

Mastering smart factories

The future of manufacturing is waiting for those who can scale their efforts

Smart factories have the potential to deliver huge benefits. However, only a minority of companies are taking action to seize the opportunities. Multiple factors may prevent the acceleration of smart-factory initiatives, so it is time for companies to identify those issues and create a roadmap to achieve success.



Smart factory explained

Smart factories leverage digital technologies to gain significant improvements in productivity, quality, flexibility, and service. Three key technologies enable the smart factory:

1. Connectivity: Leverage IIoT to collect data from existing equipment and new sensors
2. Intelligent automation: Advanced robotics, machine vision, distributed control, and drones all deliver more automation opportunities
3. Cloud-scale data management: Data is the key to implementing predictive analytics and artificial intelligence (AI).

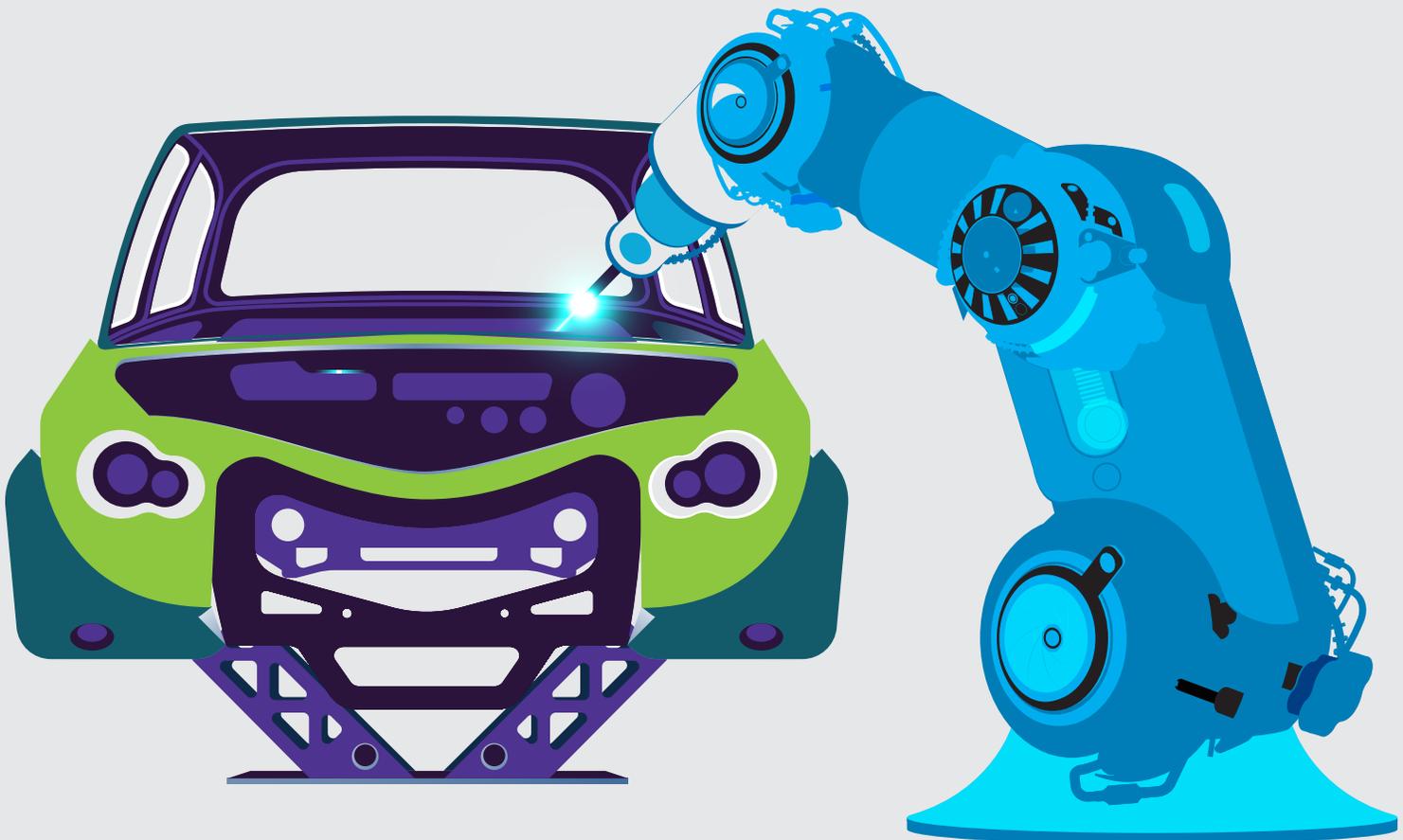
The three digital technologies work together to enable the convergence of information technology and operational technology (IT-OT) to ensure end-to-end digital continuity. Smart factories provide a closed-loop, data-driven optimization of end-to-end operations. The ultimate goal is to reach autonomous operations, in which the factory constantly adapts to demand, variations in supply, and process deviations.

Investing in smart factories

According to the Capgemini Research Institute's *Smart Factories @ Scale: Seizing the trillion-dollar prize through efficiency by design and closed-loop operations*, nearly 70% of manufacturers are investing heavily in smart factories and continue to increase their annual spend. But only 14% said they would characterize their smart-factory deployments to date as a success.

The major challenges that impede success are:

- Deployment and integration of digital platforms and technologies
- Data readiness and cybersecurity
- Hybrid and digital capabilities
- Leveraging data to continuously improve operations
- Vision, leadership, and transformation
- Being efficient by design.



Becoming a smart-factories master

The research shows only 10% of companies are in a position to realize the benefits of smart factories. Here is how you can become a master:

1. Command your technology

- IT-OT convergence capabilities must include the adoption of digital platforms and technologies while delivering data readiness and cybersecurity.
- Deploy efficiency by design to optimize the production process via simulation and visualization tools before physical production has begun.
- Operational excellence will leverage data and advanced analytics to reach closed-loop and, ultimately, self-optimizing operations.

2. Transformation mastery

- Vision and leadership to back a concrete plan to implement and execute
- Use hybrid and digital capabilities to address the need for talent with digital, soft, and hybrid skills and the upskilling of current employees.
- Smart factory leaders are better at getting to scale and realizing the benefits.

Accelerating smart-factory transformation

1. Design a strong governance program, metrics, and methodologies to assess progress

- Assign and adjust roles and KPIs to transformation objectives
- Design metrics and methodologies to track the success of the initiatives
- Monitor progress and ensure objectives are realized
- A strong governance program will help translate vision into reality

2. Develop a program for deploying and integrating digital platforms and technologies

- Make an enterprise transformation possible, rather than taking a narrow view
- Focus on deploying integrated manufacturing platforms which can work across factories

- Choose solutions that will provide visibility into enterprise-wide data, such as cloud
- Develop a hybrid architecture which supports both short- and long-term capabilities

3. Develop a culture of data-driven operations

- All smart-factory initiatives have one underlying, critical component: availability of the right data
- With the number of sensors increasing, data volumes are only going to grow, and companies need clearly defined ways to manage the data explosion
- Store, retrieve, and analyze data at the required granularity
- Make data visualization and analytic tools available
- Establish a data governance framework

With a complete vision and comprehensive roadmap for the smart-factory journey, you can:

- Focus on building efficiency by design in all areas, right from product design
- Strive to achieve operational excellence through closed-loop operations
- Ensure there is consistent feedback between the design process and operations
- Drive IT-OT convergence while ensuring proper data availability and strong security policies
- Develop hybrid, soft, and digital skills.

Smart factories are the future of manufacturing, with benefits across the value chain. Now companies need to learn how to scale their initiatives to gain the biggest rewards. Companies must strengthen their foundations by incorporating efficiency by design and achieving operational excellence through closed-loop operations.

Schneider Electric's first smart factory in the US has tracked quantifiable benefits from its IIoT implementation, including a 20% reduction in mean time to repair and a 90% elimination in paperwork.

Smart factory advice from the frontrunners

“The plan is to incorporate smart-factory technologies in all of our plants eventually. But, we are piloting different technologies first, leveraging our global network of plants to learn the technologies and the use cases.”



Martin Widsing
Senior Manager – Virtual Methods and IT
Volvo Cars

“Without good-quality data, even ERP systems become unreliable. If the data does not have the proper structure – and lacks details such as the use of material and dates – you cannot really make use of ERP to improve your operations.”



Juha Ehrola
Director of Operations Development
Valmet

“There are three primary reasons why we took up the smart-factory initiative. The first is to improve the productivity of our old factories through modernizing and digitizing their operations. The second is to deal with the quality issues that are difficult for human beings to detect. And the third is to incorporate made-to-order or mass-customization capabilities.”



Dr. Seshu Bhagavathula
President, New Technologies and
Business Initiatives
Ashok Leyland Group

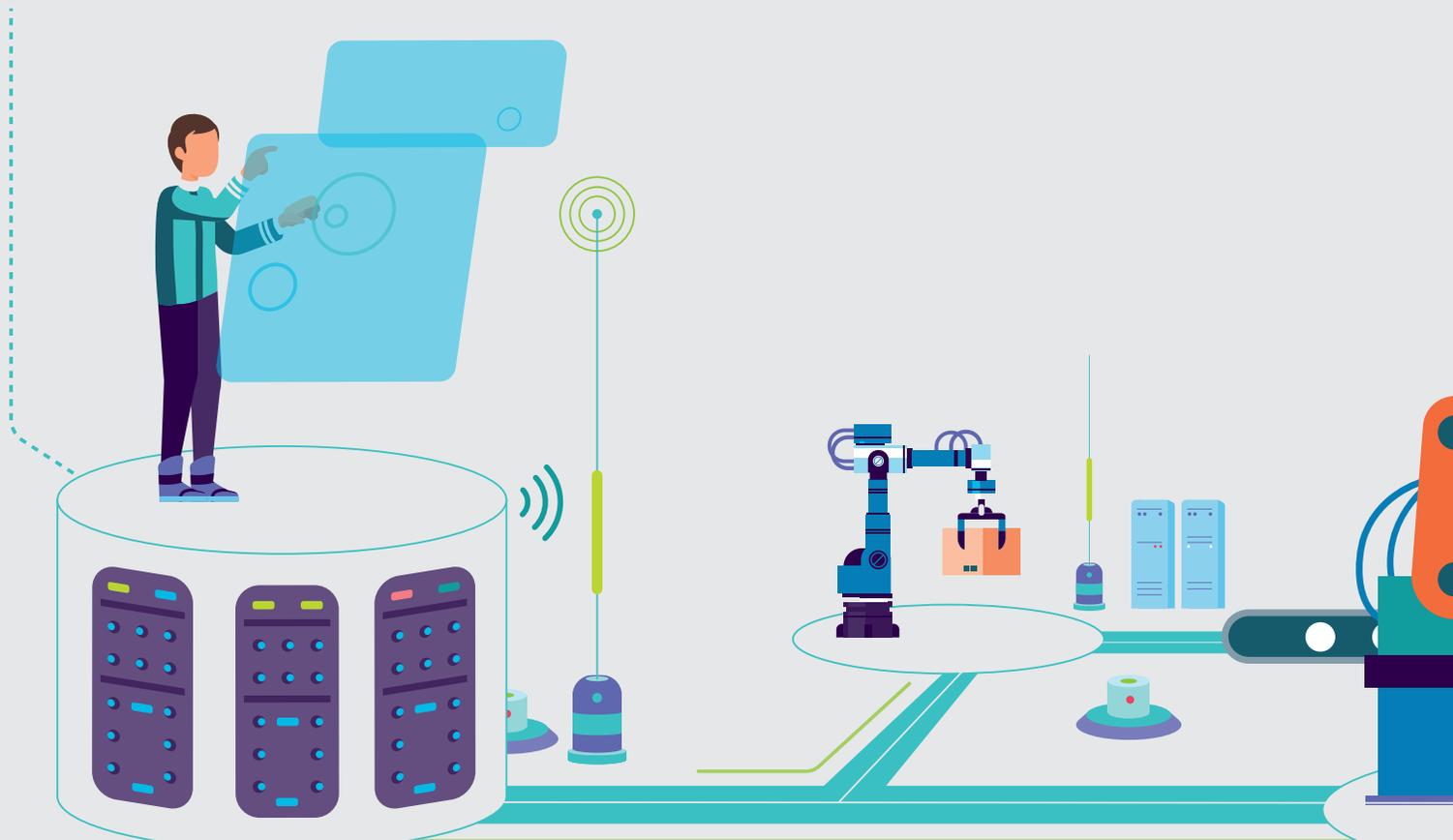
“Supervisors or managers who have worked in the shop-floor environment for a long time can typically judge a situation and take decisions based on that. However, this hampers efficiency. If integrated data is available to them, they will be able to take better decisions that will enhance efficiency.”

Nitin Dharmadhikari
Deputy GM
TATA MOTORS



Aging workforce leaves manufacturers exposed to knowledge deficit

Baby boomers have a lot of corporate knowledge, and they are retiring in increasing numbers. Technology can help keep this know-how within the company, but time is running out to execute a knowledge-transfer plan.



Every manufacturer is facing the same issue with their workforce: baby boomers are retiring, and their acquired knowledge will disappear when they leave.

You cannot stop the inevitable. Operations, maintenance, and engineering will all be affected. The person who knows by listening to a conveyor belt that something is wrong or by looking knows the color of the product is incorrect is going to retire.

It is already too late to extensively train the next generation to take over. It is not possible to initiate the 10-year overlap now that is required for the younger generation to absorb the skills of the older one. But you do not need to lose their valuable expertise, because technology can help before the retirement party starts.

Some issues, like maintenance and quality, can be addressed with technologies such as artificial intelligence, machine learning, Industrial Internet of Things (IIoT), and deep-learning applications. But these cannot solve everything.

And as the industry moves to smart factories, the skills gap will increase. According to the Capgemini Research Institute's *Smart Factories @ Scale: Seizing the trillion-dollar prize through efficiency by design and closed-loop operations*, companies are hampered by a shortage in the specific skills required for smart factories. These initiatives are not just pure technology transformation but involve hybrid or cross-functional skills, soft skills, and digital skills. This makes gathering the information on your shop floors even more imperative.

The process of filling the gaps starts with finding the right Subject Matter Expert (SME) to put at the center of your manufacturing. Once that person is in place, you gather all of the necessary details and network with every site which could benefit from the knowledge. Information can be provided on a dashboard to any of your facilities, no matter where they are in the world.

It is then the job of the SME to connect to people to ensure knowledge is shared. Imagine an augmented-reality situation that allows the SME to be in one location and provide local people with remote instructions on how to fix an issue. That expert may fix in 60 minutes a problem that would keep an assembly line quiet for a day or two while less-experienced people try to diagnose the cause of the breakdown.

The value of the SME solution is enormous, but it requires preparation to identify SMEs and the number of relevant sites and then deploy a network solution. The SME has to reside in a factory, versus being located at the HQ, so they can stay in contact with the reality of the shop floor and keep learning.

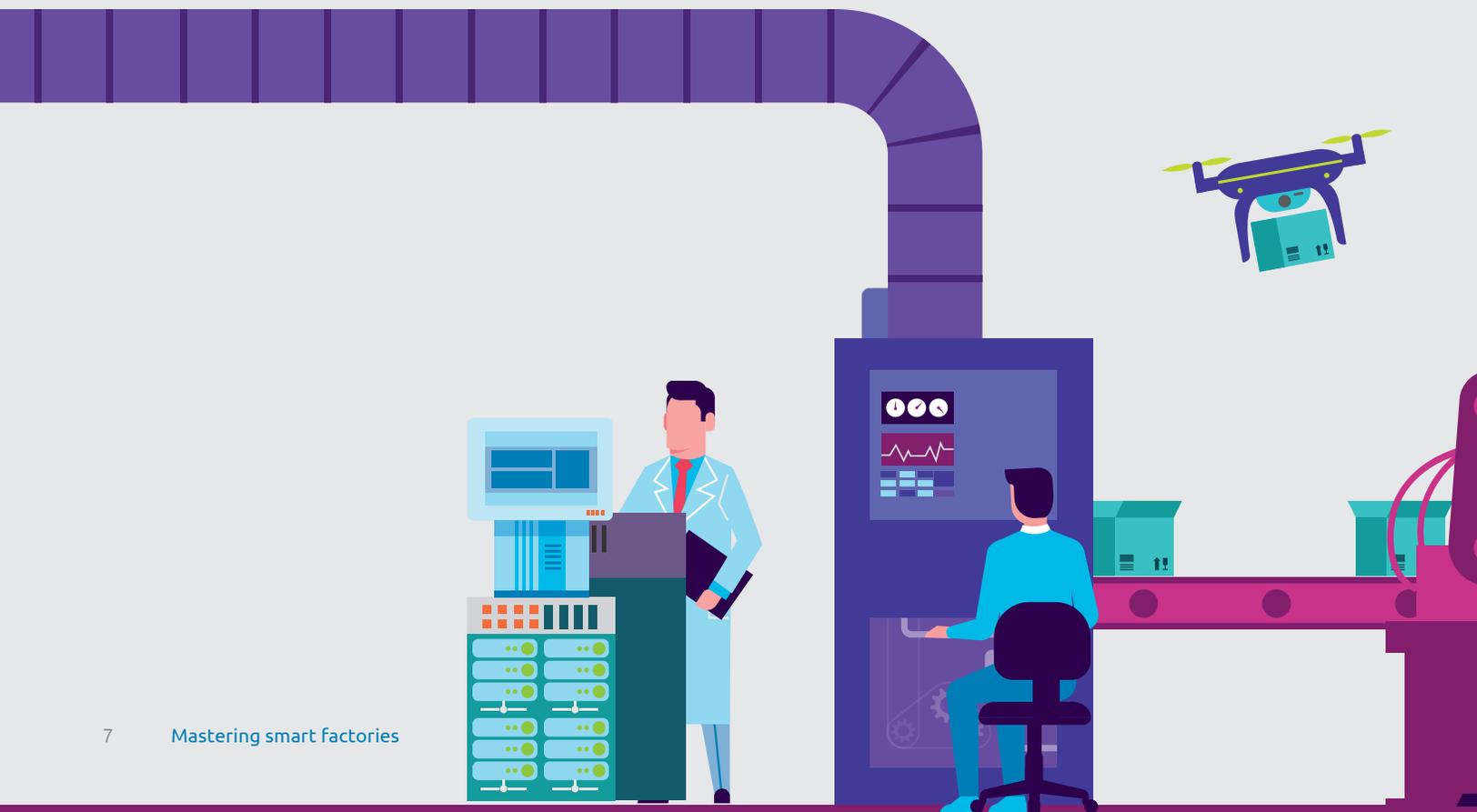
This preparation is also a perfect opportunity to review processes at different locations and determine which ones should be adopted as best practices by all facilities. Your employees have valuable insights into the business, and you should leverage what is already inside your organization. By finding these best practices and rolling them out, manufacturers usually achieve greater payback.

But time is running out. When your employees retire, the opportunity is lost. You do not want to find yourself with a knowledge deficit once your assets have left the building.



Encountering resistance to digital manufacturing projects? You need to push through

Change is hard, but only by moving forward with digital-manufacturing initiatives do you get value from new technologies. Delaying projects may put you at a competitive disadvantage.



Sixty percent of global manufacturers will rely on digital platforms, which in turn will support up to 30% of their overall revenue by 2020, according to IDC. These companies are looking to new digital technologies such as cloud, mobile, big data, analytics, and IoT. These promise to create significant business value and the agility manufacturers need in the market.

Change, however, always brings out the skeptics. The impulse to stay the same can be tempting but, as technology and new entrants disrupt every industry, manufacturers need to embrace the potential of new ways of doing business.

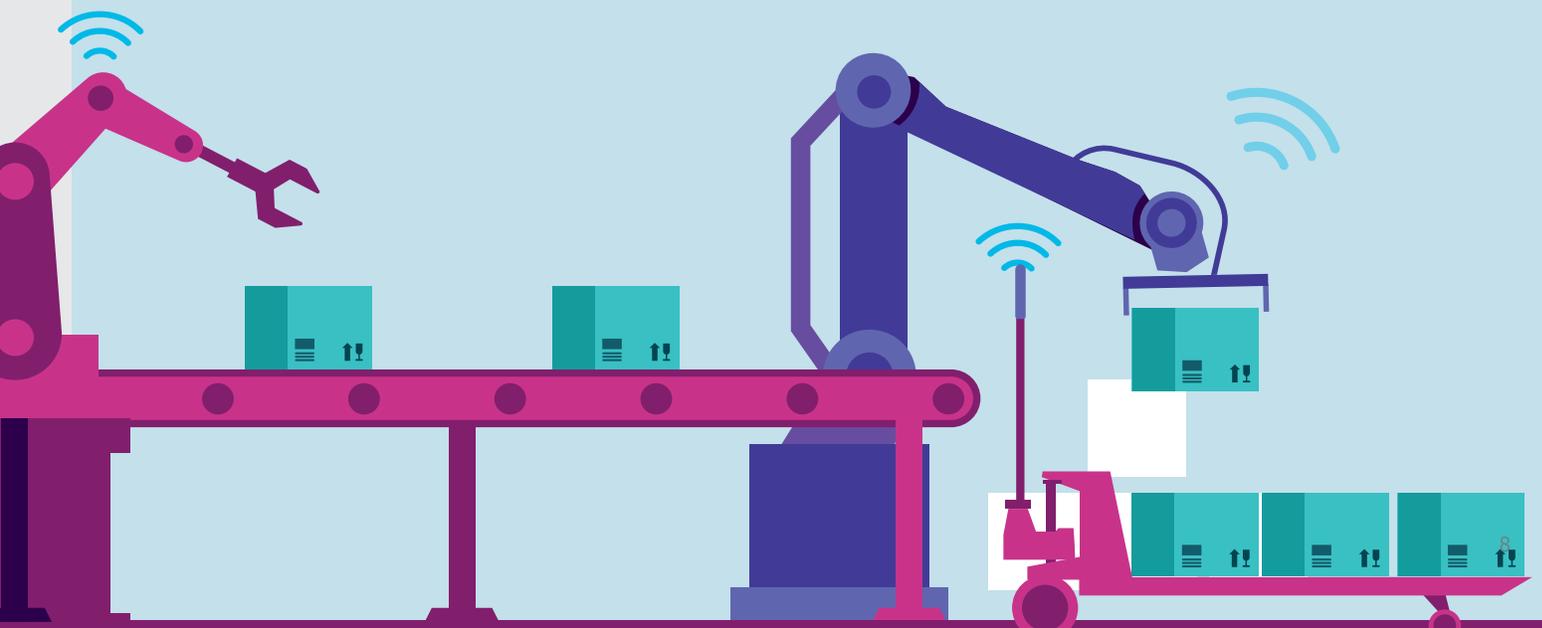
Here are the reasons you need to move forward with your digital manufacturing (DM) project:

- **Reduced inventory costs:** DM makes quality more consistent, so it reduces waste and rework. It also allows you to track inventory in real-time to avoid missing parts or ingredients when starting a new work order.
- **Plan capital expenditures:** Track and benchmark asset performance to find improvements before investing in new assets.
- **Quality improvement:** DM will increase the reliability of your warehouse picking, since it is able to select the right part and the right specs for a specific work order. Operators receive the WO in real-time and their performance can be measured against specifications and bills of material. Make sure qualified operators are doing the right job. And in the case of recalls, track and trace make it more efficient.
- **Reduce lead time:** Better quality will increase throughput and make sure all of the ingredients or parts are ready before starting a new WO. Electronic work instructions to operators avoids wasting time finding the right information.

- **Enable customizations:** DM provides the ability to connect your Product Lifecycle Management (PLM) system to the shop floor. It can also simulate a new BOM before production starts.
- **Regulation compliance:** The worst-case scenario is a recall, but track and trace capabilities ensure the process can be faster and more efficient.
- **HR resource management:** Your workforce is aging, and you need to capture the acquired knowledge they have before the retirement party begins. Digital technologies such as artificial intelligence and augmented reality have the power to capture this knowledge so you can retain it. It will also give you the ability to connect Subject Matters Experts (SMEs) to the organization from anywhere, so they can provide local support and keep production moving.

Greenfield projects often require investments to the tune of hundreds of millions of dollars. The cost of land, construction, electrification, and machinery can quickly add up. For example, P&G's greenfield smart factory in Cincinnati spans 485 acres and will cost \$500 million. And Audi invested more than \$1 billion into its greenfield smart factory in San José Chiapa in Mexico. In percentage terms, greenfield smart-factory initiatives are going to take up a significant share of revenues, especially in the small- to mid-size bracket, but those costs are easily outpaced by the efficiencies and savings listed above.

Inertia is as real in the world of business as anywhere else, and it is the enemy of progress in digital manufacturing. The benefits these systems deliver – reductions in cost and wasted time, increases in quality and customization, and the capture of invaluable institutional knowledge – are simply too extensive to sacrifice to old ways of thinking.



Manufacturers need to break free from pilot purgatory

Modern IIoT technology makes it easy for manufacturers to initiate and run pilots – but then the process dies. Pilots need to be more than just a project. They need to be tied to business outcomes in order to have any chance of real success at-scale.



The Industrial Internet of Things (IIoT) offers the promise of innovation, efficiencies, and cost savings. Manufacturers are talking about IIoT and conducting proofs of concept but, for most of them, the rate of progress has stagnated.

Nearly 70% of manufacturers are pursuing smart-factory initiatives, according to the Capgemini Research Institute report *Smart Factories @ Scale: Seizing the trillion dollar prize through efficiency by design and closed-loop operations*. The same report showed companies have already made one-third of their factories smart, and plan to transform 40% more over the next five years.

Manufacturers know they need to change their mindset in a market that is rapidly transforming. Products are commodities. It is no longer about making a certain widget but rather a focus on helping customers to also meet their critical objectives. As an example, should an electrical-motor manufacturer focus only on making units or also on helping the end-user gain uptime while lowering the cost of motor operation?

IIoT vendors make it easy to conduct pilots but they fall down on actually helping companies employ IIoT concepts on a daily basis. To break this cycle, manufacturers need to find projects with real business potential and then stick with them until they deliver.

This is not an isolated problem. Most manufacturers are on the pilot project treadmill and not getting anywhere. Before a pilot project can be successful, it needs to address four major issues:

1. Concentrate first on real business outcomes that will positively impact the company.
2. Assign an executive sponsor with a corporate view of the business outcome.
3. Invest the time, energy, and resources needed to explain to all the stakeholders involved in business outcomes why technology will help them in their daily job routine.
4. Address concerns about network and cybersecurity with IT stakeholders. There are potential IT and network risks but every door IIoT opens to a problem will be closed by good data and network governance.

Pilot projects will have challenges, but you cannot just give up. IIoT is a crucial technology to the future of manufacturing success. Going forward is the only way. Business outcomes need to align technology with goals and objectives. What is your strategy? How is it going to positively impact your business situation? You must develop a vision and prioritize your business goals. Is the company looking for monetary payback, or trying to mitigate risks?

Tangible business outcomes, the right executive sponsorship, and buy-in from other stakeholders will get a project to move beyond a pilot. Choose your stakeholders and executives carefully. Look for people who can own the business and talk to the people who will be impacted by the pilot. You will need to get support from stakeholders and someone to act as an IT facilitator, because you will need the technology required to deliver the business outcomes you want.

Pilots can no longer happen in isolation. They can bring a good idea forward but there needs to be follow through. Bringing in the right sponsors and stakeholder will give you a better understanding of the issue. What is good for one factory may not have the same impact on others in the company. If that is the case, you need to re-evaluate and find an issue that is shared across the organization and rely on the pilot as proof that it will work everywhere.

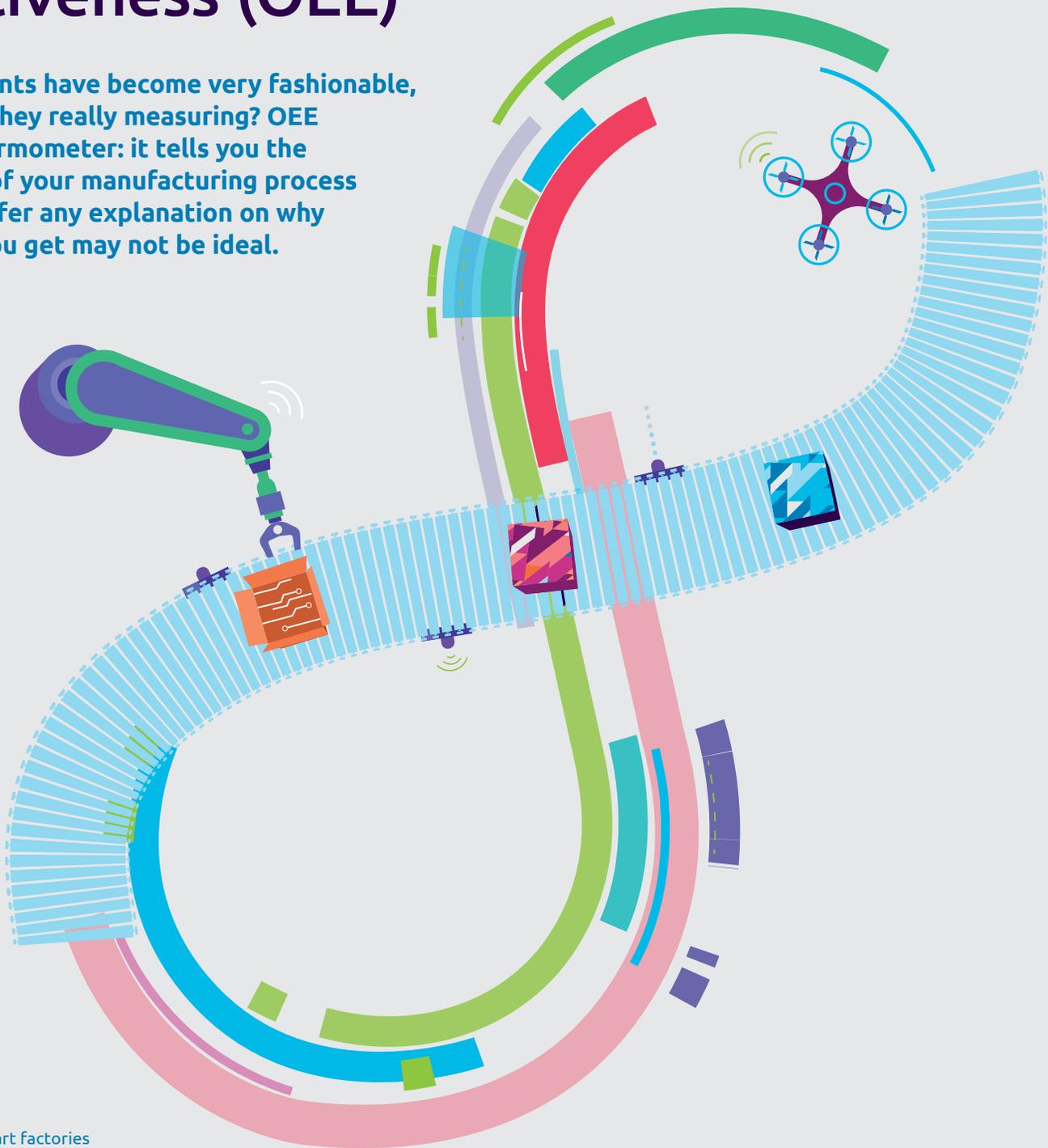
Frontrunners are gaining the competitive advantage. For example, Schneider Electric's first smart factory in the United States has tracked quantifiable benefits from its IIoT implementation including a 20% reduction in mean time to repair and a 90% elimination of paperwork.

The size of the smart factory prize is \$2 trillion, according to the Capgemini Research Institute report. Two-thirds of this overall value is still to be realized: efficiency by design and closed-loop operations will make equal contributions. Success is still elusive, with just 14% characterizing their existing initiatives as successful. There are multiple challenges to be overcome, including the need to scale pilots to achieve their full value.

IIoT has matured, and it is time for IIoT implementations to do the same. Move on from proofs of concept – it's been done, and the concepts proven. Now concentrate on long-term value.

Moving beyond Overall Equipment Effectiveness (OEE)

OEE assessments have become very fashionable, but what are they really measuring? OEE acts like a thermometer: it tells you the temperature of your manufacturing process but doesn't offer any explanation on why the number you get may not be ideal.



Overall Equipment Effectiveness (OEE) is a measure of how well a manufacturing operation is using its industrial assets, time, and materials compared to its full potential during regular operations. OEE began in the automotive sector and is now reaching other industries.

OEE has become very fashionable lately, but it is just one metric.

What Capgemini calls “real OEE” collects data and calculates KPIs electronically and automatically, instead of by hand. If the score is 80% or above, OEE will help to detect what is difficult to measure otherwise – events which occur very quickly but often. That could help to bring OEE to about 90% or more. In this scenario, implementing OEE by itself makes sense.

If, on the other hand, the OEE is below that benchmark, let’s say less than 70%, there is a high probability that larger problems exist. These should be solved first to deliver higher payback. By first analyzing the impact of OEE, we can identify technology that will deliver greater payback, change management, or a combination of the two.

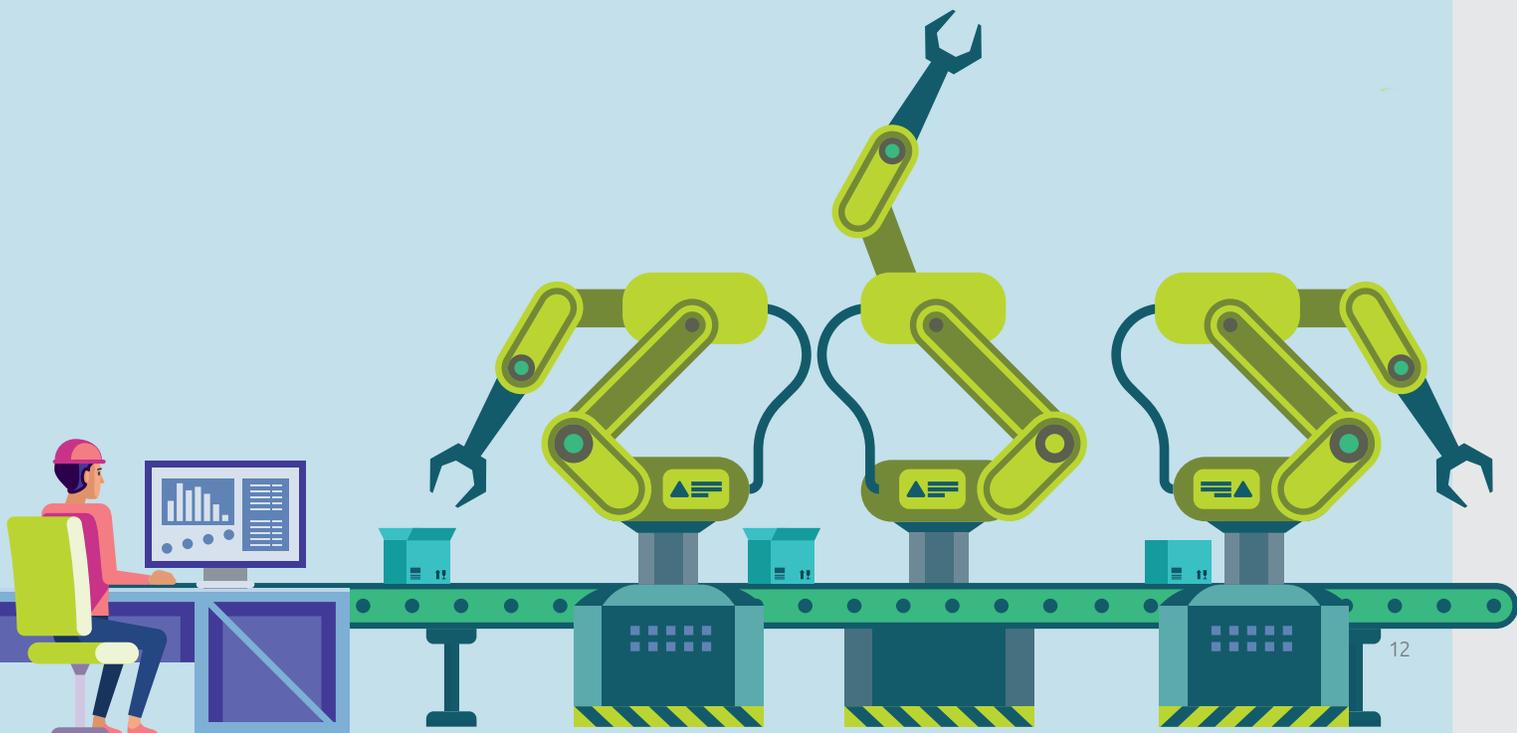
For example, a low OEE could be the result of inefficient real-time inventory management. Typically, when operators start a new work order, there may not be enough parts to complete it. Giving line supervisors or warehouse people access to an accurate inventory in real-time could boost OEE dramatically.

The same applies to quality issues. Defective or incorrect parts impact OEE measurements and could increase cost if the issue is only detected later.

It is common to be contacted by a client to request an OEE application. And while OEE does provide a useful gauge of how efficient a manufacturing line is, it is the interpretation of those results that is critical. A score can also be used to indicate that a fix is required for an existing problem. This generates a productivity boost and a new OEE assessment will then allow us to measure the improvement.

All of which means implementing an OEE solution in isolation could be deceptive in term of payback, because it is just a metric. Instead, assess first what improvements the OEE could suggest that will in turn generate enough payback to justify the entire project.

Tracking progress of smart-factory initiatives through various KPIs is important. OEE or capacity utilization is one measure, but KPIs will change over time. Be prepared to adjust KPIs in your transformation objectives. Have metrics and methodologies to track the success of initiatives and monitor progress to make sure your overall objectives are achieved.





About Capgemini

A global leader in consulting, technology services and digital transformation, Capgemini is at the forefront of innovation to address the entire breadth of clients' opportunities in the evolving world of cloud, digital and platforms. Building on its strong 50-year heritage and deep industry-specific expertise, Capgemini enables organizations to realize their business ambitions through an array of services from strategy to operations. Capgemini is driven by the conviction that the business value of technology comes from and through people. It is a multicultural company of over 200,000 team members in more than 40 countries. The Group reported 2018 global revenues of EUR 13.2 billion (about \$15.6 billion USD at 2018 average rate).

Learn more about us at

www.capgemini.com

Further smart-factory analysis and insight are available in Capgemini Research Institute's Smart Factories @ Scale: Seizing the trillion-dollar prize through efficiency by design and closed-loop operations report.

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