

electroindustry

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The Next Normal

How Improved Supply Chains and
Greater Automation Will Help
Manufacturers After the Pandemic



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electroindustry

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Manufacturing is getting more national attention in this difficult pandemic year than at any time in recent memory. The people who make the goods we rely on are playing a heroic role by continuing to keep operations running smoothly while many of us have had the luxury—and challenge—of learning to work and lead from our homes.

As anyone in the industry knows, there has been unique pressure on supply chains. We see mirror images playing out before us, with demand surging in some areas while collapsing in others. Temporary production shutdowns to keep workers safe have caused some supply chain delays and interruptions that continue even now.

In other cases, companies quickly pivoted their energies to make entirely new product lines, such as the spirits producers who started “brewing” hand sanitizer or the automotive plants that rushed to produce masks or ventilators. New supply chain requirements ensued.

We have faced an unpredictable array of new challenges to our manufacturing processes and supply chains during the spring and summer of 2020. Yet, three simple questions arise over and over: What can be done to keep our factory floor employees safe and our supply chains operational? How can manufacturers cope with radical swings in supply and demand? And finally, how can U.S. manufacturers get to market more quickly and more flexibly than ever before?

The answers can be found in robotics, advanced automation, and digitalization, the topics covered in this issue of *electroindustry*. At all levels, especially in the production process, technology is already available today to ensure that our factories stay open and operate in a way that is safe for employees. This is the heart of keeping our supply chains strong. Artificial intelligence can help us with social distancing as well as tracking and tracing contacts in the event of infection. And when demand lurches from brick and mortar stores, for example, to ecommerce channels, cobots and robotics optimized for warehouses and logistics can speed the processing of orders to keep critical supplies flowing.

Digital technologies are the key to achieving this inspiring level of resiliency in manufacturing. In this issue, you’ll have a chance to hear from experts in NEMA companies and beyond about these topics and many more. ☺

Raj Batra

Chair, NEMA Board of Governors

Balancing Priorities in a COVID-19 World

The world is confronting a pandemic affecting millions of people at a level not experienced in a century. The impacts of this disease are significant – affecting each of us, and forever changing how we will all go about our daily lives. For many, this disease has taken the lives of loved ones, struck down too early. As a Member of the electrical manufacturing community, Nidec Motor Corporation extends our sympathies to their friends and families.

Also, we want to express our thanks and appreciation to the healthcare workers and all those supporting the health and welfare of the people directly affected by this disease. These individuals have been the true heroes of this once-in-a-generation event. I am proud of the contributions many Members of the Nidec team have made to support these heroes—from printing 3-D masks for local hospitals to ensuring that we ramp up delivery of critical components of vital equipment. As we all know, NEMA Members are crucial elements of the global response to the COVID outbreak.

What we do touches nearly every aspect of life. Many of our collective customers are deemed vital to the mechanizations of the world's infrastructure. From the hospital room to power generation—and everything in between—motors, electronics, and controllers are critical to our collective efforts to face this pandemic head-on and come out safely on the other side.

The challenge we face as global manufacturers during this pandemic is complex. We must balance the needs and expectations of our employees and their families, our customers, our shareholders, our suppliers, and the vendors that support us around the world. At Nidec, our priority is always the safety and security of our employees. We have engaged our teams to address this pandemic by balancing our priorities.

- First, we engage our team Members. Just like any business improvement effort, our team Members on the front lines have the best ideas to keep them and their teammates safe. This is clear in every facility where we have implemented so many safety measures and improvements, from wash stations and social distancing requirements to safety gear and

barriers. We have listened to their feedback and incorporated the recommended changes to our daily operations.

- Second, we established a COVID leadership task force focused on staying abreast of the massive volume of medical and government guidance. They sift through the information, ensure that all team Members are aware of these changes as they occur, and implement broad compliance requirements meant to provide the right balance of risk management.
- Third, we work with our customers to understand priorities and deadlines, all done remotely via video conferencing—prioritizing the best we can based on our production capabilities. We are also working with our supply chain to overcome issues from suppliers that are in distress.
- Fourth, we assess the availability and safety of our team Members and balance these factors against customer demand and supplier capabilities. Our supply chain and planning teams collaborate continuously in this ever-changing world.

As a team, and as a Member of the electroindustry community, we are learning every day how to adjust to this post-COVID world. By placing the health and well-being of each other ahead of all other priorities, we will come out ahead. We must learn together how to adjust to the new normal that we find ourselves in and come out stronger. ☺



David Buckley joined Nidec Motor Corporation as the COO for their ACIM Division (Appliance, Commercial, Industrial Motors/Drives) in 2020 and holds an MBA from the University of Pennsylvania and Wharton School of Business, along with a bachelor's from the U.S. Naval Academy.

NEMA Members are on the front lines addressing critical infrastructure needs to combat the global COVID-19 pandemic. Send news about your company initiatives to *ei* Managing Editor Jena Passut at jena.passut@nema.org.

NEMA Well-Positioned for Next Administration

NEMA has been advocating for an updated national infrastructure policy for years. The association's seven Divisions offer products and solutions designed and manufactured to help customers operate efficiently and productively.

But as we move ever closer to the November elections, it's easy to get caught up in the ebbs and flows of the daily news cycle. If we zoom out to take a longer-term view, it's possible to see that the electroindustry in general—and NEMA Members in particular—are well-positioned to thrive, no matter who wins the Presidency or which party controls Congress. There are several reasons for this.



NEMA believes that any plan to repair and update America's infrastructure needs to be comprehensive, modernizing, and realistic.

OUR AGENDA IS FUTURE-ORIENTED

NEMA strongly believes that any plan to repair and update America's infrastructure needs to be comprehensive, modernizing, and realistic. A thorough plan will cover traditional physical infrastructure aspects such as roads, bridges, and electricity but also foster forward-looking advanced technologies. A modernizing plan will ensure that America meets its infrastructure needs in the future in addition to patching

today's potholes. Finally, a realistic strategy will focus resources on those areas that ensure safety, reliability, and efficiency using proven, cost-effective technologies. While there is room for debate over the details, neither political party disagrees with the premise that updating America's infrastructure is needed.

OUR AGENDA LOOKS BEYOND EFFICIENCY

The electroindustry has been ahead of the curve by offering innovative products that help customers reduce their energy consumption. But other environmental concerns beyond efficiency have gained traction in recent years, making these products even more valuable.

Here again, NEMA Members will meet customer demands for products and equipment that can also advance America's policy objectives in those areas where society demands it.

OUR AGENDA IS BIPARTISAN

We support congressional action on infrastructure legislation to help the country recover from the COVID-19 pandemic and get our economy moving again. NEMA recommendations focus on high-value-added sectors and segments of our industries and the economy overall. We believe that when U.S. companies succeed, both domestically and in overseas markets, it helps U.S. employment, so public policy should focus on attracting businesses to the U.S. and fostering open trade.

Wanting to successfully move the U.S. economy into a post-pandemic Next Normal period is something that any Congress or Administration would seek to accomplish. We will need to move beyond short-term proposals and into long-term investments to benefit the country in measurable ways.

But the bottom line for the electroindustry is this: no matter who wins the 2020 elections, NEMA and its Members will be well-positioned for success because we make the products people want for a clean, reliable, and safe future. ☺

NEMA Addresses Critical Minerals Supply Chain Issue

The Federal government is monitoring potential threats to the security of our nation's critical minerals supply chain, and with that vulnerability comes a rare opportunity for NEMA and its Members.

Rare earth elements (REEs) are 17 minerals found in low concentrations around the world. Because of their unique properties, REEs are increasingly used by manufacturers for advanced electronics. Despite this increased demand, there are only a few suppliers, which creates an inherent liability in manufacturers' supply chains.

The Federal government has enacted policies designed to assess reliance on foreign supplies of REEs and to restrict acquisition from potentially adversarial nations.¹ For example, the U.S. Department of Defense (DoD) has implemented regulations prohibiting procurement of REEs from China, Russia, North Korea, and Iran.² China produces approximately 80 percent of the global supply of REEs.³

These circumstances prompted NEMA to explore the potential for a new program called NEMA Select, which would enable NEMA and its Members to influence and take advantage of emerging REE policies. It would provide a new service connecting manufacturers and end users through improved supply chain management and transparency.

NEMA Select would establish a multi-tier verification program helping manufacturers and suppliers identify products that are either free of REEs or are appropriately sourced, while providing a way for end users such as government agencies to easily identify products that meet their needs.

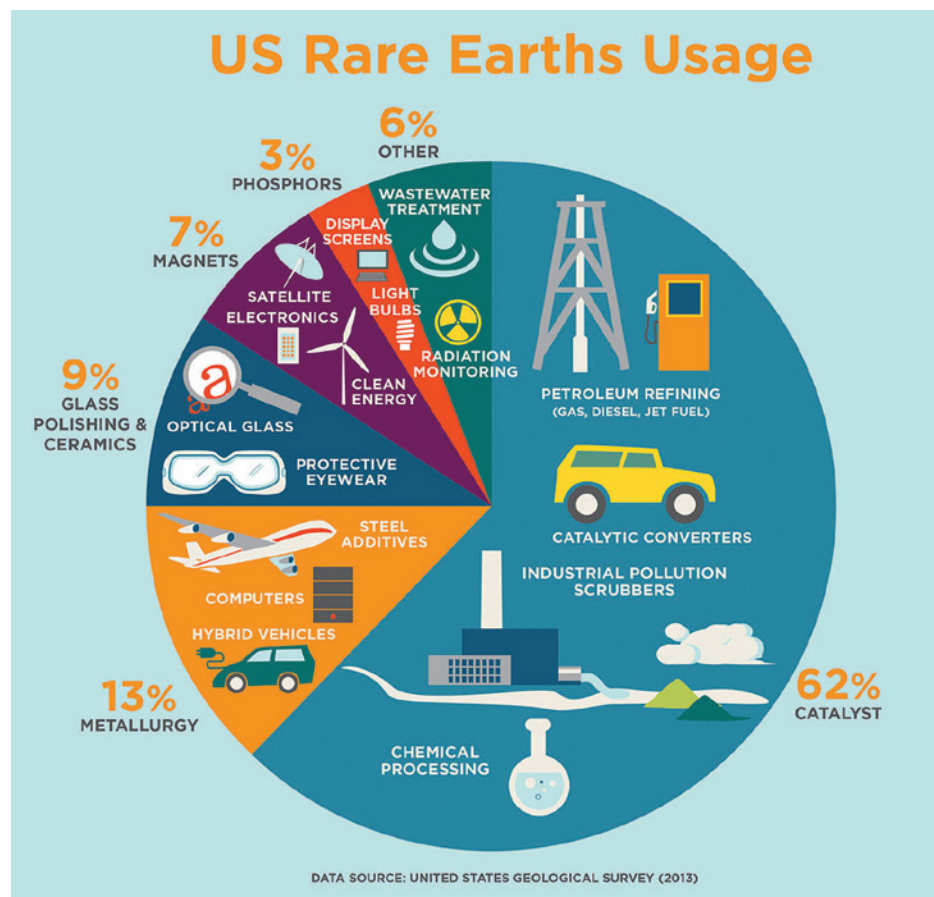
Benefits for NEMA Members and other program participants include access to emerging markets and increased profitability. Benefits for end users include increased supply chain sustainability and the reduction of the acquisition of non-compliant products.

If you are interested in learning more about this initiative, please contact Stacy Tatman, Government Relations Manager, at Stacy.Tatman@nema.org, or Kirk Anderson, Industry Director, at Kirk.Anderson@nema.org. ☎

1 A Federal Strategy To Ensure Secure and Reliable Supplies of Critical Minerals, Executive Order 13817, December 20, 2017, <https://www.federalregister.gov/documents/2017/12/26/2017-27899/a-federal-strategy-to-ensure-secure-and-reliable-supplies-of-critical-minerals>

2 Prohibition on acquisition of sensitive materials from non-allied foreign nations, 10 USC 2533c, <https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title10-section2533c&num=0&edition=prelim>

3 "Rare Earths Statistics and Information," National Minerals Information Center, <https://www.usgs.gov/centers/nmic/rare-earth-statistics-and-information#:~:text=The%20principal%20economic%20sources%20of,%2C%20yttrium%2C%20and%20the%20lanthanides>



NEMA Councils Address Emerging Product Areas

For nearly 100 years, NEMA has been the voice of the electroindustry. Over this time, the association has evolved into a federation of 58 product groups (Sections) covering autonomous vehicles, the latest lighting technology, utility transformers, and the automation products highlighted in this month's issue.

But what about emerging product areas like additive manufacturing, or cross-cutting concerns like seismic resiliency of products?

For situations like these, NEMA has started launching Councils. Like Product Sections, many Councils include Standards work. Unlike Sections, Councils are created to address a need and then, once fulfilled, be retired. Participation in a Council also differs from regular Sections. Councils are voluntary and often allow non-NEMA Members to participate.

By gathering information from a broader set of participants, NEMA can develop solutions that benefit both NEMA Member and other industries. Participating in Councils also allows non-NEMA Members to "dip their toe in the water" and see how NEMA works while benefiting from working with a trade organization to help develop solutions for broad industry issues.

Here are some of the new Councils NEMA is highlighting:



AUTOMOTIVE COMPONENTS COUNCIL

The evaluation process for components used in automotive applications has been considered by many as a hindrance to innovation. By using outdated and lengthy evaluation processes, manufacturers often cannot offer the best products to manufacturers. NEMA is launching the Automotive Components Council to collaborate with component suppliers and try changing how suppliers work with this traditionally closed industry. The NEMA Automotive Components Council was established to increase manufacturer collaboration in the changing and expanding automotive component market.

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ELECTROMAGNETIC COMPLIANCE COUNCIL

As society embraces electrification, the potential for electromagnetic interference increases. The Electromagnetic Compliance Council provides a forum for industry to promote product compatibility and immunity and identify Standards and regulations that are science-based and align with industry needs. The Electromagnetic Compliance Council will provide action and guidance in matters of electromagnetic compatibility and immunity as they apply to products manufactured by Member companies.

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HEALTHCARE FACILITIES COUNCIL

NEMA is helping the healthcare industry explore the future, including telemedicine, how connected products can benefit society, and how hospitals will change as a result of the pandemic. The Healthcare Facilities Council is being established to promote opportunities in the connected healthcare space. Join the Healthcare Facilities Council to help us improve the healthcare experience.

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INDUSTRIAL CONTROL PANEL COUNCIL

The NEMA Industrial Control Panel Council was established to promote the sale of and proper installation of industrial control panels as defined by Article 409 of the NEC by: providing guidance and recommendations on installation practices for various jurisdictions, acting as an advocate for Standards and best practice documents for the industry, and developing and driving messaging and educational materials.

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POWER-OVER-ETHERNET COUNCIL

As people rethink building use, the promise of flexible and safe solutions becomes even more important. The Power-Over-Ethernet Council helps provide a focal point for manufacturers and users of POE equipment to help accelerate the adoption of these products, making factories, offices, and residences safer and more useful through activities like developing product Standards, advancing building codes, and advocating at the local, state, and Federal levels.

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SEISMIC COUNCIL

As we experience more severe weather events, we see the need for robust and resilient equipment. Manufacturers that sell products into seismically active zones, and those living in those zones, may want to join the NEMA Seismic Council. The Seismic Council will be the focal point of NEMA seismic work regarding the business and public policy opportunities associated with seismic qualification of electrical and medical imaging equipment for commercial building code applications.

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SMART MANUFACTURING COUNCIL

As more countries launch national initiatives to promote advanced automation within their regions, the need for a cohesive and comprehensive U.S. strategy becomes increasingly important. To help address this gap, NEMA has created the Smart Manufacturing Council. The goal is to bring manufacturers and end users together, create and execute a strategic vision on the global stage, and promote the adoption of Smart Manufacturing products and systems while helping make the U.S. more competitive in the global marketplace. The NEMA Smart Manufacturing Council will be the focal point of NEMA efforts to develop a U.S. position and overall strategy to increase adoption and expand the market of Industrial Internet of Things/smart-enabled products and systems.

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CRITICAL MINERALS COUNCIL

Electrical products increasingly rely on certain critical minerals and key components to provide the efficiency and functionality demanded in today's applications. In some cases, only a few (or a single) source of these essential parts is available, creating a potential risk in the supply chain.

The NEMA Critical Minerals Council is addressing this risk by promoting policies and programs that will foster a more diverse source of suppliers of these strategically important materials and provide manufacturers with new options for sourcing these components.

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Reshaping Manufacturing



Digitalization and automation hold the potential to solve today's problems and create the opportunities of tomorrow

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As the world of manufacturing gradually returns to work, it will have to contend with unprecedented changes on multiple levels that will bring with them challenges both new and amplified. From linking back dislocated supply chains to ensuring efficiency as employees work remotely, organizations are having to rethink their strategies to bring their businesses back to capacity.

In this new reality, companies will have to build resilient yet flexible manufacturing processes to enable them to improvise the fundamentals of their business, including shifting supply chains to new geographies without high risk or developing new product mixes in a high-cost environment. While these challenges are actively discussed around boardrooms and on investor calls, so are concepts such as digitalization and automation that promise to help businesses thrive in the new industrial landscape.

Boost Efficiency with Automation

As businesses chalk out their new strategies, they are increasingly looking at ways to automate their operations to enhance productivity and efficiency and mitigate the challenges of a lack of skilled labor. With social distancing measures in place, at least for the near term, automation, especially with robots, can help manufacturers continue their work while keeping their human employees safe.

The evolution of robotic automation has moved toward making robots more accessible to small and medium-sized companies. Smaller-sized collaborative robots can be easily programmed without specialized training, can be installed on existing production lines, and are cheaper than larger industrial robots, making them ideal for small-scale and family-owned businesses. These robots can work alongside and with human operators and boost productivity and flexibility in processes such as palletizing and small

parts assembly. The absence of safety fences and large peripheral equipment also means that the investment needed for a robotic work cell can go from more than \$200,000 to under \$50,000.

While manufacturers scramble to adjust to changing demand patterns, they can rely on robotics to provide the necessary boost to production. Take, for instance, the task handed to Sweden's Tiki Safety to produce hundreds of protective respiratory masks to meet a surge in demand from all around the world. Tiki Safety's existing production process was time-consuming, so the company invested in a pick-and-place robot that reduced a portion of the assembly process from six minutes to just 40 seconds.

Digital Is the Next Normal

The digitalization of industrial processes and the adoption of Industry 4.0 concepts, including automation, advanced analytics, and digital connectivity, have been well underway in many organizations across the world. Digitalization enables companies to capitalize on the benefits of digital tools, including sensors, cloud computing, and the internet, to add value to existing processes. In manufacturing, which is based on testing physical prototypes using a vast amount of seemingly disparate data, digitalization can provide actionable insights that, in turn, help manufacturers find the best ways to manufacture new products and reduce the time it takes to bring them to market.

In today's reality, digitalization has moved from being a long-term strategy to a much-needed remedy to increase the reliability and efficiency of the manufacturing process. Digital simulations of factory concepts, new products, and processes can iron out issues virtually before manufacturers make any physical investment, while digital twin technology can provide clarity and transparency in increasingly complex manufacturing environments.

Digitalization does not have to be a time-consuming upgrade, nor does it always require significant investment. Even small, family-owned businesses can easily integrate digitalization technologies to boost productivity, reduce downtime, and eventually save money by mitigating unplanned downtime.


Gaining transparency across the factory floor is another benefit that digitalization offers manufacturers. This is especially useful for companies developing new products, implementing new processes, or working with new technologies. Simple monitoring solutions can add value to manufacturing by giving operators the ability to move from a time-based maintenance approach to a condition-based one, thereby reducing the chances of unscheduled stoppages.

Remote service has become a buzzword in the current manufacturing environment, as it provides quick and easy solutions to an otherwise time-consuming process. With monitoring services, companies can track the health of their assets and maximize their performance with little interruption to operations. The monitoring is provided remotely, enabling a company to perform remedial actions and improve product health without stepping on-site. This ultimately boosts the efficiency and productivity of the operation and leads to better savings.

Expand Reality for Better Results

As the rules of manufacturing change, maintaining business continuity and ensuring the smooth operation of assets are at the top of the agenda for companies across the world. Companies are increasingly turning to digital solutions to access their operations and perform simplified, restorative maintenance to keep their processes running smoothly.

One way to address this issue is by using augmented reality (AR) technology to connect field personnel to remote professionals offering diagnostic and repair guidance. For example, ABB piloted an AR service at ArjoWiggins Creative Papers in Scotland and Papierfabrik Adolf Jass in Germany. Headsets augmented with maintenance strategies, documentation, guidance, access to expertise, and other best practices were given to employees on-site. Field operatives streamed live video of asset conditions at the site to remote experts, who, in turn, delivered live audio instruction, overlaid onto video to help them resolve issues quickly.

In the manufacturing world, adversity has often been the spark for innovation, and this time around, manufacturers will have to take bold decisions to ensure that they remain ahead of the game. Integrating the right digital and automation strategies is the first step in this direction. 

Use Market Research to Improve Manufacturing and Supply Chain

Tim McLean,
Director of
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Research

*Mr. McLean's
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and medical
journalism, and
clinical education
for practicing
doctors and nurses.*

Market research is vital to any business in any sector. While certainly no crystal ball, quality market research helps mitigate the magnified risks inherent to manufacturers.

Manufacturing is a game of momentum, less so of agility. If you're going to make something, you almost always want to make a lot of it, and that is a commitment akin to a freight train—fast and powerful but difficult to stop or change direction. Informed market research represents reliable data—in market sizing, market landscape, identification of who makes buying decisions in potential customer companies, and streamlining and optimizing supply chains.

As part of a supply chain, any manufacturer would agree that vision along that chain dims in either direction as distance increases. Market research provides a telescope (not so much a microscope as it does in some sectors) to grasp trends far out along both directions of the chain. From understanding shifts happening way up toward the raw materials direction, to anticipating buyers' changing attitudes down at the retail end (well past most of your direct customers, but nonetheless ultimately steering the ship), this market intelligence is a powerful, and always customizable, tool in your box.

That tool is personified in the market analyst. She has her attention fixed at a position along the chain where yours is not. She lives and breathes, say, rare earths production—so you don't have to. On the opposite end, another analyst cares only about (and watches like a hawk) customer preferences in consumer electronics.

Value to Electrical Manufacturing

A level deeper in specificity is market research's value to the *electrical* manufacturer, and that is distinguished simply by an increase in sensitivity. The building or building infrastructure, lighting systems, industrial or utility products, transportation, and medical imaging industries are not going anywhere. They are among the “essential workers” of our modern machine, and they can't take a sick day. But that apparent sense of security is dwarfed here by the specter of innovation—someone might do it better than you, and it becomes a game of inches (and ideas).

Market research can assist less with the ideas, unfortunately (with exceptions, obviously). That's on you. But the game of inches is precisely why this research is so vital. The most accurate and up-to-date market intelligence, up and down the supply chain, at any given moment, is often the difference between thriving and struggling. You need company profiling to know your competitors and what they are working on next. You need patent reviews and what's coming out of academia, so you know who your next competitors will be.

Seeing the Forest *and* the Trees

The COVID-19 pandemic has changed everything, and we are nowhere near the end of it. But successful companies are changing the way they use market research to survive, and even thrive.

Traditional market research is generated like this:

Analysts step back from their subject to paint the whole thing, just like an artist executing a monarch's portrait. Current markets are sized by performing bottom-up (from unit price to gross revenue) and then top-down analyses, and then the two data sets are compared and triangulated. Past years are analyzed the same way to detect patterns.

Analysts factor current market landscape forces and make a forecast usually going four or five years into the future, and communicated via the *lingua franca*—the compound annual growth rate (CAGR). This is all called secondary research, and, ironically, the analyst then performs primary research—she picks up the phone and talks to companies.

Traditional market research is consumed like this:

Decision-making entities in organizations purchase and read (or, far more often, have a staff read, interpret, and deliver a consumable summary of) these reports, which are hundreds of pages long. They typically do this once a year. The decisions they make are broad ones, carefully weighed, with an eye on the future... about four or five years into it.

This is as it should be, like a good driver whose eyes are focused four to five car lengths ahead. Any closer or more distant and driving becomes poor and dangerous. So, looking at CAGRs and other figures, a small pharmaceutical company will decide to change from traditional manufacturing to continuous manufacturing, even though the initial investment is immense. Or, a capital venture firm will decide not to invest in an esports virtual venue, because it will all be on mainstream TV within five years anyway. Thus spoketh the CAGRs.

Traditional research and the traditional way of consuming it are not going away. But that doesn't mean manufacturers don't need more help and more tools. That was true before COVID-19 hit. During COVID, BCC Research did some healthy omphaloskepsis and asked our Members (a mix of corporate and academic entities of all sizes, all over the world but including many manufacturers), "In this strange time, what else could you use from your market research? What is the research NOT giving you that you need?"

They spoke with a remarkable level of unity, and the major theme was that they want ultra-specific operational-level data delivered regularly in a monthly or quarterly heartbeat, in a simple form. This is very

different data than is normally found in traditional reports. These are things like number of units shipped, weights, number of trucks carrying them, and actual retail prices at stores.

Read advice from Schneider Electric on how to deepen your industrial digital transformation at <https://www.nema.org/news-trends/ei>

Beyond Traditional Research

I recently helped a Member company obtain information on the manufacturing of PPE masks for civilian use. BCC has been covering this area for years with regular full-length reports featuring five-year CAGR forecasts. Our latest version was written well into the pandemic, so justifiably showed dramatic growth rates for these items. I assumed this was exactly what the Member needed, and I proudly gave the report to my contact at the company.

"No," she said. "I have this already—and it helps, thanks. We are already committed to going into manufacturing these masks. That decision has been made. I'm just a project manager—I need to know whether to make them out of cotton or synthetics. And I need to decide that by learning which material type stores better and longer, and which ships at a lower rate. As time goes by, I need to watch those rates."

So COVID has not toppled the five-year CAGR in market research, but it has diminished the centrality of the tool and made skeptics of us all. While an infectious disease outbreak had been predicted for some years by experts, it's fair to say no one saw the magnitude of this disaster coming, especially its effects on the United States economy. We can no longer use traditional research alone—that view of four to five car lengths simply cannot anticipate global catastrophes like COVID.

Granular, specific, regularly updated operational-level research is vital to augment it, as it allows a company to maneuver in the new world a disaster like this creates. ☎

3D Printing at Scale Will Redefine Global Supply Chains



A century ago, the only way to hear Johannes Brahms' "Wiegenlied"—colloquially known as "Lullaby"—was to receive an invitation to a performance.

Since then, we have moved from opera halls, to recordings, to broadcast radio, to personal devices and digital music services that deliver the music you want to hear, when and how you want to hear it. A violinist may download sheet music, reproduce the melody, embellish to her taste, and publish or resell her recording.

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across both R&D
and supply chain
in multiple product
categories.*

Printing in 3D at scale and the changes in supply chain as 3D printing moves into production are now undergoing a metamorphosis analogous to the music industry after the invention of the phonograph. 3D printing at production scale promises the mass production, distribution, and personalization of creative products, just like recorded music.

The Promise of 3D Printing

The last few years have seen exponential advances in the range of technologies, scale, and efficiency of 3D printing. The COVID-19 pandemic highlighted the critical need—and promise—of 3D printing at production scale, as it proved to be a viable local manufacturing solution.

HP and its global community of digital manufacturing partners have produced more than 3.3 million 3D-printed parts to help healthcare workers on the front lines. The technology allowed the rapid design of crucial components transferred digitally and manufactured locally for immediate production and delivery into the hands of medical staff.

As companies demand flexible, resilient supply chain models, this is one example of the opportunity to reshape the future of supply chains. The key to unlocking this future is scale, which, until recently, was not a component of any additive manufacturing technology.

Impacts on Supply Chain

As 3D printing expands beyond prototyping and into production, supply chain professionals should anticipate profound impacts on the entire supply chain. 3D printing at scale may alter virtually every system dynamic: logistics, services, flows of materials, the transmission of supply and demand signals, specifications, Standards, customs, security, intellectual property rights, laws and regulations, and sustainability.

Three pillars underpin the changes we can expect as 3D printing scales to production: postponement, radical customization, and a translation of physical products to digital embodiments. Each compounds and reinforces each other.

Ultimate Postponement

Postponement is the supply chain principle of delaying differentiation in material for as long as possible in the production cycle. Material that remains common to many purposes is more flexible and useful than material customized for a single purpose. An item such as a common screw can be used anywhere; a subassembly may be usable in a range of products, but not all of them; and a final product will meet only its intended use.

Large manufacturers use postponement regularly. It is cheaper and easier to forecast, stock, and send a box of screws than to manage the right quantities of every product a factory may produce. Effective postponement increases supply chain efficiency, reduces cost, and reduces waste. In other words, deliberate procrastination may be profitable.

But while postponement strategies usually happen in factories or warehouses, the basic raw materials for 3D printable parts may be positioned at or near the point of final customer delivery, formed on demand. As cost continues to decrease, this obsoletes a hub model based on massive central warehouses of millions of products.

Radical Customization

Traditionally, customization comes at a price. Volume discounts are a universal supply chain principle.

Manufacturing efficiency depends on eliminating variation and being able to offer your product, as Henry Ford famously said in 1909, “any colour that he wants so long as it is black.”

Production-scale 3D printing abolishes that constraint. Customization of sub-groups, or even of every single item, carries zero additional production cost; 500 physically unique objects cost the same as 500 identical objects. There is design and setup overhead, but once on the production floor the customer receives uniqueness free. A barrier today is that the baseline cost in 3D printing remains higher than other manufacturing techniques, but the gap is narrowing.

3D technology providers have roadmaps for various characteristics that may soon be customizable. For simplicity, consider only the physical form for now.

With postponement, a contractor could order any part from a digital catalog on demand. Radical customization means the part does not even have to be in the catalog. A customer can bring in a USB drive with their part design or bring something similar to what they want; it could be scanned with a 3D scanner and be modified digitally to suit the customer’s purpose. It effectively adds infinite additional products for variations of parts that it might not have been possible even to imagine, much less to forecast, order, and stock traditionally. A 2030 Henry Ford might say, “give the customer a car in any color that he can imagine, because it doesn’t cost me a nickel more than black.”

This capability is a significant reason 3D printing is popular as a prototyping tool. Now we see it realized at production scale.

Physical to Digital

Gene Roddenberry envisioned in *Star Trek* a food “synthesizer” that could produce colored and flavored edible cubes on demand. This fictional contraption evolved, and in *Star Trek: The Next Generation* became a “replicator.” 3D printing is limited at present to a narrow range of materials. But the ability to describe physical characteristics in digital format, transmit the description over the internet, and realize an object in the physical world is closer to a replicator than people may realize.

Physical objects ship as digital descriptions to the point of local realization, anywhere in the connected world, immediately and at virtually zero cost. And, in the end, they are made on demand, with customization or alteration as desired and permitted.

The Impending Proliferation

The great barrier to the realization of this ecosystem is the limited range of “things” that can be 3D printed at production scale. Under that crucial constraint, is this worth any professional’s time to consider? In the last year, the additive manufacturing (AM) industry achieved nearly an order of magnitude increase in sophistication, speed, and scale across technologies.

More materials and capabilities are on the horizon, including metal. Opportunities for 3D printing at scale are feeding a strong positive feedback loop of materials, investment, and innovation.

Today, injection molding is the dominant approach to manufacturing in high volume. It likely will be for some time. But injection molding tooling is expensive. Additive manufacturing is an attractive new complement for manufacturers. It similarly delivers new capabilities and forms not achievable by other means at any price. “Digital shipping” adds flexibility to build 100 units at 50 locations instead of molding 5,000 units on a toolset to ship around the globe, providing a dramatic reduction of time, cost, and the carbon footprint of shipping.

More to Come

3D printing, also known as additive manufacturing, is still in its infancy. One barrier to faster growth is the adoption of industry Standards, which are being developed. AM is an enabler of digital manufacturing, a cornerstone of digital transformation and reduced time to market.

Supply chain is not simply the flow of material, but also the flow and management of information and cash.

If we look again at the music industry, the phonograph eventually spawned unforeseen industries, including record companies, radio, and now streaming services such as Pandora and Spotify. Similar unknowns lie ahead in the future of supply chain with the 3D printing and digital manufacturing revolution. 



Large-scale 3D printer

How Can Manufacturers Become More Agile in the Post-COVID-19 World?

Bruce Albrecht,
Vice President of
Innovation and
Technology, Miller
Electric Mfg. LLC

*Mr. Albrecht
is a Member of
the NEMA Arc
Welding Section.*

From supply chain disruption to production delays, 2020 brought a new host of challenges for manufacturers. While many manufacturers have continued operations through the interruption caused by COVID-19, it has been far from business as usual.

What does a post-pandemic world look like for manufacturers? Many operations will look for ways to streamline or improve agility in people, equipment, and the supply chain.

In today's tough economic environment, it's important to be productive, even with varying demand. It is crucial to have the ability to adjust workforce and machinery capital within a factory based on product mix and customer demand. It is also key to utilize labor and equipment solutions that maximize value-added activities and minimize non-value-added events (such as setup time) and quality problems that include scrap, rework, and grinding for metal fabrication and welding.

Metal fabrication and welding are vital parts of many manufacturing operations—and an area where companies can find efficiencies that contribute to improved productivity and flexibility overall.

Consider the following three factors that can help optimize welding operations in the current environment.

Factor 1: Labor Agility

The ability to easily bring in new employees and move people within the operation as needed improves agility. In a welding operation, agility is increasingly important because of the shortage of skilled welders. The American Welding Society (AWS) estimates there will be a shortage of nearly 400,000 welders by 2024, making production capacity harder to maintain.¹

Manufacturers can do their part by providing technologies that help operators maximize their performance with greater visibility and a wider operating window of the technique used when welding. Some examples include new welding helmet technologies; intuitive, easy-to-use welding power sources; and welding intelligence solutions that electronically gather data that manufacturers can use to drive positive change. Upgraded welding helmets can give welders a clearer view of the weld pool and surrounding workpiece.

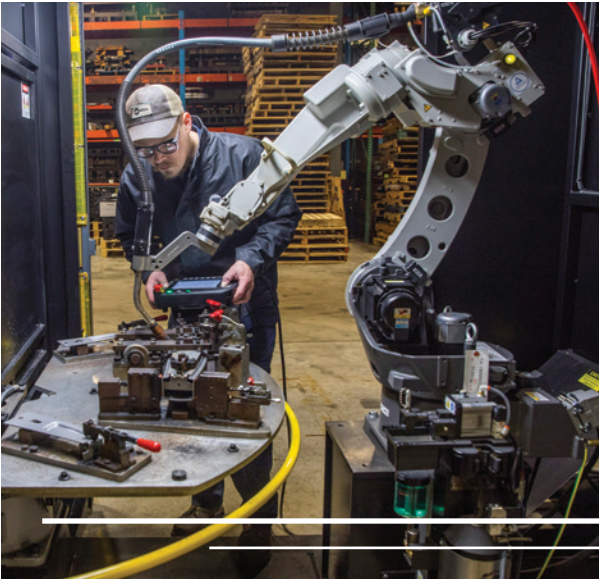
Welding intelligence technologies can provide work instructions during welding—for immediate feedback to help correct mistakes or inconsistencies—and also help operations track quality levels using real-time data.

These technologies can help deliver better weld quality and less rework. When operators spend less time grinding, adjusting parameters, and completing rework, they can spend more time welding. As a result, the manufacturing operation can increase capacity for value-added activities, take on more projects, and boost revenue.



▲ More power sources used in industrial and heavy manufacturing applications are being designed with ease of use and simplified interfaces in mind. Photos courtesy of Miller Electric Mfg. LLC

¹ "How to train and retain welding operators," Engineering 360, September 21, 2019, <https://insights.globalspec.com/article/12636/how-to-train-and-retain-welding-operators>



▲ Miller® PerformArc™ robotic welding systems are available preassembled and prewired. These cells are also designed for easy programming and are agile when the product mix or market shifts.

Factor 2: Equipment Agility

In many cases, automation can be an affordable and flexible way to augment a manufacturer's workforce. In the right applications, automation can deliver greater weld consistency.

Large, customized automation cells provide benefits for many manufacturers. Still, in the current disruptive environment where redeployment, lower costs, and agility are critical, these larger robotic welding systems don't offer mobility. They frequently require dedicated support staff with in-depth training on the system to support production, making return on investment difficult within demand shifts.

Smaller, more nimble automation cells may be the answer for many manufacturers that want to implement robotic welding.

Robotic welding cells are available that are easy to install and get running quickly; systems are available preassembled and prewired. These cells are also designed for easy programming and are agile when the product mix or market shifts within challenging economic cycles.

These cells don't require as much overhead or labor to keep running. A smaller capital outlay, plus ease of installation and use, results in a better return on investment—and agility during times of economic disruption.

Factor 3: Relying on Data

Running a manufacturing plant on data helps maximize equipment and labor agility for both automated and manual operations.

Evaluating the welding operation is critical when a company wants to improve overall throughput and productivity. Integrating the many aspects of the manufacturing operation using a data-centered approach can help companies optimize production and control costs. Tracking and analyzing weld data plays an essential role in this process—and can help companies improve quality and productivity overall.

Agility in Manufacturing

As the welding industry continues to evolve, there are more and more solutions to help manufacturers improve agility in their operations. These are especially important as manufacturers adjust to current industry challenges.

Consider options that help improve labor and equipment agility as well as provide data that can help streamline the weld cell—and both upstream and downstream processes. ☼



▲ Integrating the many aspects of the manufacturing operation using a data-centered approach can help companies optimize production and control costs. Tracking and analyzing weld data plays an important role in this process.

Want to read more? See our expanded coverage at nema.org.

NEMA Offers Guidance to the NEC on Reconditioned Electrical Equipment

Jack Lyons

Northeast Field Representative,
NEMA

As the adoption of the 2020 *National Electrical Code*® goes through the regulatory and legislative review process, there has been clarity added to the rules related to reconditioned equipment. In the 2017 NEC, a requirement was placed into section 110.21(A)(2) for marking of equipment that has been reconditioned. This led to many questions and concerns about what constitutes reconditioning and how it differs from normal servicing and maintenance.

The NEMA Policy on Reconditioned Electrical Equipment was a guiding factor in many of the rules that are in the 2020 NEC. There was a new definition for “reconditioned” placed into Article 100, which, along with other new requirements, helps guide the industry in maintaining the safety of personnel and property when using reconditioned electrical equipment. Rules on marking were expanded to ensure compliance to product safety Standards and may require possible recertification. There were many new sections in the NEC that clearly identify products that may or may not be reconditioned.

Proper reconditioning as outlined in the NEMA position paper includes first seeking approval by the original manufacturer, using their guidance or other industry-developed Standards, using qualified parts, and using only qualified workers to perform reconditioning tasks. The distinction between reconditioning and normal servicing and maintenance, particularly with equipment that remains within a facility or entity, is based on good service records that ensure proper guidance has been followed from the manufacturer. The change in section 110.21(A)(2) reflects this difference in servicing and maintenance and reconditioning in a facility.

In its paper, NEMA developed a list of items that are not to be considered suitable for reconditioning. NEMA Sections determined that the listed products had no process to safely restore to the original safe operating condition for which they were originally manufactured.

The list goes on to state there are some products that have certain industry Standards associated with reconditioning of specific equipment, e.g., switchboards and controllers. In these cases, the original manufacturer should be consulted, as they are aware of all safety aspects of their products and the product Standard it was certified and built to.



This switchboard could be repaired and/or reconditioned.

The 2020 NEC has taken a considerable step forward in safety by addressing concerns related to reconditioning. The vast expansion of reconditioning requirements and substantiation related thereto will ensure the reconditioning continues to meet the original safety Standards that the original manufacturer built the equipment to. Proper verification of the reconditioned equipment's safety and reliability is part of the approval process to reinstall equipment back into service. The Authority Having Jurisdiction must approve equipment to meet the basic function of the NEC, which is the protection of personnel and property from hazards arising from the use of electricity. Ⓜ

New Motors and Generators Industry White Paper Focuses on Safety and Reliability

As efficiency regulations continue, regulators and end users should widen their focus to the value of thinking beyond efficiency alone. For instance, product safety and reliability are of equal importance over the long run.

NEMA MG P2-2020 *Reliable Short-Term Operation and Safety Must Take Precedence over Efficiency* is a new white paper that helps regulators and end users understand that maintaining safety and reliability should be the highest priority, and this publication provides examples to help give context.

The primary audience of this paper is manufacturers of motors, drives, and regulators.

It is available as an electronic download for no cost.

OTHER RECENTLY PUBLISHED STANDARDS:

ANSI C78.55-2020 *American National Standard for Electric Lamps—LED Lamp Specification Sheets for HID Replacement and Retrofit Applications* is available for \$100.

ANSI C82.16-2020 *American National Standard for Light-Emitting Diode Drivers—Methods of Measurement* is available for \$176.

NEMA HV 3-2019 *Suggested Purchase Specification Guidelines for High Voltage Insulators* is available as an electronic download for no cost.

NEMA LSD 64-2019 *Lighting Controls Terminology* is available as an electronic download for no cost.

NEMA LSD 41-2020 *UN2911 Labeling and Transportation of Lamps Containing Radioactive Substances* is available as an electronic download for no cost. ☎



SPOTLIGHT



I Am NEMA

Roman statesman Cicero once said, “The people’s good is the highest law.” As the General Counsel and Corporate Secretary of NEMA, I am proud to serve the Members whose products promote the public good by improving lives.

Undergirding that higher law is an intricate and often byzantine framework of statutes, regulations, guidance documents, and judicial precedent. My role is to help NEMA navigate those authorities to protect and promote the electrical and medical imaging industries.

I ensure that NEMA remains compliant with a multitude of legal obligations, including protecting its nonprofit status, implementing corporate governance requirements, ensuring antitrust compliance, protecting NEMA intellectual property, crafting clear and durable contracts, and ensuring political law and lobbying law compliance. I also help to protect NEMA against groundless litigation, comply with

labor and employment laws, and ensure legally compliant Standards development.

In my role, I also support NEMA public policy advocacy by helping staff navigate the requirements of Federal regulatory rulemaking and by providing legal analysis and arguments in support of regulatory comments. When Federal agencies or other government actors overreach in ways that harm NEMA Members, I identify opportunities to defend the industry—whether through a direct lawsuit to challenge the government action or by filing “friend of the court” briefs to pursue a favorable ruling.

My professional background includes other leadership positions in trade associations in the manufacturing and energy industries, representing clients in litigation at major international law firms, and enforcement responsibilities at the Federal Energy Regulatory Commission. I am thrilled to be part of a world-class team at NEMA, and I am honored to represent companies that promote the “people’s good” every day. ☎

**Peter J. Tolsdorf, NEMA General Counsel and
Corporate Secretary**

Solid Business Investment Leads to Faster Economic Growth

Capital expenditures, commonly known as business investment, is a key measure to understanding the health of the economy and serves as a barometer of business confidence. While the outbreak of COVID-19 has upended industry, at least temporarily, manufacturers recognize the importance of continuing to invest in new facilities, equipment, and intellectual property in order to maintain a competitive edge and improve manufacturing processes.

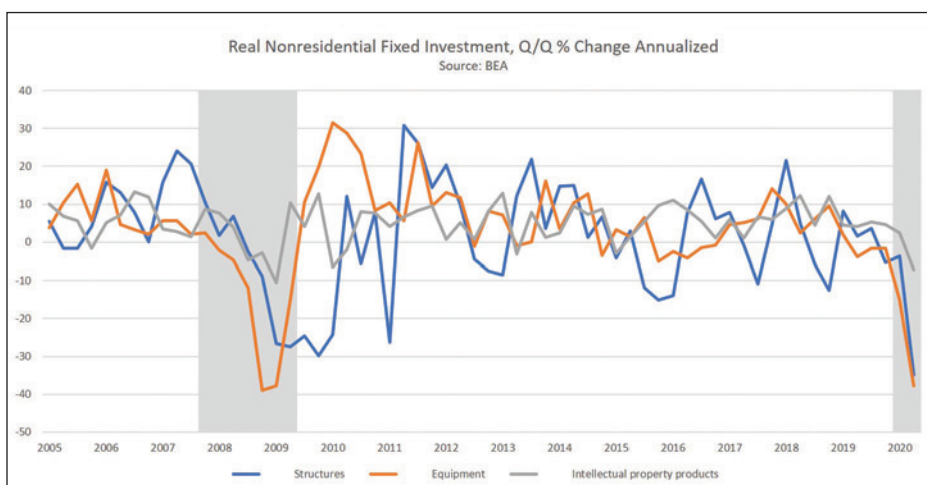
The most recent GDP report from the Bureau of Economic Analysis, a branch of the Department of Commerce, showed that Q2 2020 real nonresidential investment contracted 27.0 percent at annualized rate from the prior quarter as government-mandated shutdowns and demand destruction related to the COVID-19 pandemic left almost no industry unscathed. A more detailed breakdown showed that investment in structures and equipment were hit the hardest, sinking 34.9 percent and 37.7 percent, respectively, during the quarter. Intellectual property products, a third component of nonresidential investment, slipped 7.2 percent, the first quarterly decline since Q2 2013.

A sectoral breakdown of investment is published annually from the Census Bureau in their Annual Capital Expenditures Survey. The most recent data for 2018 showed that nominal investment by electrical equipment, appliances, and components manufacturers fell 1.1 percent and has seesawed

between positive and negative growth since 2009. By comparison, the manufacturing sector overall has seen nearly uninterrupted growth in investment since 2004 except for a 27 percent decline in 2009 as a result of the financial crisis and a 0.6 percent decline in 2016.

A more detailed breakdown indicated investment in structures has increased in each of the last three years, with growth in 2018 measuring 16.4 percent. Meanwhile, electrical equipment, appliance, and component manufacturers' investment in equipment saw swings of double-digit growth and contraction in equipment investment between 2014 and 2017 and a decline of 5.4 percent in 2018.

Investment in industrial automation equipment, sensors, and other equipment and structures enables manufacturers to improve their process by leveraging data, developing new products, and pivoting to fill demand in a rapidly changing economic environment. While the recent decline in business investment suggests corporate executives may be uncertain about the future, maintaining and even accelerating investment is a proven way to help ensure manufacturing vitality as the economy recovers. 📈



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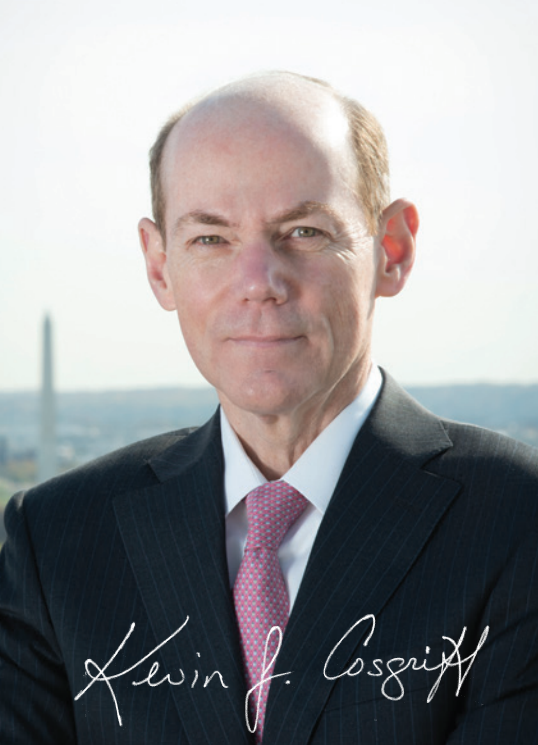
In Southwire's 70 years of business, we continue to demonstrate our company's dedication to partnering with organizations who are helping to revitalize and support communities around the world. In that spirit, we are pleased to announce that we are expanding our giving efforts throughout 2020 in response to COVID-19 with a focus on hunger, education and hope for the holidays.

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ENDNOTES FROM THE **PRESIDENT**

As COVID-19 spread from China to Europe to the United States, manufacturers were put to the test. After years of eliminating inefficiencies to achieve low-cost, just-in-time manufacturing, companies of all types were largely unprepared for the myriad and global-scale disruptions of the pandemic. At least at the onset, modern manufacturing practices proved ill-equipped to weather a worldwide economic meltdown.

Productivity fell as many factories curtailed operations in response to government directives. And both upstream material and finished product shipments were interrupted amid confusion in the transportation sector. And as if the pandemic-related challenges were not enough, ongoing trade tensions and uncertainty arising from U.S. and other governments' policies regarding all manner of "normal" interactions posed further business complications.

About a half-year into the COVID-19 era, what have we learned? One area of special note is the need to rethink supply chain security. Specifically, two attributes are in need of analysis: robustness and resilience. By addressing both robustness (the ability to maintain essential shipments, even during disruptive events) and resilience (the ability to return to normal or reconfigure quickly after a disruptive event), manufacturers can improve their overall business reliability (the ability to deliver finished goods on time consistently).

These are not new concepts, and many companies regularly reviewed their processes with these sorts of criteria in mind, even if by different names. However, given the widespread shutdowns and resulting economic disruption, we can conclude most of us did not anticipate scenarios where entire regions are unable to ship products, sometimes for months.

Another area, related to but not wholly dependent on a given supply chain structure, is in industrial automation. These systems can improve manufacturing processes

by reducing production errors and more. For instance, with the proliferation of connected systems (Industrial Internet of Things, Industry 4.0, Smart Manufacturing, etc.), factories can gather and process information efficiently and conduct analysis apace from these data. In turn, plant managers can optimize operations in response to supply chain disruptions. Combining on-site data with upstream and downstream information digitally is one way to add robustness and resilience to a company's overall stream of commerce.

Increasingly, this end-to-end data chain will rely on machine learning and artificial intelligence both for detecting anomalies in manufacturing and for alerting managers to potential supply chain vulnerabilities or likely disruptions.

A pandemic may not seem like the optimum time to make major decisions. But most observers believe the "next normal" is emerging in ways that suggest applying much of the foregoing will separate the successful companies from the stragglers. And while some investment will be required, most will initially rely on incrementally embedding sensors and connecting existing equipment digitally.

For its part, NEMA has secured the Technical Advisor and Secretary positions, respectively, for the U.S. Technical Advisory Group (TAG) and the International Electrotechnical Commission Smart Manufacturing Systems Committee (IEC SyC SM). By taking on these important roles, NEMA will have a clear view of, and influence on, relevant Standards that over time will incorporate the economic and business lessons learned during the pandemic, and map a future that evolves largely from rethinking how to connect existing systems digitally.

While COVID-19 took the world by surprise, humans are resilient, and business leaders are problem solvers. The post-COVID world is being fashioned by the numerous decisions being made today and for all the todays that follow. Aligning upstream production and downstream processes and connecting them will empower rapid decision-making and contribute to overall company reliability. ☺

Kevin J. Cosgriff
NEMA President and CEO

2020 Editorial Calendar

November/December

Building Infrastructure

Increasing productivity in manufacturing



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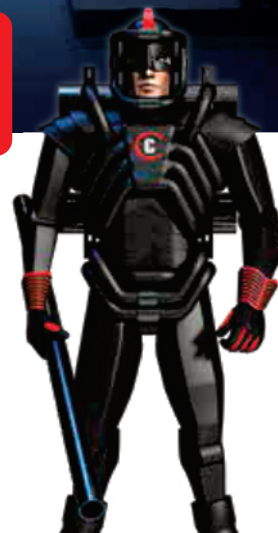


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