

## CRITICAL PERSPECTIVE

### What is Happening in Manufacturing?

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What is happening today in U.S. manufacturing? For over a decade, one wave of change after another has been breaking over manufacturers in this country. Faced with global economic restructuring, rapid technological change, and a babble of new solutions, manufacturers have had a difficult challenge sorting out that which is necessary and important from that which is fad.

As we painfully recall, the 1981-82 economic crash shook the confidence of American manufacturing, and of Americans in manufacturing. Between 1979 and 1984, 20% of U.S. manufacturing workers were displaced (Bureau of Labor Statistics 1992). As the economy began to recover, we bought the line that we could forget our recessionary hangover by turning to strong growth in service jobs, consumer products, real estate, and junk bonds. The merger and acquisition mania swept in like a tsunami, leaving even survivors staggering under debilitating debt.

Unfortunately, with the tight grip of the Federal Reserve on the supply of money during that period, a strong dollar enabled increasingly more aggressive foreign competitors to encroach on American markets and encouraged U.S. companies to expand production abroad. As early as the mid-1980s, foreign companies began to dominate a number of traditional domestic markets. Our international trade deficit shot up like a rocket.

When we asked our customers—here and abroad—why they had turned on us, they said that we couldn't make high quality, affordable products with attractive features like those of our foreign competitors. The truth hurt. It was a sobering decade for the country, especially its manufacturers.

#### The Promise of Computer-Integrated Manufacturing, and Others

As we moved into the 1980s, Computer-Integrated Manufacturing (CIM) with its elements, Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), Flexible Manufacturing Systems (FMS), and many others, were touted as “the answer.” Then Just-In-Time (JIT) and a host of Japanese techniques—kanban, kaizen, poke yoke—flooded the field. Steadily gaining momentum over the decade, Total Quality Management (TQM) and its derivatives became revealed truth. Concurrent Engineering recently gained its advocates. Now “agile manufacturing” is supposedly the 21st century approach (Nagle 1992).

The siren song of CIM promised productivity gains and better profits. CIM was “automation and integration.” The new combination of robotics, more sophisticated microelectronics in machining equipment, and important advances in computer integration software seemed to offer instant benefits to manufacturers, especially those who depended heavily on machining operation. A number of large manufacturers, particularly those in the defense, aerospace, and automotive industries, invested billions of

dollars in robots, automation, and “computer-aided everything” software, running on big mainframes. There were some spectacular successes—leadtime reductions of 50-70%, work in progress (WIP) reductions of 40%, raw materials reductions of 60%, and operating cost reductions of 25% (Scrimgeour 1988).

Unfortunately, hardware and software vendors oversold CIM and its vision of the lights-out factory. Those big dollar investments (big mainframe computers, big machining centers, big consulting fees) often did not lead to improved productivity and a better bottom line. Fortunately, the cost of CIM kept most smaller companies from jumping on the bandwagon.

Why didn't CIM deliver? Basically, the answer is that automation and information technologies alone can not serve as the means of improving productivity and quality. At that time, very few American companies were willing and/or able to wrestle with methods to integrate CIM equipment and software into the existing workforce, operations, and corporate competitive strategies.

In retrospect, we can see that the CIM of that era primarily included engineering design and discrete parts manufacturing. Often these were not the pacing steps needed for getting new, high quality products to market. All related business operations must be synchronized as well. Such synchronism does not occur by accident, so reducing a few (already low) direct labor hours often had little if any impact on productivity or profits.

Another trap was a favorite slogan of the CIM salesmen: “Emigrate, Automate, or Evaporate.” This led some companies to invest millions (even billions) in automating processes which were inefficient or even superfluous. As pointed out, one needs to clean up the mess first, rather than automating it (Kelly 1992). In fact, a careful review of product design and process operations often entirely eliminates costly, troublesome steps.

There was also the small problem of not getting people involved. From *Competing in World-class Manufacturing*: “For those companies that failed with technology, the typical common denominator was a lack of attention to the human element” (Giffi et al. 1992). With few exceptions, as recently as a decade ago, there was no place for such radical departure from accepted manufacturing management practice. The gurus of CIM embraced the twin mantras that “you have to have top management commitment” and “you have to have a CIM champion within the corporation,” but they were selling CIM on the basis of **reducing** direct labor, not empowering it.

As noted, few small- and medium-sized manufacturers were bitten by the CIM bug, since they could not absorb the cost without betting the future of their companies. They were also warned off by the “horror” stories of big companies that had invested heavily and lost.

### TQM Moves to the Head of the Class

Total Quality Management (TQM) arrived in the U.S. at a fortunate time. Some lessons had been learned from CIM efforts, others from Japanese management, and others still from the market. Top management had to become committed and involved in the decision to make real changes in the company, not just to launch another management craze or approve another capital equipment request. Top management involvement became a virtual necessity, not just an additional hurdle, with TQM.

Through employee involvement, TQM began to change companies by dragging all kibitzers into the quality game. Employee teams helped determine how quality could be embedded in manufacturing processes, backed up by rigorous quantitative methods. Employees who would use new equipment and techniques became involved in their selection and implementation. The importance of designing and deploying quality products, processes, and supporting technologies was not diminished, but rather the entire enterprise was brought into quality efforts. Continuous improvement was extended to every operation of the company, not just the factory.

Attention to customer satisfaction shortened the distance between engineering and manufacturing and the market place. High quality in products is now accepted in many companies as a given, with customized products being the new objective.

One additional major advantage of TQM is that it is not restricted to large firms. With relatively low barriers to entry, TQM is accessible to the 20-employee shop. Initial benefits are sometimes seen within months as low-cost, high-payback projects begin to bear fruit.

While TQM continues a favorable run, there are growing signs that it, too, is not proving to be a panacea. Critics point to the poor business performance of some Baldrige Quality Award winners as evidence that the claims for TQM are overblown. While allegations that TQM is a failure in America (Matthews 1992) are off the mark, many manufacturing CEOs are evaluating their recession-wracked numbers trying to determine the real contributions of Total Quality Management. The TQM gurus are counseling patience since it takes time (two to three years) to realize the benefits of new approaches.

### A Sea Change in Manufacturing?

Waves of change continue to break. As mentioned, Just-In-Time, Concurrent Engineering, and Agile Manufacturing, to name a few, are advocated as ways to confront the turbulence facing U.S. manufacturing. One wonders if a significant part of the problem arises from a sea change in the nature of manufacturing itself. Although this sea change is driven by many forces, one unresolved clash is that between the traditional view of labor and the new view of the empowered worker.

Since the beginning of the Industrial Revolution, the role of labor (read blue-collar) has been to add value during production and to leave managing to managers. In early years of the modern industrial organization (1880-1930), direct labor accounted for most of the cost of production beyond the cost of raw material. Thus, the first law of

productivity increases was simple: increase output and decrease direct labor.

Since World War II, that truism has become less true each year, with direct labor accounting for a smaller fraction (in some companies, less than 10-20%) of the production costs as compared with raw material costs. But the vast majority of manufacturing companies cling to outdated accounting systems that still count direct labor hours as the only important factor, with all other costs "allocated" by formula. Most companies continue to look to "savings" in direct labor hours as the critical factor in cost cutting efforts and in capital investment decisions, with little regard to external forces (i.e., what their competition is doing) or to ripple effects within the corporation.

This obsession with reducing direct labor hours has, for years, bedeviled engineering managers trying to justify CAD, CAM, and other automation equipment, and is now hobbling TQM managers. But the prevailing U.S. manufacturing management culture is to reduce direct labor first, ask questions later.

A major countervailing influence has emerged with TQM, Continuous Improvement, Kaizen, and others. These approaches place major emphasis on involving front-line workers in determining what strategies lead to higher output and the best product quality, and in implementing of required changes. In fact, training workers in problem solving and Statistical Quality Control empowers them to know more about how to improve their operations than does anyone else. Along with team techniques, manufacturing cells, and improved technology where needed, proper worker empowerment has nearly become antithesis of reducing labor through automation.

An associated development is the "flattened" organization. Many companies are discovering that they can do better with fewer layers of mid-level managers, and they are even reducing the ratio of first-line supervisors to machine operators. Obviously, with fewer non-value added stops in the loop, the right information must be delivered to the right place at the right time the first time. This is, of course, putting increased emphasis on information integration and communication.

Few experts are trying to reconcile the two fundamentally different approaches to dealing with labor. It should not be surprising that Peter Drucker, long-time management authority, has asserted himself to make sense out of the confusing and conflicting manufacturing strategies. In a recent *Harvard Business Review* article (Drucker 1990), Drucker says, "We cannot build it yet. But already we can specify the 'postmodern' factory of 1999." Although falling short of a unified theory, Drucker's article (Drucker 1990) identifies four concepts that together constitute a new approach to manufacturing. The first concept is Statistical Quality Control (SQC) which identifies the quality and productivity that can be expected from a given production process. Drucker claims SQC resolves the century-old conflict between Taylor's "scientific management" and Carnegie's "human resource" approach. He says, "SQC makes it possible to attain both traditional aspirations: high quality and productivity on the one hand, work worthy of

human beings on the other.” The second concept is the new time-based manufacturing accounting, the solution to the shortcomings of conventional cost-accounting described earlier. The third is manufacturing as a “flotilla” or modular organization as opposed to today’s “battleship” factory. Organizing manufacturing into modules connected via an information network accommodates both standardization and flexibility, according to Drucker. The fourth concept, systems design, envisions the whole of manufacturing as an integrated process which converts materials into goods. This will require the transformation of functional managers into business managers.

Drucker argues that these four concepts, taken together, “tackle the conflicts that have most troubled traditional, twentieth century mass production plants: the conflicts between people and machines, time and money, standardization and flexibility, and functions and systems.” While not definitive, Drucker’s article at least suggests that there may be ways to reconcile what we were taught with what we are now experiencing.

### **The New Importance of Time**

As we learned from Ben Franklin, “Time is money.” Drucker identifies time as the new measurement unit in production and its importance in cost accounting, but his article only touches on the changes that the new perception of time is already forcing on manufacturing. A number of experts have been developing approaches based on the growing importance of getting products to the market quickly. The approaches are called “simultaneous or concurrent engineering,” “rapid product realization,” and “time-based strategies.” The idea is simple. Instead of doing tasks in sequence, do them in parallel. Concentrate on shortening the longest task, and move to next longest.

As opposed to the sequential processes (product concept, preliminary design, prototyping, testing, and so on) traditionally used by manufacturers, simultaneous engineering provides for input from all key design and manufacturing professionals early in the design phase, and continues their involvement until the product is marketed. In addition to building in quality, reliability, and low cost, the approach minimizes future difficulties such as delays in production.

Successful implementation of this concept relies on multi-functional teams, co-located for maximum advantage, as AT&T, Chrysler, and others have learned. Simultaneous engineering brings together people who have never worked together before—even though they may have previously been involved in developing the same product. In this approach, the challenge is to build and support the “product team” from beginning to end, not to rush and pick up the baton when it is dropped during handoff from one department to the next.

Results of this “parallel processing” approach to engineering manufacturing have been dramatic, from automobiles to laptop computers. And, in many companies, the concept relies heavily on computer-aided design and analysis tools as the means by which several groups can simultaneously design, review, evaluate, modify, and perfect the ultimate design.

### **But Isn’t CIM Dead?**

According to *Industry Week’s* John Sheridan (Sheridan 1992a), “CIM is more alive than ever, but it has taken on a new set of personalities and new dimensions . . . the vision of computer-integrated manufacturing in the 1990s bears only slight resemblance to the CIM vision of 10 or 20 years ago.” The evolution of CIM is partly the result of improvements in computer technologies such as those mentioned above according to the manufacturing executives interviewed by Sheridan, over 80% of whom rate CIM either “essential” or “very important” as a competitive weapon for U.S. industry.

Manufacturers are also recognizing that people play an even bigger role in the process than do computers. As one executive interviewed by Sheridan (Sheridan 1992b) put it, “. . . we have empowered people with information—in some cases with computers. To us, the most important elements of CIM are the business processes that you develop. They are what drive the whole people process. Secondary to all of that is the computer hardware and software.”

With people and processes now receiving equal consideration to information, CIM is definitely becoming “enterprise-wide integration,” a new description which fortunately doesn’t fit an acronym easily. Also, today many CIM components are affordable to smaller companies.

### **What’s Happening with Smaller Manufacturers?**

Over the last four years, our experience in assisting Northern Ohio manufacturers in their modernization efforts has been primarily with smaller companies (i.e., less than 250 employees). These companies generally focus on what needs to be done before they make substantial (for them, large) CIM investments. Most of our Great Lakes Manufacturing Technology Center (GLMTC) projects involve quality techniques (24%), plant floor hardware (23%), business systems software such as Manufacturing Resource Planning (21%), product design (16%), and CAD/CAM/CAE and environmental problems (11 and 5%, respectively) (Sutherland 1992).

Some GLMTC projects involve process automation, and those that do concentrate on removing production bottlenecks, replacing manual labor-intensive processes, or creating innovative products—elegant but simple. Often when visitors are told this, they respond with quizzical looks (as if, “We thought your job was recommending CIM or FMS equipment!”). Any company—especially a small- or medium-sized company—has to begin where it is, then take manageable and affordable steps before installing sophisticated automation. In these companies, appropriate technology is still a major driving force. Many technologies today are driven by the continuing microelectronics revolution which translates into cheap, friendlier, computing power. The price/performance ratios (\$/MIP) of computers, especially workstations, continue to drop. More computer networks (such as LANs) are showing up in smaller companies. High quality telecommunications are within reach of many smaller companies.

### What Does the Future Hold for Manufacturing?

U.S. manufacturing has made considerable progress over the last decade. The effect of the 1991-92 recession on U.S. manufacturers was much less severe than that of the 1981-82 recession. In fact, until the European and Asian economies recently slowed to a standstill, export of U.S. manufacturing goods was rapidly growing. Taking advantage of foreign markets, many smaller companies had begun exporting seriously for the first time.

As the U.S. economy begins to expand again, orders are being solidified for most companies, the major exception being those heavily dependent on defense contracts. Most economic indicators are showing positive, if cautious, signs. As the world economy rebounds, exports will again begin growing. Assuming that the North American Free Trade Agreement is eventually approved in some form, export trade with Canada and Mexico will accelerate.

Two promising themes from the Clinton campaign were increased technical assistance for smaller manufacturers and expanded workforce training programs. During 1992, CAMP worked closely with the National Coalition for Advanced Manufacturing and others for the passage of the National Competitiveness Act (H. R. 5231 and its Senate companion, S. 1330) (Kwiatkowski 1992). We are hoping for quick passage in early 1993 of an expanded version of that legislation since it would establish a national network of technical assistance programs for smaller manufacturers.

We are also hopeful that the President's new workforce training programs will broaden the eligibility to currently employed workers and will establish incentives for these workers to upgrade their skills.

Finally, spurred by the healthy debates of the presidential election, we appear to have awakened to realize that

manufacturing is the basis of generation of wealth in this country, that indeed "manufacturing matters." With a new administration seemingly well-aware of the central importance of manufacturing to long-term economic growth, it could be a promising era. However, given the national short attention span, and given the thousands of other issues clamoring for the attention of the President and Congress, it becomes problematic whether an idea can be retained long enough to produce results.

Is it too much to hope for that we can generate the right combination of success factors to restore U.S. manufacturing to the most competitive in the world? We'll probably know the answer before the end of this decade.

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