The New Industrial Facility

In 1913, Henry Ford's Model T proved the assembly line concept. Even before this symbol of American manufacturing leadership celebrates its 100th anniversary, we stand on the threshold of another major paradigm shift in industrial operations.

Manufacturers today can't just study new ways for moving components; they seek more efficient methods for moving information. A number of technologies now reaching commercialization create new opportunities for companies to capture and exploit critical data describing their facilities and products.

With proper implementation, these technologies could provide the competitive advantage American manufacturers need to succeed in today's global marketplace.

Today's model features more players

In modern manufacturing's early days, companies kept prices competitive by limiting consumer choice (as memorialized by Ford's famous offer – "you can have any color, so long as it's black"). Today's buyers *demand* customization and constantly seek new opportunities to follow the cutting edge.

As a result, successful manufacturers in this fast-moving market require facilities flexible enough to respond as tastes and technologies evolve. Additionally, manufacturers who wish to thrive must work with a much wider variety of outside suppliers than previously; depending where they are in the value chain, this applies to customers as well.

Facility owners waste billions due to technology-interoperability disconnects.

Where last century's captains of industry aimed to control the full length of their supply chain, from the foundries to the showroom floors, today's companies prefer to outsource component manufacturing. Some 80% of today's automobiles are assembled as components by outside suppliers, whose ranks can stretch eight tiers deep.

Such a far-flung environment puts a premium on accurate communication of product-design data and more. Frictionless communication is now vital to any manufacturing facility's success. Finally, today's manufacturers face an ever-greater need for speed. Reducing time-to-market can create tremendous advantage in today's intensely competitive marketplace. Further, industrial customers expect and demand just-in-time deliveries that match their own operational schedules.

Communications & design savings

While products from today's manufacturers are becoming increasingly sophisticated, the methods used to develop the facilities used to make those products can prove frustratingly behind the times. Efforts are underway to modernize the design and construction process.

Capturing all facility design data in platform-neutral formats is one key goal of these initiatives. In the past two decades, CAD/CAM/CAE software has produced enormous efficiency gains over old-school hand-drafted drawings, but the inability to transfer drawings between users of different products without losing crucial information has kept this technology from reaching its full potential.

Worse, the communications difficulties have cost facility owners billions of dollars. A 2004 report from the National Institute of Standards and Technology (NIST) estimated that technology-interoperability problems cost capital-facility developers and owners – including owners of commercial, industrial, and institutional facilities – $15.8 billion per year.

How will this be improved? The commonly shared vision calls for easy transfer of design data across building-team disciplines – including intelligent drawings accessible via handheld devices and mobile phones as well as standard PCs. One key accomplishment: Eliminating the need to manually re-enter data with every change request into drawings and other documents.

And there's more. General contractors surveyed for the NIST report indicated such advances would enable them to compress their schedules by up to 7.5%.

Additionally, should changes be automatically entered into drawings as approved, final drawings would be true "as-built drawings." This would eliminate the need for future re-surveying of actual conditions before starting a renovation project.

Digital manufacturing

"Just-in-time" (JIT) principles have become commonplace among U.S. manufacturers, who have sought to reduce their own inventory costs by requiring suppliers to hold deliveries until materials are needed. Originally promoted by automakers, these ideas have worked their way down successive layers of the supply chain across many industries; they now guide production efforts of even small parts producers.

Where's JIT going? Automakers and aerospace manufacturers are beginning to champion a sort of next-generation version of JIT management, called product lifecycle management (PLM). Potentially, PLM could prove to be just as revolutionary to how manufacturers work – and in how manufacturing facilities are designed.

PLM efforts reach across a business enterprise to track a product's development from initial concept through design. Today's three-dimensional CAD software enables PLM advocates to begin designing manufacturing processes – including related production lines and work cells – while the product, itself, is still under development.

At the cutting edge of this technology, manufacturers are able to commission automated lines and work cells using validated logic code downloaded directly to programmable logic controllers (PLCs), robots and other equipment. In what is coming to be called "digital manufacturing," engineers are able to simulate and test manufacturing processes before a single part or assembly has rolled off the line.

Greener Technologies Reduce Fuel Costs

Crystal-ball gazing can be a risky business, but it's safe to assume that energy costs won't be any less expensive for the factories of the future. Emissions regulations are likely to be stricter, as well. The following energy technologies could become more important as manufacturers seek to insulate themselves from fuel price hikes and promote a greener way of doing business.

- ***Building-integrated photovoltaics.*** Solar-power developers have made tremendous strides in the past decade in raising efficiency levels while lowering costs of photovoltaic materials. Incorporating thin-film products into roofing and windows will become an increasingly common means for reducing grid dependence – especially if scientists can continue to match the recent rate of improvements.
- ***Cogeneration.*** As industrial-facility owners seek ways to reduce their use of grid-supplied electricity demand and improve power reliability, cogeneration will continue to gain, because capturing waste heat from onsite generating equipment is an obvious way to meet both these goals. Fuel cells could become the power source of choice for these installations if recent technology improvements continue and emissions regulations become more stringent.
- ***AC-powered lift trucks.*** Emissions-free operation means these vehicles can be used both inside and outside a plant, and reduced running costs can make for a favorable return on investment.

With their heavy investments in capital equipment and long product-development timelines, automotive and aerospace companies have become the first adopters of this new technology. They hope to benefit from reduced lead times, speeding both line changeovers and time to market. Already, Boeing has used advanced simulation features in the design of its 787 Dreamliner. Wider adoption is inevitable as software and control-system prices fall.

Where installable technologies fit

Communications technologies are critical to making a reality of this future vision of facility development and operation. Falling technology prices now are bringing remote monitoring and control capabilities down to the I/O level of manufacturing-floor equipment. In fact, more than 60% of respondents to a December 2006 *Control Engineering* magazine reader survey indicated they already were using devices equipped with one of the most popular communications technologies – the Ethernet protocol – to control at least some manufacturing operations.

Connecting such devices can mean a lot of wiring, and, because wiring is easier to put in place before floors, walls and ceilings are sealed, facility designers, developers, and owners may want to consider future needs – and not just present requirements – when specifying wire and cable. For example, CAT 5 copper cable now may meet most current data needs, but it could fall short as communications requirements continue to grow.

CAT 6 cable, though more expensive, offers greater data-handling capacity than standard CAT 5 products. Importantly, CAT 6 also is less vulnerable to surrounding electrical noise. Fiber optic cable, the most expensive option, may work best for installations involving long distances or intense electrical interference.

Of course, wiring could become much less critical if new efforts to adapt wireless communications to industrial environments are successful. The newest wireless sensors are as small as a quarter and can last two years or more on a single battery – eliminating the need for hardwired electrical connections.

Two hurdles still prevent significant adoption of wireless technologies on the factory floor. First, wireless installations may be attempting to bring together devices and networks never designed to communicate with each other, so programmers have to establish common interfaces to allow connected objects to "understand" each other.

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Second, these installations are still new enough that programmers currently may have to write custom code to deploy even simple applications, which can be an extremely time-consuming process. Researchers are now looking at ways to incorporate an unifying software layer into wireless-device programming to address both of these issues.

Another wireless option, radio-frequency identification (RFID), may not have yet lived up to early promises of its rapid adoption, but it continues to provide advantages to manufacturers who need to be able to track individual products wherever they are within their organization. This is particularly useful in today's industrial facilities that are increasingly called on to serve distribution as well as manufacturing functions. Shipping pallets now are often built to custom specifications, made up of partial orders of multiple products.

Low-cost RFID tags could help cut order-picking times significantly in such scenarios, making initial system investment a worthwhile expense.

Technology: tomorrow's competitive advantage

Back when the assembly line revolutionized industrial production, cheap and abundant labor was the "natural resource" keeping that line running. Today's cutting-edge industrial facilities run on a different kind of resource – data. Acquiring and moving that data, whether it's describing a facility's design or a product's fabrication, will play a critical role in any manufacturer's successful transition to a new way of doing business.

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