast significantly with the tendency in many firms for managers to assume that some degree of opportunism among lower-level managers is inevitable as part of the job's perquisites. Greater workers' power in the higher levels of firm governance—through the institutionalization of union participation in top management decisions—can help maintain top management's commitment to trust and respect. Nano:

> The key to NUMMI's success is that management gave up some of its power, some of its traditional prerogatives. If managers want to motivate workers to contribute and to learn, they have to give up some of their power. If management wants workers to trust them, we need to be 50/50 in making the decision with them. Don't just make the decision and then say, "Trust me."

Viewed in this light, the instances of favoritism, the signs that production pressure might lead to excessive stress, and the weakness in union strategy highlighted in the previous discussion all suggest a potential weak point for NUMMI. If NUMMI is to be interpreted as an alternative model for long-term competitiveness characterized by high levels of both workflow bureaucracy/Taylorism and worker and union power, then it is with the caveat that it is not clear that in the period under discussion they had a sufficiently strong union.[46]

Even with this caveat, the "NUMMI model" does not represent a new formula that magically sweeps away to fundamental dilemmas of the competitive firm and the wage relationship. Even if management and workers recognize their common interest in the productive efficiency of the plant, there remains the contest over distributional issues such as wages and benefits. Smith argued for the importance of unions in this regard:

> Workers need that independent organization because ultimately, even with the best will in the world, management's loyalty has to be with the stockholders. That gets proven every three years when we negotiate a contract, as well as in day-to-day stuff. So even if NUMMI management is more consistent than others, the union will have a definite role to play in the future of NUMMI and other plants like it.

It is obvious that there is room here for both union and management opportunism. There is no structural means at the level of the individual firm by which to stop the union or management from engaging in a form of a strategic bargaining that threatens to withdraw cooperation in production in order to extract concessions in distribution.

While this analysis shows the fragility of the NUMMI model, it also shows how far NUMMI has shifted the terms of the various tradeoffs involved and thereby gained considerable performance benefits. This view contrasts with the neo-Marxists analysis of Dohse, Jürgens, and Malsch (1985) and Burawoy (1979,1985), who assume that profitability is a zero-sum game because it is primarily determined by the struggle over work intensity. In this assumption, their analysis is similar to the views of many more mainstream economists (as argued by Goldberg, 1980) and industrial managers: the underlying premise is that the existing production technology is optimal (in the language of economics, all firms know, and can operate at, the production possibilities frontier) and that the principal source of variance in productivity comes from the social relations expressed in work intensity. While these observers concede that the interests of workers and managers are sometimes common and not always divergent, these assumptions lead them also to assume that the divergent interests will generally drive out the common ones.

The NUMMI case shows that performance can be greatly improved by reorganizing the production process to increase the ratio of productive to unproductive effort even at constant levels of work intensity. Moreover, in an organizational context that foregrounds common goals, even higher levels of work intensity can be seen by workers as in their own interests.

NUMMI and the Future of "Post-Taylorism"

This study began with a reference to the current debates over the significance of Japanese manufacturing management methods. This debate, however, is part of a broader debate on the possibility that the mass production/Tayloristic model of manufacturing may have "exhausted" itself, and that the future "central tendency" of manufacturing organization may be a model based on flexible automation, high-skill jobs, and semi-autonomous teams. Several authors with somewhat different premises have reached similar conclusions along these lines (Aglietta, 1979; Piore & Sabel, 1984; Kern & Schumann, 1987; see also the survey in Wood, 1989, 1991).

This study of NUMMI suggests some lessons for this broader debate, too. As I interpret the NUMMI case, it suggests that the hopes for a "post-Taylorist" system of production organization may not be realized in the forseeable future in sectors like automobile final assembly. More specifically, I am thinking of sectors where (a) the level of automation is low and the level of manual skill requirements is modest, and where these technical conditions are likely to

persist for quite some years to come, and where (b) competition is basically cost-driven, and therefore product quality, differentiation, variation, etc. are secondary factors, albeit increasingly important secondary factors. In these sectors, the NUMMI case suggests that Taylorism may not be an "exhausted paradigm" at all.

The implications of the superior performance of the NUMMI plant seem to be contrary to the "post-Taylorist" thesis, because this example suggests that the future of auto assembly work is more likely to resemble democratic Taylorism than the "systems controllers" described by Kern and Schumann or the "craft" models of work described by Piore and Sabel (1987). These more "organic" forms of work organization are most appropriate to environments that are much more dynamic than those of auto mass production, whether this dynamism is "pulled" by the proliferation of niche markets or "pushed" by the diffusion of flexible automation. By contrast, mass production of automobiles is essentially a stable task where only low levels of automation are (as yet) economically feasible. In industries such as this, Taylorism, recast in more democratic form, may have a future after all.

It may, however, be unrealistic to expect managers to cede so much of their power, especially in the United States where the institutional and political context militates against such "enlightened" management approaches. The superior efficiency of democratic Taylorism may not be sufficient to ensure its successful diffusion. But if U.S. managers are not willing to make this shift while managers in other countries are, then the global market may force some changes upon us.

CONCLUSION

The question with which this study began was: What is the significance of Japanese manufacturing management methods for the quality of worklife? The case evidence tends to support a basically positive interpretation: NUMMI's performance has been remarkable and workers' morale was high, even though on some points workers' evaluations were mixed. None of the critics interviewed had any hesitation in acknowledging their strong preference for working at NUMMI over GM-Fremont, and although some workers advanced some potentially important criticisms of a more fundamental nature, most of their criticisms were of facets of NUMMI management that may prove to be "growing pains." The detailed analysis of the NUMMI case suggests that it represents a modified version of the Toyota model—a version that may prove more viable over the longer term in advanced industrialized countries because it accommodates greater worker and union power.

This conclusion is, however, provisional. First, it is based on only a small number of interviews supplemented by a limited stock of supplementary

material; these interviews may not be representative of the full spectrum of views; and we lack a comprehensive survey to assess the relative frequency of different responses. Second, my interpretation of workers' responses is contestable. Third, the evidence suggested that the union's power may not be great enough even at NUMMI to deter forms of management opportunism that would undermine workers' commitment. Fourth, it will be important to see whether the plant's performance and morale persist over the longer term: it is possible that the powerful socialization forces put into motion at the founding of NUMMI continue to shape workers' assessments but that these forces will dissipate in coming years, with the arrival of new hires who do not experience the unique conditions of NUMMI's start-up, and with the introduction of a more demanding production schedule. Finally, even if NUMMI proves to be a persistent success, perhaps the conditions of its founding were too unique to allow it to become a generalizable model.

This last caveat, however, has two subclauses. The first points us in the direction of the change in workers' attitudes—the fact that an unexpected and painful period of unemployment unfroze long-held values. On this point, the interview evidence is mixed: some interviewees felt that this unfreezing was a critical *sine qua non,* while other attributed it a much less significant role. The evidence was much less ambiguous on the important of the second part of this caveat: the founding of NUMMI also brought into place a unique set of managers. If the workers' attitudes had been changed but managers' had not, NUMMI would have been a failure. On this, the interviewees were in broad agreement.

So the generalizability of the NUMMI model, assuming its desirability, may not happen so easily through the adaptation of existing organizations. It may require the substitution of new firms for failing old ones, as suggested by population ecology approach (Hannan & Freeman, 1984). Moreover, if the diffusion of the NUMMI model requires greater acceptance by managers of worker participation in the firm's governance, then this diffusion may depend critically on broader societal changes in laws, institutions, and attitudes. But whether it is through adaptation or selection, the superior performance of the NUMMI model is such that other firms will likely be driven to attempt to follow its lead.

Despite these data limitations and interpretive difficulties, the study of NUMMI has identified some directions for future research on Taylorism and associated forms of workflow bureaucracy. I have proposed distinguishing within Taylorism a technical dimension—division of labor, standardization, formalization—and a social dimension—the distribution of authority and power relations. Theoretical research has tended to conflate the two, assuming either that capitalist firms can only implement Taylor's technical innovations over worker resistance—thus necessitating an authoritarian centralization of power—or that such centralization is a universal characteristic of capitalist

authority relations. The NUMMI case suggests that the analytic distinction may become progressively more salient as firms are forced to acknowledge the competitive advantages of a more democratic form of Taylorism.

Phrased in terms of the broader sociology of bureaucracy, the NUMMI case suggests that it may be opportune to renew the research program suggested by Gouldner (1954, 1955): if the effects of formalized, bureaucratic systems on alienation, innovation, motivation, and power are a matter of design rather than destiny, then the pessimistic "metaphysical pathos" surrounding conventional notions of bureaucracy as an "iron cage" (Weber, 1978) should be discarded. I have proposed that we can distinguish "learning bureaucracies" from "compliance bureaucracies," and the NUMMI case suggests some of the conditions of existence of the learning-oriented form: common goals, participation in defining key policies and standards, trust and respect, and a balance of power.

We need further research to specify better the nature of the contrast between the two forms of both Taylorism and bureaucracy, and we need to identify the contextual factors that support each of these forms. It would be a dereliction of our duty as researchers to allow our enthusiasm for relatively privileged forms of work, resembling our own jobs as academics and researchers, to deter us from efforts to clarify the options facing the much larger number of people like auto workers whose work tasks are much more routine.

ACKNOWLEDGMENTS

The research on which this study is based would not have been possible without the generous cooperation of managers, workers and union officials at NUMMI. Gary Robinson helped transcribe taped interviews with them and discern the key points. This article has benefitted from the comments of several NUMMI people and from the responses of many friends and colleagues: Chris Argyris, Joel Beinin, Christian Berggren, Bob Brenner, Clair Brown, El Buffa, Bob Cole, John Ettlie, Steve Frenkel, Don Gerwin, Meg Graham, Jan Hopland, Sandy Jacoby, Ed Lawler, Ann Majchrzak, Ruth Milkman, Michael Reich, Dick Scott, Bill Simon, David Stern, Steve Wheelwright, Bob Sutton, Lowell Turner, and Stephen Wood. My thinking has also been stimulated by the reaction of colleagues to presentations at the USC, Harvard Business School, NYU, UCLA, and UC Berkeley. My thanks to all these people, many of whom still disagree.

NOTES

1. Toyota was the initiating party. In 1980, Toyota had contacted the Washington, D.C. law firm of Arent, Fox, Kintner, Plotkin and Kahn to assist them in finding a U.S. joint venture partner. The initial efforts were in the direction of Ford Motor Company, but when these failed, Toyota approached GM (Jacobson, 1986, pp. 19-20).

2. The first of Toyota's motives appears to be somewhat misstated here, given evidence (cited below) that Toyota was not initially interested in employing a unionized work force. The second motive might also be better specified: Toyota's primary concern with respect to suppliers was to identify potential suppliers and establish relations with them. NUMMI President and CEO, Kan Higashi explained to me: "One of GM's biggest contributions to NUMMI was information on the supplier base. For a Japanese company coming into the United States, that information is almost impossible to get" (Adler, 1991).

3. William J. Usury, Jr., an arbitrator who helped establish the terms of the Letter of Intent, has also been quoted to the effect that Toyota would have preferred to hire none of the GM-Fremont workers and indeed to avoid UAW involvement altogether (*San Jose Mercury,* April 8, 1985; see also Jacobson, 1986). (Usury had served as Secretary of Labor under President Ford and later became head of the Federal Mediation and Conciliation Service.) Mike Furuhashi, one of the first of Toyota's labor relations managers at NUMMI, is quoted as saying: "We were told... that's the worst plant in the world: high absenteeism, drug abuse, alcoholism. And the UAW Local 1364 [the GM-Fremont local], the terrible, the worst, the most militant UAW in the United States" (*San Jose Mercury,* April 30, 1990).

4. Toyota also sent a core staff of between 30 and 35 managers and production coordinators to staff the venture. They stayed on for three to five years. They were supported by a group of 30 to 60 lower-level Toyota managers and engineers who served as trainers; they rotated out after three months, some back to Japan, others to Toyota's Ontario and Kentucky plants. These trainers were the primary "learning mechanism" for Toyota. GM, limited by the FTC agreement in the number of personnel on its payroll allowed to work at NUMMI, loaned only a small group of managers who rotated back into GM after three years. In order to augment GM's learning, GM also set up a liaison office, which arranged short tours for visiting GM staff and made available to the GM system a range of materials on NUMMI methods. GM also arranged summer internships at NUMMI for GM employees on educational fellowships (Krafcik, 1986).

5. In the early 1980s, there were almost no comparable union-wage jobs in the San Francisco Bay area, since several large employees had recently closed (notably Caterpillar, Mack Truck, Peterbuilt, and Ford-Milpitas). Laid-off workers were eligible for GM's Supplemental Unemployment Benefits for one year and (for those with more than 10 years seniority) Guaranteed Income Stream beyond that first year. But GIS benefits were withdrawn if workers refused a GM job elsewhere. Some 2500 laid-off workers took jobs in other GM plants, primarily in Oklahoma, St. Louis, and Kansas City. In their new plants, they were at the bottom of the seniority lists, thus forced into the most difficult jobs. With rumors of the plant reopening under GM-Toyota management, many workers left their families behind in Fremont (Turner, 1991).

6. According to the senior member of GM's management team at NUMMI, Mark Hogan, "NUMMI is 10 to 20% less automated than the typical GM plant producing J-class, compact cars. We'd be in the lowest quartile as far as overall automation level is concerned. Firstly, we just can't justify the capital expenditure. The market hasn't been very kind to us, and in any case, the small car market never leaves much room for heavy investment. Moreover, like all Toyota's final assembly plants, NUMMI has taken a very conservative approach to automation so we can stay flexible. We also inherited Toyota's overall automation philosophy of perfecting small automated cells and expanding them only gradually" (quoted in Adler, 1991).

7. In the rest of this article, quotes without sources come from Adler (1991).

8. "Takt" is a German word for musical meter or tempo. Takt time is defined by Toyota/NUMMI as the number of seconds between cars coming off the line. During 1987, it was slowed from 54 seconds to 60, then to 63 seconds in May 1987, to 68 seconds in September and to 78 seconds in November.

9. Childs explained the rationale for this policy in these terms: "At GM-Fremont, people would go across the street to the bar during their 42 minute unpaid lunch. That gave workers enough time for two beers and a shot before they came back to work—if they wanted to come

back. It's worth it for us to pay for their lunch period to avoid these problems. It also means that we have a bit more flexibility in exactly when to break."

10. Krafcik had the advantage of working as a quality control engineer at NUMMI between 1984 and 1986, and senior managers at NUMMI expressed to me their high opinion of the accuracy of his analysis.

11. Krafcik (1990) reports rankings by 8 auto companies of competitors' products in terms of their manufacturability: Toyota emerged as the top-ranked company whereas GM ranked tenth. These rankings correlated strongly with assembly-plant productivity.

12. Data supplied by J.D. Power and Associates. The Prizm introduction was accompanied by the introduction of several new domestic suppliers, some of whose components needed refinement.

13. Brown and Reich (1989) elaborate: "According to a company representative, those workers who were not rehired had such poor records, such as assault of co-workers or supervisors, that they would have been discharged in a traditional adversarial labor-management system. The union activists who were rehired included several who had pressed the lawsuit to block the joint venture in the first place. According to Nano, the union was able to obtain second chances for employment even for workers who tested positive on drug tests." (p. 42). The lawsuit mentioned here was filed by the old UAW Local against the UAW International and its role in negotiating the Letter of Intent.

14. The technical system is thus broader than technology, defined by Berniker as codifiable knowledge of cause and effect relations. See discussion by Weick (1990) and Sproull and Goodman (1990).

15. As indicated earlier, overall indicators of worker satisfaction at NUMMI have risen over the longer term.

16. Consistent with a philosophy that Stern (1992) calls "doing by learning," these training sessions often used real current production problems as teaching examples.

17. "Andon" means lantern. The andon board is a display panel on which lights signal abnormal conditions.

18. Borton also discussed other weak spots in implementing standardized work at NUMMI:

> A lot of skilled workers in the plant still believe that standardized work doesn't apply to them. Their response to standardized work is: 'How can you standardize something like a maintenance function? You never know what's going to happen.' But fixing things isn't maintenance—that's repair. NUMMI wants preventive systems with standardized maintenance procedures rather than fire-fighting. You really get results if you try. Take the stamping machines' clutch and brake adjustments, for example—that's a task we perform about twice a week. We've gotten the adjustment time down from 75 minutes to 33 minutes. The general idea is to replace repairs with routine maintenance. We've just started getting the skilled trades to accept Toyota's way of doing things.
>
> Another weak spot is the white collar area. At Toyota, everyone in the entire organization standardizes their work. But at NUMMI, we haven't really gotten started on office personnel as yet. I suppose they still don't like to think of their work as routine—they still haven't understood the point.
>
> At Toyota, even the engineers standardize their work. Take the example of dies. They build all their die castings to the same dimensions. You can't believe how much that facilitates die-cutting and how many mistakes that avoids. It takes a lot of up-front planning and work and expense; but when they design a die, they don't have to worry about all the ancillary stuff that comes when dies aren't standardized, so their design work is a lot more efficient. Or take tool design: they have standardized the starting point and the whole thought-process. I'm very cautious about saying that—it sounds almost like communist indoctrination. So far at NUMMI, we're just getting started, with some structured approaches for problem-solving, root-cause analysis, and so forth.

19. My interviews with a NUMMI engineer (interviewee D) confirmed the importance NUMMI attached to interdepartmental cooperation. He pointed out that, unlike at GM, engineers loaned out to the plant were rated by both their engineering manager and their temporary boss in the plant. Moreover, new engineers at NUMMI would begin their careers with several weeks working alongside production workers on the line.

20. Baldamus (1961) theorized this effect under the heading "traction," the feeling of being pulled along by the steady rhythm of the work.

21. The new procedure weighted several criteria: ability to perform the job, as measured by hands-on-job evaluations, interviews, and participation in relevant pre-promotion training courses (45%); job experience and general job knowledge, as measured by seniority, related industry experience, interviews, participation in relevant training courses, and written test results (28%); and attitude and behavior, as measured by attendance, disciplinary record, suggestions, interviews, and participation in relevant training courses (27%). Noteworthy in the detail of this weighting scheme is that seniority—a traditional union emphasis—only accounted for 8 points, and judgements about the candidate's attitude—a traditional concern of management—only accounted for 3 points (I thank Clair Brown, Michael Reich, and David Stern for pointing this out).

22. NUMMI's policy was that shift changes, assuming a job opening, required both seniority and knowledge of the job, whereas at GM-Fremont, seniority sufficed.

23. In the June 5,1991 union elections, the Administration Caucus candidates lost three of five top positions to People's Caucus candidates. According to a *San Jose Mercury* article (June 22,1991), the key issue behind the People's Caucus campaign was workers' anger at the union leadership's agreement in December 1990 to a lower starting wage for new hires—75% of the regular rate, progressing to 100% over 24 months, as opposed to 85% and progressing to 100% over 18 months. Wages for new hires were plausibly a particularly sensitive issue, since many of the 650 new hourly hires anticipated for the new truck line would, by informal agreement, be family members of current employees. However, my conversations with workers in the plant suggested that this may have not have been such a major concern. According to S, for example, the more important factor was that the Local leadership had "lost touch" with the concerns of the rank-and-file: some workers felt that union leaders were devoting too much time to outside engagements, and that the union officials on the shopfloor were not doing a thorough enough job in covering the day-to-day problems. Subsequent developments in the Local has restored the dominant role of the Administration Caucus.

24. I am grateful to Lowell Turner for suggesting this perspective.

25. Littler (1982) presents a similar thesis, noting that Taylor was more focused on the columns on the left-hand side of Table 7 and Weber more interested in ones toward the right-hand side. My summary of Taylor comes from Kelly (1982), whose account is more nuanced than Littler's, and reveals more elements relating to the right-hand side of the chart. Littler argues that overall the consistency between the two sets of ideas is high, except for Taylorism's exclusion of career progression by its insistence on worker interchangeability. But his evidence for including worker interchangeability as a defining feature of Taylorism is weak, relying on the high turnover rates at Ford in the 1910s. Kelly (1982, p. 26) argues that Taylorism created promotion opportunities in the Planning Department and through the reallocation of less-skilled tasks from highly skilled to unskilled workers; but these are surely rather limited opportunities. A more fundamental difference between Taylorism and Weber's bureaucratic ideal-type is the importance Taylor attached to wage incentives as opposed to the bureaucratic determination of salary levels by rank and seniority. But a fair comparison would need to acknowledge the difficulty of implementing wage incentives in administrative activities such as those undertaken by the bureaucrats discussed by Weber. Finally, we should note that the parallels between Taylorism and bureaucracy are not merely theoretical. Taylorism was self-consciously applied in improving the efficiency of the U.S. government: "Woodrow Wilson and the Civil Service Reform League saw the preservation of democracy in the adaptation of patterns of European bureaucracy, and

Scientific Management as the means of ending the spoils system" (Merkle, 1980, p. 69; see also Haber, 1964).

26. Taylor (1911) wrote: "It is only through the *enforced* standardization of methods, *enforced* adoption of the best implements and working conditions, and *enforced* cooperation that this faster work can be assured. And the duty of enforcing the adoption of standards and of enforcing this cooperation rests with the *management* alone" (p. 83, italics in original).

27. In terms of role theory, Parker and Slaughter's (1988) critique seesm to focus primarily on role overload (Kahn et al., 1964).

28. This argument undermines the assumption made by Mintzberg (1979) that when bureaucracies formalize work processes, this formalization is necessarily imposed on workers by staff experts. Mintzberg contrasts "machine bureaucracies" where experts create standardized processes—these organizations are efficient in performing simple tasks but they are alienating for workers—and "professional bureaucracies" where skills are standardized but work processes are not—these organizations are efficient in performing complex tasks and are also less alienating and more democratic. The NUMMI production system assumes that the task is complex—the system's design reflects the assumption that the task is rich in improvement opportunities—and it therefore decentralizes power; this is consistent with Mintzberg but contrary to the assumptions implicit in more traditional U.S. production management. Contrary to Mintzberg, however, the NUMMI system also assumes that workers can be motivated to participate in formalizing processes; NUMMI thus represents a hybrid organization that standardizes both skills and processes. This is hybrid is not as rare as Mintzberg's typology would lead one to suggest: it suffices to consider the cases of professionals such as surgeons and aircraft pilots whose work processes as well as training are intensively standardized and formalized.

29. The main exceptions to these results are those of Haig and Aiken (1967), but Dewar, Whetten, and Boje (1980) have shown that their measures of formalization and standardization (job codification, job specificity and rule observation) are flawed.

30. The notion of centralization needs greater refinement. Its current operationalizations suffer from several weaknesses. First, most of the survey-based research has focused on de/centralization within management ranks, to the exclusion of a consideration of employee power. Second, and more troubling, the survey instruments do not seem to have caught up with the increasing sophistication of theories of power (for an early overview, see Lukes, 1974; for more recent views, see Clegg, 1989). The NUMMI case points in particular to the need for conceptualizations of power and its centralization that can account for the fact that workers felt that some decisions, such as marketing strategy, required specialized expertise, and they interpreted centralized decision-making by appropriate experts as entirely legitimate in these domains: workers' notions of democracy were sophisticated enough to embrace representative as well as direct forms of democracy. Workers' resentment was directed at instances where centralization of decision-making reflected not technical requirements but lack of "trust and respect" and antagonistic power relations.

31. The Taylor system, Lenin (1967) wrote, "like all capitalist progress, is a combination of the subtle brutality of bourgeois exploitation and a number of the greatest scientific achievements in the field of analyzing mechanical motions during work, the elimination of superfluous and awkward motions, the working out of correct methods of work, the introduction of the best system of accounting and control, etc. The Soviet Republic must at all costs adopt all that is valuable in the achievements of science and technology in this field. The possibility of building socialism will be determined precisely by our success in combining the Soviet government and the Soviet organization of administration with the up-to-date achievements of capitalism. We must organize in Russia the study and teaching of the Taylor system and systematically try it out and adapt it to our purposes."

32. For one step in this direction, see Adler and Borys (1991).

33. Not only does NUMMI's disciplined production system support continuous improvement in the assembly of given products; it also facilitates change between products and the introduction

of new products. The evidence for this proposition is, however, indirect. Toyota is like other Japanese auto manufacturers in that it produces a greater number of models and introduces them more frequently than its U.S. competitors. More important for the present argument is the finding that Japanese assembly plants can handle this demand for flexibility more effectively: Clark, Fujimoto and Chew (1987) and Fujimoto (1989) show that Japanese auto plants take only 4 months to return to normal productivity after a new model introduction, as compared to 5 months in U.S. plants, and only 1.4 months to return to normal quality levels, as compared to 11 months in the U.S. These results are all the more impressive when the Japan/U.S. differences in "normal" levels of productivity and quality are recalled. (See discussion in Womack, Jones, & Roos [1990, Ch. 5].)

34. Despite Volvo's efforts to design motivating jobs, the MIT International Motor Vehicle Program analysis suggests that the productivity and quality at Uddevalla were far below that of NUMMI (see "Edges Fray on Volvo's Brave New Humanistic World," 1991.)

35. In this sense, the NUMMI case can be read as a counter-example to the markets/hierarchies/clans trichotomization of modes of coordination advanced by Ouchi (1979): NUMMI derives great performance advantages by combining the shared values characteristic of "clan" organizations with the formalized bureaucracy characteristic of "hierarchies." The NUMMI case also undermines the coercive/remunerative/normative trichotomy of modes of compliance proposed by Etzioni (1961), since Etzioni assumes that normative types of organizations would have little use for the bureaucratic formalization characteristic of the two other types.

36. In organizations characterized by more conflictual and competitive relations between hierarchical levels, efforts to learn from failure are often stymied by blaming behaviors. The focus on success is also encouraged by the widespread assumption that "there are 100 ways to fail for every one way to succeed." But this assumption may not be accurate: successful firms are usually rather idiosyncratic, and their success derives from the unique "fit" that they develop among the various aspects of their organization. Moreover it is very hard to learn from success. Psychological research has revealed a very strong "attributional bias": people typically attribute responsibility for success to themselves and attribute responsibility for failure to uncontrollable contextual elements. I thank Meg Graham for a suggesting this line of reflection.

37. "Task significance" is defined as the perceived impact of the job on the lives or work of other people inside or outside the organization.

38. This argument echoes that advanced by Morse and Lorsch (1970) in their critique of McGregor's (1970) Theory Y.

39. By "fordism," Dohse et al. refer to the combination of Taylorist job design and the automated moving convey-belt (see also Aglietta, 1979; and Blackburn et al., 1985).

40. The NUMMI case thus at least partially supports Dore's reading of Kamata's account: "The submissiveness requirement [...] can be separated out from the holistic-corporation recipe. And so can the intense, almost frenetic pace of work" (see Dore's Introduction to Kamata, 1983, p. xxxvii).

41. Note however the contrast between Kamata's portrayal and the analysis of another (otherwise critical) observer, Fujita, whose surveys of assembly line workers at Toyota City in 1980 and 1981 reveal a "high morale for work" (1988).

42. The Confederation of Japan Auto Workers surveyed 10,000 of its 750,000 members in 1985 and 1990. In 1990, they found that 56% of the men and 36% of the women said they were satisfied with their work as compared to 70% of the men and 46% of the women in 1985 (Solo, *Fortune,* 1990). The Confederation's chairman was quoted as attributing much of the decline to the stress associated with frequent model changes.

43. Nohara (1988) found in his 1981 survey that a disproportionate number of Toyota City workers came from rural backgrounds (90 of his sample of 205 "direct manufacturing" workers, 50 of 133 semi-direct, and 30 of 101 indirect employees). He argues that "the workers join Toyota company at the age of eighteen, coming from distant villages in districts such as Kyushu and

Hokkaida, i.e. south and north Japan. Therefore they are separated from all the social networks they used to be involved with and this is why they accept without question the networks offered by the company."

44. This analysis is consistent with Shimada and MacDuffie's (1986) characterization of the Toyota system as "fragile" by virtue of its dependence on work force motivation, as well as on work force capabilities and production regularity.

45. This argument expands on the ideas advanced by Dow (1987). Perrow (1981), Goldberg (1980), and others have pointed out that Williamson (1980) is unwarranted in ignoring the possibility that managers as well as workers could be led by "human nature as we know it" to engage in opportunistic behavior. Dow (1987) argues further that "authority relations generate the *structural preconditions* under which employer opportunism is most like to be encouraged; namely, information impactedness, small numbers, and the availability of a tool (decision by fiat) which is tailor-made for unilateral pursuit of self-interest" (1987, p. 21, italics in original). Dow focuses on the risks of opportunism by top management; a second type of risk of management opportunism needs discussion too—that of opportunistic behavior by lower-level managers (see below).

46. It is instructive in this regard to compare NUMMI and the other Japanese "transplant" auto facilities in the United States. See the richly documented study by Parker and Slaughter (1988) and the more recent report by Berggren et al. (1991).

REFERENCES

Adler, P.S. (1990). *NUMMI, circa 1988.* IEEM, Stanford University.

Adler, P.S., & Borys, B. (1991). *'Tools, not weapons': An inductive study of engineers and formalization.* Unpublished manuscript.

Aglietta, M. (1979). *A theory of capitalist regulation.* London: New Left Books.

Baldamus, W. (1961). *Efficiency and effort.* London: Tavistock.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychology Review, 54,* 191-215.

Bennis, W. (1967). Organizations of the future. *Personnel Administration, 30*(5), 6-19.

Bennis, W. (1966). *Changing organizations.* New York: McGraw-Hill.

Berggren, C. (1989). "New production concepts' in final assembly—The Swedish experience. In S. Wood (Ed.), *The transformation of work?* (pp. 171-203). London: Unwin Hyman.

Berggren, C., Björkman, T., & Hollander, E. (1991, August). *Are they unbeatable? Report from a field trip to study transplants, the Japanese owned auto plants in North America.* Unpublished report. Royal Institute of Technology, Department of Work Sciences, Stockholm, Sweden.

Berniker, E. (1987, November). *Understanding technical systems.* Paper presented at Symposium on Management Training Programs: Implications of New Technologies, Geneva, Switzerland.

Blackburn, P., Coombs, R., and Green, K. (1985). *Technology, economic growth and the labour process.* New York: St. Martin's Press.

Blau, P.M. (1963). *The dynamics of bureaucracy* (rev. ed.). Chicago: University of Chicago Press.

Blau, P.M., & Schoenherr, R.A. (1971). *The structure of organizations.* New York: Basic Books.

Blau, P.M., & Scott, W.R. (1962). *Formal organizations.* San Francisco, CA: Chandler.

Braverman, H. (1974). *Labor and monopoly capital.* New York: Monthly Review Books.

Brown, C., & Reich, M. (1989, Summer). When does cooperation work? A look at NUMMI and GM-Van Nuys. *California Management Review, 31*(4), 26-37.

Burawoy, M. (1979). *Manufacturing consent: Changes in the labor process under monopoly capitalism.* Chicago: University of Chicago Press.

Burawoy, M. (1985). *The politics of production.* London: Verso.
Burns, T., & Stalker, G.M. (1964). *The management of innovation.* London: Tavistock.
Child, J. (1972). Organization structures and strategies of control: A replication of the Aston Study. *Administrative Science Quarterly, 17,* 163-177.
Chinoy, E. (1955). *Automobile workers and the American dream.* New York: Doubleday.
Clark, K.B., Fujimoto, T., & Chew, B.W. (1987). Product development in the world auto industry. *Brookings Papers on Economic Activity,* no. 3.
Clawson, D. (1980). *Bureaucracy and the labor process: The transformation of U.S. industry, 1860-1920.* New York: Monthly Review Press.
Clegg, S.R. (1989). *Frameworks of power.* London: Sage.
Cole, R.E. (1989). *Strategies for learning.* Berkeley, CA: University of California Press.
Cole, R.E. (1992). Issues in skill formation in Japanese approaches to automation. In P.S. Adler (Ed.), *Technology and the future of work* (pp. 187-209). New York: Oxford University Press.
Crozier, M. (1964). *The bureaucratic phenomenon.* Chicago: University of Chicago Press.
Dewar, R. D., Whetten, D.A., & Boje, D. (1980, March). An examination of the reliability and validity of the Aiken and Hage scales of centralization, formalization, and task routineness. *Administrative Science Quarterly,* pp. 120-128.
Dohse, K., Jürgens, U., & Malsch, T. (1985). From 'Fordism' to 'Toyotism'? The social organization of the labor process in the Japanese automobile industry. *Politics and Society, 14*(2), 115-146.
Dow, G.K. (1987). The function of authority in transaction cost economics. *Journal of Economic Behavior and Organization, 8,* 13-38.
Edges fray on Volvo's brave new humanistic world. (1991, July 7). *New York Times.*
Endo, K. (1990). *Satei (personal assessment) and inter-worker competition in Japanese firms.* Unpublished paper, Department of Economics, Yamagata University.
Etzioni, A. (1961). *A comparative analysis of organizations.* New York: Free Press.
Fama, E.F., & Jensen, M.C. (1983). Separation of ownership and control. *Journal of Law and Economics, 26,* 301-325.
Freud, S. (1958). *Formulations on the two principles of mental functioning* (Vol. 12, Standard Edition). London: Hogarth Press.
Fucini, J.J., & Fucini, S. (1990). *Working for the Japanese.* New York: Free Press.
Fujimoto, T. (1989). *Organization for effective product development: The case of the global automobile industry.* Ph.D. dissertation, Harvard Business School.
Fujita, E. (1988, April). *Labor process and labor management: The case of Toyota.* Paper submitted to an international symposium on the Microelectronics Revolution and Regional Development, Labor Organization and the Future of Post-Industrializing Societies, University of Milan.
Goldberg, V.P. (1988). Bridges over contested terrain: Exploring the radical account of the employment relationship. *Journal of Economic Behavior and Organization, 1,* 249-274.
Gouldner, A. W. (1955, June). Metaphysical pathos and the theory of bureaucracy. *American Political Science Review,* pp. 496-507.
Gouldner A.W. (1954). *Patterns of industrial bureaucracy.* New York: Free Press.
Grinyer, P.H., & Yasai-Ardekani, M. (1980). Dimensions of organizational structure: A critical replication. *Academy of Management Journal, 23,* 405-421.
Guest, R.H. (1955). A neglected factor in labor turnover. *Occupational Psychology, 29,* 217-231.
Gyllenhammar, P.G. (1977, July-August). How Volvo adapts work to people. *Harvard Business Review.*
Haber, S. (1964). *Efficiency and uplift: Scientific management in the progressive era.* Chicago: University of Chicago Press.
Hackman, J.R., & Oldham, G.R. (1980). *Work redesign.* Reading MA: Addison-Wesley.

Hage, J., & Aiken, M. (1967). Relationship of centralization to other structural properties. *Administrative Science Quarterly, 12,* 72-92.

Hannan, J.D., & Freeman, J. (1984, April). Structural inertia and organizational change. *American Sociological Review, 49,* 149-164.

Hayes, R.H. (1981, July-August). Why Japanese factories work. *Harvard Business Review,* pp. 57-66.

Herzberg, F. (1966). *Work and the nature of man.* Cleveland, OH: World Publishing.

Hill, S. (1981). *Competition and control at work: The new industrial sociology.* Cambridge, MA: MIT Press.

Hughes, T.P. (1989). *American genesis: A century of invention and technological enthusiasm, 1870-1970.* New York: Viking.

Imai, M. (1987). *Kaizen.* New York: Random House.

Jacoby, S.M. (1983, October). Union-management cooperation in the United States: Lessons from the 1920s. *Industrial and Labor Relations Review, 37*(1), 18-33.

Jackson, S.E., & Schuler, R.S. (1985). A Meta-analysis and conceptual critique of research on role ambiguity and role conflict in work settings. *Organizational Behavior and Human Decision Processes, 36,* 16-78.

Jacobson, E.K. (1986). *NUMMI: A model in human relations.* BSIE thesis, General Motors Engineering and Management Institute.

James, L.R., & Jones, A.P. (1976). Organizational structure: A review of structural dimensions and their conceptual relationships with individual attitudes and behavior. *Organizational Behavior and Human Performance, 16,* 74-113.

Kahn, R.L., Wolfe, D.M., Quinn, R.P., Snoek, J.D., & Rosenthal, R.A. (1964). *Organizational stress: Studies in role conflict and ambiguity.* New York: Wiley.

Kamata, S. (1983). *Japan in the passing lane.* New York: Random House.

Katz, D., & Kahn, R.L. (1966). *The social psychology of organizations.* New York: Wiley.

Kelly, J.E. (1982). *Scientific management, job redesign and work performance.* New York: Academic Press.

Kenney, M., & Florida, R. (1988). Beyond mass production: Production and the labor process in Japan. *Politics and Society, 16*(1), 121-158.

Kern, H., & Schumann, M. (1987). Limits of the division of labor. *Economic and Industrial Democracy, 8*(2), 151-170.

Klein, J. (1991, January). A reexamination of autonomy in light of new manufacturing practices. *Human Relations, 43.*

Koike, K. (1988). *Understanding industrial relations in modern Japan.* Basingstoke: Macmillan.

Krafcik, J. (1986). *Learning from NUMMI.* MIT International Motor Vehicle Program.

Krafcik, J. (1990). *The effect of design manufacturability on productivity and quality: An update of the IMVP Assembly Plant Study.* MIT International Motor Vehicle Program.

Lenin, V.I. (1918, April 28). The immediate tasks of the Soviet Government. *Izvestia.* In *Selected works* (Vol. 2). Moscow. (Original work published 1918).

Leventhal, G.S. (1980). What should be done with equity theory? In K.J. Gergen, M.S. Greenberg, & R.H. Willis (Eds.), *Social exchange: Advances in theory and research* (pp. 27-55). New York: Plenum Press.

Little car that didn't. (1988, January 3). *San Jose Mercury.*

Littler, C.R. (1982). *The development of the labour process in capitalist societies.* London: Heinemann.

Locke, E.A. (1982). The ideas of Frederick W. Taylor: An evaluation. *Academy of Management Review, 7*(1), 14-24.

Lukes, S. (1974). *Power: A radical view.* London: Macmillan.

Merkle, J.A. (1980). *Management and ideology: The legacy of the international scientific management movement.* Berkeley, CA: University of California Press.

McGregor, D. (1960). *The human side of enterprise.* New York: McGraw-Hill.

Miller, K.I., & Monge, P.R. (1986). Participation, satisfaction and productivity: A meta-analytic review. *Academy of Management Review, 29,* 727-753.

Mintzberg, H. (1979). *The structuring of organizations.* Englewood Cliffs, NJ: Prentice-Hall.

Monden, Y. (1983). *Toyota production system.* Atlanta, GA: Institute of Industrial Engineers.

Morse, J.J., & Lorsch, J.W. (1970, May-June). Beyond theory Y. *Harvard Business Review,* pp. 61-68.

Nelson, R.R., & Winter, S.G. (1982). *An evolutionary theory of economic change.* Cambridge, MA: Belknap/Harvard University Press.

Nohara, H. (1988, April). *The average worker of a large Japanese company.* Paper submitted to an international symposium on the Microelectronics Revolution and Regional Development, Labor Organization and the Future of Post-Industrializing Societies, Univeristy of Milan.

Ordover, J.A., & Shapiro, C. (1985). The General Motors-Toyota joint venture: An economic assessment. *Wayne Law Review, 31*(4), 1167-1194.

Organ, D.W., & Greene, C.N. (1981). The effects of formalization on professional involvement: A compensatory process approach. *Administrative Science Quarterly, 26,* 237-252.

Ouchi, W.G. (1979, March). Markets, bureaucracies and clans. *Administrative Science Quarterly, 25,* 129-141.

Parker, M., & Slaughter, J. (1988). *Choosing sides: Unions and the team concept.* Boston, MA: South End Press.

Perrow, C. (1979). *Complex organizations: A critical essay* (2nd ed.). Glenview, IL: Scott, Foresman.

Perrow, C. (1981). Markets, hierarchies and hegemony. In A. Van de Ven & W. Joyce (Eds.), *Perspectives on organizational design and behavior* (pp. 371-386). New York: Wiley.

Pierce, J.L., & Delbecq, A.L. (1977). Orgnaizational structure, individual attributes, and innovation. *Academy of Management Review, 2,* 22-37.

Piore, M., & Sabel, C. (1984). *The second industrial divide.* New York: Basic Books.

Podsakoff, P.M., Williams, L.J., & Todor, W.D. (1986). Effects of organizational formalization on alienation among professionals and non-professionals. *Academy of Management Journal, 29,* 820-831.

Pugh, D.S., & Hickson, D.J. (1976). *Organizational structure and its context: The Aston Program.* Lexington, MA: D.C. Heath.

Rizzo, J.R., House, R.J., & Lirtzman, S.I. (1970). Role conflict and ambiguity in complex organizations. *Administrative Science Quarterly, 15,* 150-163.

Roethlisberger, F.J., & Dickson, W.J. (1939). *Management and the worker.* Cambridge, MA: Harvard University Press.

Rycroft, C.A. (1973). *A critical dictionary of psychoanalysis.* Totowa, NJ: Littlefield, Adams.

Salancik, G.R., & Pfeffer, J. (1978, June). A social information processing approach to job attitudes and task design. *Administrative Science Quarterly, 23,* 224-253.

Schonberger, R.J. (1982). *Japanese manufacturing techniques: Nine hidden lessons in simplicity.* New York: Free Press.

Shimada, H., & MacDuffie, J.P. (1986). *Industrial relations and 'humanware': Japanese investments in automobile manufacturing in the United States.* Working paper. Cambridge, MA: Sloan School of Management, MIT.

Smith, J., & W. Childs. (1987). Imported from America: Cooperative labor relations at New United Motors Manufacturing, Inc. *Industrial Relations Law Journal, 1,*(9).

Solo, S. (1990, October 22). Japan's unhappy auto workers. *Fortune,* pp. 10-11.

Sproull, L.S., & Goodman, P.S. (1990). Technology and organizations: Integration and opportunities. In P.S. Goodman, L.S. Sproull, & Associates, *Technology and organizations* (pp. 254-266). San Francisco, CA: Jossey-Bass.

Steers, R.M., & Porter, L.W. (1987). *Motivation and work behavior.* New York: McGraw-Hill.

Stern, D. (1992). Institutions and incentives for developing work-related knowledge and skill. In P.S. Adler (Ed.), *Technology and the future of work* (pp. 149-186). New York: Oxford University Press.

Sutton, R.I., & Kahn, R.L. (1987). Prediction, understanding and control as antidotes to organizational stress. In J.W. Lorsch (Ed.), *Handbook of organizational behavior* (pp. 272-285). Englewood Cliffs, NJ: Prentice-Hall.

Suzaki, K. (1987). *The new manufacturing challenge.* New York: Free Press.

Tannenbaum, A.S. (1968). *Control in organizations.* New York: McGraw-Hill.

Taylor, F.W. (1967). *The principles of scientific management.* New York: Norton. (Orginal work published 1911.)

Thompson, V.A. (1975). *Bureaucracy and innovation.* University, AL: University of Alabama Press.

Turner, L. (1991). *Democracy at work.* Ithaca, NY: Cornell University Press.

Walton, R.E. (1985). Toward a strategy for eliciting employee commitment based on policies of mutuality. In R.E. Walton & P.R. Lawrence (Eds.), *HRM trends and challenges.* Boston, MA: Harvard University Press.

Weber, M. (1978). *Economy and society.* Berkeley: University of California Press.

Weber, M. (1947). *The theory of social and economic organization.* (A.M. Henderson & T. Parsons, trans.) New York: Oxford University Press.

Weick, K.E. (1990). Technology as equivoque: Sensemaking in new technologies. In P.S. Goodman, L.S. Sproull, & Associates (Eds.), *Technology and organizations* (pp. 1-44). San Francisco, CA: Jossey-Bass.

Wilinson, B., & Oliver, N. (1989, January). Power, control and the kanban. *Journal of Management Studies, 1*(26), 47-58.

Williamson, O.E. (1985). *The economic institutions of capitalism.* New York: Free Press.

Womack, J.P., Jones, D.T., & Roos, D. (1990). *The machine that changed the world.* New York: Raven.

Wood, S. (1989). *The transformation of work?* London: Unwin Hyman.

Wood, S. (1991, December). Japanization and/or Toyotaism? *Work, Employment and Society, 5*(4), 567-600.

Zaltman, G., & Duncan, R. (1977). *Strategies for planned change.* New York: Wiley.