The End of Silos:

How Industrial Connectivity is Transforming Engineering

New IIoT technologies and digital processes are taking collaboration and innovation to new levels. The result has the potential to dramatically improve operational efficiencies, increase uptime, and rein in R&D costs.

IndustryWeek

EXECUTIVE SUMMARY

New IIoT technologies and digital processes are taking collaboration and innovation to new levels. The result has the potential to dramatically improve operational efficiencies, increase uptime, and rein in R&D costs.

As an abstract goal, the Industrial Internet of Things (IIoT) paints an orderly picture of manufacturing. It offers a vision of the ideal state of equipment, security, and communication—all assets and processes seamlessly sharing data, sophisticated analytics programs streamlining production, and IT and Operations coordinating to make quick, data-driven decisions that improve the holistic production.

But that vision doesn't exactly match the true state of the industry.

In reality, most manufacturing plants are composed of a broad ecosystem of new and old equipment from a variety of vendors, all of which offer disparate functionality and different communication requirements.

Pulling all of that data together is vital for a true and effective IIoT implementation. It is an essential step of the digitization process that will actualize the efficiency and productivity gains promised by the IIoT—and determine the ROI on all the work involved.

However, pulling the data together can be extremely difficult. Without a solid data integration strategy, it can be impossible. As a result, many plants are left with "silent" or siloed assets on the floor that are unable to communicate with the broader IIoT network, which can drastically cut the effectiveness and returns of the digital transformation.

To fully realize the vision of IIoT, manufacturers first need to develop a strategy to fully connect their equipment ecosystems. From new and old, vendor to vendor, all equipment must share their data in a language the overall system can understand.

This collection of articles and how-tos is designed to help you do just that. From approaches to integrating legacy data and achieving full data transparency to breaking down system and interdepartmental silos, this collection offers a rich resource of critical expert advice to help you get the most out of your implementation. With it, manufacturers can finally get off the digitization sidelines and begin their journey into the connected world of the Industrial Internet of Things.

SIX WAYS TECHNOLOGY IS TRANSFORMING ENGINEERING

New ways of collaborating and innovating can speed up product development and rein in R&D costs.

MARC BOILARD, SIMON SCHNURRER, KEVIN SMEETS

The number of sensors and digital systems collecting data on aircraft, railway cars, locomotives and automobiles is rapidly expanding. Artificial intelligence, machine learning and other technologies are transforming the basics of how transportation equipment operates. And customers, recognizing the possibilities, are demanding more customized equipment and intelligent interfaces.

These new components and technologies are also reshaping the way engineers design and develop equipment. They create opportunities that, when used to full potential, can contain research and development (R&D) costs and substantially speed up the incorporation of innovations—allowing manufacturers to better adapt to rapidly changing customer demands.

REAL-TIME INNOVATION

In the past, inventing transportation equipment required a trial-and-error process and multiple prototypes. For instance, developing a new model of car typically took close to four years, with the model staying on the market for seven years. For aircraft and rail rolling stock, the combined timetable for development and the equipment's time in service can be three to four times longer than for autos.

Given the current pace of technological change and adoption, that's too long.

Digitization is changing the playing field for engineers. It alters the culture by providing more real-time data on the performance of equipment in the field today, allowing engineers to consider improvements that can be achieved in months through data algorithms rather than years or decades. Instead of focusing only on breakthrough technologies and new models, engineers can significantly expand the capabilities of equipment already in service through incremental upgrades in software downloads or the incorporation of new sensors.

Transportation manufacturers can operate more like an Apple or Microsoft, sending software updates to improve performance or security. Regular upgrades and the flexibility that digital systems provide are transforming what original equipment manufacturers can offer customers – and what engineers can develop. Since its inception, Tesla, for instance, has let its electric car customers incorporate technology upgrades through simple downloads while the vehicles sit in the garage or parked on a street.

The pressure to keep technology cutting-edge is even more intense for aircraft and rail equipment manufacturers whose products remain in service for decades. Public transport authorities are beginning to demand faster turnaround on new trains and trams to provide riders the latest comforts and conveniences; airlines want to distinguish themselves in the market with more customization of their planes and the customer experience through advanced connectivity.

THE REALITIES OF BUDGETS

Making sure that products keep up with technological advances costs money at a time when most manufacturers are forced to look for cuts. As a result, engineering departments are transferring funds from traditional R&D to digital in an impossible race to reduce both the cost and time to reach market with new products.

Annually, equipment makers budget more than $814 billion on R&D and engineering – a significant cost of operation. Adopting data-driven engineering could shave up to 10 percent off these budgets, with the savings likely to increase as transportation equipment becomes more digital, autonomous, and electric.

To accomplish this, engineering departments will have to change how they work. Here, we explore six trends that are redefining the design and development of transport equipment.

TREND ONE: TWO TYPES OF ENGINEERS

The biggest challenge facing transportation companies is finding candidates with the right mix of engineering skills. The growing technical sophistication of transportation equipment demands deep expertise in narrow scientific fields like artificial intelligence, but their complexity also creates a need for system engineers and architects. These specialists, probably the hardest of engineers to find, have mastered several engineering disciplines and can address a product holistically, understanding how various systems interact and support each other.

Meanwhile, as human resources departments look to recruit more engineers, information technology tools and artificial intelligence systems will be taking over certain engineering assignments, primarily simple design tasks. It's estimated that robots will eventually take over as much as 25% of the work of engineers, just as they have replaced production workers in factories and changed the skillset necessary for those remaining.

TREND TWO: OPEN ENGINEERING ECOSYSTEMS

Outsourcing was once a means of cutting costs, but today it's done to access new skills in areas like artificial intelligence or to reassign legacy work so in-house engineers can focus on new technologies. That often involves collaborating with technology startups, which can create culture clashes.

The tech industry is accustomed to perfecting systems over time based on usage data, but for transport equipment makers, problems in the field can threaten more than their reputations and customer relationships. Yet the two types of engineers need to work together, which will require more alignment between engineering processes, signoff procedures and validation requirements, among other things.

Already, major companies leverage engineering ecosystems—essentially teams of in-house and outsourced engineers from multiple companies working together—in half of their programs, according to an Oliver Wyman survey. But many transportation companies said in survey interviews that they had problems finding the right ecosystem for software development. Among the biggest hurdles for most organizations in this type of collaboration are maintaining control over design methodologies, the lack of standardized IT systems and mitigation of the potential for cyberattack when working with third-party vendors.

TREND THREE: OPTIMIZING DESIGN WITH PRODUCT DATA

New engineering initiatives are arising from the growing pools of data supplied by aircraft, automobiles and railway cars themselves. Manufacturers have added more and more sensors to their products as the cost has come down and advanced analytics become available to interpret the data. (Oliver Wyman believes equipment

EQUIPMENT MANUFACTURERS COULD GAIN $10 BILLION ANNUALLY FROM IMPROVEMENTS BASED ON SUCH INTERNET OF THINGS DATA.

manufacturers could gain $10 billion annually from improvements based on such Internet of Things data.)

Even in aviation, where product data has been used for years, manufacturers are finding new implementations. For example, flight optimization equipment is being introduced that would allow flight plans to be altered based on real-time data on weather and traffic, leading to better fuel use and fewer delays. Planes are also sharing data more readily with air traffic control and other aircraft to improve safety and traffic management.

For automakers, the problem has been the fact that data rarely makes it back to the engineers. Vehicle internal error codes are tracked and used by repair shops to diagnose problems but often deleted after the car is fixed. If they were fed into a database, engineers could track frequently recurring problems with, for instance, navigation and infotainment systems, and find the root causes. They could then fix them in subsequent designs.

TREND FOUR: CUSTOMER-CENTRIC PRODUCT DESIGN

Demand for customization means that engineering companies are working closer than ever with their customers. Sixty percent of top-performing companies now collaborate intensively with their customers to get feedback on products and understand what they want next.

Equipment makers do not involve their customers in the technical design, but smart ones use them as integral parts of the testing process for new technologies. In the past, train operators were invited to give feedback on new trains already in production, but now manufacturers provide virtual simulators to let drivers try out different designs before the production phase.

In automobiles, by monitoring drivers' habits digitally, automakers might identify driving patterns that cause higher emissions and adjust the exhaust systems' control algorithms for individual drivers.

TREND FIVE: PROJECT DATA MANAGEMENT AND OTHER IT TOOLS

Project data management (PDM) tools are one way to cope with the growing complexity. PDM arranges a technology system into a cnnected library of subsystems, a bit like LEGO blocks, and allows data sharing across a company, removing functional silos. It can speed up development and cut the design cycle in half. PDM could be particularly useful for the rail industry, where there's more scope for customization than in automotive or aerospace, and where the need to limit complexity makes data about every variable easily accessible.

Rail manufacturers have begun the journey to modularizing their sub-systems, and automakers are using similar parts on multiple platforms. Yet engineers are often reluctant to adopt new IT tools like PDM, with their rigidity and poor user interfaces that are often a struggle to use. These are problems that software editors need to address if they want their technologies to be fully implemented.

TREND SIX: IMPLEMENTING FULLY AGILE DEVELOPMENT

Traditional engineering development was based on a steady sequence of steps from concept to implementation. Sometimes engineers wouldn't know a system wasn't working until far into the testing process, forcing them to lose time as they went back to re-engineer it. Today, software uses agile processes in which teams quickly iterate, test, and gather feedback on a product. Big tasks are divided into smaller ones, and teams tend to work in sprints.

As the digital content of engineered products grows, companies will increasingly turn to agile methods. The result is much faster product development cycles, with estimates that agile processes will deliver faster results in over 90 percent of projects. However, even with this impressive number, it may not be easy to get engineers to give up their traditional development process. ●

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GOODBYE SILOS: GETTING MAINTENANCE AND OPERATIONS TO WORK TOGETHER

Changing a culture where these areas are at odds is critical to success.

ROBERT GOLIGHTLY

In recent years, manufacturers have faced increased pressures, from rising operational costs to an ever-changing regulatory landscape. They've had to learn to function with greater efficiency and flexibility, to quickly respond to changing market dynamics and compete. Operational excellence is key to that. It requires an ongoing transformation and not just the digital transformation that has so much buzz.

Most transformations start with an organization-wide project analysis that shows how to utilize technology to boost performance. Fewer manufacturing companies tackle a transformation with the goal of changing their *culture*.

Let me elaborate on the culture piece: Manufacturers are at their most competitive when all operational assets are running as close as possible to their limits, without compromising reliability or degrading the asset. However, historically, maintenance and operations teams (the manpower behind the assets) have not worked together to achieve that—they've been siloed and sometimes even oppose one another. Changing that is key to operational excellence via reliability and asset optimization.

Transformation without *cultural change* is impossible.

SHORTCOMINGS OF A SILOED APPROACH

Across industries, maintenance is typically considered a service department rather than an integrated part of production and operations. This is a mistake. To improve uptime and, therefore, production, manufacturers must instead set up their maintenance teams to function in a proactive vs. reactive way.

From a data analytics perspective, consider that current data suggests that over 80% of downtime can be traced back to operational events, or the way in which manufacturers operate the assets. The technology challenge is to bring maintenance and operations data together to find the operating behaviors that degrade asset integrity and reliability.

For example, we worked with one large global chemicals company that had been seeking better notification of fouling in a quench oil tower. Using fouling data from the previous year, prescriptive maintenance software provided an alert with a 125-day lead time. The customer took no action and had to shut down the quench oil tower due to fouling.

Another example of the costs of reaction time: in a European refinery, vacuum bottom pumps had been affected by repeated seal and bearing failures. Prescriptive maintenance software learned the failure history (over a dozen different failure signatures; data that went back to a known event in 2014) and provided lead times of 28 and 31 days for future seal failures on the pumps, and lead times of 10 and 28 days for future bearing failures. The refinery ignored the warnings and was forced to replace seals/bearings after failures occurred.

These clearly demonstrate that improving uptime takes more than consolidating and analyzing data. There's a cultural challenge, which requires change management to get people to trust data and work together to act upon data. Success will only be achieved when capability and culture come together.

Look at lean manufacturing, which has been utilized by countless companies and generated billions of dollars in benefits for production operations. It's not a set of technologies but a philosophy that drives culture, with technology as part of the overall method. By adopting lean techniques, maintenance and operations has an opportunity to change from a reactive cost center to a proactive partner in driving increased asset performance and efficiency. This collaborative approach will drive uptime, productivity and ROI on a manufacturer's capital expenditure.

MAKING CULTURE CHANGE STICK

To create a culture change, ultimately every aspect of a manufacturing operation—from scheduled maintenance shutdowns, work requests, daily workflows and even department mission statements—requires reconsideration. Change only occurs if organizations redefine the backbone of their cultures and push employees to be agents of change through altering how they think. Manufacturing leaders must nurture a problem-solving mentality in their employees by introducing new processes into the workflow that facilitate collaboration and require workers to jointly question processes and brainstorm improvements. Company leaders must also show how this culture shift may reshape employees working relationships with their colleagues, other departments within their company and their own, personal responsibilities.

> **CHANGE ONLY OCCURS IF ORGANIZATIONS REDEFINE THE BACKBONE OF THEIR CULTURES AND PUSH EMPLOYEES TO BE AGENTS OF CHANGE THROUGH ALTERING HOW THEY THINK.**

On a tactical level, for manufacturing leaders to be able to unite operations and maintenance groups in a successful manner, they should first designate a project team to monitor and support the cultural collaboration across plant groups. The project team should have regular meetings and produce reports on a weekly and monthly basis that track progress—this will ensure a rapid response to potential roadblocks.

Here are some additional approaches, inspired by lean principles, to improve operations and maintenance collaboration:

Challenge the Status Quo – Changing the "if it's not broken, don't fix it" mentality and longstanding practices like scheduled maintenance help achieve true asset performance management. There needs to be a proactive attitude that asks, every day, whether corporate-level reliability goals are truly being met. This requires a mind shift to systems-level thinking, which makes decisions based on the impact across every facet of the organization, rather than single departments. To achieve this, there must be a continuous shared information flow between planners, schedulers, reliability engineers, operating engineers and process engineers.

Get Up, Get Out and Go and See – In a lean framework, stakeholders jointly go to and assess processes to find the root of the problem. No one leaves until there's an action plan for every production barrier. Asset reliability requires the same level of collaboration. Maintenance and operations need to both "go and see" to jointly come up with solutions that meet organization-wide objectives.

Continuous Improvement (kaizen) – Improving the way maintenance and operations work together doesn't have to incur a high bill. Data can help identify areas of risk and need, and during a cultural shift nothing works to reinforce the right behaviors like repeated peer recognition. Even something as simple as an internal recognition program, such as "I Made a Difference," where contributors are hailed as heroes, can help institutionalize a behavior.

Respect – Operations and maintenance teams play an equally important role in asset reliability, and they must build off of each other's work based on a relationship of trust and open communication. Removing emotion from the equation by focusing on facts and data is critical to maintaining a collaborative and open culture.

Teamwork – Business leaders need to train teams on how to identify opportunities to work together. A good starting place is to look for areas that have caused high costs and lost production and define how each group's actions have an impact on that process, as well as the other group's efforts. Working through this process can unlock barriers that have historically existed. And, where there's been success, manufacturing leaders should widely communicate joint progress and ROI throughout the organization to build pride in the achievements and encourage additional collaboration between departments.

Change management at a cultural level is a massive undertaking for manufacturers that requires active participation and communication from leadership, commitment to questioning existing processes and beliefs, and education to build buy-in and accountability across the organization. Organizations who have followed this path have successfully transformed their cultures from reactive to proactive, and in achieving reliability have also dramatically improved their bottom-line business performance.

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HOW MOBILITY IS FUELING THE LATEST TECH TRENDS IN MANUFACTURING

Verizon found IoT network connections in manufacturing increased 84% between 2016 and 2017, surpassing any other industry and bringing big changes to the factory floor.

MICHAEL KOTELEC

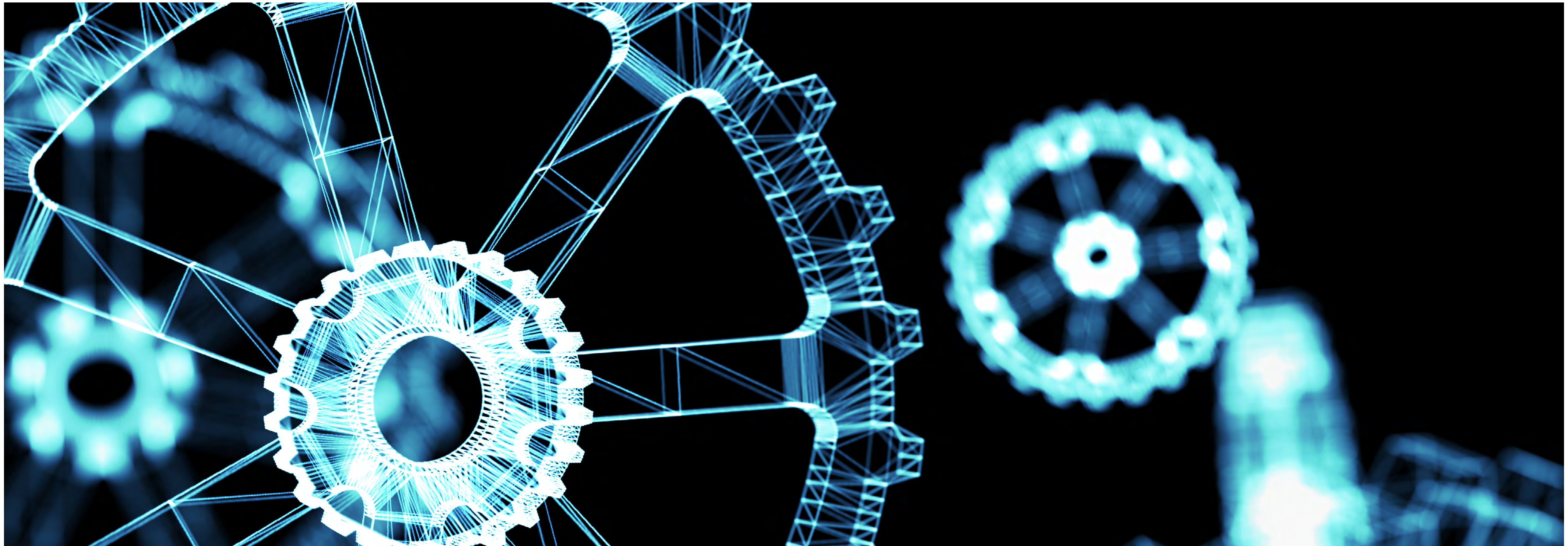
The manufacturing industry is in the midst of what many have coined as the Fourth Industrial Revolution – a digital coming-of-age for an industry with heavy roots in a low-tech era long past. The recent adoption of mobility strategies into core business operations is helping manufacturers support unprecedented business demands due to evolving customer expectations from today's digital world, the explosion in e-commerce and advancements in IoT that are driving critical efficiencies and cost savings.

Having a strong mobility strategy is now more important than ever for manufacturers given the rise of IoT adoption, augmented reality (AR), artificial intelligence (AI) and an increasingly connected (and robotic) workforce on the factory floor.

UNPRECEDENTED GROWTH OF IOT

The number of connected devices across industries is forecast to increase to an estimated 8.4 billion devices, up 31% from 2016. In manufacturing specifically, Verizon research recently found an 84% boost in IoT network connections between 2016 and 2017, surpassing any other industry, including transportation, energy and even healthcare, by more than 100%. In 2017 alone, the manufacturing industry invested an estimated $183 billion in IoT, again outspending both the transportation and utilities industries. In the year ahead, IoT platforms will become more and more seamless, streamlining the deployment of IoT applications, which will continue to make in-roads into the enterprise. Securely collecting, analyzing and integrating data will continue to be enterprises' most critical concern.

This comes as no surprise as sensor data and connected manufacturing devices, which measure and analyze real time data, offer a wealth of information for control rooms – one of the main benefits being predictive maintenance or signaling future machine maintenance needs before an alarm sounds or issue arises. Predictive maintenance is crucial for maintaining schedules, reducing downtime, cutting costs and keeping production humming.



BRINGING THE SMART FACTORY TO LIFE ONE SOLUTION AT A TIME

Technological advancements have transformed the factory floor as we know it – and for the better. AR and AI solutions driven by mobility are gaining steam in manufacturing. These technologies are helping manufacturers with complex assembly, increased automation of the work floor and improved quality assurance. From smart glasses that overlay computer-generated video or graphics onto machinery for repairs, or factory robots that learn how to complete tasks via machine learning, it's anticipated that AR and AI deployments will soon be accelerated across the industry. In fact, futuristic technologies are already being integrated into manufacturing floor operations. For example, a recent GE trial of smart glasses for wiring tasks found that AR headsets improved worker performance by 34% on the first use.

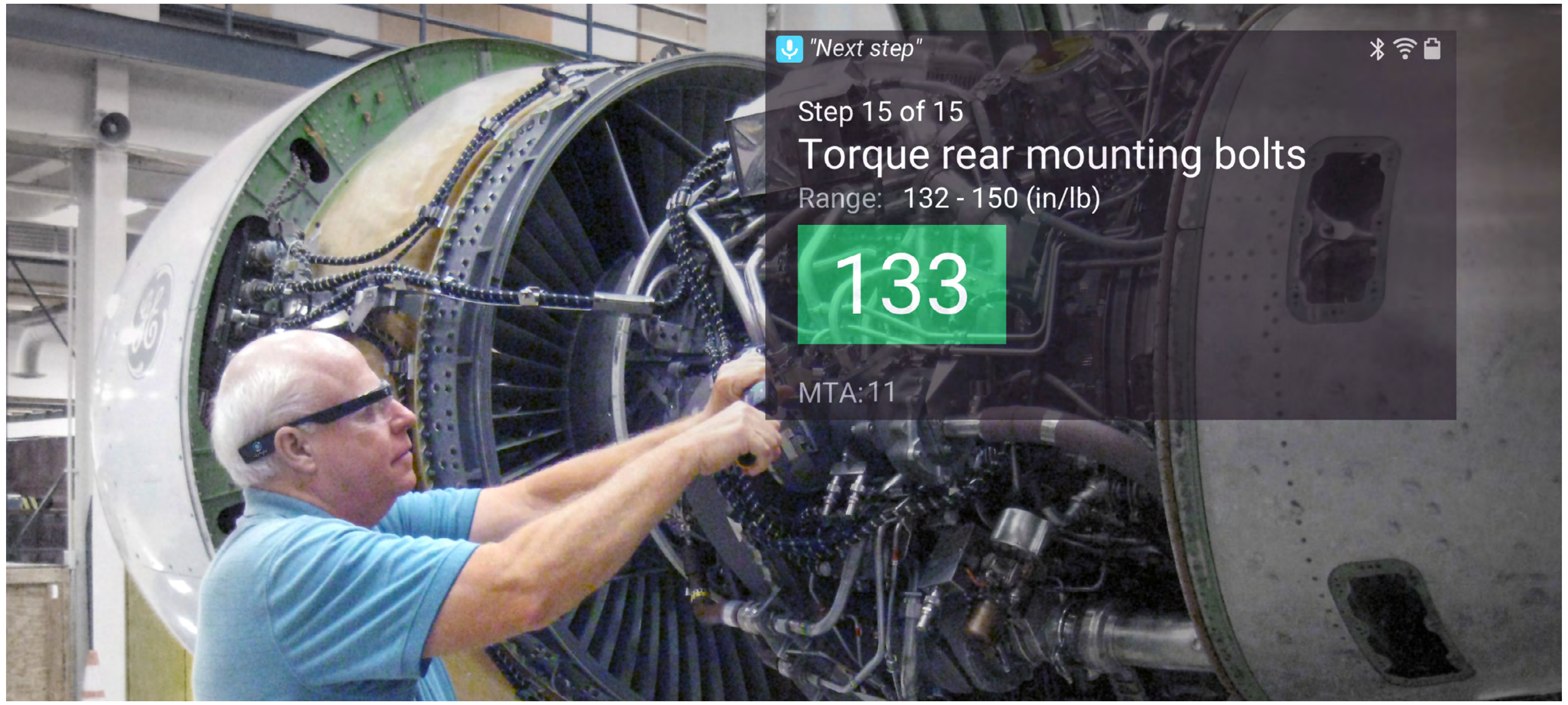
The introduction of robotics to manufacturing has also created new possibilities and adoption is soaring, with 1.3 million industrial robots expected to join factory workforces by 2018. These skilled robots are able to take on an increasing number of technical jobs, freeing up human workers for safer, more complex jobs on the floor. Though this has created some concerns with workforce advocates, a recent McKinsey study found that less than 5% of careers would be completely eliminated, and instead robots and humans would work side-by-side in a complementary fashion.

POWERING THE FACTORY OF THE FUTURE NOW

The influx of technology and automation in manufacturing has brought never-ending changes to the industry, but enterprises must ensure the correct infrastructure is in place to support these high-powered machines and devices.

On one end, mobility is fueling an emerging theme among manufacturers known as "hyper-convergence" or systems that combine mobile connectivity, compute, hybrid cloud orchestration, and security into all-in-one virtualization solutions. These hyper-converged technologies manage the endless stream of data flowing through facilities and are easy for IT teams to operate. For manufacturers to take the next step and create a customer-centric digital supply chain, they need to create systems of connectivity, compute power, servers, converged edge applications and IoT systems that link the customer to the inside of the four walls control systems to suppliers and product designers.

The future manufacturing vision will include a network of interdependent networks keeping these technologies online and connected to multiple end points – and all securely. As the manufacturing industry continues to undergo digitization, having an agile and flexible network in place is crucial for success. A network infrastructure with the capacity to support fast, secure processes - whether for robotic arms, VR headsets or tablets on the factory floor - can help protect workers, prevent delays and enable a steady stream of production. Ultimately, these network-enabled, mobile technology solutions will be instrumental in evolving an industry with a strong heritage in society and the economy, into the factory of the future.



Overall, GE has found that workers complete tasks 15% faster using AR glasses, solution provider Upskill says. (source: Upskill)

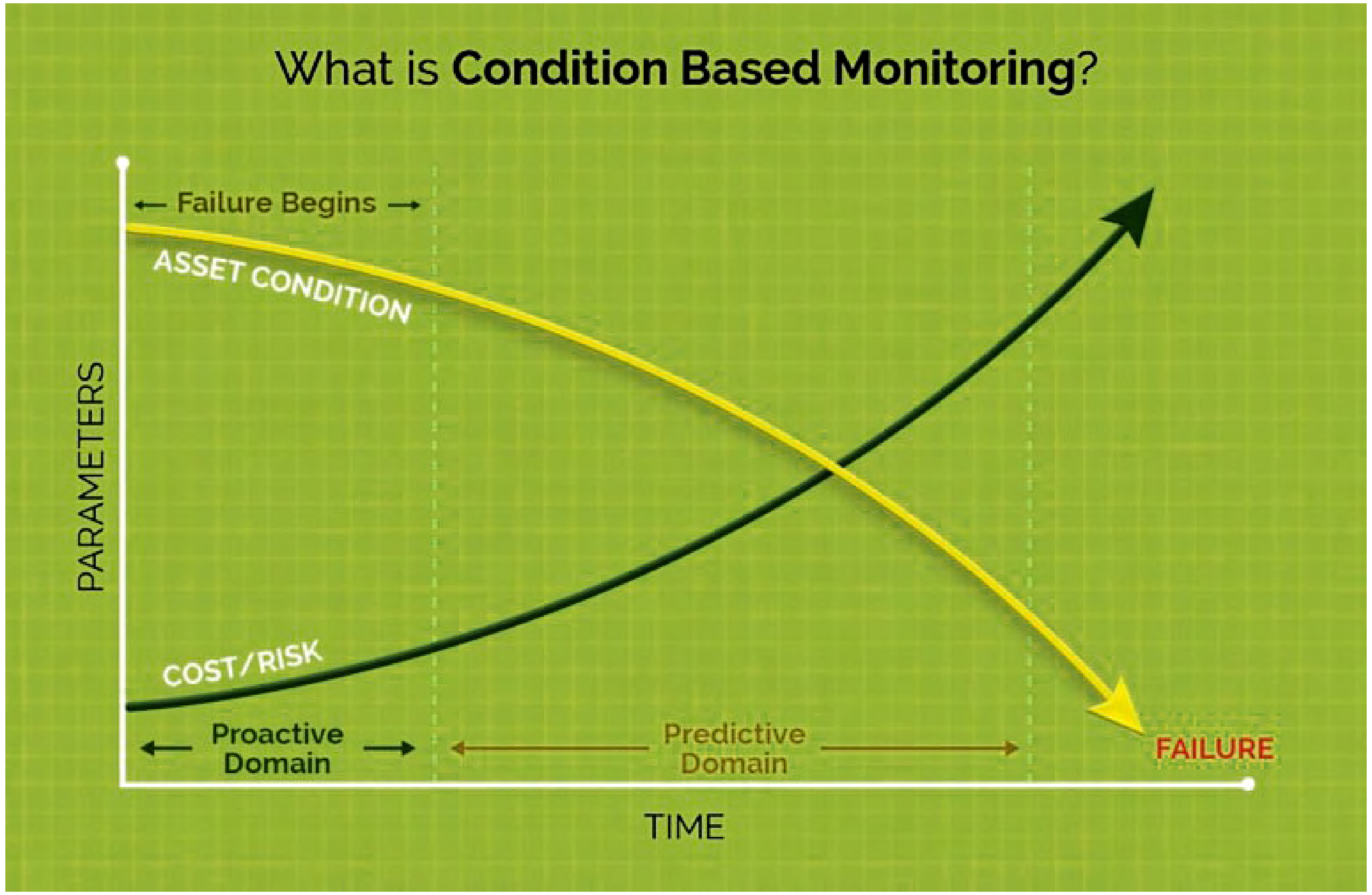
Collaborative robots such as Rethink Robotics' Baxter are meant to work side-by-side humans, not replace them. (source: Rodon Group)

Michael Kotelec is a global practice leader with Verizon Enterprise Solution's manufacturing vertical practice.

5 STEPS TO ACHIEVE DATA TRANSPARENCY AND EFFICIENCY

Achieving success with the IoT: A study in production quality.

VINAY NATHAN



Based on the root causes highlighted by the IoT solution, the company could meet a project charters objective for quality improvements. Following the results of a pilot test in one plant, the program was expanded to 12 plants. The company saw a 10% reduction in defect degradation and was able to reduce delivery delays by 8%. The pilot project payback (deployed across a single line) has been realized in less than 15 months. In the end, after three years, the implementation will add millions in profit to the bottom line.

In today's industrial settings, there's a huge push for digitalization of factories. Such digitalization isn't a preference; it's imperative to future competitiveness and survival. Why? Most manufacturers lack real-time visibility into machines, assets, and factory operations. This deficit limits a manufacturers' ability to make informed, data-driven decisions. Instead of spending quality time in strategizing for better output based on predictions, most managers spend time reacting to situations, finding root causes, and offering retrospection.

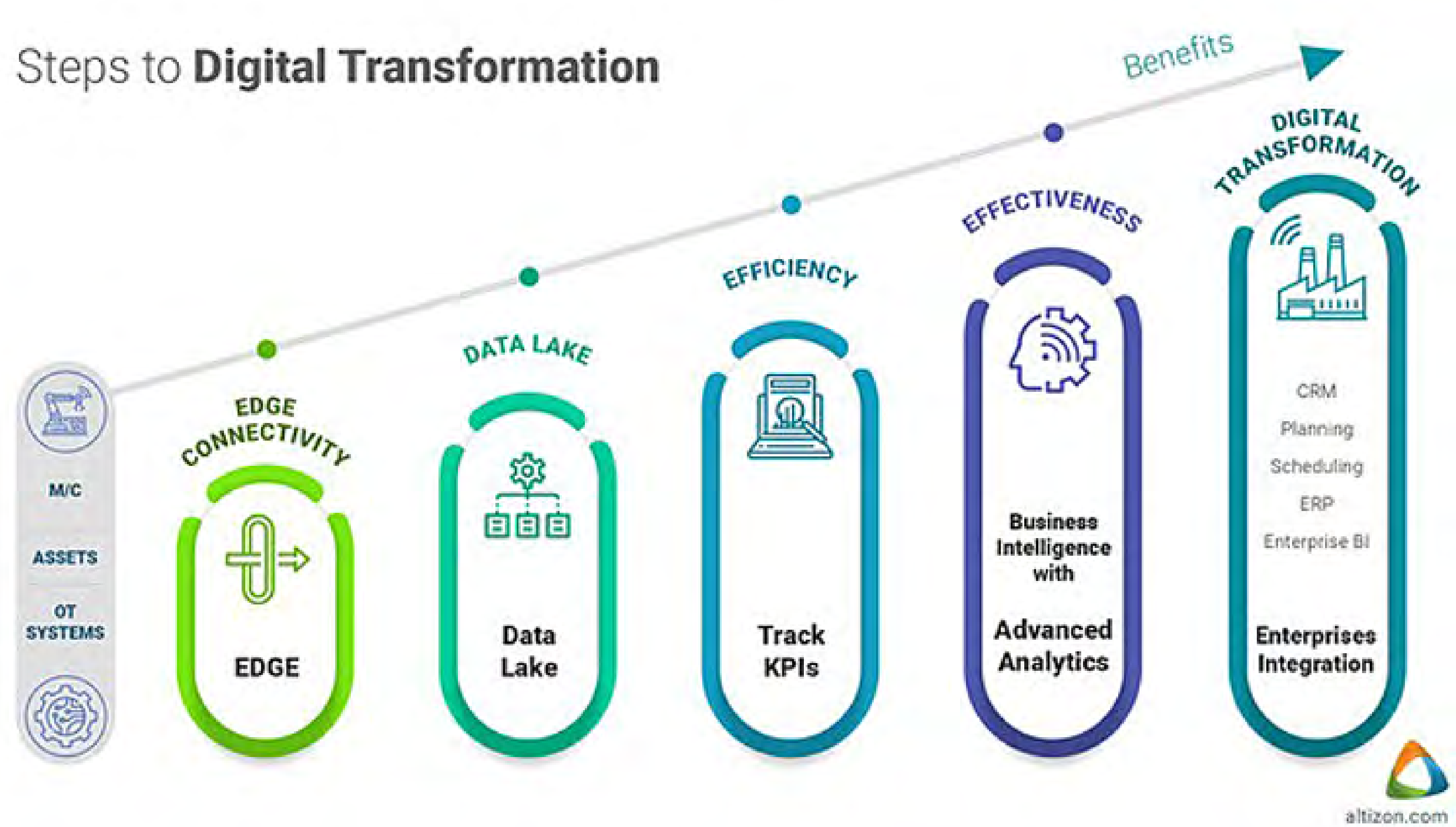
The solution is to consolidate machine data and make it available in real time, where edge machines talk to business decisioning applications, such as enterprise resource planning (ERP) and Business Intelligence (BI). This is possible if all the hardware and software in factories are connected and communicate (exchange data) with each other.

WHY THE IIOT MATTERS

The Industrial IoT enables industrial companies to obtain a heightened level of intelligence for improving their business and financial performance. A primary driver of business improvement in today's modern factory, a.k.a. Industry 4.0, is better intelligence through machine data. In turn, these insights can translate into widely accepted business goals, including reducing costs, boosting production, and improving efficiencies. For companies with factories ranging from tire makers to toothpaste producers, the alignment of the IIoT maps directly to their financial goals—and thus, improvements to the bottom line. In the end, achievement of these goals sustains the rationale for continued investments in the sensors, software, and systems that comprise the IIoT.

To work toward the greater goal, the IIoT requires data from across various silos and from different networked system levels such as the edge, the factory floor, the fog (where local data resides), and the cloud (where data is stored off site). All these system levels connect to feed data into a central point (dashboard) that must be highly accessible and up-to-date in real time.

To progress to this point, machines on the shop floor and various other places in the field must communicate with one another seamlessly for rich data output. Machines must either be upgraded or swapped out for ones that connect and "speak" to one another. In most cases, retrofitting is a more viable option than replacing.



CASE STUDY: PACKAGING FILMS MANUFACTURER

A large company in India is a leader in manufacturing packaging films. It undertook an IoT pilot project to reduce quality degradation incidents. Previously, it had been constantly evaluating possible causes for quality defects, as well as monitoring for issues such as faulty gauges, operation errors, incorrect machine settings, and composition of input parameters through a sampling-based statistical quality control and total quality management (TQM) techniques. Still, they couldn't fully identify the real root causes due to limited real-time data and non-standard products.

The company turned to IoT technology to capture and show machine data and quality management system data in a time series. The system had to feature a flexible intuitive data analytics framework that was supported by data science applications. The IoT solution established the correlation between the quality of the films produced and the corresponding machine settings at that time.

Utilizing real time machine data, the company's IoT system acted effectively to map anomalies to quality defects using support vector machines, performed machine learning (ML) -based algorithms, and established a condition-based monitoring (CBM) application to narrow down to two critical parameters (out of 30-plus potential parameters) that caused quality degradation. Using all the data, the company established a baseline to work from.

Based on the root causes highlighted by the IoT solution, the company could meet a project charters objective for quality improvements. Following the results of a pilot test in one plant, the program was expanded to 12 plants. The company saw a 10% reduction in defect degradation and was able to reduce delivery delays by 8%. The pilot project payback (deployed across a single line) has been realized in less than 15 months. In the end, after three years, the implementation will add millions in profit to the bottom line.

Does IoT sound interesting now for your manufacturing business? Here are five steps to achieve significantly improved levels of data transparency and efficiency:

1. Build edge connectivity. Use common connectivity protocols, such as OPC-UA, Modbus, Ethernet, and Profinet so that your edge machines/devices can quickly connect to a common network or cloud network. Lean toward intelligent edge connectivity that's capable of light analytics, decision making, alerts, and notifications.

2. Create a manufacturing data lake. Collect data from machines, existing SCADA and DCS systems, enterprise data historians, and manufacturing execution systems (MES) into a single repository. Gather all data into one place.

3. Track KPIs that are relevant to your plant operations. With real-time stream of data incoming, track performance indicators such as overall equipment effectiveness (OEE), capacity utilization (CU), and machine downtime analysis.

4. Leverage Business Intelligence (BI). Build systems to establish benchmarks and create customized reports that track the KPIs that are relevant to you, then share them with your team. Leverage power of analytics to predict what may happen. Establish correlation models and use alerts and notifications to drive informed business decisions.

5. Integrate. The true power of manufacturing intelligence is when that machine data and enterprise systems data interacts with each other. Use IoT to integrate your operational technology data with your enterprise IT systems such as ERP, CRM, and enterprise planning and scheduling systems. Custom adapters are available via APIs.

FROM REAL-TIME VISIBILITY TO PREDICTABLE FUTURE

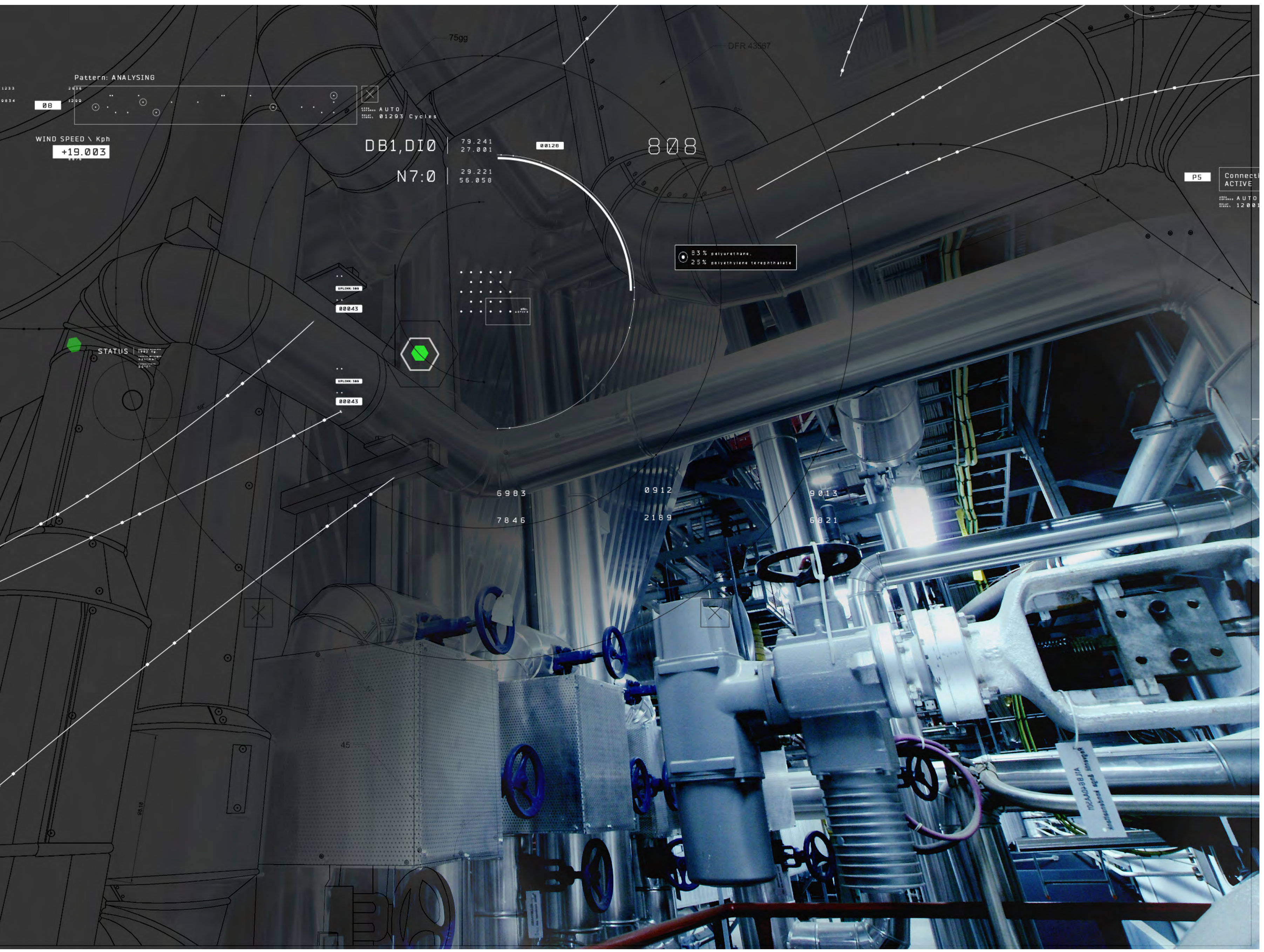
By connecting machines and collecting data, organizations can gain real-time visibility into factory operations. With real-time time series data, they build a great manufacturing data lake. Using big data and machine learning, manufacturers can build a predictive model and derive the real benefits from digitalization. These include optimized energy use and a better read of how your organization is using its resources. For manufacturers that have made the jump, this is not just another IT transformation: It means a quantum leap forward in improvement—and to the bottom line.

Vinay Nathan is co-founder and CEO at Altizon Systems, the Industrial IoT Company. He is a strategic business leader with 15+ years of global expertise in corporate sales and engineering. He specializes in the Industrial Internet of Things (IIoT), including sensors, big data analytics, and edge computing.

INTEGRATING LEGACY DATA INTO IOT INITIATIVES: THREE METHODOLOGIES

BY JEFF BATES, DIRECTOR OF PRODUCT MANAGEMENT, KEPWARE

Today's factory floor is a melting pot of equipment, with the newest machines relying on technology that didn't even exist when the oldest machines were built.



Integrating data from different machine generations can be a huge challenge, but is vital to optimizing the plant floor and creating an effective Internet of Things (IoT) ecosystem. Legacy equipment contains valuable data, but most legacy tools weren't built for seamless data access. In fact, some legacy equipment was specifically structured to prevent direct integration for security reasons.

In 2016, an IDG Research Survey found that 64% of senior IT manufacturing executives said that integrating data from disparate sources in order to extract business value from that data is the single biggest challenge of the IoT. Data integration has been a challenge for IT and Operations teams for years, but IoT makes the need for integration more urgent—and more challenging.

For more than 20 years, Kepware has been helping customers access their industrial data in order to extract meaning and value from that data. In that time, we've seen the benefits and drawbacks of different approaches to incorporating legacy equipment into IoT initiatives. These are the three main approaches—and their key benefits and potential trade-offs—that manufacturers have traditionally taken (and will continue to take) when integrating legacy tools with their IoT initiatives.

APPROACH 1: RIP-AND-REPLACE

A "rip-and-replace" approach involves fully scrapping

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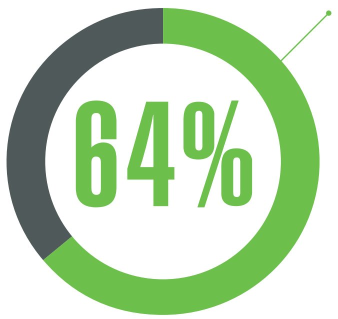
legacy equipment and replacing it with modern, IoT-enabled machinery. It is often attractive in theory (who wouldn't want the best and most efficient equipment across the plant floor?), but in practice can be hampered by time sinks and budget restrictions. Sourcing activities (such as developing RFPs and vendor negotiations), uninstalling current equipment, installing new equipment, ensuring appropriate vendor support during the installation phase and re-training employees are just a few of the challenges inherent in this approach. Combined with the cost of new equipment, rip-and-replace is often unrealistic for most organizations. However, replacing outdated assets ensures an organization can reap the benefits of the most up-to-date technology, including improved performance, lower power consumption and readiness for next-gen features, such as augmented reality (AR).

A large-scale rip-and-replace also has ramifications beyond the plant floor. Investing in this option may require an organization to forgo other lucrative investments. On the other hand, the benefits of enterprise-wide visibility into operational KPIs may be enough to make it worthwhile. So if the immediate cost and time concerns can be overcome, this approach can be lucrative over the long-term as it creates an efficient, future-focused factory.

APPROACH 2: BEST-OF-BREED THIRD-PARTY SOLUTION

Also referred to as a "retrofit" or "wrap-and-extend" solution, this method involves using third-party, IoT-ready connectivity solutions—such as OPC servers, IoT platforms, IoT Gateways and sensors—that extend the capabilities of legacy equipment. A Best-of-Breed approach enables communication to the legacy protocols used by the equipment (or by the equipment's components), such as PLCs, control applications and embedded sensors. It can also involve adding sensors that directly measure KPIs and make this data accessible to the IoT. Best-of-Breed solutions are IoT-ready and reach beyond the plant floor to provide visibility into operational data for the entire enterprise.

The impact of a best-of-breed third-party solution on the enterprise as a whole depends on how the data is used. By gathering integrated data from both legacy and modern machines, this approach has the potential to enhance decision-making at all levels of an organization, and includes the added benefit of being extremely customizable to different needs.



OF SENIOR IT MANUFACTURING EXECUTIVES SAID THAT INTEGRATING DATA FROM DISPARATE SOURCES IN ORDER TO EXTRACT BUSINESS VALUE FROM THAT DATA IS THE SINGLE BIGGEST CHALLENGE OF THE IOT.

– IDG Research, 2016

One drawback to this approach is that it often requires factories to upgrade their networks. Best-of-breed third-party solutions are capable of collecting huge amounts of data, and the bandwidth necessary to transmit that data can result in extra costs. Edge-based processing—which enables down-sampling or summary analytics before the information is sent to an IoT solution—can help mitigate this issue. A best-of-breed approach can be beneficial for organizations that need to integrate legacy equipment quickly and efficiently.

APPROACH 3: IN-HOUSE SOLUTIONS

In-house solutions are typically created by internal personnel using internal technical resources, and are fully supported in-house. An in-house approach ensures that an organization's specific, unique goals are met. And because the organization has direct control over its resources, technicians are more likely to be readily available to make changes. However, there may be more demands on the in-house IoT-support team than they can meet in a timely manner. They will be responsible for bug fixes, troubleshooting, training, product improvements and maintenance. This might not seem like much at first, but can add up over the lifespan of an IoT solution.

In addition, after a legacy asset is connected, that data needs somewhere to go. Collecting data is one challenge, but displaying it, analyzing it, or otherwise turning the data into actionable intelligence in a timely and useful manner is a whole other issue. Technicians that are experts in both connectivity and IoT application development are hard to come by. And if your lead technician were to leave the company, could you find a suitable replacement?

WHAT APPROACH WORKS BEST FOR YOU?

Each of these approaches can serve to optimize data access for an organization. But, the best approach will almost certainly involve working with a myriad of IoT solutions and vendors, bringing some internal resources to bear and replacing some equipment. For example, instead of full rip-and-replace, you might replace just some outdated equipment while keeping other legacy equipment and incorporating plug-and-play sensors—taking the best of different approaches to fit your business needs. Striking the right balance will involve considering the specific goals of your organization and making strategic trade-offs, with a focus on staying competitive and efficient into the future.

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ABOUT KEPWARE

Kepware, a software development business of PTC, provides software solutions to overcome the connectivity gaps between diverse industrial automation devices and applications. Kepware's market-leading solutions are used by thousands of customers worldwide. Kepware provides a portfolio of software solutions that connect industrial automation devices, machines, and software applications to enable the industrial Internet of Things (IoT) for customers in Manufacturing, Oil & Gas, Building Automation, Power & Utilities, and more. PTC and Kepware are at the forefront of the connected, digital transformation that is redefining how companies create, operate, and service products. With support for both legacy and IoT-ready manufacturing technology, Kepware connectivity is a key component of any smart, connected factory.

KEPServerEX—Kepware's single-source data connectivity solution—is the industry's leading OPC and IT-centric data connectivity software. KEPServerEX enables users to connect, manage, monitor, and control diverse automation devices and software applications through one intuitive user interface—providing a single source of real-time industrial data to power decisions across the enterprise.

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