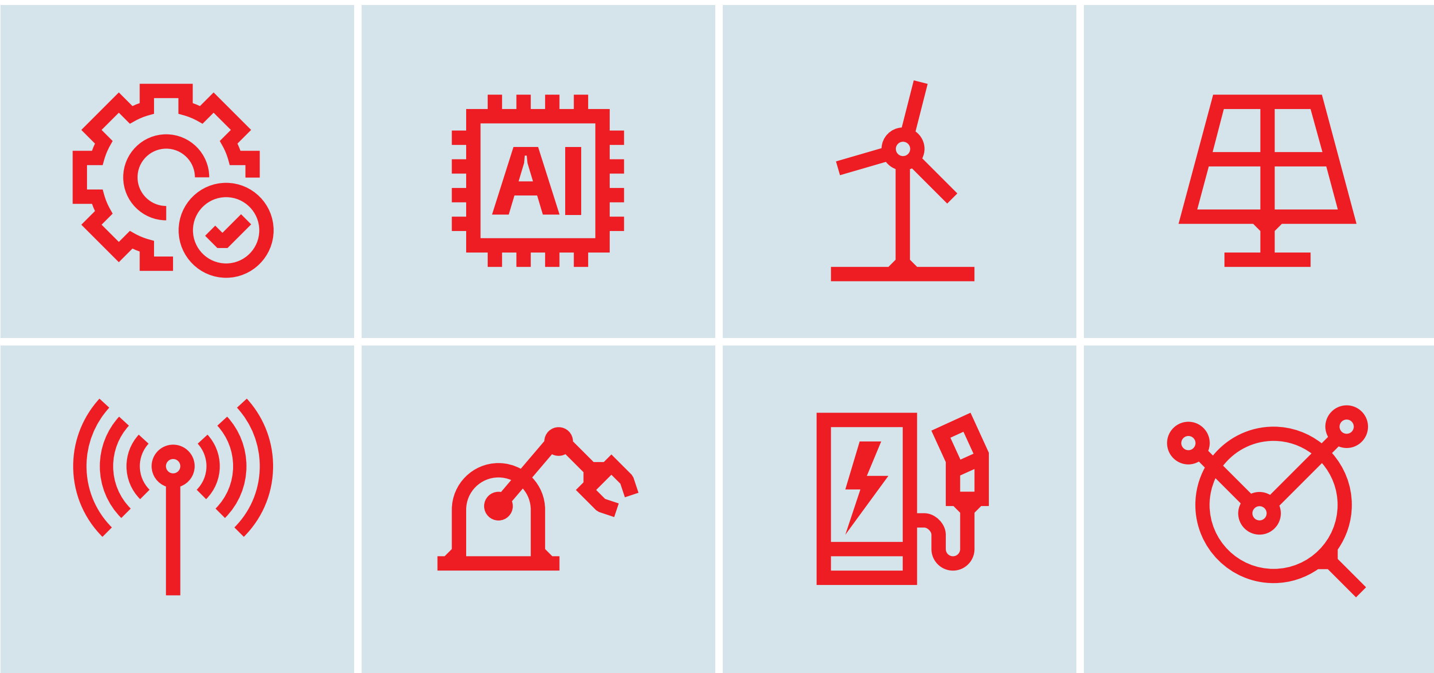
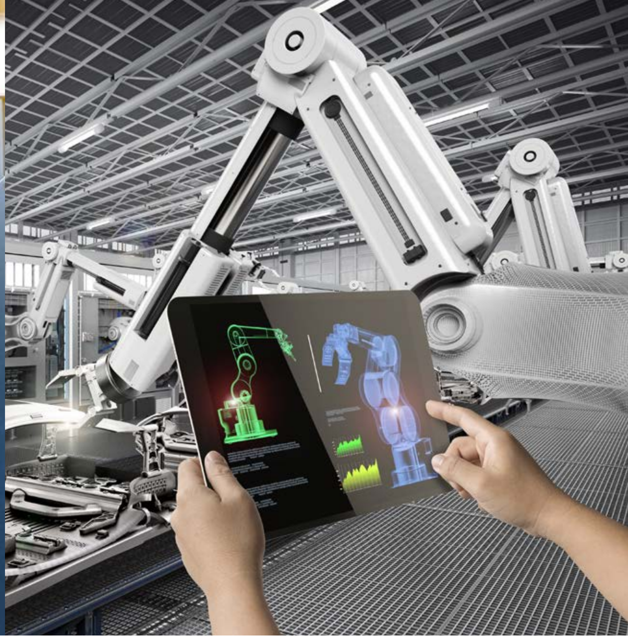
INNOVATION, AUTOMATION AND CONSERVATION

Transformational Technology Trends in the Industrial and Power Sectors

Justin Kolbe

Significant advances and transformational changes across the industrial automation and power conversion markets are bringing impressively intelligent capabilities that will shape the future of smart manufacturing, energy efficiency and power access worldwide. Broad and intersecting, these innovations are enabling a new industrial age where geography is no longer the determinant of cost-effective manufacturing, emerging markets have access to robust power sources and environmentally-conscious technology is widely available. Below is a snapshot of the major trends and their current and potential impact.





Industrial Automation Industrial Electronics

Industry 4.0 and the Industrial Internet of Things (IIoT):

As computational power and sensor integration become cost-competitive and more prevalent, while controls and drives grow smarter and increasingly connected, data acquisition and real-time analysis will continue to raise productivity and lower cost. When widely implemented, a high degree of automation stands to level the playing field and reduce geographical influence on end-product cost.

Augmented Reality:

In a manufacturing environment, the ability to simulate workflows and potential outcomes through digital projections of information has profound and far-reaching implications for optimization and output. Remote access and oversight, preemptive mitigation and labor maximization are just a few.

Wireless Communication:

The impact of burgeoning wireless communications across applications (automotive ADAS, telemedicine, etc.) and new 5G connectivity standards are driving the need for an increase in the number of access points and higher-speed real-time information transfer. Managing the higher power consumption, keeping pace with new RF shielding obstacles and ensuring long-term system reliability are emerging challenges that must be met.

Cybersecurity:

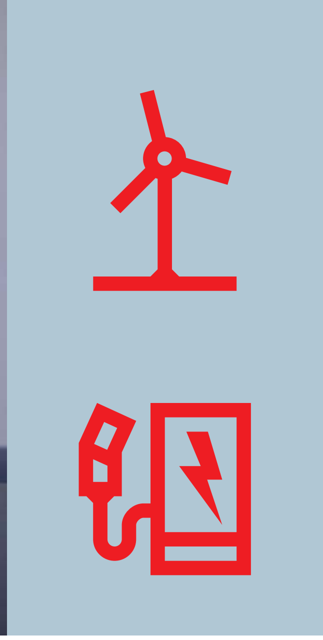
Recent events have illuminated the critical importance of cybersecurity protocols. Downtime due to a security event or total breach can often be more costly and more insidious to detect. This is a significant downside to broad connectivity and why some manufacturers are reluctant to fully embrace Industry 4.0.

Machine Learning and Artificial Intelligence (AI):

Power management sophistication for emerging machine learning and AI technologies will be required. These complex systems can increase agility, reduce implementation time and massively improve production efficiency but, again, the cost is a major leap in processing power due to the computational intensity.

Robots, Cobots and Human/Machine Hybridization:

While robotics have been integral to automated production operations for decades, the complexity and remarkable agility of modern robots, task- and space-sharing cobots, autonomous guided vehicles and mobile robots (AGVs/AMRs) is enabled by next-generation AI and sensor technology. Exoskeletons and sensory augmentation allow the power of robotics to be integrated with human decision-making. As part of the Industry 4.0 landscape, this trend will continue to advance geographical cost equality. And, if you're skeptical of the transformation these advances portend, *check out this video*.



Power Conversion Energy Efficiency

DC Power:

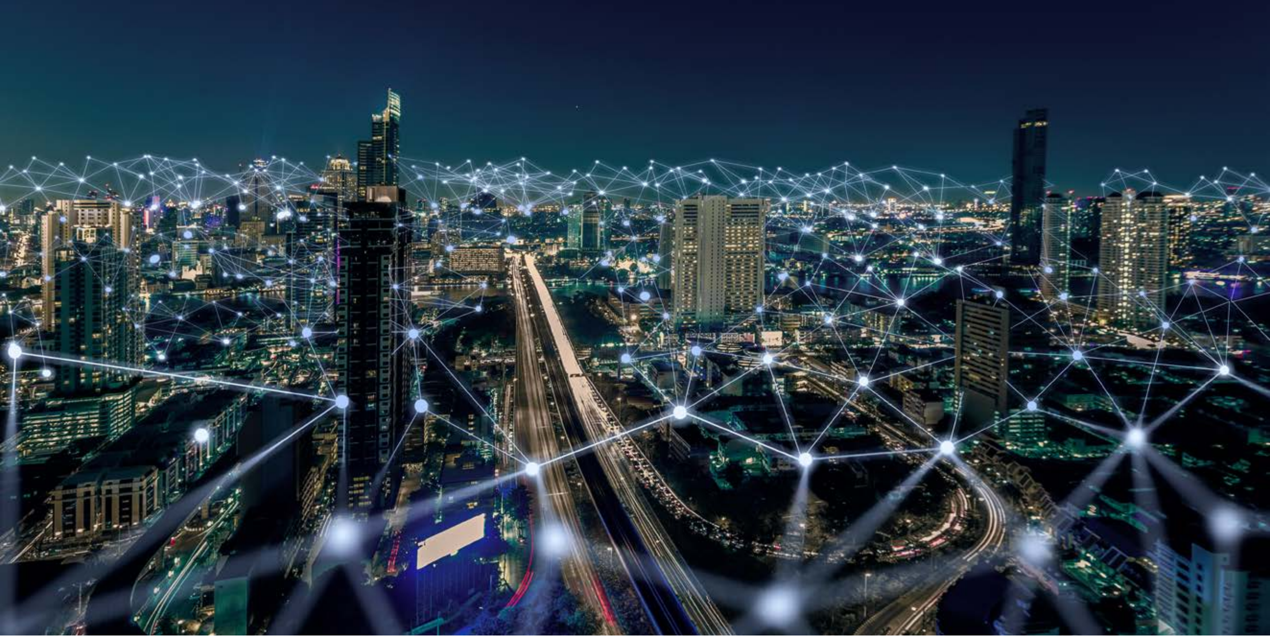
As the world's population grows and technology adoption requires more energy, power supply efficiency is increasingly important. Using DC power buses or transmission can provide many advantages over standard AC power transmission. Less complexity and a reduction in the number of conversions required (as compared to AC power) make DC power an efficient, cost-effective alternative for many applications.

Mobile Power

Being able to access power no matter where you are is increasingly important for many sectors – from transportation to communication. Electric vehicles, e-scooters and even industrial robots require battery packs. Because of this, battery innovation is a significant area for technological progress. Reducing the likelihood of thermal events (fire) and maximizing power output are key to the technology roadmap for battery development.

Energy Resiliency:

Like reliable mobile power solutions, building resilience (i.e. interruption-resistance) into the power structure is elemental to serving the energy needs of the global community. Microgrids, which are localized and can disconnect from the main grid for autonomous operation, along with improvements in energy storage solutions, add flexibility and efficiency to the power infrastructure. Leveraging alternative energy sources such as solar also contribute to a fortified supply. Again, ensuring the reliability of the systems delivering these alternatives is central.



EV Infrastructure:

While the EV market continues to fuel growth in the automotive sector, there is still a gaping hole in EV infrastructure. We'll have the vehicles, but perhaps not the robust framework to support them. Innovations such as solid-state transformers, wide band gap semiconductors, battery management systems and, yes – widely available charging technology – will require considerable investment sooner rather than later.

> **While each of these technology milestones instills tremendous optimism for a resilient, eco-friendly and more automated future, there are still hurdles to be overcome. Security is top among them, as is the ability to build reliability, safety, efficiency and longevity into the electronics enabling all of this functionality.**
>
> **Our company is tackling these challenges at the material level and working with the world's top automation and power conversion innovators to help drive progress for a connected, sustainable and energy-enabled world.**

Justin Kolbe

The Author

Justin Kolbe currently serves as Henkel's Director of Market Strategy for Power and Industrial Automation within the company's Adhesive Technology business unit, where he is focused on setting broad strategic guidance and market insights. In 1996, Kolbe joined The Bergquist Company (acquired by Henkel in 2014) as a Process Engineer and has since worked in various capacities including process development, applications engineering, R&D and marketing. A chemical engineer by training, he has extensive experience in thermal management solutions and electronic materials development and processing.

With an impressive professional track record and a long history of providing reliable solutions for customers in multiple markets including power conversion, automotive, industrial automation and power electronics, Kolbe is passionate about ensuring Henkel materials not only deliver on performance, but also on cost and sustainability objectives. Based in Henkel's Chanhassen, MN facility, Kolbe holds a Bachelor's degree in Chemical Engineering from the University of Minnesota.

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