Book The Technology Machine

How Manufacturing Will Work in the Year 2020

Patricia E. Moody and Richard E. Morley
Free Press, 1999

Recommendation

Patricia A. Moody and Richard E. Morley take a fascinating trip into the future, the not-too distant future, by exploring what manufacturing and product delivery to consumers will look like in the year 2020. By discussing past and current advances, the authors articulately present convincing arguments for their ideas with great zest. Don't worry, you won't find impenetrable technological prose here, quite the contrary. Instead, you'll find visions of point-of-consumption manufacturing, small work groups made up of people who live near their job sites and biotechnology that enables customized creation of replacement body parts. Gene Bylinsky of Fortune magazine calls this well-received volume, "a beautifully written, insightful and important new book... your best guide to success" in the 21st century. *BooksInShort* recommends this book to forward-looking managers who understand that, even in the complex future, the main rule will be: Keep it simple.

Take-Aways

- Complex manufacturing systems will lead to simple manufacturing solutions.
- The core of future growth lies in technology, knowledge and individual experience.
- Real-time online systems will link customers and suppliers.
- Customer-designed, point-of-consumption, product manufacturing will drive businesses.
- In the future, successful organizations will take a holistic approach.
- Breakthrough technologies will increase productivity and enable functionality and post-installation optimization.
- Machines will not run every operation.
- Wild-card events will affect future technologies as they have influenced past technologies.
- Businesses are complex systems that must adapt to survive.
- Knowledge will be currency.

Summary

The Technology Machine in Action

Autonomous agents, emergent systems and complexity theory will change the way you live and work in the 21st century. Today's manufacturing and production systems will grow more and more complicated, leading the science of complexity to produce paradoxically simple solutions by the year 2020. Technology, knowledge and individual experience are at the core of this transition.

> "The biggest areas of opportunity lie ahead of and after manufacturing. Look at the areas that feed and draw on the manufacturing function - all the places where idea transfer and development barriers stand in the way of ultimate customer fulfillment

The lingering problems that beset today's manufacturers are rooted in three bad business habits: shortsightedness, restrictive structures and unbalanced improvement fads. Business must leave those faults behind. The technologies that will dominate the business world in the future will lead customers and suppliers to be linked by real-time online systems. Business will be driven by customer-designed, point-of-consumption replication of the product. The successful future organization will take a holistic approach and will look nothing like the "sweatshop-like" companies of the past.

> "Government regulatory groups and some investors do not understand the inevitable cycle of technology birth, growth and passing."

Many visions of the future are distorted and show machine intelligence running every operation. That is simply not going to happen. Instead, people will shape technology that works with their intelligence, values, technical mastery and quest for constant innovation. Breakthrough technologies will have to perform four key functions: increase productivity, enable functionality, enable the user and enable post-installation optimization, survivability, market share and user lock-in.

Current visionary leaders to keep an eye on in the future include:

Ken Iverson - chairman of Nucor Steel, a technologist who changed the way steel is made and launched a new technology. Gordon Lankton - of Nypro, an engineer who implemented real-time in-line process control to make very high-quality plastics and who continues his enthusiastic support of workforce improvement from the ground up. Gene Kirila - president and founder of Pyramid Systems in Greenville, Penn., who creates technology solutions where none existed before.

Predicting the Future

How accurate can future predictions be? The future, as always, contains many unknown wild cards. Look at this list of predictions published in 1901 in Houchi News, a leading Japanese newspaper. Some 100 years later, 17.5 of these 24 predictions (73%) have come true.

- Worldwide wireless telephone.
- Worldwide color photo instant transfer.
- Extinct wild animals.
- Green Sahara.
- Rise of China, Japan and Africa.
- Round-the-world trip in seven days, global travel for everyone.
- Warships in the air.
- Extermination of flies and fleas.
- Air conditioning.
- Cultivation of tropical plants in Greenland using electricity.
- Advanced voice transmitter, talk over a distance of 10 miles.
- Picture telephone and shopping by picture telephone.
- Electricity as fuel.
- Bullet train 2.5 hours between Tokyo and Kobe.

- Rubber-tire trains in the air and under the ground.
- Worldwide railroad network.
- Natural disaster control.
- Everybody taller than six feet.
- Electric needle health treatment without pain or medicine.
- Automobiles without horse.
- Animal language literacy.
- Advanced education.
- Countrywide electricity distribution.

> "Although technological progress has in the past owed much to achievements in hardware, in the future, success will depend on large software-intensive products and these products will have tasks and goals much harder to understand than today's hardware-related products."

What predictions can be made about the 21st century? Here are a few that will be enabled by technology breakthroughs:

- Technology will drive social structures, communications and manufacturing.
- Mass production will give way to fully distributed or point-of-sale manufacturing.
- Intellectual property law will boom and dominate Internet exchange and all other information media, because ideas will be your currency.
- The manufacturing, ground support, antennas, communications and control of satellites will be big business.
- People will live where they work, thus ending the commuter traffic jam.
- Television will be dead because downloads and uploads through Internet communications boxes will produce customized entertainment and communications.
- Computers will be 10,000 times more powerful.
- Software will be dead and embedded intelligence will rule.
- Biotechnology allows your DNA to be used to create spare body parts for you.
- Complex adaptive systems and intelligent agents - not humans - will run railroads, airports, banking and other data-rich and extremely dynamic operations.
- Behavioral modification through drugs will offer good health, stress relief, weight control, pain treatment and happiness. Drugs will mold docile workers and well-trained, highly educated, multiple-tasking professionals. The science of management - how and what drugs to deliver to which workers - will become the science of pharmacopias.

The Programmable Logic Controller (PLC)

The Programmable Logic Controller was invented more than 30 years ago; the first one is now housed at the Smithsonian Institution in Washington, D.C. It revolutionized how things are made and even changed factory design. "This box of software encased in cast-iron could generate the same results as 50 feet of cabinets, relays and miles of wires," explains its inventor Richard E. Morley. The PLC offered reliable and consistent process control for the first time.

> "Adaptive systems fit the system to the problem."

Not all manufacturing innovations have simplified the manufacturing process the way the PLC did. Many innovations have managed to make things even more complicated because of labor restrictions, archaic purchasing practices, incorrect approaches to filling critical jobs on the manufacturing floor, CEOs with no technical understanding and the 1980's problem of "too much automation, too soon."

Intelligent Systems: Complex Adaptive Systems

Murray Cell-Mann, Nobel-prize-winning physicist and founder of the Santa Fe Institute, coined the phrase "complex adaptive systems." "We are interested in the relation between the simple underlying laws of nature and the complex phenomena of which we are a part," he explained. "When we call something complex, we don't mean random. A complex adaptive system takes a stream of data about the world. The data includes its current and previous behavior and the consequences. The system takes all the regularities that it notes in that data stream and compresses them into a schema (model), a highly compressed description. The schema can

undergo change and mutation; it can combine with additional data from the real world and be used for prediction of behavior in the real world, because all of these will have real world consequences."

"The technology machine will be built on intelligence, simplicity and pure process, a new way of building distributed manufacturing production networks."

Businesses are complex adaptive systems. They adapt to survive. A complex adaptive system is inherently an intelligent system. When you fit a system to the problem, you remain flexible and therefore adaptive. You are using intelligence to make the adaptations. All complex adaptive systems have these characteristics in common: interacting agents, emergent phenomena, distributed control, an open environment, probabilistic events, a non-equilibrium and non-linear system, the ability to co-evolve adaptively and the capacity to self-regulate.

Managing the Technology Machine

Technology-smart businesses will be run by these rules:

- Hire top people.
- Have strong leaders.
- Deliver a message from on high.
- Have an "enemy" that energizes your workers against the competition.
- Ship products.
- View work as the reward.
- Advocate complete local control.
- Form small work groups of no more than seven people.
- Avoid surprises.
- Use metrics of performance.
- Keep outsiders out.
- Base pay on performance, not longevity.

"Third-world countries with emerging technology power, such as China and Pakistan, will be sources of high-tech profits."

The driving ambition of the successful enterprise won't just be making money; it will be a passion to show the world the right way to do things.

Working and Living in the Future

Technology managers face the challenge of selecting the right technologies to win. Winning managers will find the right balance between human wisdom and governance vs. the intelligent machines required to run the enterprise of the future. Any organization that is going to thrive must be run in an atmosphere of trust, opportunity and inspiration, not fear and survival. Any company that forgets this simple idea is doomed, even the one with the most advanced and successful technology.

"We have no choice but to fit the system to the problem."

Expect the factory of the year 2020 to look more like an air traffic control center or a laboratory that operates 24 hours a day, seven days a week. Technology leaders will be scientists, chemists, physicists, engineers and other knowledge-intensive workers.

Historically, villages located manufacturing sites in the location of raw materials. Later, factories were located based on the availability of labor. In the future, societies will locate manufacturing facilities at the point of consumption, with no inventory in the process. By 2020, strawberries will be grown and harvested in the supermarket, cars will be assembled on demand at the dealer's showroom and custom clothing will be cut and sewn on-site.

"All the new approaches spring from the bottom up, rather than top down."

All of these manufacturing changes will contribute to excellence in customer fulfillment and satisfaction, supported by excellent communications. Simplicity will rule.

About the Authors

Patricia E. Moody is the former editor of Target magazine. She is a manufacturing management consultant and writer with more than 25 years of industry experience. Her client list includes Solectron, Motorola, Johnson & Johnson and Mead Corporation. **Richard E. Morley** , the CEO of Flavors Technology, Inc., is the founder or co-founder of more than ten companies, including Modicon and Andover Controls.