These Industries are the Future of Additive Manufacturing

written by Lauri Moon | December 13, 2016

Aerospace and medical industries lead additive manufacturing adoption. Here's why–along with how other industries can catch up.

(IW – Patrick Boyd: 11-17-16) Often considered a "futuristic" technology, industrial 3-D printing (also known as additive manufacturing) is already being implemented in a wide variety of industries, and companies are reaping the benefits.

The process of additive manufacturing involves growing objects layer by layer from a variety of materials, such as plastics or metals. The benefits are widespread, allotting for more design freedom, improving costs when manufacturing small batch sizes and allowing for increased product customization, among others.

Although companies in a wide range of industries, including automotive, tooling, dental, etc., find value in the additive manufacturing process, there are two industries that are positioned particularly well to see growth and success from additive manufacturing: aerospace and medical.

Aerospace Industry. The aerospace industry, one where safety and consistency is not only a priority but a necessity, was quick to adopt additive manufacturing. An industry dependent on advanced research and development, additive manufacturing presented aerospace with a means to easily prototype new products.

However, it doesn't end there. A study from SmarTech Markets forecasts that the "aerospace industry's adoption of 3D printing solutions is projected to increase from $723 million in 2015 to $3.45 billion in 2023, attaining a 18.97% compound annual growth rate."

The projected accelerated growth stems from the countless benefits additive manufacturing provides the aerospace industry–including but not limited to cost reduction, lightweight design, and tool-less production.

Leading helicopter manufacturer, Bell Helicopter, used additive manufacturing to prototype a

range of different components for their aircraft, but wanted to begin to use the technology for functional parts. With the help of additive manufacturing company, EOS, Bell Helicopter designed and produced flight-certified components for its commercial aircraft.

Bell Helicopter discovered one of the biggest benefits to using this technology: the increased ability to quickly and easily reiterate their new designs. No company gets everything right on the first try, but usually changing the design of a manufactured product involves new molds, new tool paths and a lot of money.

However, changing the design of an additively manufactured component simply requires revising a CAD file, resulting in very little wasted time and money. This, along with the elimination of assembly costs, means that not only can companies manufacture superior products, but they can do so at a lower cost.

Medical Industry. While additive manufacturing can save the aerospace industry time and money, it can also save lives in the medical field. With an expected growth of $2.88 billion from 2015 to 2023 according to SmarTech Markets, the medical industry can expect a future of nano-scale medicine and even complex printed organs. Currently, 3-D printing technology allows for quick and cost-effective production of specialized surgical instruments, medical devices and implants.

Every person is unique and has individualized needs. So when a person was missing a significant portion of cranial bone, Oxford Performance Materials (OPM) turned to additive manufacturing to develop the cranial implant. Using EOS' machines, OPM created a customized, patient-specific cranial implant–the exact right fit. This meant a shorter surgery, shorter recovery time and lowered risk of infection for the patient. Additionally, this saves the patient money as hospital and operating room rates run upwards of $60 per minute.

And this is just the beginning for additive manufacturing in the medical field. OPM President and CEO, Scott DeFelice, notes "there is no region of the human skeletal anatomy that won't be touched by this technology."

Rapid prototyping, hyper-customization and ability to manufacture small batches of product all contribute to the aerospace and medical industries' quick and accelerating adoption of additive manufacturing. However, the technology provides solutions to companies in industries ranging from consumer and lifestyle to tooling to automotive. The industrial world is only beginning to

understand the value of additive manufacturing, and there is no doubt that new applications will continue to be discovered as the technology advances.

One of additive manufacturing's greatest challenges rests in the mindset of engineers and manufacturers. Before the world sees mass-adoption of the technology, there must be a shift in how we approach design. In the past, production capabilities determined the design of products. Now it is critical to re-train engineers and designers think in terms of design-driven manufacturing — providing high degrees of design freedom. Only once the thought process behind manufacturing changes will additive manufacturing fully reach its potential.

(Patrick Boyd is Director of Marketing for EOS.)

Closing Tech Gaps Can Fortify Advanced Manufacturing and Save $100 Billion Annually

written by Lauri Moon | December 13, 2016

(Georgia Tech Manufacturing Institute – Laura Reilly: 11-18-16) To spur significant innovation and growth in advanced manufacturing, as well as save over $100 billion annually, U.S. industry must rectify currently unmet needs for measurement science and "proof-of-concept" demonstrations of emerging technologies. This is the overall conclusion reached by economic studies funded by the National Institute of Standards and Technology (NIST) of four advanced manufacturing areas used to create everything from automobile composites to zero-noise headsets.

"Gaps in the technology infrastructure—including the lack of reliable measurement and test methods, scientifically based standards, and other formal knowledge and tools—limit advanced manufacturing's further development and adoption," said NIST economist Gary Anderson, coordinator of the economic studies prepared by

RTI International (link is external), an independent nonprofit research institute.

Using data collected through extensive interviews and surveys with researchers, developers, manufacturers and other stakeholders, each of the four studies identifies 5 to 10 critical technical barriers to the adoption of its specific manufacturing technology. The studies also estimate the impacts of eliminating those obstacles and define which needs should be met first to do so.

For example, establishing industry-wide standards and measurements for the inks and substrates used in roll-to-roll (R2R) manufacturing—the fabrication of electronic devices on a roll of flexible plastic or metal—is projected to reduce production costs by 15 percent. Likewise, the development and adoption of verified reference data, robust measurement technologies and testing protocols, and standardized modeling and finishing methods could yield some $4 billion in annual benefits and savings for additive manufacturing, a process also known as 3D printing.

The two largest predicted cost savings were the $57.4 billion and $40.1 billion for the smart manufacturing (where all manufacturing data from design to finished product is electronically exchanged and processed) and advanced robotics and automation sectors, respectively. Among the needs that must be met to realize both of these benefits, the researchers said, is increasing access by small- and medium-sized manufacturers to the same state-of-the-art methods, tools and knowledge as their larger counterparts.

For each of the four advanced manufacturing technologies studied, the estimated annual cost savings and percentage reduction in production costs are:

- **Additive manufacturing: $4.1 billion, 18.3 percent**
- **Advanced robotics and automation:** $40.1 billion, 5.3 percent
- **Roll-to-roll manufacturing:** $400 million, 14.7 percent
- **Smart manufacturing:** $57.4 billion, 3.2 percent

The researchers stated that their studies only looked at benefits directly attributable

to closing the identified technical gaps in each sector; therefore, the impact estimates are conservative. “If we consider the larger-scale outcomes brought about by meeting these needs—such as new and improved products, increased production quality, long-term industry growth and job creation—the impacts would be significantly higher,” Anderson said.

The studies also support a number of key strategies for overcoming technical barriers and fortifying advanced manufacturing, including:

- keeping standards and performance measures nonproprietary,
- using public research institutions to develop those tools, and
- working through manufacturing research consortia and technology extension services to ensure that all manufacturers—especially small- and medium-sized enterprises—can access them.

“Our studies emphasize that full economic impact will only be realized if all technical needs are met, and all stakeholders regardless of size, not just large manufacturers, can share in the rewards,” Anderson said.

A summary of the overall findings from the four economic studies is available. The individual reports and the overview brief for each also may be accessed:

- Additive manufacturing: Study, brief
- Advanced robotics and automation: Study, brief
- Roll-to-roll manufacturing: Study, brief
- Smart manufacturing: Study, brief

Are You Incorporating These Lean

Manufacturing Best Practices?

written by Lauri Moon | December 13, 2016

(American Machinist – Megan R. Nichols: 11-2-16) According to the originators of Lean Manufacturing methodology, the five fundamental principles revolve around adding value to products and services, enhancing the value stream from end to end, improving workflow, reducing the overall time-to-market, and achieving perfection throughout the entire program. While it can be difficult to achieve all five principles, there are a number of best practices you can implement on the manufacturing floor to underscore the importance of these strategies and generate quantifiable results.

Minimizing waste — The general purpose of the Lean methodology is to minimize and, if possible eliminate, excess waste. Whether this is achieved in the actual manufacturing process of products or during another phase, such as packaging or shipping, waste can be found in nearly every business process associated with modern manufacturing.

Lean manufacturing methods highlight a number of different wasteful areas of an industrial operation. This includes overproduction in order to meet perceived or forecasted demands, inefficient inventory control, defects or bottlenecks in the production process, redundant inspections or requirements, excess transportation, idle time, unnecessary motion or handling of products, and the overall "culture" of your operation.

Eliminating nonvalue — Implementing Lean on the manufacturing floor also requires eliminating any nonvalue-adding steps or services that currently are a part of the production process. To do this effectively, you must first make the differentiation between value and waste.

Taiichi Ohno, inventor of Lean's predecessor, the Toyota Production System, considers waste to be anything that is above and beyond the absolute minimum requirements of your company's specific manufacturing process. Parts, materials, tools, equipment, and even labor may be considered as waste.

Consolidating vendors — Consolidating your external vendors into one centralized point-of-contact is a great way to reduce waste in areas other than actual manufacturing processes. Purchasing all of your parts and components from one source instead of several not only saves you the time and ordeal of maintaining communications with multiple vendors, but it can also reduce your overhead costs.

However, it can be difficult to find one vendor that offers every individual part needed for the manufacturing process. This is precisely why many manufacturers will adopt a vendor managed inventory system, or VMI. Apart from consolidation, this approach has the potential to strengthen business partnerships, jumpstart communications, and bolster customer service.

Achieving workplace safety — While many manufacturers equate the principles of Lean solely with the production process, it's important to remember that the eight primary types of waste identified by Lean manufacturing principles can be applied to the workforce, too. As such, any effective Lean implementation should go hand in hand with employee safety.

Once you start thinking "outside the box" of standard manufacturing management methods, it's easy to see how these two concepts relate to one another. Reducing and minimizing unnecessary motions, for example, can reduce ordinary worker fatigue significantly, and even reduce the potential for injury. Manufacturers have even increased their workers' safety by eliminating defects in the manufacturing process itself, either by repairing and upgrading machines, adding more ergonomically designed equipment, or eliminating the use of any toxic parts and materials.

Understanding the benefits of Lean — Many of the benefits of Lean are readily apparent. Less waste, improved allocation of time and resources, improved production quality, and an increase in customer service are among some of the most obvious.

Dive deeper into the impact of Lean, however, and you'll find significant financial advantages as well. Satisfied customers are more likely to return or even recommend your product to their friends, while lowering the overall time to market of your goods will have a significant impact on the amount of warehouse space

needed to hold your inventory. Ultimately, this should lead to even lower overhead expenses.

While nearly everyone embraces the concepts and ideas behind the Lean methodology, some see it as an overly complicated, archaic, and downright burdensome set of standards that are too costly or time-consuming to implement. However, when implemented correctly, Lean manufacturing methods can pay huge dividends in the long run.

(Megan Ray Nichols' past contributions to American Machinist have looked at the importance of aerospace ceramics and the "positive disruption" expected from the Industrial Internet of Things.)

Digital Tools for the Future Factory

written by Lauri Moon | December 13, 2016

(advancedmanufacturing.org – Patrick Waurzyniak: 11-11-16) Transforming manufacturing with advanced digital tools is well underway, but manufacturers who haven't adopted Industrial Internet of Things (IIoT) or Industrial 4.0 strategies are best advised to take a long look at the digital future of manufacturing.

At SME's *Smart Manufacturing Series' Digital Transformation* seminar held Wednesday at the Digital Manufacturing and Design Innovation Institute (DMDII) at UI Labs in Chicago, many key players in the smart manufacturing world offered a glimpse of where manufacturers' efforts stand in their digitizing efforts, and how far they have to go in adapting to a fully digital manufacturing world.

Not every company has the size and breadth of GE, which has made massive investments in the digital arena. But manufacturing operations managers can learn a lot from lessons learned by the pioneers in digital manufacturing. At GE, this has included a huge cultural change, noted Robert Borchelt, Industrial Solutions – Brilliant Factory IT Leader, CIO – Advanced Manufacturing Deployment, General

Electric (Boston). GE's numbers are big, Borchelt noted, with more than 300,000 people in 180 countries.

"Many of the jobs we go after are not small. I'm not here to sell you—most of my focus at GE is internal," said Borchelt, who noted that GE had 2700 patents in 2014-15. With the Digital Thread "innovation comes from everywhere," Borchelt said. "Additive, drones, predictive analytics and Big Data—that's not that out there." Such technologies with manufacturing and digital analytics that give manufacturers a full Digital Twin of the factory floor will give adopting manufacturers a huge edge in the future.

"Additive manufacturing gives you the ability to make a difference—there's just no other way to make some parts," Borchelt said. New methods, like crowdsourcing of parts, can also give companies an entrée into this world, he noted, noting the efforts of Fuse, a new Chicago-based crowdsourcing venture where GE is opening a "microfactory" located in the mHub technology incubator.

With factory automation, cloud-based systems, fog computing, predictive analytics, prognostics and condition-based monitoring, manufacturers have many new tools for the future digital factory, he said. "Machines can't tell us everything. We use predictive analytics to filter out the noise," Borchelt added. "We have some factories that are doing this now, but we're not there yet—it's a journey."

Digital Technologies

Manufacturers should brace for major changes in automotive, as the industry and others will be substantially transformed by digital technologies, noted Tom Apostolos, senior vice president, Global Exteriors, Magna International (Aurora, ON, Canada). With the fast pace of change in the fully connected digital world, more than 50 billion devices will be connected to the Internet by 2020,and some 2-3 billion people will be on the Internet by 2025, and as many as 10 million self-driving cars will be on the road by 2020, Apostolos said.

"The CNC 7600, one of the fastest supercomputers in the world in 1969-75, had the same computing power as the iPhone 4," he added. "How does this affect the shop floor? Automation, artificial intelligence and other technologies are all converging.

Where is industrial production going? A lot more embedded intelligence is going to be really integrated into your supply chain."

Manufacturing companies are going to need different skills from their employees to compete in the future, Apostolos said. "You don't have to go to Silicon Valley to change the world—you can do it right here."

Several other manufacturers, including much smaller organizations, described their efforts to digitize their manufacturing operations. Bill Metz, vice president, Operations, Richards Industries (Cincinnati) and Mohamed Abuali, CEO of Forcam Inc. (Cincinnati), talked about the steps shops need to take in adopting a Smart Factory approach.

"If you cannot measure it, you cannot improve it," Abuali noted. "*With Smart Manufacturing, training is essential*. You have to understand how and why you are collecting the data." Metz, whose company manufactures a variety of valves and other industrial products, described Richards Industries' Smart Manufacturing journey, where the company started a 10-machine pilot in August 2015, first by collecting machine data and moving to later phases including Order Data Management (ODM) and later paperless manufacturing with DNC.

"You really need to understand what data's needed," Metz said, noting the benefits and ROI of the systems are substantial—as much as 30-40% improvement in Overall Equipment Effectiveness (OEE), the factory-floor metric that is key to digital manufacturing operations. "That's about four times more than we originally estimated."

Smart Strategies

In a panel discussion, *Thrive or Die—Why Smart Manufacturing is Critically Important to the 21st Century*," Jim Carr, president and CEO, Carr Machine & Tool (Elk Grove Village, IL); Bill Fienup, founder and managing director, mHub (Chicago); and Fernando Ortiz, VP and GM of Roberts Swiss Inc. (Itasca, IL) gave their insights on making the move into smart digital manufacturing.

Collaboration will be a major key to manufacturers surviving, and thriving, in this

new digital age. “We’re excited about Bill’s startup manufacturing [mHub] here. This is going to bring new opportunities for collaboration for small manufacturers,” Ortiz said. “We partner with the OEMs, we train, and we give ownership to them. Collaboration is important—we call it the ‘supplier alliance,’ where we apply our manufacturing expertise and we learn from their design skills. In the early ’90s, everything was a secret.”

Additive manufacturing will be a key part of things in the future, Carr noted. But additive’s not there yet, added Fienup. “I think it’s the software that’s lacking.” Ortiz said that precision in additive manufacturing processes must improve. “We work in the fourth, fifth or sixth decimal place to the right. It’s becoming something that’s more attainable, but the precision’s not there yet.”

(Patrick Waurzyniak is Senior Editor of *advancedmanufacturing.org*)

How U.S. Manufacturing Is About to Get Smarter

written by Lauri Moon | December 13, 2016

The aim is to make factories more productive, less costly to operate, and more reliable

(WSJ – Christopher Mims: 11-13-16) Here’s a paradox of America’s highly automated, increasingly labor-independent manufacturing — while sophisticated, for the most part, it isn’t all that high-tech. Picture metal-stamping machines in an auto-parts factory that can easily have a long useful life of up to 40 years.

Now picture the assembly line just outside Austin, Texas, where Samsung Electronics Co. makes core chips for Apple Inc.’s iPhones. I toured the facility last summer. It is a pristine white environment filled with WALL-E-like robots ferrying boxes full of silicon wafers from one station to the next. Every detail of the factory is measured by sensors pouring data into a

centralized repository where it can be processed to optimize production. The only humans present are there to fix the machines doing all the work.

But that means there is still a big opportunity to use in manufacturing all the learning Silicon Valley has applied to, for example, advertising. “People are really thinking about applying venture capital and technology innovation to things that are 10 times the size of the ad market,” says Jon Sobel, chief executive of Sight Machine Inc., which helps companies process all the data coming off their assembly lines. Manufacturing is a $12 trillion industry globally a year. Annual spending on ads globally is just north of a half a trillion dollars.

This transformation in the way we make things has many names—the fourth industrial revolution, the industrial Internet of Things, smart factories—but at base it is about harvesting as much data as possible from all the machines in factories, shipping it to the cloud, parsing it with artificial intelligence, and using the results to make those factories more productive, less costly to operate, and more reliable.

The goal is to break data out of its silos—the machine, the factory floor, the shipping and logistics system—and pool it in a way allows for real-time decision-making.

Here are examples of what this “revolution” can accomplish: deciphering how ambient air temperature affects productivity of an entire factory. Or ramping up and down production in a way that is more responsive to sales. Or preventing unplanned downtime as when a single critical machine breaks unexpectedly, which can be incredibly costly because it can hold up an enormous production line stretching from raw materials to finished goods.

We’ve seen this “preventive maintenance” pioneered in jet planes and even our cars where sensors plus software can determine in advance when a part will fail and alert operators to pre-emptively replace it.

I’d thought, based on all the industry chatter about the “industrial internet,” that we were pretty far along in this process. But that turns out not to be the case.

Even General Electric Inc.—which along with Siemens AG, International Business Machines Corp., Cisco Systems Inc. and others has been a major proponent of the industrial internet in the U.S.—has faced challenges implementing the new process in its own manufacturing facilities.

“Candidly, one of the things we work on is how we can get our legacy equipment connected,” says Karen Kerr, senior managing director at GE Ventures. GE has nearly 500 factories, and the company’s goal is to transform 75 of them into smart, connected factories this year.

Part of the challenge is to properly use the hardware companies already have. Newer machinery is bristling with sensors and data ports that are typically only used when these machines are being built or repaired, says Dennis Hodges, chief information officer of Inteva Products LLC, a major manufacturer of auto parts. Though the data from these sensors was never intended to be used for real-time insight into how a machine is doing, it turns out that even indirect measures of a machine’s health, like its temperature, can be combined with other data to allow engineers to understand things about a device they can’t measure directly, and what to do to keep them from breaking.

Others are working on ways to put additional sensors where they weren’t previously—an effort that creates new challenges, like how to power them all.

Recently I put on a smartwatch on that could be a harbinger of this sensors-everywhere future. The Matrix PowerWatch, launching this week, never needs recharging. Its power source is thermoelectrics, which means that it can turn any difference in temperature—typically that between a solid object and the air around with it—into electricity. As I looked at it, a little power bar slowly grew, until the watch was generating 200 microwatts of energy harvested directly from my body heat. It is a relatively tiny amount of power, but enough for a smartwatch—or for the sensors and transmitters deployed in smart factories.

Power sources like this, or solar panels, or piezoelectrics, which gets power from vibrations, are key to getting sensors onto more of our built environment, preventing the cost and time in changing sensor batteries.

“You want to be able to put it there and forget about it,” says Mr. Hodges of Inteva. “Just the fact that you don’t have to run power or a network drop could really be an interesting thing,” he adds, especially in factories that are up to 750,000 square feet, as some of Inteva’s are. Such devices, combining a sensor, wireless transmission and Matrix’s energy technology, are under development by Civionics Inc., says CEO Gerry Roston.

The application of these technologies to watches and manufacturing is just the beginning. Civionics’ customers include a company that monitors the health of bridges in India, and a

multinational mining giant that needs to put sensors on its largest and most expensive equipment. The giants in these fields have taken notice— 3M Co. is a strategic investor in Matrix, and GE is an investor in Sight Machines.

NIST Helps Small Businesses Improve Cybersecurity

written by Lauri Moon | December 13, 2016

NIST provides guidance to help small businesses secure their data and information in the new publication.

(NIST – Evelyn Brown: 11-10-16) Small-business owners may think that they are too small to be victims of cyber hackers, but Pat Toth knows otherwise. Toth leads outreach efforts to small businesses on cybersecurity at the National Institute of Standards and Technology (NIST) and understands the challenges these businesses face in protecting their data and systems.

“Businesses of all sizes face potential risks when operating online and therefore need to consider their cybersecurity,” she said. “Small businesses may even be seen as easy targets to get into bigger businesses through the supply chain or payment portals.”

Toth is the lead author of NIST’s *Small Business Information Security: The Fundamentals (link is external)*. The guide is written for small-business owners not experienced in cybersecurity and explains basic steps they can take to better protect their information systems.

“Many small businesses think that cybersecurity is too expensive or difficult; *Small Business Information Security* is designed for them,” Toth said. “In fact, they may have more to lose than a larger organization because cybersecurity events can be costly and threaten their survival.” In fact, the National Cyber Security Alliance

found that 60 percent of small companies close down (link is external) within the six months following a cyberattack.

The new NIST publication walks users through a simple risk assessment to understand their vulnerabilities. Worksheets help them to identify the information they store and use, determine its value, and evaluate the risk to the business and customers if its confidentiality, integrity or availability were compromised.

The guide is based on NIST's *Framework for Improving Critical Infrastructure Cybersecurity*, which was issued in 2014 as part of efforts to protect the nation's critical infrastructure. The framework's processes and tools provide key standards and best practices developed over decades by the federal government and industry. Its simple language allows organizations to better communicate, and its overall design helps them identify, assess and manage cybersecurity risks.

For example, the new guide describes how to:

- limit employee access to data and information;
- train employees about information security;
- create policy and procedures for information security;
- encrypt data;
- install web and email filters; and
- patch, or update, operating systems and applications.

Other recommendations may require new equipment, and the guide can help businesses perform cost/benefit analyses. "We recommend backing up data through a cloud-service provider or a removable hard drive and keeping the backup away from your office, so if there is a fire, your data will be safe," Toth said. And a backup can be used to restore data in case a computer breaks or malware infects a system.

The guide also suggests:

- installing surge protectors and uninterruptible power supplies to allow employees to continue to work through power outages and to save data;
- considering the purchase of cybersecurity insurance; and
- ways to find reputable cybersecurity contractors.

NIST has been in the business of helping small businesses with information security since 2001 when it joined forces with the U.S. Small Business Administration (link is external) and the Federal Bureau of Investigation's InfraGard (link is external) program to provide introductory cybersecurity workshops to small businesses.

International Markets Growing Source of Revenue for Small and Medium-Sized Businesses

written by Lauri Moon | December 13, 2016
Over the next five years, more than three-quarters of companies surveyed anticipate their revenue from global sales to increase by about 30% on average.

(MH&L – Staff: 11-8-16) A recent survey of companies selling outside the U.S. found that 80% say revenues are greater compared to one year ago, and on average one quarter (26%) of their revenue growth can be linked to international sales alone.

The 2016 American Express Grow Global Survey also found that as companies forecast future revenues, they are optimistic about exporting. Over the next five years, more than three-quarters (76%) anticipate their revenue from global sales to increase by about 30% on average.

While an overwhelming majority of surveyed companies (90%) agree that international markets offer significant growth opportunities, growth does not come without challenges. The most significant concerns for those selling outside the U.S. include the ability to build relationships with foreign partners (75%) followed closely by the ability to comply with local and international law, trade regulations, and transportation and shipping costs (each, 73%).

Businesses recognize they need help navigating challenges that arise when doing

international business, some of which include cultural differences/different business practices (65%), political instability (64%), language barriers (59%) and a general lack of knowledge about the markets in which they operate (57%).

American Express created the Grow Global program in 2015 to help ease business owners' concerns, and provide valuable resources and networking opportunities for U.S. *small and medium-sized businesses* that currently export as well as those who are considering exporting.

Survey findings include:

The Path to International Sales: Intentional vs. Accidental Exporters
According to the survey, most small and mid-size businesses entered foreign markets intentionally as part of a strategic business decision (78%), and many of them (63%) feel informed about how to conduct international business. However, while most intentional exporters feel informed about conducting business globally, almost four in ten (37%) indicated they have insufficient market knowledge on exporting, meaning they could benefit from the ability to tap into knowledgeable resources.

In contrast, as many as one in five small and mid-sized businesses (21%) began exporting accidentally when an opportunity fell into their lap. Comparing these accidental exporters to their more intentional counterparts:

- 44% say they are very informed about how to conduct international business (vs. 69% in the intentional exporters group)
- 44% say they are familiar with the markets where they sell (vs. 51% who export intentionally)
- 29% say they are familiar with the culture where they do business (vs. 44% in the intentional exporters group)

To obtain knowledge about the international markets where they do business, companies overall are most likely to rely on their network (71%) or the websites and marketing material of potential trade partners and customers (64%). Significantly fewer rely on data from market research reports (54%), news publications (47%), advisory firms (40%) or government programs (33%).

North America is the Focus of Future Investment Of small and mid-sized U.S. companies that currently sell internationally, sales efforts are mostly concentrated in Mexico or Canada (43%) and Europe (29%), with much fewer selling in Asia (17%). Mexico and Canada are the first choices (34%) as regions with the most potential for exporting sales over the next five years, followed by Asia (24%) – particularly China, Japan and Korea. This suggests that while exporters are more likely to see the regions where they are already exporting and regions nearest to home as possessing the greatest growth potential, Asia may experience increased sales efforts in the next five years.

Nearly two-thirds of surveyed businesses (63%) have sought financing in order to invest in entering and growing business in these regions. Eight in ten (82%) say they have used a variety of working capital and receivables financing tools to supplement commercial finance products for growth in these markets.

The Impact of Global Economic and Political Environment on Plans for Trade Despite the changing global economic and political environment over the last six months, few companies say they are being cautious about their future plans for international trade (30%). In fact, nearly four in ten (39%) plan to increase their efforts to pursue sales internationally in the next six months, and roughly one-third (31%) say changing global economics have had little impact on their future plans.

However, the recent U.S. presidential election is one factor that may have more of an impact on plans for international trade. Seven-in-ten (70%) say the impact of the election will be at least ‘somewhat significant.’

IMC Client Success Story –

Philipsburg’s DiamondBack Truck Covers

written by Lauri Moon | December 13, 2016

Philipsburg’s DiamondBack Truck Covers goes from class project to $6 million in sales.

Ethan Wendle was a junior and Matt Chverchko a senior at Penn State when they collaborated on a class assignment to develop a product and pitch it for investment.

Their idea for a high-quality, load-bearing truck cover has taken them from the classroom to a two-man garage operation to, 13 years later, a new 38,000-square-foot plant under construction in Philipsburg, PA.

Read on…

Digital Innovation in Consumer-Goods Manufacturing

written by Lauri Moon | December 13, 2016

Consumer-goods companies have begun to capture value by applying digital tools to manufacturing. Here’s a look at how they’re doing this today—and how they might do so tomorrow.

(McKinsey Quarterly — Søren Fritzen, Frédéric Lefort, Oscar Lovera-Perez, and Frank Sänger: November 2016) Consumer-goods companies have been at the forefront of digital innovation in commercial areas such as marketing and sales. Supply chain and operations have been less of a focus for their digital efforts, but *recently, leading consumer-goods companies have started to explore the use of*

digital solutions in manufacturing processes. This is a natural development as Industry 4.0—the digitization of the entire manufacturing value chain—is slowly becoming a reality.

Some consumer-goods companies, however, are unsure where to start: Which aspects of manufacturing can benefit most from today's digital technologies? And what should leading-edge companies set their sights on next? In this article, we examine the two most prevalent ways in which consumer-goods companies are using digitization in manufacturing: applying digital tools to lean transformations and using advanced analytics to optimize specific manufacturing processes. We then look at the next horizon of opportunity for digital manufacturing in the consumer-goods sector. Finally, we discuss the organizational enablers that can help digital-manufacturing efforts succeed.

Taking lean to a new level

Lean transformations have already had a dramatic impact on many companies, but digital solutions are taking lean operations to a new level. Consider the case of a food-manufacturing company that invested in lean techniques but didn't have a standard process or system for collecting data, tracking performance, and sharing information. The company's data—sales- and operations-planning data, machine-level data (such as those in sensors), benchmarks, operating standards for equipment, training materials, work plans, and so on—resided in several different databases and repositories, making it difficult for supervisors to find and analyze information. For instance, due to ad hoc tracking of equipment downtimes, supervisors never knew the exact quantity of goods produced until shipping time, when shortages could disrupt the entire supply chain.

Following a practice that has worked well in other industries, the company consolidated data and assets into a cloud-based digital hub. The hub contains three suites of tools to support day-to-day lean operations: a performance-tracking and management system, a set of modules for assessing operational capabilities and planning improvement initiatives, and a platform for best-practice sharing and real-time collaboration.

Supervisors can now access company-wide information on intuitive dashboards and

heat maps, allowing them to detect performance gaps and compare metrics by product, site, and region. They can easily access detailed historical performance data or information on specific operational topics, such as the breakdown of overall equipment efficiency (OEE) by category. Since the hub automates data collection, data exports, tracking of key performance indicators, and generation of email reports, employees' paperwork has substantially decreased.

The digital hub also introduced a new culture of collaboration and continuous improvement. For instance, all functions now systematically track and share equipment-downtime information via the hub. The shared data enable more productive cross-functional discussions about production problems, including root causes and potential solutions. Frontline workers are thus more likely to discover and resolve issues in real time, preventing small problems from becoming major disruptions. Staff members can submit new best practices or improvement ideas at any time, which makes them feel more invested in the transformation. And scaling up is easy, with managers able to deploy the new digital tools to new sites or business lines rapidly, using minimal resources.

After launching the digital hub, some of the company's factories improved OEE by as much as 20 percent within a few months.

Unlocking manufacturing insights through advanced analytics

Leading consumer-goods companies have already scored big wins by using advanced analytics in a number of manufacturing processes. In our view, some of the highest-impact developments have been in *quality control* … *predictive maintenance* … and *supply-chain optimization*.

Quality control. A potato-chip manufacturer wanted to ensure that its products had a consistent taste, especially when it came to "hotness," or spiciness. In the past, it had assessed hotness by conducting taste tests in which a panel of human testers rated various taste parameters (for example, rating the hotness level on a scale of one to ten)—an expensive and unreliable process, since taste is subjective. To increase accuracy, the manufacturer began using infrared sensors to identify and measure recipe parameters associated with hotness. It then developed customized algorithms to process the sensor data and determine how they were correlated with

the recipe. Researchers also compared the sensor data with the results of a taste-test panel for each batch. Together, this information allowed the company to create a quantitative model for predicting hotness and taste consistency. Within a year of implementing the program, customer complaints about variability in the flavor of the company's chips dropped from 7,000 a year to fewer than 150—a decrease of 90 percent.

A margarine producer took a similar approach when attempting to understand how variations in multiple process settings could change product viscosity, an important quality parameter. During a pilot, the company tested variations of a number of parameters (such as temperature) and used sensors to evaluate emulsion crystal size, the primary determinant of viscosity. After analyzing data from the pilot—much more detailed and extensive than what it would have obtained in the past—the company was able to correlate viscosity levels with certain parameter variations. With this information, analysts created a model that predicted the viscosity that other parameter combinations would produce, which reduced the need for additional testing and helped the company identify optimum operational settings. This approach reduced the fraction of margarine tubs that had to be discarded because of quality issues from 7 percent to almost zero.

Predictive maintenance. Consumer-goods companies have begun to apply predictive analytics to maintenance activities, *decreasing maintenance costs by 10 to 40 percent*. A diaper manufacturer had historically replaced all cutting blades at certain intervals, regardless of their condition. This sometimes resulted in blades being replaced too soon—which increased costs—or too late, after their dullness had already affected diaper quality. To address these problems, the company turned to sensors that could detect microfibers and other debris—indications of blade dullness—by analyzing video feeds of diapers during the manufacturing process. After uploading the results of the analysis to the cloud, the company analyzed them in real time, using customized algorithms to determine the optimal time for blade replacement. By making adjustments to the maintenance schedule, the company lowered costs while improving product quality.

Supply-chain optimization. At a leading European dairy company, raw-milk purchases represented almost 50 percent of the cost base. Most of the raw milk was

used to produce pasteurized milk; the company had to decide how much of the rest to use making butter, cheese, or powdered milk. The profits associated with each of these product categories fluctuated significantly, adding another layer of complexity. In the past, the company gave its regional businesses the freedom to make their own raw-milk allocation decisions, provided they followed a set of simple guidelines. In an effort to reduce costs and optimize supply-chain planning, the company used an analytics software solution that determined the best allocation plans for each region, taking into account variables such as available milk supply, regional factory capacity, and global demand. The improved allocation helped the company *increase profits by about 5 percent* without changing production volumes or capacity.

The next horizon for digital manufacturing

Consumer companies may also soon reap greater benefits from new digital tools that are continually being refined. Consider the following innovations:

- Augmented-reality tools. These tools provide data about the user's environment in real time and facilitate information sharing. With smart glasses, for instance, employees can see and view new work orders while on the factory floor, or take and transmit photos of broken machines to offsite experts. We estimate that smart glasses could improve productivity by 5 to 10 percent by increasing the speed of operations, improving communication, and enabling paperless processes. Other augmented-reality tools could provide instructions to technicians responsible for complex changeovers or to warehouse workers searching for particular items.
- 3-D printing. Consumer-goods companies could use 3-D technology to facilitate product design and the manufacture of samples. At one shoe manufacturer, 3-D technology reduced the number of employees needed to create prototypes from 12 to 2, significantly decreasing costs. Companies could also use 3-D printing to print low-frequency replacement spare parts on demand at a production site rather than keeping them in stock or having them shipped after a breakdown. This approach would reduce the cost of holding spare parts, facilitate maintenance processes, and reduce downtime.
- Connected sensors and controls. Companies across industries have recognized the potential of the Internet of Things (IoT) and invested in

connected sensors, such as those that can detect unusual machine vibrations and transmit their findings to monitors in a remote location, allowing offsite staff to direct corrective actions without having to travel to the facility. In heavy industries like mining, IoT sensors have reduced costs by 40 percent and downtime by half. While some consumer companies (such as the diaper manufacturer mentioned earlier) have invested in IoT sensors, most lag behind their peers in other sectors. We believe this will change as IoT offerings become more sophisticated and consumer companies realize the value at stake.

Organizational enablers for digital manufacturing

Some companies, especially those in the services sector, have already made changes to their organizational structures and strategy to support digitization efforts—for example, by buying niche technology players or creating innovation labs in talent-rich locations. Consumer-goods companies must now follow their example to gain maximum benefits as they digitize their own production lines. Since few consumer-goods companies today have the in-house capabilities needed to support the development and use of innovative digital manufacturing tools, they must upgrade their strategies for recruiting, training, and retaining data scientists, software engineers, and other technology staff. Competition for this talent is stiff, with demand four times higher than supply for some positions.

Corporate governance must also become more agile to promote digital manufacturing. The technology staff responsible for developing and testing tools should generally have the authority to set budgets and priorities, since they will lose momentum if they have to wait weeks for approval from upper management. When a major initiative does require leadership support or input, local teams should have easy access to decision makers.

Finally, large consumer-goods companies may need to pursue partnerships with smaller players or start-ups to gain essential digital capabilities. Many companies in other sectors have already pursued this strategy, with good results. For instance, *Amazon* acquired Kiva Systems, a small robotics company, to develop the cutting-edge robot technology now in widespread use across its warehouses. Partnerships among large players can also contribute to the development of solid digital

platforms. Consider the recent collaboration between *SAP*, the enterprise-software giant, and *UPS*, a large package-delivery company. The companies ultimately hope to create a global network that provides industrial 3-D-printing services, on-demand production capabilities, and other services.

Consumer companies are already benefiting from the use of digital tools in marketing and sales—applying them to manufacturing is therefore an obvious next step. What is also clear, however, is that companies cannot simply implement digital solutions and hope to achieve lasting impact. *They must also undertake an organizational transformation that involves acquiring new talent and capabilities, streamlining the decision-making process, making governance more flexible, and collaborating with external partners.* This transformation touches every group within the company and will require the full commitment of employees at all levels. But the long-term benefits of digital solutions, which will usher in a new era of manufacturing efficiency, more than justify the effort.

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Smart Manufacturing: Enabling Three Key Areas of Excellence

written by Lauri Moon | December 13, 2016
(IW – Jonathan Katz: 11-5-16) A disruptive force known as the fourth industrial revolution is already underway. Known as the Industrial Internet of Things (IIot), the digital enterprise or simply "smart manufacturing," it's a phenomenon that's creating a host of opportunities for manufacturers around the world.

This interconnected system of machines, products and parts can help manufacturers

reduce costs and time to market, dramatically increase productivity and take machine reliability and performance to new levels. While the competitive advantages are clear, some manufacturers are slow to digitize their operations because they're unaware of the technologies available to them or are concerned about the required time, cost and infrastructure investments.

This white paper explores three key benefits of IIoT and some practical steps manufacturers can take to make digitization a reality.

Benefit #1: Stamp Out Downtime

Repeated downtime leads to lost productivity, late deliveries and dissatisfied customers. Downtime costs plants an average of $500 per hour, per stand-alone machine. Plants often struggle with reliability because they lack advanced predictive technologies. Traditional preventive maintenance is based on the assumption that machines will follow failure patterns as they age. But this only applies to 18% of assets, according to ARC Advisory Group. The majority of assets display random failure patterns.

Smart-manufacturing technologies can help manufacturers increase visibility into machine performance and reduce unexpected failures. For example, predictive asset analytics software can identify subtle deviations in operating behavior that are often the early warning signs of equipment problems. The software can be integrated with existing machinery sensors, historians, and control and monitoring systems for increased data access and ease of implementation.

Toyota Motor North America has already achieved significant maintenance savings from a smartmanufacturing

program that it implemented at its North American plants. The company developed a system using smart technologies to capture data in real time, conduct automated analysis of the information and create visualizations for team members, including information displayed on mobile devices. Toyota Motor North America has slashed 40,000 minutes in downtime at one plant for a total cost savings of $6 million.

Benefit #2: Supercharge Productivity

Knowledge is power. Employees who have more information at their fingertips also are more productive. But many plants are struggling to boost productivity as skilled workers retire. Smartmanufacturing technologies can help reduce the learning curve for new operators.

Referred to sometimes as the "augmented operator," mobility tools enable operator autonomy and faster decision-making. Tasks that previously required two operators can instead be accomplished with a single worker. Sensors affixed to equipment or materials can feed critical information, such as energy usage, machine speed, maintenance or inventory, to employees' mobile devices. Previously, such tasks may have required a second operator to inspect equipment and log data.

In fact, the primary benefits from IIoT technologies are productivity improvements, McKinsey & Co. reports. Several manufacturers are experiencing measurable productivity spikes related to IIoT implementations.

Stanley Black & Decker's DeWalt Power Tools plant in Reynosa, Mexico, for example, has implemented a system of RFID (radio-frequency identification) tags working in sync with routers to form a real-time location system. The tags provide real-time location and line status to workers, shift supervisors and plant managers, helping them spot problems faster. The workers can signal an issue by pressing a button on the line, which sends data to a software system. The software system generates messages with the location of the issue and suggestions on how to correct the problem. The system helped the plant improve line efficiency by 96%, increase throughput by 10% and reduce material inventory carrying costs by 10%.

Benefit #3: Boost Quality

Smart technologies can help manufacturers quickly identify and troubleshoot product quality issues during production and in the field. Quality is among the primary reasons why many manufacturers adopt IIoT solutions. In one survey, 58% of respondents said product quality is one of the top five reasons they're implementing IIoT technologies.

Manufacturers can embed smart technologies, such as sensors, into products to receive real-time, automated information about warranty claims or product defects.

IIoT technologies also can help manufacturers with post-sales service, such as scheduled maintenance. For example, Xerox has a central data warehouse that logs data from its devices located at customer sites. The company has set parameters that signal maintenance needs or possible equipment failure. The result is fewer on-site trips and more efficient maintenance.

Sensing technologies also can help reduce scrap, rework and defects. In a machine-to-machine, or networked, environment, sensors affixed to equipment can communicate output variations to downstream machines, which automatically make adjustments to ensure the product is within specifications.

For example, MFC Netform, a producer of powertrain parts for the automotive industry, ties its automated quality inspections to standards specified within its cloud Enterprise Resource Planning system. If the system indicates a part failure, the operator has the option to shut down the machine. Also, communication between the company's vision and ERP systems allows operators to calculate the true cost of rejected parts.

The Next Steps

The path to smart manufacturing may seem daunting. Many manufacturers cite cybersecurity, integration and the management of business requirements as major challenges to implementing an IIoT infrastructure.

However, there are steps manufacturers can take to overcome these hurdles, including:

- Seeking devices that can integrate with existing legacy systems. This "wrap and reuse" approach minimizes the need for a complete infrastructure overhaul. Examine how well the sensors or actuators interact with the manufacturing execution or ERP system. Consider Ethernet-ready devices or sensors that can connect wirelessly to the cloud. Also, consult with an integrator who can design modular architectures that are easily adaptable for future upgrades.
- Partnering with IIoT experts and vendors who can help interpret the data generated by smart technologies. These experts can help identify gaps

between business needs and current IT capabilities. Some experts, such as Schneider Electric, provide simulation services, asset performance consulting and energy-consumption assessments. They also may offer cybersecurity and workforce training services. Training is critical because it shortens the learning curve for employees and ensures they can maximize the benefits of IIoT technologies.

Conclusion

IIoT technologies offer game-changing potential for manufacturers. Schneider Electric research shows that manufacturers can save up to 40% on maintenance costs, 50% on machine downtime and 18% on energy consumption, and increase productivity up to 55% through the use of smart technologies.

But unlocking the full value of IIoT often requires *interoperability of multiple systems*.

In fact, in the worksite setting, 60% of the potential value of IIoT is dependent upon the ability to integrate and analyze data from various systems. In addition, most data companies are not using most of the data they collect from existing smart technologies, according to McKinsey & Co.

Strategic partners can help manufacturers design, install and integrate IIoT technologies with minimal disruption to their current operations. They also can provide the support that manufacturers need to ensure they're gaining the full benefits from their smart operations.

Clearly, creating the digital enterprise doesn't have to be a cumbersome, disruptive process.

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