Future factories are fast becoming a competitive imperative as the adoption of advanced Manufacturing 4.0 technologies continues to drive efficiency, flexibility, customization, autonomy, and product innovation. Early adopters will gain advantage, fast followers will play catch-up, but manufactures that play the wait and see game may find it’s suddenly too late.

FACTORIES OF THE FUTURE ARE CLOSER THAN YOU THINK
THE CHANGING NATURE OF PRODUCTS AND CUSTOMER ENGAGEMENT in today’s evolving world is creating new industry segments and reinventing, sometimes even eliminating, others. In this fluid environment, manufacturers have become acutely aware of the risks of being left behind if they do not master emerging technologies on their plant floors. But manufacturers don’t acquire and implement technologies just because they are cool. There has to be a compelling reason based in business gains and/or competitive pressures in their markets. Many of the advanced technologies often cited as part of the new digital transformation have in fact been around for a long time. Now, however, they have matured and the barriers to adoption have been lowered, or simply removed. These emerging technologies, combined with the slow but steady drumbeat of socioeconomic changes, are colliding to create both the ability and necessity of new Manufacturing 4.0 approaches.

Manufacturing’s agility has sometimes been likened to that of the Titanic – slow, expensive to change, and disastrous when things go wrong. Factory infrastructure has historically required large investments with long capitalization periods. With so much at stake, why should companies start steering production towards the modern ‘factory of the future’ that capitalizes on cutting edge technology?

It’s the socioeconomic changes that in the end will cause the most dramatic shift in how our factories operate, where they operate, and the kinds of technologies that will drive them. Without the changes in economies and customer’s needs and expectations, many of the new technologies would be destined to adoption on a use-by-use basis. Understanding the underlying drivers from customers, product innovations, geo-political, and competitive pressures is pivotal to understanding the factory of the future.

Manufacturers have traditionally reacted to the need for greater efficiency with automation, more sophisticated decision systems, and robotics to eliminate high cost labor. But the factory of the future pushes past the simple replace labor with a machine scheme. To convert materials to products more efficiently in the future, machines will need to make decisions in more flexible, unstructured ways.

The Evolution of Factory Intelligence

Many emerging technologies will be deployed to help create these enhanced capabilities. Artificial intelligence will develop so that it not only directs physical operations, but also transforms our current understanding of product configuration, production scheduling, and real-time decision making for optimized profitability.

Digital twin capabilities will evolve as the ultimate factory management tool, where the physicality of the factory is combined with past and current data attributes of product and process to assess impacts on throughput, quality, or product/machine changeover. The sophistication of the digital twin becomes the instant-replay of production sequences for analysis.

IoT will be combined with 5G cellular connectivity to go beyond creating a central repository into data lakes for analysis. Networked machines will communicate critical data to other machines in what is destined to be defined as a state of awareness. In reality, this real time communication within the physical material conversion network becomes the ultimate lean manufacturing control mechanism. Data shared amongst the machines turns into intelligence that ensures that manufacturing assets operate as a balanced system.

The need for manufacturing flexibility, responsiveness, and efficiency will also change the physicality of workspaces. Machines are now learning to work alongside human labor where human intelligence and flexibility of movement are required to maintain the integration of sub-systems within the factory. However, the evolution of machines will continue. Production assets will no longer need to be dedicated to a small set of conversion tasks. Their enhanced capabilities will be the foundation of the modular production facility, where manufacturing processes can be configured on an order by order basis.

Ultimately, these dynamics and technical capabilities may create factories that can autonomously recognize demand, configure a production plan, assemble the necessary assets for the conversion of material, and react to real-time feedback within the factory ecosystem.

Product Innovation Will Depend on Advanced Environments

The digitization of the economy is also changing the nature of products. Data will no longer be a by-product of the manufacturing process, but will become a co-product that delivers increasing economic value to both the customer and manufacturer. As a product’s

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physical attributes become commoditized by competition and higher quality, manu-
factures will compete in non-traditional ar-
eas. Factories will produce goods that have
converged attributes which are important to
the customer. Physical, digital, and social ca-
pabilities become parts of the same product,
eventually deployed in the heart of a manufac-
turing line where multiple parts are simultane-
ously produced and consumed into higher level
assemblies, creating the most efficient just-in-
time delivery possible and a key enabler for pro-
duct individualization.

Globalization Favors the Tech-savvy
Globalization has been an economic
dynamic that has affected manufac-
turing since WWII. Historically,
globalization was mostly about international
trade agreements, standardizing methods
and terms, and ensuring financial liquidity
between states. This had a direct effect on the
factories of developed economies as it opened
up foreign markets to increased sales.

However global access to lower labor rates
since the 1970s has also meant that factory as-
sets and jobs have shifted to developing coun-
tries such as Latin America, and then to Asia,
and then back to Latin America, and soon.

But today’s manufacturing environment is
rapidly evolving from the goal of minimizing
direct labor costs and maximizing the econo-
 mies of scale, to the potential elimination of
many direct labor costs and the maximizing of
market-driven product customization. This
evolution is perhaps, a natural progression,
driven by both changes in the global labor
pool and advancements in production capa-
bilities. It is happening now because the eco-
nomic constraints that have previously made
these changes impractical have also changed.

Much like the way cheap oil stymied the adop-
tion of alternate energy sources, cheap labor
has for decades stymied the investment in pro-
duction capability. The business proposition
for investment in new facilities simply wasn’t
able to overcome the low cost of labor in devel-
oping countries, until now.

While the labor component costs of prod-
ucts shrink, the need to be closer to markets
is also becoming a prominent driving fac-
tor. The flexible capabilities of advanced
manufacturing will slowly cause the migra-
tion away from large centralized factories,
towards smaller, more agile, networked pro-
duction assets that are located closer to the
markets they serve. This is particularly com-
pelling for products that have localization
requirements in product and political attri-
butes, or where a reduction in transportation
costs creates a competitive advantage. All
economies may benefit in some ways from
this trend. The shrinking and redistribution
of factory assets will simultaneously create
repatriation of manufacturing to developed
economies, and maintain/expand satellite fa-
cilities for markets abroad.

A Hyper-Connected Business
The exponential adoption of ad-
anced technologies presents a
hairy array of potential changes
and investment demands for manufactur-
ing in the years ahead. It is clear that the
manufacturing business is changing into
a hyper-connected endeavor, both within
and without the four walls of the factory.

Huge datasets, AI, and autonomous pro-
duction will combine to execute complexity
that extends beyond the human capacity to
manage in real time. A virtual facsimile of
the physical factory will become the interface
to production as physical execution becomes
increasingly removed from direct human
management decisions and intervention.

But not all technology will be adopted at
the same scale and pace. It’s certain that some
technologies will find their most effective ap-
plications in individual industries, while the
same technologies may have little penetration
in others.

The Future is Closer Than You Think
Many technologies of the future
are already in place. The differ-
eence will be the scale of deploy-
ment. IIoT will continue to expand to every-
thing imaginable; AI will be ubiquitous and
extend to every transaction; the compute in-
frastructure will be split between the cloud
edge networks, while technologies such as
virtual and augmented reality will be
more application specific, enhancing hu-
an tasks with data and expert knowledge.

The advanced factories of the near future
have already begun their digital transformation
and early adopters are beginning to cre-
ate competitive advantage. By investing in
emerging technologies today, many leading
companies are now well on their way to cre-
ating the technical expertise and the critical
digital transformation culture they need to
succeed and thrive in the years ahead. That’s
the competitive imperative now facing all the
world’s manufacturing companies.

The future may look far off, but it will be
here before we know it. M

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