

Time-and-Motion Regained

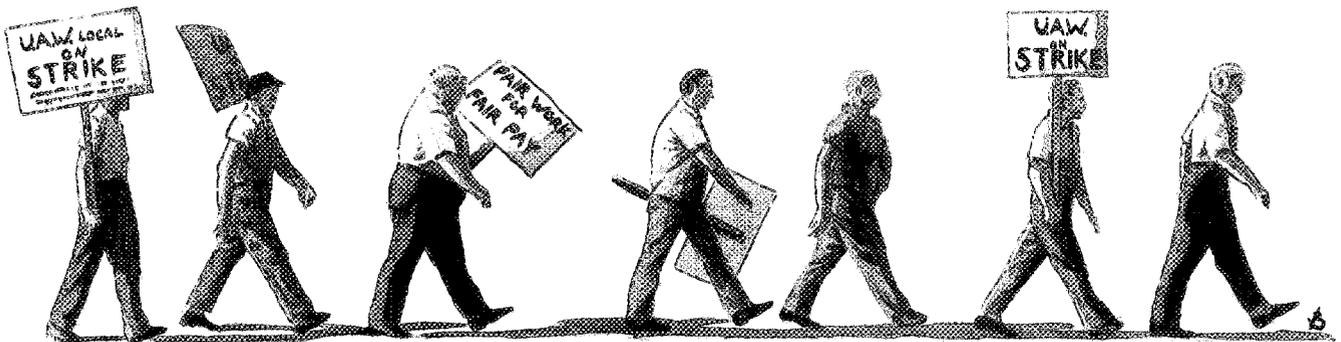
By

Paul S. Adler

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With workers defining their own job standards, quality and productivity at the Fremont plant went from worst to best.

Time-and-Motion Regained



by Paul S. Adler

Standardization is the death of creativity.

Time-and-motion regimentation prevents continuous improvement.

Hierarchy suffocates learning.

U.S. manufacturing is in the throes of revolution, and assumptions like these are becoming the new conventional wisdom about work. This new gospel sets up Frederick Winslow Taylor and his time-and-motion studies as the villain. It asserts that quality, productivity, and learning depend on management's ability to free workers from the coercive constraints of bureaucracy. It insists that detailed standards, implemented with great discipline in a hierarchical organization, will inevitably alienate employees, poison labor relations, stifle initiative and innovation, and hobble an organization's capacity to change and to learn.

But what if, as I believe, this new creed is wrong? What if bureaucracy can actually be designed to encourage innovation and commitment? What if standardization, properly understood and practiced, should prove itself a wellspring of continuous learning and motivation?

In Fremont, California, a GM-Toyota joint venture called New United Motor Manufacturing Inc., NUMMI, for short, has succeeded in employing an

innovative form of Taylor's time-and-motion regimentation on the factory floor not only to create world-class productivity and quality but also to increase worker motivation and satisfaction. What's more, NUMMI's intensely Taylorist procedures appear to encourage rather than discourage organizational learning and, therefore, continuous improvement.

This outcome seems surprising because for decades our attitudes toward work have been shaped by a chain of reasoning that has led us to expect (and guaranteed that we would get) a vicious circle of escalating managerial coercion and employee recalcitrance. The reasoning runs something like this:

- When tasks are routine and repetitive, efficiency and quality require standardized work procedures.
- High levels of standardization rob jobs of their intrinsic interest, reducing motivation and creativity.

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□ Demotivating work leads to dysfunctional employee behavior such as absenteeism, high turnover, poor attention to quality, strikes, even sabotage.

□ Counterproductive behavior by the work force requires more authoritarian management, more hierarchical layers, and even higher levels of standardization.

In short, Taylorism leads inevitably to work-force discontent and union belligerence, which in turn lead inevitably to higher levels of bureaucratic excess. The organization of work comes to build on the dehumanizing logic of coercion and reluctant compliance. Meanwhile, quality, profits, and job satisfaction all suffer.

NUMMI's experience flies directly in the face of this thinking. That's because the second step in this chain of reasoning is false. Formal work standards developed by industrial engineers and imposed on workers *are* alienating. But procedures that are designed by the workers themselves in a continuous, successful effort to improve productivity, quality, skills, and understanding can humanize even the most disciplined forms of bureaucracy. Moreover, NUMMI shows that hierarchy can provide support and expertise instead of a mere command structure.

What the NUMMI experiment shows is that hierarchy and standardization, with all their known advantages for efficiency, need not build on the logic of coercion. They can build instead on the logic of learning, a logic that motivates workers and taps their potential contribution to continuous improvement.

In practice, NUMMI's "learning bureaucracy" achieves three ends. First, it serves management by improving overall quality and productivity. Second, it serves workers by involving them in the design and control of their own work, increasing their motivation and job satisfaction, and altering the balance of power between labor and management. Third, it serves the interests of the entire organization—management and the work force—by creating a formal system to encourage learning, to capture and communicate innovation, and to institutionalize continuous improvement.

The Worst Plant in the World

NUMMI is housed in what was once the General Motors assembly plant in Fremont, California, 35 miles southeast of San Francisco, which opened in 1963 and manufactured GM trucks and the Chevy

Malibu and Century. At the old GM-Fremont plant, work was organized along traditional Taylorist lines, with more than 80 industrial engineers establishing assembly-line norms that management then did its best to impose on the work force, with the predictable results.

Over the years, GM-Fremont came to be what one manager called "the worst plant in the world."

GM-Fremont had low productivity, abysmal quality, drug and alcohol abuse, and absenteeism over 20%.

Productivity was among the lowest of any GM plant, quality was abysmal, and drug and alcohol abuse were rampant both on and off the job. Absenteeism was so high that the plant employed 20% more workers than it needed just to ensure an adequate labor force on any given day. The United Auto Workers local earned a national reputation for militancy; from 1963 to 1982, wildcat strikes and sickouts closed the plant four times. The backlog of unresolved grievances often exceeded 5,000.

GM-Fremont reached its peak employment of 6,800 hourly workers in 1978. Numbers then declined steadily to a little over 3,000 when GM finally closed the plant in February 1982.

Discussions between GM and Toyota about a possible joint venture began that same year. In February 1983, the two companies reached an agreement in principle to produce a version of the Toyota Corolla, renamed the Nova, at the Fremont plant, using Toyota's production system. GM would be responsible for marketing and sales; Toyota would take on product design, engineering, and daily operations. The new entity, NUMMI, would manufacture and assemble the car. Beginning in 1986, the plant also made Corolla FXs. In 1988, both the Nova and the FX were phased out, and Fremont began building Corollas, Geo Prizms, and, as of late 1991, Toyota trucks.

The two companies' objectives were complementary. GM wanted to learn about Toyota's production system. It also obtained a high-quality subcompact for its Chevrolet division at a time when GM's market share was rapidly eroding. Toyota wanted to help defuse the trade issue by building cars in the United States. To do this, it needed to learn about U.S. suppliers.

Toyota later claimed it had also wanted "to gain experience with American union labor," but at first Toyota wanted nothing to do with the UAW. As it

happened, there was no alternative. GM offered them no other facility, and the UAW had de facto control of Fremont. Moreover, GM was afraid of a union backlash at other plants if it tried to set up the joint venture as a nonunion shop.

In September 1983, NUMMI and the union signed a letter of intent recognizing the UAW as sole bargaining agent for the NUMMI labor force, specifying prevailing auto-industry wages and benefits, and stipulating that a majority of the work force would be hired from among the workers laid off from GM-Fremont. In return, the UAW agreed to support the implementation of a new production system and to negotiate a new contract.

NUMMI was formally organized in February 1984. Toyota contributed \$100 million in capital, and GM supplied the Fremont plant. Hiring began in May. Every applicant went through three days of production simulations, written examinations, discussions, and interviews. Managers and union officials jointly evaluated applicants for the hourly jobs: team leader and team member. The union also played a role in selecting managers, except for the 16 who came directly from GM and a group of about 30 Toyota managers and production coordinators who came from Japan. The CEO, Tatsuo Toyoda, brought with him the prestige of the company's founding family.

Over the following 20 months, NUMMI hired 2,200 hourly workers – 85% from the old GM-Fremont plant, among them the old union hierarchy. (Almost none of GM-Fremont's salaried employees

The NUMMI production system not only made people work harder, it made them work smarter as well.

was rehired. In any case, many had long since moved to other GM plants.) Since GM-Fremont had done little hiring for several years before it closed, the average age of the new work force was 41. Most had high school educations. About 26% were Hispanic, 20% black, and 15% female.

The first group of 450 team leaders and the entire NUMMI management team attended a three-week training program at the Toyota plant in Japan – Takaoka – on which NUMMI was modeled. These people then helped to set up the new plant and train workers.

The NUMMI production system required people to work harder than they had at GM-Fremont. Jobs at the old plant occupied an experienced worker

about 45 seconds out of 60. NUMMI's norm is closer to 57 seconds out of 60. And because workers have to meet much higher quality and efficiency standards, they have to work not only harder but smarter as well.

By the end of 1986, NUMMI's productivity was higher than that of any other GM facility and more than twice that of its predecessor, GM-Fremont. In fact, NUMMI's productivity was nearly as high as Takaoka's, even though its workers were, on average, ten years older and much less experienced with the Toyota production system. Quality, as rated by internal GM audits, customer surveys, and *Consumer Reports* was much higher than at any other GM plant and, again, almost as high as Takaoka's.

Equally important, absenteeism has dropped from between 20% and 25% at the old GM-Fremont plant to a steady 3% to 4% at NUMMI; substance abuse is a minimal problem; and participation in the suggestion program has risen steadily from 26% in 1986 to 92% in 1991. When GM-Fremont closed its doors, it had more than 2,000 grievances outstanding. As of the end of 1991, some 700 grievances had been filed at NUMMI altogether over the course of eight years. The overall proportion of employees describing themselves as "satisfied" or "very satisfied" has risen progressively to more than 90%.

In 1990, Toyota announced that it would invest \$350 million in an additional assembly line to build a Toyota truck for the U.S. market. So NUMMI hired 650 hourly workers on top of the 3,100 – plus 400 salaried personnel – already employed. The first trucks rolled off the line in August 1991.

Fear, Selection, Socialization

NUMMI's remarkable turnaround poses an obvious question: How is it possible to convert a plant from worst to best quality and from dismal to superlative productivity over the course of a few months? The most obvious answers are not entirely satisfying.

For example, fear. The GM-Fremont plant closed in 1982, and the people rehired by NUMMI didn't go back to work until 1984. Two years of unemployment can produce a great deal of cooperation. In fact, some NUMMI workers believe management makes deliberate use of the specter of another plant closure as a veiled threat to keep people in line. But the chairman of the union bargaining committee points out that while the old plant's closure obviously made workers more receptive to NUMMI's

Voices from the Factory Floor: Excerpts from Interviews with Managers,

Team Leader

I'll never forget when I was first hired by GM many years ago. The personnel manager who hired us got the...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."

Team Leader

Once you start working as a real team, you're not just work acquaintances anymore. 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....At NUMMI, I know my team needs me.

Team Leader

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 the workers who 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 ran only 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 place, and half of it was defective anyway. Being consistently busy without being hassled 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 - and feeling a hell of a lot better about yourself!

Team Member

In our standardized work training, our teachers told us we should approach our fellow team members and suggest ways to improve their jobs. Hell, do you see me trying that with a team member who's six-foot-four 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. I'm no fool.

Department Manager

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. I don't think that people work harder at NUMMI than in other plants. Not physically anyway. But the mental challenge is much greater.

Team Leader

I don't think industrial engineers are dumb. They're just ignorant. Anyone can watch someone else doing a job and come up with improvement suggestions that sound good....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 them out.

There's a lot of things that enter into a good job design....The person actually doing the job is the only one who can see all factors. And in the United States, engineers have never had to work on the floor - not

new approach, a return to old coercive management methods would have produced a rapid return to old antagonistic work-force behavior patterns.

A second possibility is that management weeded out troublemakers in the rehiring process. But in fact NUMMI rehired the entire union hierarchy and many well-known militants. In general, very few applicants were screened out. The union even

won a second chance for some who failed drug tests the first time around.

A third answer is that NUMMI made use of a comprehensive socialization process during hiring to instill a new set of values in the new work force. Certainly, NUMMI did its best to shape and alter the attitudes of both workers and managers. For example, the company tried to undercut the custom-

Workers, and Union Officials

like in Japan. So they don't know what they don't know... Today we drive the process, and if we need help, the engineer is there the next day to work on it with us.

UAW Official

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....It would be fine if the robots worked perfectly – and the engineers always seem to imagine that they will. But they don't, 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 awhile, and we had to raise it in the safety meetings and argue about it. And they came through. That would never happen at GM-Fremont – you never saw automation simply to help the worker.

UAW Official

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....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, 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.

UAW Official

Now when I try to explain [NUMMI] to old UAW buddies from other plants...they figure that I'm forced to say all this stuff because they shut our plant down and I had no choice. They figure 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 man-

ufacturing 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.

Team Member

In the old days, we had to worry about management playing its games, and the union was there to defend us. But now, with the union taking on its 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.

Team Leader

There are people here who 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 at 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.

ary we-they divisions between workers and management by eliminating special parking and eating facilities for managers and by introducing an identical dress code – uniforms – for everyone. Management also devoted a great deal of attention to each individual hire and welcomed each personally to the company that was going to build "the finest vehicles in America."

However much these three factors – fear of unemployment, selection, and socialization – may have contributed to the final outcome, they do not adequately explain NUMMI's continuing success or its ability to let workers draw improved motivation and greater satisfaction from a system that places them in a more regimented and bureaucratic environment and makes them work harder and

faster. The most critical piece of that explanation lies in the production system itself and in the policies and practices that buttress it.

The NUMMI Production System

The idea of a production *system* is itself something of a novelty in many U.S. manufacturing plants. All factories have production techniques, procedures, and policies, but these usually comprise not so much a system as an ad hoc accumulation of responses to changing and often contradictory business and design demands. NUMMI's production system is a finely tuned, superbly integrated whole, refined by Toyota over decades of manufacturing experience.

The basic techniques are familiar at least in name. The assembly line is a just-in-time operation that does away with work-in-progress and makes quality assurance the responsibility of each work station. The application of *kaizen*, or continuous improvement, includes an extraordinarily active suggestion program, constant refinement of procedures, and the designation of special kaizen teams to study individual suggestions or carry out specific improvement projects. Every machine and process is designed to detect malfunctions, missing parts, and improper assemblies automatically. Every job is carefully analyzed to achieve maximum efficiency and quality. Job rotation is standard; workers are cross-trained in all team assignments and then allowed to shift from one task to another. Planned production leveling eliminates variation in daily and weekly schedules.

This system is essentially the same one Toyota uses in Japan, the same one many American manufacturers are now beginning to adopt. But NUMMI's approach is distinctive in two respects: first,

The NUMMI approach has two distinctive features: a commitment to the social context of work and a focus on standardization.

its strong commitment to the social context in which work is performed, and, second, its intense focus on standardized work.

In terms of social context, NUMMI seeks to build an atmosphere of trust and common purpose.

NUMMI maintains exceptional consistency in its strategies and principles, it carefully builds consensus around important decisions, and it has programs ensuring adequate communication of results and other essential information.

The basic structural unit is the production team, of which NUMMI has approximately 350, each consisting of five to seven people and a leader. The idea is that small teams encourage participative decision making and team bonding. Four teams comprise a group, led by a group leader who represents the first layer of management.

Above and beyond the production teams, the bigger team is everyone – all the workers, team leaders, managers, engineers, and staff in the plant as well as NUMMI's suppliers. Toyota leadership wants workers to understand that the company is not the property of management but of everyone together. In NUMMI's view, the primary purpose and responsibility of the management hierarchy is to support the production teams with problem-solving expertise.

The most substantive expression of this big-team strategy is the no-layoff policy spelled out in NUMMI's collective-bargaining agreement with the union. Recognizing that "job security is essential to an employee's well being," NUMMI 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." NUMMI agrees to take such drastic measures as reducing management salaries and assigning previously subcontracted work to bargaining unit employees before resorting to layoffs.

Management sees the no-layoff policy as a critical support for its overall production strategy not only because it reinforces the team culture, but also because it eliminates workers' fear that they are jeopardizing jobs every time they come up with an idea to improve efficiency.

Workers came to trust this no-layoff commitment when in 1988 poor sales of the Nova brought capacity utilization down to around 60%. Workers no longer needed on the assembly line were not laid off but instead assigned to kaizen teams and sent to training classes.

Another important support for NUMMI's team concept is its radically simplified job classification system. Where GM-Fremont had 18 skilled trades classifications, NUMMI has two. Where GM-Fremont had 80 hourly pay rates, at NUMMI all production workers get the same hourly rate – currently \$17.85 – regardless of their jobs, except that team leaders get an extra 60 cents. There are no seniority-, performance-, or merit-based bonuses.

Important as money is, equity is more important still in reducing tensions and resentments.

The second distinctive feature of NUMMI's system is standardization. Typically, American companies approach team empowerment by allowing teams considerable autonomy in how they accomplish tasks. NUMMI, in contrast, is obsessive about standardized work procedures. It sees what one NUMMI manager has called "the intelligent interpretation and application of Taylor's time-and-motion studies" as the principal key to its success. The reference to Taylor may be jarring, but it fits.

Standardized Work...

At GM-Fremont, industrial engineers did all time-and-motion analysis and formal job design, and workers tended to view them with resentment or contempt. The problem, as one union official described it, was that management assumed a "divine right" to design jobs however it saw fit. Industrial engineers with no direct experience of the work beyond capsule observation would shut themselves in a room, ponder various potentials of the human body, time the result, and promulgate a task design. Or so it seemed to workers, whom no one ever consulted despite their intimate familiarity with the specific difficulties of the work in question.

Normally, when an industrial engineer presented one of these pedantically designed jobs to a supervisor, the supervisor would politely accept it, then promptly discard it in favor of the more traditional kick-ass-and-take-names technique. The worker, in turn, usually ignored both engineer and foreman and did the job however he or she was able – except, of course, when one of them was looking. If an industrial engineer was actually "observing" – stopwatch and clipboard in hand – standard practice was to slow down and make the work look harder. The entire charade was part of an ongoing game of coercion and avoidance. Multiply this scenario by two shifts and thousands of workers, and the result is anything *but* the rational production of a high-quality car.

At NUMMI, in radical contrast to GM-Fremont, team members themselves hold the stopwatch. They learn the techniques of work analysis, description, and improvement. This change in the design and implementation of standardized work has far-reaching implications for worker motivation and self-esteem, for the balance of power between workers and management, and for the capacity of the company to innovate, learn, and remember.

The job design process itself is relatively simple. Team members begin by timing one another with stopwatches, looking for the safest, most efficient way to do each task at a sustainable pace. They pick the best performance, break it down into its fundamental parts, then explore ways of improving each element. The team then takes the resulting analyses, compares them with those of the other shift at the same work station, and writes the detailed specifications that become the standard work definition for everyone on both teams.

Taking part in the group's analytical and descriptive work involves every team member in a commitment to perform each task identically. In one sense, therefore, standardized work is simply a means of reducing variability in task performance, which may seem a relatively trivial achievement. In fact, however, reduced variability leads to a whole series of interconnected improvements:

- Safety improves and injuries decline because workers get a chance to examine all the possible sources of strain and danger systematically.
- Quality standards rise because workers have identified the most effective procedure for each job.
- Inventory control grows easier, and inventory carrying costs go down because the process flows more smoothly.
- Job rotation becomes much more efficient and equitable, which makes absences less troublesome.
- Flexibility improves because all workers are now industrial engineers and can work in parallel to respond rapidly to changing demands. For example, NUMMI can convert to a new line speed in four to six weeks, a process that might easily have taken six months to a year at GM-Fremont, with its engineers frantically recalculating thousands of tasks

If orders decline, NUMMI can slow the production line to produce fewer cars. In the same situation, GM-Fremont had to lay off an entire shift.

and trying to force the new standards on workers. In fact, GM-Fremont never even attempted anything as demanding as a line-speed change. If orders declined, GM-Fremont had to lay off an entire shift. NUMMI's new capacity to alter line speed means, among other things, that the plant can accommodate a drop in orders by slowing production.

- Standardized work also has the overall benefit of giving control of each job to the people who know it

best. It empowers the work force. Not surprisingly, NUMMI discovered that workers bought into the process quite readily. As one manager put it, "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."

...and Continuous Improvement

Yet by far the most striking advantage of standardized work is that it gives continuous improvement a specific base to build on. As one manager put it, "You can't improve a process you don't understand." In this sense, standardization is the essential precondition for learning.

Indeed, standardization is not only a vehicle and a precondition for improvement but also a direct stimulus. Once workers have studied and refined their work procedures, problems with materials and equipment quickly rise to the surface. Moreover, since each worker is now an expert, each work station is now an inspection station – and a center of innovation.

At GM-Fremont, worker suggestions were apt to meet a brick wall of indifference. At NUMMI, engineers and managers are meant to function as a support system rather than an authority system. When a team can't solve a problem on its own, it can seek and get help. When a worker proposes complex innovation, engineers are available to help assess the suggestion and design its implementation.

The difference between traditional Taylorism and the learning-oriented NUMMI version resembles the difference between computer software designed to be "idiot-proof" and the kinds of computer systems that are meant to leverage and enhance their users' capabilities. The first "de-skills" the operator's task to an extent that virtually eliminates the possibility of error, but it also eliminates the operator's ability to respond to unpredictable events, to use the system in novel ways or adapt it to new applications. The idiot-proof system may be easy to use, but it is also static and boring. Leveraging systems make demands on the operator. They take time to learn and require thought and skill to use, but they are immensely flexible, responsive, and satisfying once mastered.

The difference goes deeper yet. At GM-Fremont – where work procedures were designed to be idiot-proof – the relationship between production system and worker was adversarial. Standards and hierarchy were there to coerce effort from reluctant workers. If the system functioned as expected and the

operator was sufficiently tractable and unimaginative, the two together could turn out a fair product. There was little the operator could improve on, however, and the role of the system was utterly rigid until it broke down, whereupon everything stopped until a specialist arrived.

At NUMMI, the relationship of workers to the production system is cooperative and dynamic. Instead of circumventing user intelligence and initiative, the production system is designed to realize as much as possible of the latent collaborative potential between the workers and the system.

Suggestion programs illustrate the two approaches to organizational technology design. At many companies, suggestion programs are idiot-proof and opaque. They are designed primarily to screen out dumb ideas, and the basic review criteria, the identity of the judges, the status of proposals, and the reasons for rejection are all a black box as far as the workers are concerned. Predictably, a lot of these programs sputter along or die out altogether.

At NUMMI, the program is designed to encourage a growing flow of suggestions and to help workers see and understand criteria, evaluators, process, status, and results. Like a computer system designed to leverage rather than de-skill, the program helps employees form a mental model of the program's inner workings. Not surprisingly, workers made more than 10,000 suggestions in 1991, of which more than 80% were implemented.

In systems that de-skill and idiot-proof, technology controls, indeed dominates, workers. In systems designed for what experts call usability, the operator both learns from and "teaches" the technology. Using learned analytical tools, their own experience, and the expertise of leaders and engineers, workers create a consensual standard that they teach to the system by writing job descriptions. The system then teaches these standards back to workers, who, then, by further analysis, consultation, and consensus, make additional improvements. Continual reiteration of this disciplined process of analysis, standardization, re-analysis, refinement, and restandardization creates an intensely structured system of continuous improvement. And the salient characteristic of this bureaucracy is learning, not coercion.

This learning orientation captures the imagination. People no one had ever asked to solve a problem, workers who never finished high school, men and women who had spent 20 years or more in the auto industry without a single day of off-the-job training found themselves suddenly caught up in the statistical analysis of equipment downtime, putting together Pareto charts. One worker report-

ed that he did literally a hundred graphs before he got one right.

A woman on the safety committee in the body shop described how she applied kaizen techniques to her kitchen at home after a fire on her stove. She analyzed the kitchen layout, installed a fire extinguisher, and relocated her pot tops so she could use them to smother flames. In short, she subjected herself and her home work space to the formal problem-solving procedures she had learned at the NUMMI plant.

The paradoxical feature such stories have in common is their enthusiasm for a form of disciplined behavior that both theory and past practice seem to rule out. This paradox grows from our failure to distinguish between what Taylorist, bureaucratic production systems *can* be and what, regrettably, they have usually been.

The Psychology of Work

The chain of reasoning by which disciplined standardization leads inescapably to coercion, resentment, resistance, and further coercion seems to turn Taylorism and bureaucracy into what sociologist Max Weber called an iron cage. Taylorism and bureaucracy may have a devastating effect on innovation and motivation, the reasoning goes, but their technical efficiency and their power to enforce compliance seem to be the perfect tools for dealing with employees assumed to be recalcitrant. Taylor himself at least occasionally endorsed this coercive view of work. *Italics bristling*, he once

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."

Against this background, it is hardly surprising that most managers and academics, at least in the West, have come to believe that Taylorism and bureaucracy will inevitably alienate workers and squander their human potential. But the psychological assumption underlying this expectation is that workers are incapable of delayed gratification. Managers seem to believe that performance will improve only as work comes more and more to resemble free play – our model of an intrinsically motivating activity. Indeed, it is an elementary axiom of economics that work is something that workers will always avoid.

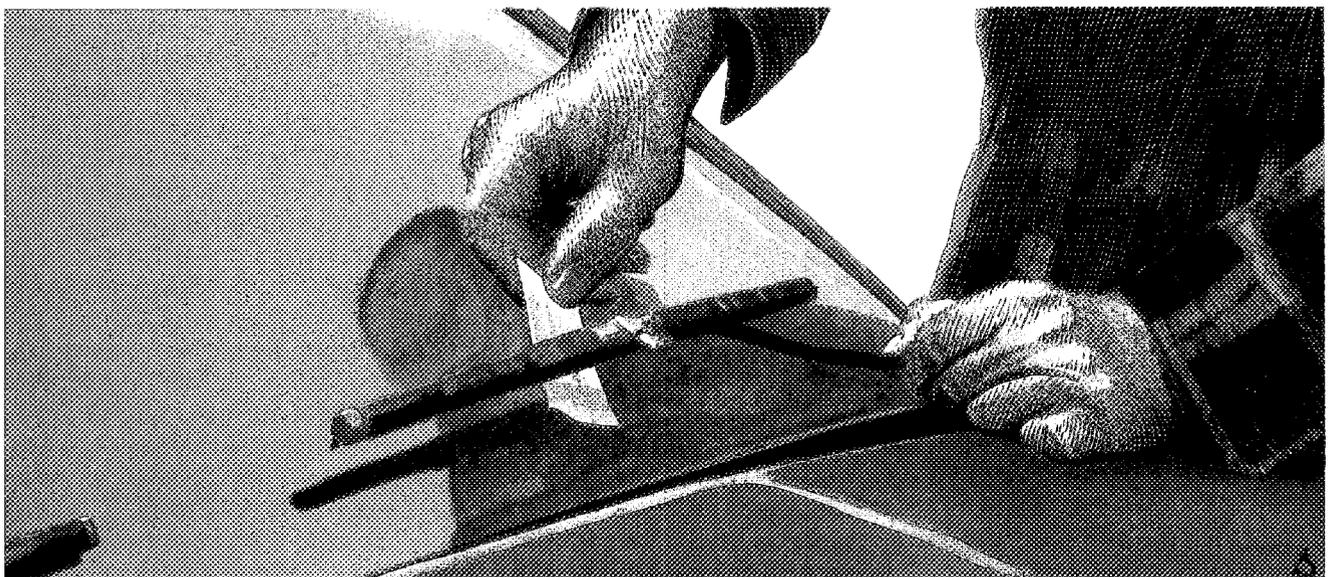
NUMMI demonstrates the error of imputing infantile psychology to workers. Interviews with NUMMI team members suggest, in fact, that this whole historical accumulation of assumptions obscures three sources of adult motivation that the NUMMI production system successfully taps into:

First, the desire for excellence.

Second, a mature sense of realism.

Third, the positive response to respect and trust.

The first of these – the desire to do a good job, the instinct for workmanship – comes up again and again in conversations with workers. The NUMMI production system and the training that went with it increased both the real competence of workers and their feelings of competence. Workers talk a lot



Workers once ashamed of their products are now inclined to let car owners know that they "helped build this one."

about expertise, pride, and self-esteem. One UAW official named "building a quality product" as one of the strategic goals that the union found most compelling at NUMMI. Perhaps the most striking story about pride in all the interviews came from a team leader:

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.

The second element of motivation is a mature sense of realism – in this case, the understanding that unless NUMMI constantly improves its performance, competitors will take its market and its workers' jobs. A useful psychological theory cannot assume that workers are so captive to the pleasure principle that their only source of motivation is the immediate pleasure of intrinsically meaningful work. The evidence suggests that at least some of the workers at NUMMI are powerfully motivated by the simple recognition that international competition now forces them to "earn their money the old-fashioned way."

Other things being equal, work that is intrinsically motivating – as opposed to mundane and routine – is better than work that isn't. But workers at NUMMI recognize that other things are *not* equal, and they are realistic in their recognition of having had an unlucky draw in terms of education and opportunity. They see automobile assembly as work

Some workers take powerful motivation from the knowledge that they have to "earn their money the old-fashioned way."

that can never have much intrinsic value, but they understand that their own motivation levels can nevertheless vary from strongly negative, at GM-Fremont, to strongly positive, at NUMMI.

"What we have here is not some workers' utopia," said one NUMMI worker. "Working on an assembly line in an automobile factory is still a lousy job... We want to continue to minimize the negative parts of the job by utilizing the new

system." Even though this work lacks the kind of intrinsic interest that would bring a worker in on a free Sunday, for example, the difference between the levels of motivation at NUMMI and at GM-Fremont spells the difference between world-class and worst-in-class.

The third explanation of increased motivation is the respect and trust that management shows workers in NUMMI's ongoing operations. For example, when the plant first began operations, the new NUMMI managers responded quickly to requests from workers and union representatives for items like new gloves and floor mats, which surprised workers used to seeing requests like these turn into battles over management prerogative.

After a few months of getting everything they asked for, workers and union representatives started trying to think of ways to reciprocate. Eventually, they decided that chrome water fountains were unnecessary and told management they'd found some plastic ones for half the price. A few weeks later, management upped the ante one more time by giving work teams their own accounts so they could order supplies for team members without prior approval from management. This kind of behavior led workers to conclude that they did indeed share common goals with management.

Power and Empowerment

The NUMMI production system confronts us with a set of formalized procedures that seem designed not primarily as instruments of domination but as elements of productive technique that all participants recognize as tools in their own collective interest. Management *and* labor support the NUMMI system. In fact, the first and overwhelming fact to emerge from interviews is that no one at NUMMI wants to go back to the old GM-Fremont days. Whatever their criticisms and whatever their positions, everyone feels that NUMMI is a far superior work environment.

NUMMI's no-layoff policy, management efforts to build an atmosphere of trust and respect, the NUMMI production system – especially the stimulus of its learning orientation – all help to explain this attitude. Beyond these formal policies, however, there are two more factors that help explain NUMMI's success with workers. The first of these, as we've seen, is the psychology of work. The final piece of the puzzle has to do with power.

There are two kinds of power to consider: hierarchical power within the organization and the power

balance between labor and management. NUMMI takes a distinctive approach to both.

In terms of hierarchical layers, NUMMI is a fairly typical U.S. manufacturing plant, and in this sense, as well as in work-flow procedures, it is a very bureaucratic organization. NUMMI's structure is not flat. It has several well-populated layers of middle management. But consistent with the idea of turning the technologies of coercion into tools for learning, the function of hierarchy at NUMMI is not control but support.

Decisions at NUMMI are made by broad vertical and horizontal consensus. At first glance, decision making appears to be somewhat *more* centralized than at most U.S. factories, but this is because consensus-based decision making draws higher and lower layers into a dialogue, not because higher levels wield greater unilateral control. Both ends of the hierarchical spectrum are drawn into more decision-making discussions than either would experience in a conventional organization.

The contrast with the popular approaches to empowerment is striking. At one U.S. telecommunications company, the model organization today is a plant of 90 workers in self-managed teams, all reporting to a single plant manager. The company's old model included a heavy layer of middle management whose key function was to command and control, so it is easy to understand the inspiring effect of the new approach. But at NUMMI, middle management layers are layers of expertise, not of rights to command, and if middle managers have authority, it is the authority of experience, mastery, and the capacity to coach.

As for the second aspect of power, many observers have assumed that the intense discipline of Toyota-style operations requires complete management control over workers and elimination of independent work-force and union power. But at NUMMI, the power of workers and the union local is still considerable. In some ways, their power has actually increased. In fact, it may be that the NUMMI model has succeeded only *because* of this high level of worker and union power.

What makes the NUMMI production system so enormously effective is its ability to make production problems immediately visible and to mobilize the power of teamwork. Implemented with trust and respect, both these features of the system create real empowerment. Wielded autocratically, they would have the opposite effect. Visible control could easily turn into ubiquitous surveillance. Teamwork could become a means of mobilizing peer pressure. A healthy level of challenge could degenerate into stress and anxiety.

The NUMMI production system thus gives managers enormous potential control over workers. With this potential power ready at hand, and under pressure to improve business performance, there is a real danger that the relationship will sooner or later slide back into the old coercive pattern.

But such a slide would have an immediate and substantial negative impact on business performance, because labor would respond in kind. An alienated work force wipes out the very foundation

The new system gives workers great positive power to improve production and great negative power to disrupt it.

of continuous improvement and dries up the flow of worker suggestions that fuel it. And the lack of inventory buffers means that disaffected workers could easily bring the whole just-in-time production system to a grinding halt. Alongside workers' positive power to improve quality and efficiency, the system also gives workers an enormous negative power to disrupt production.

In other words, NUMMI's production system increases the power both of management over workers and of workers over management.

A system this highly charged needs a robust governance process in which the voices of management and labor can be clearly heard and effectively harmonized on high-level policy issues as well as on work-team operating issues. The union gives workers this voice.

When, for example, workers felt frustrated by what they saw as favoritism in management's selection of team leaders, the union largely eliminated the problem by negotiating a joint union-management selection process based on objective tests and performance criteria.

As one UAW official put it, "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 managers want workers to trust them, we need to be 50-50 in making the decision. Don't just make the decision and say, 'Trust me.'"

Union leaders and top management confer regularly on- and off-site to consider a broad range of policy issues that go far beyond the traditional scope of collective bargaining. The union local has

embraced the NUMMI concept and its goals. But its ability and willingness to act as a vehicle for worker concerns adds greatly to the long-term effectiveness of the organization.

NUMMI's ability to sustain its productivity, quality, and improvement record now depends on workers' motivation, which rests, in turn, on the perception and reality of influence, control, and equitable treatment. It is in management's own interest that any abuse of management prerogatives should meet with swift and certain penalties. The contribution of labor's positive power depends on the reality of its negative power.

In this way, the union not only serves workers' special interests, it also serves the larger strategic goals of the business by effectively depriving management of absolute domain and helping to maintain management discipline.

Empowerment is a powerful and increasingly popular approach to reinvigorating moribund organizations. The NUMMI case points up two of empowerment's potential pitfalls and suggests ways of overcoming them.

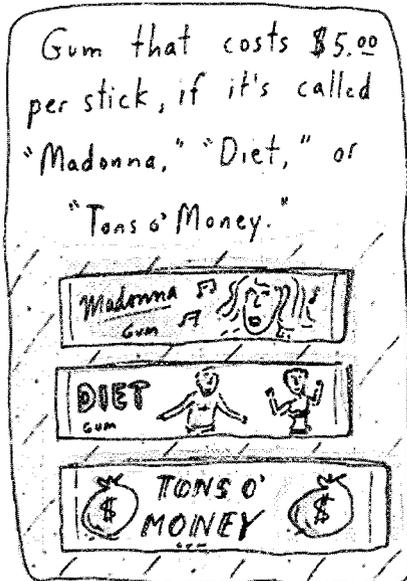
First, worker empowerment degenerates into exploitation if changes at the first level of management are not continuously reinforced by changes throughout the management hierarchy. Strong employee voice is needed to ensure that shop-floor concerns are heard at all levels of management. Without it, workers' new power is little more than the power to make more money for management.

Second, worker empowerment degenerates into abandonment if work teams fail to get the right tools, training in their use, and support in their implementation. Standardized work, extensive training in problem solving, a responsive management hierarchy, and supportive specialist functions are key success factors for empowerment strategies.

Taylorist time-and-motion discipline and formal bureaucratic structures are essential for efficiency and quality in routine operations. But these principles of organizational design need not lead to rigidity and alienation. NUMMI points the way beyond Taylor-as-villain to the design of a truly learning-oriented bureaucracy.

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WHAT THE MARKET WILL, ACTUALLY, BEAR



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