

Manufacturing Management

Anthony J. Lynch, Arun Maira, and Anjan C. Mehta

Over the past decade, we have heard a lot about the perilous decline of manufacturing in the United States. *Yet* a review of key indices, adjusted for inflation, reveals an altogether different picture. For instance, hourly output has been rising at almost 5 percent a year for the past three years. The American worker is the most productive in the world, producing on average 10 percent more in goods and services than German workers and 20 percent more than their Japanese counterparts. In fact, U.S. productivity has been growing at an annual rate of 2.5 percent, more than twice as fast as the average between 1970 and 1990.¹

The insights, strategies, and tactics articulated by the executives gathered at the Arthur D. Little Colloquium on Manufacturing Management confirmed how significantly the state of U.S. manufacturing has improved in recent years. The executives of nine well-known organizations each identified the same broad areas as critical to their continued success in the 1990s:

- Seeing the entire manufacturing process, from product development to delivery, as a means of meeting customer needs
- Viewing all the organizational parts of that process as one integrated package encompassing everything from human resources and process engineering to machines
- Leveraging opportunities for change by focusing on mindsets, motivations, and skills
- Creating an environment in which learning and knowledge-building are a continuous process
- Employing semiautonomous work teams to achieve customer focus, remain open to change, and leverage learning

Some highlights from these discussions follow.

Serving Customer Needs

Manufacturing, the participating executives agreed, is the process of making a physical product. It begins with the concept of a product and the process of making it, and ends when the product has been made and is being used by the consumer.

„Two years ago,“ Henry L. Pujol of Motorola, Inc., observed, „we visited Sharp in Japan. They were building portable telephone equipment. ‘We build products that people want,’ they told us. And that has not always been the case in the U.S.“ Pujol is Director of Manufacturing Operations for Motorola’s Pan American Subscriber Paging Division.

For too long, he noted, American industry built products without regard for the customer, secure in its global dominance in any given market and secure in its belief that people would „take what we give them.“

But „manufacturing must be the process of making a physical product *that people want*,“ Pujol said.

„Based on a business strategy that ensures that product will make a profit,“ added O. Harley Wood, Vice President of Manufacturing at S.D. Warren, a coated paper subsidiary of Scott Paper.

„You have to focus on the customer,“ added Anthony J. Alferio, UAW Coordinator with Local 1853 at the Saturn Corporation. „You have to measure the right things. Quality can’t be abstract. You can engineer the best car in the world, but if your customer doesn’t want it....“

„But how does one anticipate customer requirements?“ inquired W. Thomas Moore, Vice President and Director, Manufacturing and Engineering, Environmental Products Division of Corning, Inc. Too often, he said, it seems as if manufacturing is simply reacting to the market and is therefore frequently behind the demand curve.

„You need a philosophy of continuous improvement,“ offered Pujol. „You have to keep raising the bar.“

Understanding the Process

How do you design a manufacturing organization to maximize the rate of improvement? What work processes and human resource systems are required?

To provide perspective on these issues, the Arthur D. Little team presented the case of a major supplier of sheet metal products (doors, hoods, fenders, etc.) to the Big Three automakers. The manufacturer had a constellation of problems. In its quest for a high-quality manufacturing environment and zero defects, it had seen productivity decline. At the same time, the market for its products was shrinking as the Big Three brought more of their sheet metal work in-house. And a lack of capital investment was also preventing the supplier from upgrading equipment.

Management wanted to know which of its processes should be tweaked to improve productivity without sacrificing quality and service. Was it die maintenance? Perhaps die changeover was the crux of the problem. Or did the problem lie in quality controls, material handling, or purchasing?

The manufacturer had three cranes, that were used by production, die maintenance, and equipment maintenance to execute their tasks. But the company had no way to prioritize demands and no philosophy for the sharing of assets between these areas.

After interviewing more than 70 managers and employees, a team went back to management and reported that a world-class die changeover process could indeed be developed for the company – but that alone wouldn't solve all the problems.

In fact, they would have been better off tearing up all their processes at once, because every step was dynamic and interconnected. For instance, the equipment maintenance process wasn't working because the production scheduling process wasn't releasing the equipment to maintenance to work. And when maintenance was scheduled to get the equipment, the die changeover crew was using the crane and wouldn't give it to the maintenance people to fix the press with. So they sat idle at press time.

Meanwhile, die changeover wasn't working because production scheduling was constantly flip-flopping the decision on what part they were going to run next.

„Did they involve labor?“ Alferio of the UAW asked?

The consulting team „sometimes had better relations with the union bargaining committee than we had with management. We worked with the union right off the bat,“ he was told.

„Tearing up all the processes is a risky strategy to recommend,“ commented Leon J. Staciokas of Iomega Corporation, a leading supplier of removable disk drives for the PC and Macintosh markets. Staciokas is Iomega's Senior Vice President and Chief Internal Operating Officer.

The executives agreed, however, that piecemeal solutions can provide only incremental improvement. The sheet metal manufacturer needed to create a new environment through self-managed teams that would be able to decide how to prioritize activities. Processes that were once chaotic could then flow smoothly again. In addition, managers who wouldn't – or couldn't – buy in to the new, less hierarchical environment would be transferred. The company in question adopted just such an approach and is now well on its way back to health.

One key to efficiency, colloquium participants decided, was a thorough understanding of manufacturing processes. When processes are fully understood, disruptions – which lower yields, raise costs, and reduce profits – can be eliminated.

With that in mind, the executives explored the case of a paper company that was generating a return on assets of less than 0.5 percent. As part of an assessment period, the firm's operators were asked to note every time they made an adjustment in the manufacturing process and to write down the result.

After the first week, a team reviewed the logs and discovered that operators had made 413 adjustments. Many of the adjustments were made automatically or because the process was built-in. Still others were made by people who didn't like the quality 50 feet down on the take-up rill. After analyzing the results of each of the adjustments, the team concluded that 398 out of 413 had actually made the manufacturing process worse.

In reviewing the data, the executives agreed that the paper manufacturer was „reacting to noise rather than understanding whether it was statistically significant to make each adjustment.“

„Understanding the process,“ Moore of Corning noted. „That's where the money is.“

In a fully optimized factory, another presenter offered, „every single activity has to be value-added in a dynamic balance between customer service, inventory investment, and manufacturing performance.“

Achieving that balance he noted, requires that the organization be open to learning and change.

Leveraging Opportunities for Change

„Our job as managers is to spur change,“ stated Nicholas J. Bozich, Manufacturing Systems Leader, Saturn Corporation.

„But how do you keep the spirit of change alive within a successful environment?“ inquired one participant.

„The top 70 percent of our managers work at least 60 hours a week,“ said J.W (Jack) Shilling, Vice President-Technical, Allegheny Ludlum Corporation.

„Everybody works 60 or 70 hours a week,“ added Coming's Moore. „But we seem to move so slowly.“

„The Japanese think 10 years ahead,“ said Pujol of Motorola. „They set up a strategy and a plan and stick to it. We seem to want instant gratification. That’s an American tradition. Jack [Shilling] says, ‘We’re good. We’ve been making money for the past 20 years.’ Well, how do any of us know we’re going to make money in the *next* 20 years?“

„In 1952, Hitachi wanted an automated operation,“ another executive noted. „They worked on it for 40 years. There was a lot of failure. What is required to be able to put a stake in the ground and hold on to that kind of vision? How do you maintain continuity of vision within an environment of change?“

„We make a decision every day about what our people will be doing the next three or four years,“ Shilling. „Allegheny has invested huge sums in strip-casting. It hasn’t paid off yet, but we’re sticking with it.“

„GM invested to set up a new corporation [Saturn] to do things differently and, perhaps, help the parent,“ Saturn’s Bozich said.

„Some industries are less susceptible to dynamic change,“ commented Iomega’s Staciokas. „A car has four wheels, not three or five. In our industry [computers], the changes are so dynamic and unpredictable. The notion that you can predict ten or even five years ahead is folly. We need flexibility. If we always do what we always did, we get what we always got.“

But how do you change the management mindset?

After some discussion, the participants at the colloquium agreed that:

- Top management must see a reason to change.
- The company must articulate a clear vision of what it wants to be.
- Everyone throughout the organization must have some view of the resulting process of change.

A lively discussion ensued on the development of managers for change. „Managers tend to have a narrow focus,“ Staciokas noted. „They tend to specialize. That’s a problem. Does the distribution manager understand production problems? Does he or she care?“

Pujol: „We changed our managers’ titles to ‘coaches,’ stressing the team approach. Later, we changed them to ‘associate managers’ because ‘coaches’ inspired resentment [among managers].“

Alferio: „Managers are people working to accomplish organizational goals. Leaders work to set goals, and they are not necessarily organizational.“

Staciokas: „The CEO is a manager.“

„It’s a matter of scope,“ offered Fred Boos, Director of Operations of The Toro Company. „The CEO projects vision.“

S.D. Warren’s Harley Wood presented a formula for change: dissatisfaction times vision times FPI equals change, where „F“ equals the first step, „P“ means permission to change, and „I“ stands for the information needed to change.

Staciokas: „The problem is that we don’t train managers. We put a coat on them and say, ‘Now you’re a manager,’ without telling them what we expect.“

Pujol: „The selection process for managers is very poor. Traditionally, those who perform well get into management, often for simple financial reasons.“

Boos: „Do we define what we expect of managers?“

Alferio: „What are we measuring? Do we give feedback?“

Shilling: „It’s a human behavior problem. There are well-established models, like the ABC model. „A“ is for antecedent. What have they been asked to do? Have they been trained? Have the goals been communicated? „B“ is for behavior. Can they do what’s being asked of them? Do they have the skills? „C“ is for the consequences. Do they perceive that their actions will produce good, bad, or no consequences?“

Wood: „Consequences. Is that feedback?“

Shilling: „Proper feedback must be timely and accurate. It should be neither positive or negative. It is not a consequence. Consequence follows feedback.“

Boos: „But what do we expect from a manager? Say he makes his budget, but his people are always stirred up. They don’t like him. Is he a good manager?“

Pujol: „Are people the first priority of a manager? If you manage that right, can we assume that other things will take care of themselves?“

Staciokas: „We have to step back and ask, ‘What is the management mindset?’ We have to recognize that a bell-shaped curve exists, in which a few managers will always resist change, a few will seek it out, and a majority will be willing to be swayed either way.“

Not only upper management must be thinking about change, most of the participants quickly agreed. „The next level of managers must be actively involved with change, as well, if they are to pass down a process through the rest of the organization,“ suggested one executive.

„When you think about it,“ he added, „aren’t change and learning two ways of looking at the same thing?“

Embracing Learning and Knowledge

Executives at the colloquium also agreed that people – not processes – learn. They identified four potential blocks to the transfer of knowledge in many organizations: a management hierarchy rewarded for doing things the old way; a failure to articulate goals; the absence of a process to transfer learning; and a lack of measurements to help identify successful transfer.

The key to creating a learning environment is rewarding change leaders. „Leaders,“ said Saturn’s Nicholas Bozich, „have to be teachers. Teaching is the best way to learn. Teaching has to be emphasized as a primary management function.“

Vernon A. Dyke, Vice President and General Manager, Kodak Park, Eastman Kodak, noted: „We reward for invention. If the plant down the road comes up with a better process, many managers find it hard to say, ‘Okay, we’ll copy them,’ even if it’s the rational thing to do.“

„That’s somehow un-American,“ he added. Copying is like cheating. „The public schools need to put greater emphasis on collaboration.“

In order to transfer knowledge, according to Bozich, one has to understand that it is a process during which management should seek feedback at every step of the way. That process, he said, begins with information – first assembling it and then translating it. The next step is understanding, which requires spending time and money on training. After understanding comes commitment, the stage in which people buy in to a given goal. The final step is to act.

„You have to go through these steps one by one,“ Bozich noted. Expecting people to jump from information to action is likely to result in dysfunction.

Among the „best practices“ that emerged from the discussions were establishing minimum thresholds for education levels in work teams, forging partnerships with local technical schools, and organizing „World Competition Days“ for all company stakeholders, including customers.

For Motorola’s Henry Pujol, self-directed and self-managed work teams are essential to any vision of the continuously improving corporation of the future. And the key to successful work-team processes, he said, is continuous education.

Making Self-Managed Teams Work

According to Pujol, Motorola spends \$120 million annually on employee training, including \$2 million every year on literacy. He envisages a corporation of the future in which every employee spends nine months of every year working, two months vacationing, and one month training.

Motorola’s work teams are being nurtured toward fully internalizing their value and becoming, in effect, process owners in the company’s business. To help achieve that, Pujol noted, Motorola has gone to a 168-hour-a-week factory schedule in which people can choose to work on weekends or choose to work a four-day, 12-hour-a-dayweek, called „people-first scheduling.“

Corning, too, has self-managed manufacturing teams and a philosophy of continuous improvement, according to Moore. A goal-sharing plan compensates work teams by evaluating their performance on service (25 percent), quality (25 percent), and costs (50 percent). Compensation varies according to results, and everybody is measured by the same matrices.

Like Pujol, Moore identified education as a key to competing in an increasingly technologically oriented manufacturing environment. Corning has divided its manufacturing processes into five educational modules, and each worker attempts to master every module. The more modules workers learn (and they are tested on each one), the more they are compensated.

Harley Wood of S.D. Warren insisted that good standards, procedures, and centerlines should be in place before proceeding with self-managed teams. Otherwise, he cautioned, „you will have different shifts or different teams doing very different things with no consistency throughout the process. When you are running seven days a week, three shifts a day, that is imperative.“

In order to avoid that conflict, Wood said, S.D. Warren has created teams that represent all shifts. These teams are pulled off-shift for up to six months of training and are subsequently reintegrated back onto the line. This is competency-based training, in which „operators or craftspeople teach other operators or craftspeople. It is a methodology to determine what the competency of that job is and hence what people have to learn. Then we have those folks in turn teach other people on their team.“

At Toro, according to Fred Boos, a manufacturing work force downsized during the past decade is hard-pressed to meet growing demand for its tractors, and home, lawn, and garden equipment. The company’s answer to making more with less has been to create work groups, or teams, that are self-directed. For example, these teams can approve small-scale purchases without going through Toro’s purchasing department. They are also empowered to put in work orders for maintenance and are brought in to work with plant engineers on new product development before production begins.

All Toro employees now receive TQM training in order to help them function more efficiently and productively within these groups, Boos said. In order to make the groups intelligently self-directing, employees learn as much about the industry’s competitive environment as managers.

The company’s commitment to the team concept is multifaceted and pervasive. Internal communication within the plant is a priority. Access to upper-level management has been made easier. Boos estimated that 20 to 25 hours a year are spent on formal communication with every employee.

„How do you select team leaders?“ inquired one participant. „They usually rise to the top,“ Boos said. Leaders at Toro are typically elected by their groups.

„Let’s not overlook the fact that there can also be problems with teams,“ Allegheny Ludlum’s Shilling reminded his fellow colloquium executives. „For one, teams are good for continuous improvement within the box. But when you want to get out of the box, there can be problems. Teams are also not so good when it comes to speed. And what about management-team disputes? How do you resolve those?“

Asked about criteria for group leaders, Boos reported that Toro found leadership and interpersonal skills to be more important than technical ability. Iomega’s Staciokas added, „And we shouldn’t underestimate what people can do if you leave them alone.“

The legendary football coach Vince Lombardi said, „The achievements of an organization are the result of the combined efforts of each individual.“

Central to successful manufacturing in the late ‘90s is recognition of four interconnected processes: satisfying the needs of customers, achieving sustained organizational improvements, creating an environment conducive to learning, and fostering the emergence of semi-autonomous work teams.

¹ *The New York Times*, February 27, 1994.

Anthony J. Lynch, a Director in Arthur D. Little’s manufacturing industries area, also shares responsibility for the firm’s process redesign and change management practice. He helps companies achieve breakthrough performance.

Arun N. Maira is a Director of Arthur D. Little’s management consulting activities. He joined the firm after 25 years with TELCO, the last eight of which he spent as a member of the board of directors. Based in Arthur D. Little’s Cambridge, Massachusetts, headquarters, he has assisted clients in several industries to manage change and obtain breakthrough performance improvement.

Anjan C. Mehta is a Director in the Manufacturing Management Unit of Arthur D. Little, where he works with clients to develop manufacturing strategies and improve manufacturing operations. He has worked with clients in several industries, including auto components, medical devices, chemicals, and steel, to improve their manufacturing capabilities.