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Connected Manufacturing

A guide to Industry 4.0 transformation with private cellular technology

November 2020

In this report

This is a joint report by Ericsson, Hexagon and Arthur D. Little.

It examines and quantifies the potential value of private cellular networks for the manufacturing industry.

Smart manufacturing is producing the goods

There is a seismic shift happening now in the manufacturing industry as it advances towards Industry 4.0.

And private cellular network solutions like Private Networks and Industry Connect, provided by Ericsson, are supplying the connectivity needed to shape manufacturing into a more agile, secure, reliable, and intelligent process.

Against this is a backdrop of multiple challenges facing the manufacturing industry.

In this report, we'll detail the challenges that manufacturing is up against, and explain how smart manufacturing enabled by high performance private cellular networks can help solve them.

The manufacturing sector

Manufacturing a more connected industry

"Many facilities are operating with inflexible legacy equipment that cannot be easily moved and adapted to changing demands".

Manufacturing is a wide and varied industry that accounts for everything from microbreweries to aerospace facilities and vehicle assembly lines. According to the World Bank, it accounts for roughly 16% of the world's gross domestic product (GDP), so it's one of the foundations of our global economy.

Yet the industry is experiencing some serious challenges; customers increasingly expect faster delivery and more customized products, which requires factories to support flexible production. That's a tall order for many facilities that are operating with inflexible legacy equipment that cannot be easily moved and adapted to changing demands.

Even more troubling is that despite the general increase in automation, there has been a declining economic productivity trend in factories.

To achieve the next level of productivity, manufacturers are connecting equipment beyond the traditional means via the Internet, which brings with it several significant benefits, but also opens up factories to cyberattacks. Defending against these attacks has become a high priority for CTOs and technology officers alike.

An industry in flux

Manufacturing is a major component of the global economy, accounting for 16% of the world's GDP. And from this amount, The World Bank has calculated the value of each sector's contribution.

The four largest segments are summarized below, as a percentage of manufacturing's contribution to GDP.

- Machinery and transport equipment (31%)
- Chemicals (14%)
- Food, beverages, and tobacco (5%)
- Textiles and clothing (5%)
- Other (45%)

Manufacturing challenges

What manufacturing is up against

Manufacturing challenges

7 challenges manufacturing needs to overcome

This huge industry is currently facing some major obstacles that manufacturers must overcome if they wish to survive and remain competitive.

60% of unfilled manufacturing positions are due to a lack of applicants with sufficient knowledge of science, tech, engineering, and mathematics.

Falling productivity

Not only is manufacturing struggling to improve productivity, but there are also signs that productivity growth is starting to drop.

In the last century, the manufacturing industry has implemented many concepts to optimize production such as Six Sigma and Lean Production, but those methodologies appear to have achieved all the productivity gains they can deliver.

According to VoxEU, the total labor productivity growth has been below 1 percent both in Europe and the US since 2005. It's a worrying sign for the entire manufacturing sector, and underscores why a new approach is vital.

Supply chain disruption

As well as the internal challenges to the sector, there have been a host of external difficulties. The COVID-19 pandemic has resulted in closed borders and lockdowns, and has disrupted supply chains and local manufacturing operations.

Additionally, trade tensions and tariffs are forcing a move towards more local production and shorter supply chains. According to a 2019 survey from the US-China Business Council, more than 80% of U.S. companies experienced some negative impacts from trade tensions in the last year.

Landing the right talent

Ensuring their workforce have the key skills is another challenge for manufacturers. Modern production facilities, and especially smart factories, require new abilities compared to traditional factories.

This demand for skills is greatest in Information Technology (IT) , Operational Technology (OT) and data science.

According to a study by The Manufacturing Institute and Deloitte, 60% of unfilled manufacturing positions are due to a lack of applicants with sufficient knowledge of science, tech, engineering and mathematics.

Out with the old

Modern manufacturing skills are particularly important as manufacturers upgrade their brownfield facilities, which account for most factories today.

These facilities are burdened with old machinery and assets which can take up to two decades to fully depreciate, so companies are often hesitant to replace them.

As a result, the prevalence of so much outdated machinery can present enormous integration challenges when implementing new solutions and, because they're so hard to integrate, can create data silos that are difficult to consolidate.

The need to protect

Facilities that are updating their infrastructure and have embarked on a journey to build smart factories are facing an additional challenge: data security.

The data that factories generate is extremely valuable, and it can be at serious risk, introducing the need for the security of a private or 'on-prem' network.

According to a 2019 survey from Capgemini, more than one in five manufacturers experienced a cyberattack to their smart manufacturing initiatives in that year.

Customers want customization

One of the biggest challenges is that customer expectations are changing, and this is particularly prevalent in the discrete manufacturing space.

According to a 2018 study from Protolabs, 86% of customers say customization has some appeal, and 62% say they'd spend more money to customize their products.

This demand for rapid customization means that factories must be extremely flexible so that production can be adapted quickly to meet the requirements of these custom orders.

62% of customers say they'd spend more money to customize their products.

Fixing the fixed assets

Most factories have deployed wired connectivity to automate and digitally transform their facilities. But this fixed asset makes it extremely difficult to reconfigure the facility, whether to create custom products or simply shift to a new product. This ability to adapt quickly and be flexible is vital if factories are to successfully compete in ever-demanding modern markets.

Creating Industry 4.0

Connectivity on an industrial scale

Smart manufacturing requires flexible automation. And that automation requires robust wireless connectivity, the catalyst for industry transformation.

The five selected use cases we explore employ wireless connectivity to create the kind of automation manufacturers will need to thrive in the future.

These connected factories will then be primed to boost efficiency, safety, reliability and ultimately profitability.

Private networks

What private cellular networks can deliver

There is a solution to the many problems within the industry.

Manufacturers are increasingly seeing the value of a private network to make their business more agile.

This is achieved by introducing high-speed connectivity, low latency and strong performance in high device density environments.

This combination of high data volume and low latency can create the business edge needed to leave the competition behind.

Private networks today operate mostly on 4G LTE. The private networks based on newer 5G technology are expected to become widely available by 2021 and will play a critical role in bringing about smart manufacturing.

What is a private network?

An on-premises network deployed for an organization's exclusive use.

- In manufacturing, this typically includes factory shop floors, warehouses, and loading docks
- Most cellular private networks today are 4G LTE networks with 5G-ready capabilities

Primed for automation

86% of manufacturing executives believe smart manufacturing will drive competitiveness over the next five years.

(Deloitte 2019)

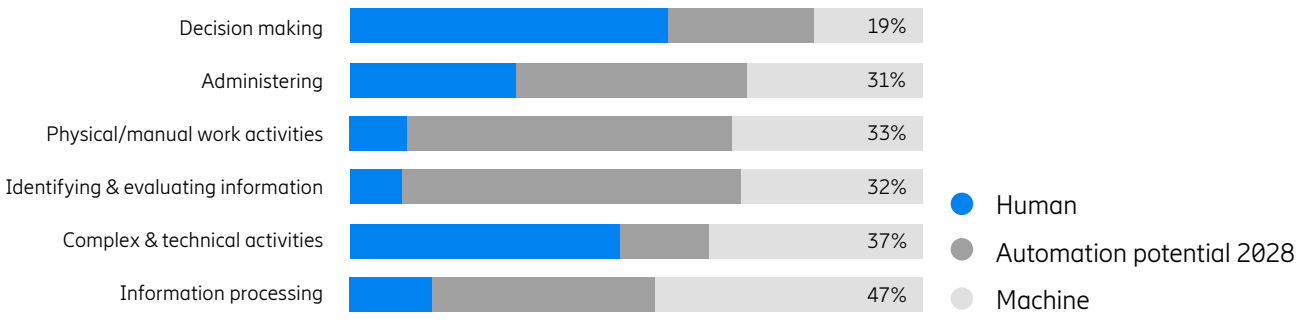
The vast majority of manufacturing executives (86%) believe smart manufacturing initiatives will drive competitiveness over the next five years, according to a 2019 survey from Deloitte.

And there's plenty of opportunity to automate, as most manufacturing tasks are still manually performed, as illustrated in the chart.

- Decision making (19%)
- Administering (31%)
- Manual work (33%
- Identifying and evaluating information (32%)
- Complex and technical activities (37%)
- Information processing (47%)

Share of human vs. machine working hours

Manufacturing industry, 2018[2]



Source: Ericsson, MAPI/Deloitte, Arthur D. Little analysis. 1) Respondents in 2019 Deloitte and MAPI Smart Factory Study, Deloitte & MAPI (2019); 2) Arthur D. Little analysis based on RPA: Robotic Process Automation, Arthur D . Little (2019), with contribution from industry experts.

The smart manufacturing concept encompasses a wide range of technologies with numerous applications within manufacturing, from product concept and design through to production, optimization, and quality assurance.

The sectors roaring ahead

Some manufacturing segments are more advanced in their journey to transform their facilities into smart factories than others. Specifically, machinery and transport is the furthest ahead, followed closely by the chemical sector.

There is a great deal of potential to automate the majority of tasks in administration, manual work, information identification and evaluation, and information processing by 2029, according to Arthur D. Little.

Total automation, total transformation

To enact smart manufacturing, every stage of the process must be connected and digitally accessible. Autonomous robotics can provide real-time, closed loop, machine-to-machine (M2M) communications, as well as untethered robots that can collaborate to complete tasks.

Enhanced video services enable three-dimensional, video-driven interactions between robots and humans. Even more advanced applications can optimize these interactions via a digital twin of the facility.

Augmented reality is the new reality

Augmented reality can hugely enhance training and worker support on the job by allowing tasks to be virtually generated, providing experience that can be implemented in real life.

With its ability to reduce training time for even complex tasks, minimize operator error, and allow remote assistance, augmented reality is seeing a growth in interest from manufacturers.

Innovation needs dedication

All of these use cases require dedicated wireless connectivity, as cabling makes rapid reconfiguration of the facility difficult and mobility essentially impossible.

A private wireless network can provide high-speed connectivity to autonomous robots and other assets as they move, or are moved, throughout the production floor. It can also provide location data (asset tracking) and is particularly useful for connective equipment that is difficult to reach and hard to wire up.

A spectrum of choice

First, manufacturers must choose what type of wireless connectivity best suits their needs, beginning with the choice between licensed and unlicensed spectrum.

Licensed spectrum is regulated by governments so that service providers and other organizations can use dedicated spectrum without worrying about others using up bandwidth.

Unlicensed spectrum, on the other hand, is available for anyone to use, but typically does not have a very long range. Generally speaking, licensed spectrum will better address the requirements of smart manufacturing enabled through a private network. The amount of unlicensed spectrum is small, so unless one is using short range wireless technologies like Bluetooth or WiFi, performance may be a problem. And short-range technologies will be unlikely to provide the scale of coverage a sizeable factory requires.

Licensed spectrum provides better reliability, improved performance and much broader coverage than unlicensed. In particular, a 5G-ready private cellular network is an ideal choice for smart manufacturing connectivity, thanks to its low latency, strong security, high speed, and enormous throughput.

The hurdles to smart manufacturing

Many manufacturers, however, will face several hurdles getting started on their Industry 4.0 digitalization journey. For example, if production is already functioning, why change it? The business case will need to be compelling to convince senior managers that it's worth the investment and potential disruption.

Given the industry's concerns around productivity and customization, private cellular networks' ability to provide the efficiency and flexibility required to accomplish these goals makes a strong case.

Plus, there are many possible use cases to implement. Management must identify the first use case to deploy, and it needs to justify the investment in private cellular technology. Finally, organizations must decide what the process of smart manufacturing deployment will look like and how integration among the various use cases deployed will take place.

Use cases

Five smart manufacturing use cases

Our top use cases using private cellular networks to enable smart manufacturing.

About the five we've chosen

This report will examine use cases of five technologies that will enable manufacturers to conduct their operations more efficiently. The use cases are:

- Autonomous mobile robots (AMR) for real-time production chain automation
- Collaborative robots for more efficient operations
- Augmented Reality (AR) for efficient quality inspections
- Asset condition monitoring for increased uptime
- Digital twins for optimized operations

The baseline factory

When analyzing these use cases, we have applied them all to what we call the baseline factory: a mid-sized, tier 1 factory in Western Europe. The factory is an automotive supplier, mainly conducting stamping and assembly operations. It has $100 million USD in revenue, around 500 employees, and a gross profit of 10%.

Methodology

Since 2017 Ericsson, in collaboration with Arthur D. Little, has released a series of studies examining the value that cellular connectivity and 5G create for industries.

We've also provided concrete guidance on how that value can be realized by ecosystem players. This year we extended the collaboration to include Hexagon, a provider of sensor, software and autonomous solutions for applications including discrete manufacturing. The aim was to further crystalize the insights in smart manufacturing.

Our joint 2020 study takes a discrete manufacturer's view and is built on a bottom-up, deep dive analysis of five high value use cases that address the most imminent pain points in the manufacturing industry.

To gauge the net economic, social and environmental value, firstly, we defined a standard factory based on concrete and validated KPIs from actual factories. Then we analyzed from the bottom up, the incremental value created by each cellular connectivity enabled use case, from deployment until operational steady state.* The incremental value from each use case is aggregated to a total benefit for a standard factory.

The overall analysis and output values are thoroughly validated with Hexagon and other experts.

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* **Steady state net value** is a combination of the terms "steady state" and "net value". **Steady state** means the use case is fully deployed, so the full benefits are activated, and only the operational costs are active (no additional CAPEX-investments). **Net value** is the value after subtracting all costs from the value of the benefits, i.e. the real "savings".

Use cases

Hexagon's helpful insights

What follows is a result of our partnership with Hexagon to gain new insights into connected manufacturing.

We'll be revealing the most relevant and mature near term use cases of private cellular networks.

By heeding these insights and deploying a private cellular network, enterprises can be confident of thriving in Industry 4.0.

"Of the five we've selected, AMRs represent the most mature use case right now and provide the most value to manufacturers".

Autonomous mobile robots

AMR: The workhorse of smart factories

When conducting quality inspections today, measuring systems are often inflexible and stationary. These inspections require a lot of time-consuming manual work.

Hexagon conducted a study of their customer base and found they face the following challenges regarding material movement and quality inspections:

- Measuring system flexibility is the most important factor for time savings (56% agreed)
- Portability is a key purchasing criteria for laser trackers and other inspection systems (49% agreed)
- Operators need to watch the inspection machines one-third of the time (45% agreed)

Hexagon already has several portable measurement solutions that could be placed on an AMR, which typically uses Lidar sensors, 3D cameras and mapping software to navigate safely around objects and people. Portable laser trackers provide six degrees of freedom for probing, scanning, and performing automated inspections as well as reflector measurement.

Dedicate to automate

Hexagon and Ericsson have researched private cellular connectivity use cases and examined how 5G cellular technology can provide connectivity for AMRs to move efficiently around the production floor to conduct quality inspections.

To enable free movement of AMRs around the production environment to conduct inspections or move materials, the manufacturer will need to process and manage a large amount of data, as well as have highly reliable, low-latency connectivity that is secure and able to provide real-time data transfer.

A private cellular network can provide this level of connectivity. With 5G, AMRs can move throughout the factory without any magnetic strips for guidance, and with 5G providing positional accuracy, robots can maneuver freely even in a facility with a high density of connected devices.

Safe and sustainable

AMRs confer many benefits, not the least of which is improved worker safety since robots can easily manoeuvre through environments that may pose risks to human workers.

But they can also handle materials much more accurately, eliminating up to 30% of typical scrap, which is not only good for the bottom line, but also a plus for the environment.

"46% of the value of AMRs comes from forklift operators being freed up to do other tasks in the factory".

Automatically cost efficient

The financial benefit reaches about 1.5% of the revenue as yearly steady state net value. The return on investment in year five is 50% and payback is less than four years.

The revenue and ROI benefits as a percentage of value are:	
Reduced downtime due to route optimization on the floor, speeding up material movement	49%
Forklift operators being freed up to do other tasks in the factory	46%
Reduction in rework	3%
Cost for quality inspections decreases as quality improves	2%

Collaborative robots

Cobots rising, quality rising.

The need for more eyes on more products

Hexagon's research found that 22% of its customers said aligning parts is the most difficult step of running a measuring routine, and 55% said a more flexible measurement system could reduce the time they have to dedicate to inspection tasks. Just less than half (47%) said that the operator must watch the equipment during an inspection about one-third of the time.

Additionally, customers today expect zero defects. To accomplish this goal, manufacturers must inspect 100% of the products they make — sample testing will not be sufficient — and that will increase the amount of testing they are required to do.

Making cobots work for you

Collaborative robots, or cobots, work side by side with operators to conduct manufacturing tasks such as operational work, drilling or assembly, as well as automated quality inspections of products that are still on the production line. In this way, all parts can be automatically inspected, not just samples.

With cobots, factories can achieve inspection of every part without increasing the time it takes to do so, which improves overall quality and customer satisfaction.

Dedicated cobots need dedicated networks

Cobots need to be flexible and easily move throughout the facility, so they can be rearranged for multiple purposes.

"As a result, Cobots must connect wirelessly to the facility network, and a 5G-ready private cellular network can provide the reliable, low latency connection cobots require".

Even amidst hundreds or thousands of other connected devices, a private cellular network will still provide a fast, stable connection because it has been designed to support environments with a high device density.

Less risk, less waste

Cobots improve worker safety and the ergonomic environment as they can perform tasks that pose risks to human workers quickly and accurately.

"Cobots offer significant financial and environmental benefits, allowing you to increase production capacity while also lowering your waste".

Financially efficient too

The financial benefit of investing in cobots reaches about 1.4% of the revenue as yearly steady state net value. The return on investment in year five is 44%. Payback is less than four years.

The revenue and ROI benefits come from:	
More efficient use of labor resources	Accounts for 68% of value
Decreased downtime	19% of value
Decreased cost of quality inspections	10% of value
Fewer quality issues	3% of value

Augmented reality

Reality check – improving inspections with AR

Boosting the quality of quality inspections

Manual inspections require specific experience and skills, such as the ability to accurately compare products to spec.

Currently, manufacturing is experiencing challenges hiring the right skills and ensuring these skills can be applied at the right place, at the right time.

Hexagon's research found that one-quarter of quality technicians are expected to retire within the next five years, and 73% of organizations say it is difficult for their company to hire skilled labor. Already, more than a third (36%) of manufacturers surveyed said that comparing parts to spec, such as a CAD model, is difficult for them to do. Plus, they're time consuming – 48% of manufacturers said automated part identification and measurement would simplify the quality workflow.

The cost of poor quality can be extremely high, especially if not identified during production. Costs grow by a factor of ten if quality issues in a finished product are first detected by the customer and not the manufacturer.

AR for inspections

Smart manufacturing can benefit from deploying augmented reality for quality inspection and diagnosis, an area facing serious challenges.

AR can make an enormous difference in quality inspections, providing human inspectors with visualizations that significantly decrease the potential for human error and reduce the amount of time spent in uncomfortable positions, moving back and forth between the equipment and a manual or screen.

In a visual overlay, personnel can see a geo-referenced 3D CAD model on a map, or a mix CAD models, OGC 3D tiles, glTF models and point clouds, all of which provide the user with precise visual analytics.

AR can also visualize the spectrum of 2D and 3D data formats across all common desktop and mobile platforms, combining multiple data types in the same view.

AR for support

AR devices enable instant support and measurement and can be used by technicians, maintenance workers and operators throughout the entire facility. Instructions can be rapidly visualized, allowing experts to support on-site personnel remotely.

There are additional benefits of AR within a manufacturing context. For example, because service experts can support local inspectors remotely, about half of their travel to appear on-site can be avoided, reducing the CO2 impact by 50%.

"With AR, service experts can support local inspectors remotely, reducing their travel-related CO_2 impact by 50%".

Dedicate to augment

To enable AR within a manufacturing environment, the facility must be able to provide reliable, highly secure, high-throughput, real-time wireless data transfer to deal with the rich media and complex analysis required, especially as the AR glasses move with the employee throughout the floor.

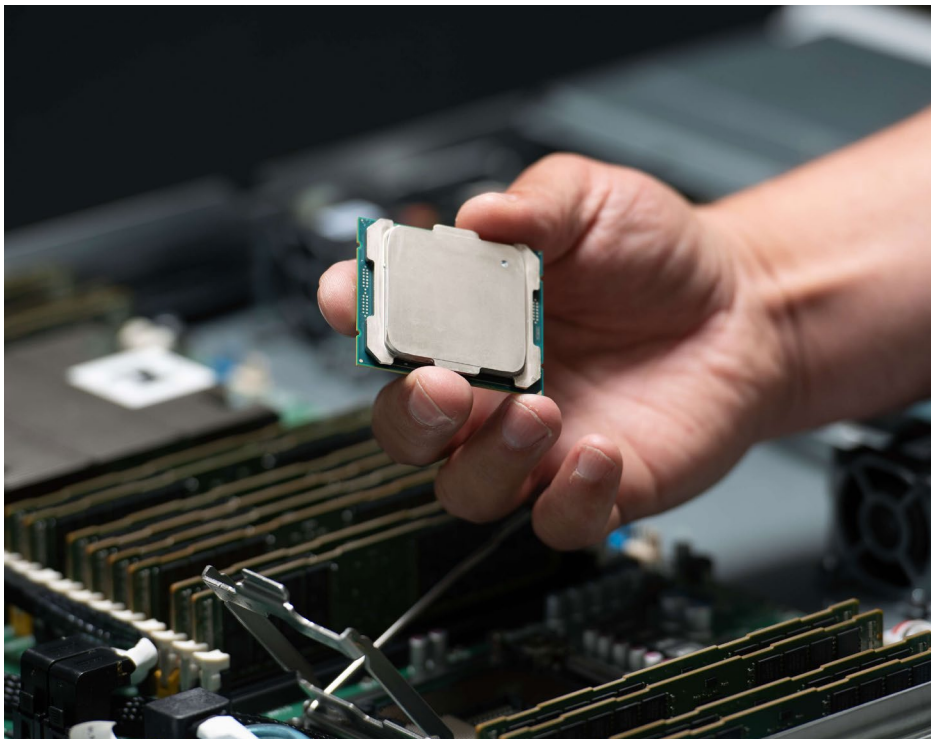
Additionally, wireless connectivity must provide extremely accurate positioning and the ability to handle a high density of connected devices anywhere in the factory. Private cellular networks meet all of these requirements.

Augment your bottom line

The financial benefit of Augmented Reality quality inspections reaches about 0.5% of the revenue as yearly steady state net value.

"The return on investment in AR in year five is 68% while payback is less than three years".

The revenue and ROI benefits as a percentage of the total value are:	
More efficient use of labor resources	46%
Decreased cost of quality inspections	34%
Decreased downtime because diagnostics and inspections can be conducted faster	10%
Maintenance labor cost savings	8%
Decreased cost of expert service trips	2%



"Manufacturers can reduce the number of spare parts required by 10% with asset condition monitoring".

Asset condition monitoring

Your best asset for maintaining machines

As detailed above, manufacturers are facing challenges in many aspects of their industry, and maintenance is no exception. Manufacturers also face challenges in understanding machine utilization and Overall Equipment Effectiveness (OEE).

Asset condition monitoring can address these problems by enabling predictive maintenance, which uses data collected by sensors to determine exactly when maintenance needs to be performed.

The status of key assets can be analyzed via a centralized dashboard, whether the assets are on a single site or in multiple factories around the world. Operators and managers can easily monitor machinery running unattended, thanks to real-time customizable notifications of the performance and status of assets, including the ability to coordinate measuring machines (CMMs) and laser trackers. Aggregated data can be used to pre-emptively schedule maintenance and identify sources of downtime.

The upside of no downtime

Automated asset condition monitoring enables manufacturers to optimize maintenance, ensuring that facilities do not experience downtime due to insufficient maintenance, nor will they invest more time and money than is required to keep equipment running well.

Asset condition monitoring keeps equipment in good shape while preventing over-maintenance and the premature replacement of parts. As a result, manufacturers can reduce the number of spare parts required by 10% and employees can cut down on the amount of repetitive work they would normally have to do.

This intelligent tracking of machines allows manufacturers to practice a more sustainable use of machinery by keeping machines running for longer.

The tech powering asset condition monitoring

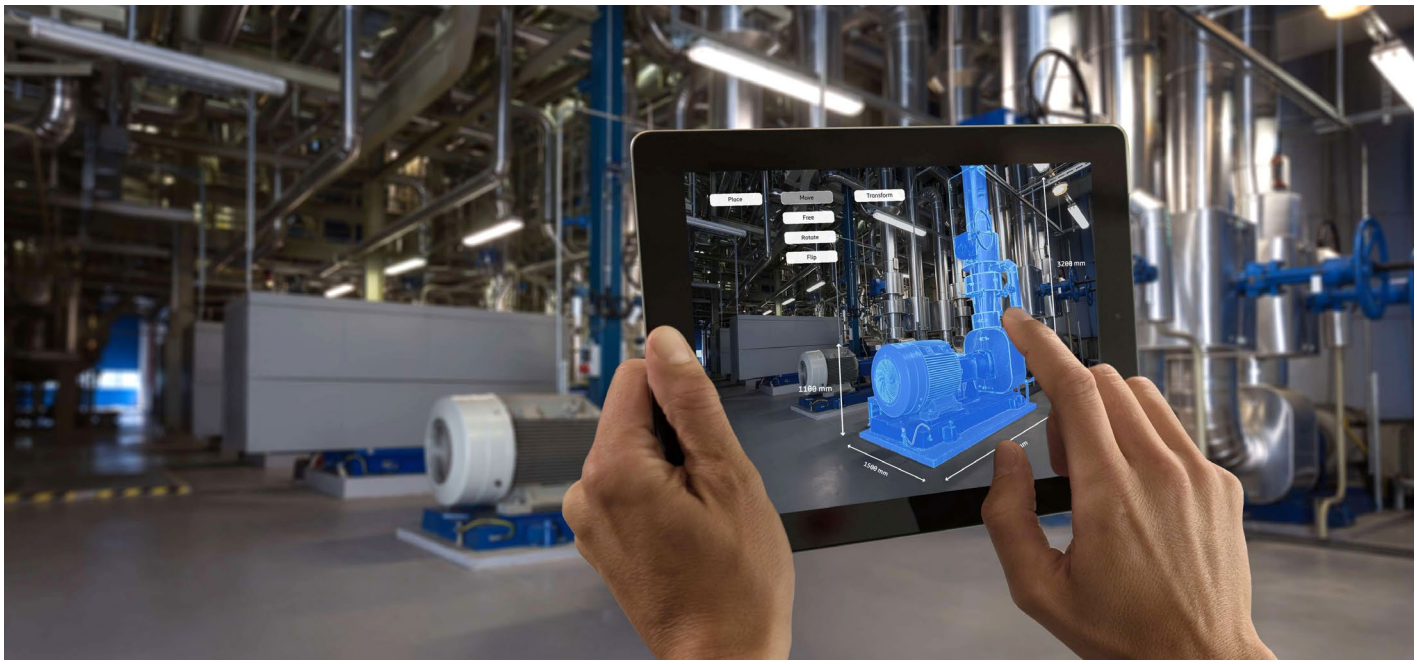
To implement asset condition monitoring, a facility needs to be able to efficiently process and manage data. Ericsson offers the necessary high reliability, high-speed, high throughput connectivity of a private network, vital for generating real-time data.

Maintaining a good ROI

The financial benefit reaches about 0.8% of the revenue as yearly steady state net value. The return on investment in year five is 151% and payback is less than three years.

The revenue and ROI benefits as a share of total value are:	
Decreased downtime	51% of total benefit
Maintenance material cost savings	36% of total benefit
More efficient use of labor resources	13% of total benefit

"Asset condition monitoring creates a return on investment in year five of 151%".



Digital twins

Manufacturers win with a digital twin

A need for more agility

To stay competitive, the manufacturing industry needs to increase efficiency, agility and quality, while reducing development costs and time to market.

Yet currently, this is hindered by manufacturers being unable to accurately track and trace components in the production process. Additionally, enacting design changes in the production line is often difficult and time consuming.

A more innovative tool is needed.

"Digital twins enable manufacturers to determine how best to streamline the production environment without physically changing any processes".

"Digital twins can produce useable insights for both process and factory, giving manufacturers full control to implement change".

The digital twin is born

A digital twin is a virtual model used in smart manufacturing to optimize a particular aspect of operations. It provides a digital representation of the entire operation, enabling manufacturers to determine how best to streamline the production environment without physically changing any processes.

Digital twins can also generate a virtual representation of the actual facility, created through the use of 3D scanners, sensors and lidar. As a result, manufacturers can create a complete, virtual 3D map of all assets.

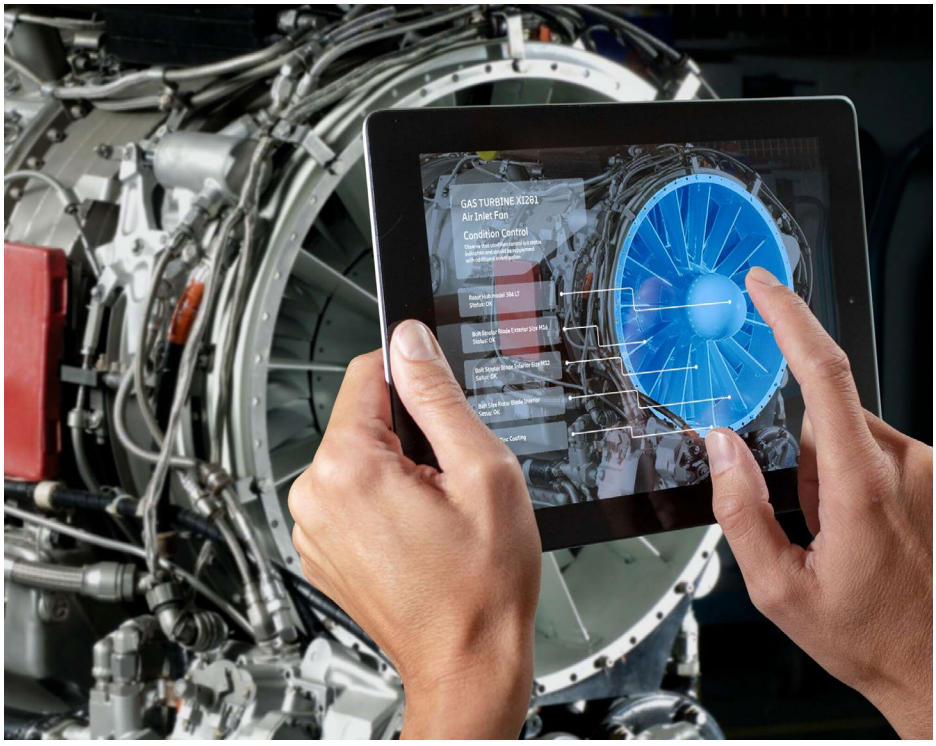
By gathering asset data in real time, manufacturers can create a fully integrated view of the asset throughout its lifecycle.

A visible difference

With the digital twin, manufacturers gain a rich visualization of the current and past state of the production environment, enabling them to plan for future states with "what-if" scenarios.

Digital twins can produce useable insights for both process and factory, giving manufacturers full control to implement change. This means they can increase asset efficiency, enhance productivity, and reduce operational risk.

And as work becomes more data-driven and digitalized, manufacturers will be able to decrease operational expenses by optimizing production and conducting more efficient product line changes.



Go private to deliver your twin

As with asset condition monitoring, effective use of the digital twin requires a massive amount of data to be processed and managed. This is due to it using 3D mapping sensors, video stream, lidar, and thermal stream, which generates large data volumes that need to be transferred in real-time. Additionally, once the entire environment is connected, the connection density becomes very high.

A private cellular network in smart manufacturing enables real-time transfer of large data volumes thanks to its high bandwidth, and continues to provide reliable connectivity even when there is a high density of connected devices. And because large amounts of critical factory data will be collected from facility devices, the private nature and ultra-high security that 5G enables is essential.

Manufacturers are keen to adopt

According to a survey from LNS research, 25% of manufacturing executives surveyed said they believe a digital twin could help increase the throughput, while Hexagon found that 30% of manufacturing executives believe a digital twin would reduce costs.

The manufacturing optimization that a digital twin enables confers several benefits, including a 10% reduction in rework, which not only has financial implications but also improves worker satisfaction. Additionally, it enables an environmentally-friendly 10% reduction in scrap.

The financial benefit reaches about 1.3% of the revenue as yearly steady state net value. The return on investment in year five is 28% and payback is about four years.

The revenue and ROI benefits come from, as a share of the total benefit:	
Optimized production flow	60%
Decreased configuration time	31%
Rework reduction	6%
Decreased downtime	3%

Combining the use cases

Using all 5 to create Industry 4.0

"When all five use cases are deployed and working together, they provide a combined ROI of 116% by year five".

Individually these use cases will create a healthy return on investment.

But when all five use cases are deployed and working together, their combined annual steady state net value reaches $6 million, which represents 6% of the manufacturer's revenues.

That means they will provide a combined ROI of 116% by year five, with total costs of $11 million USD.

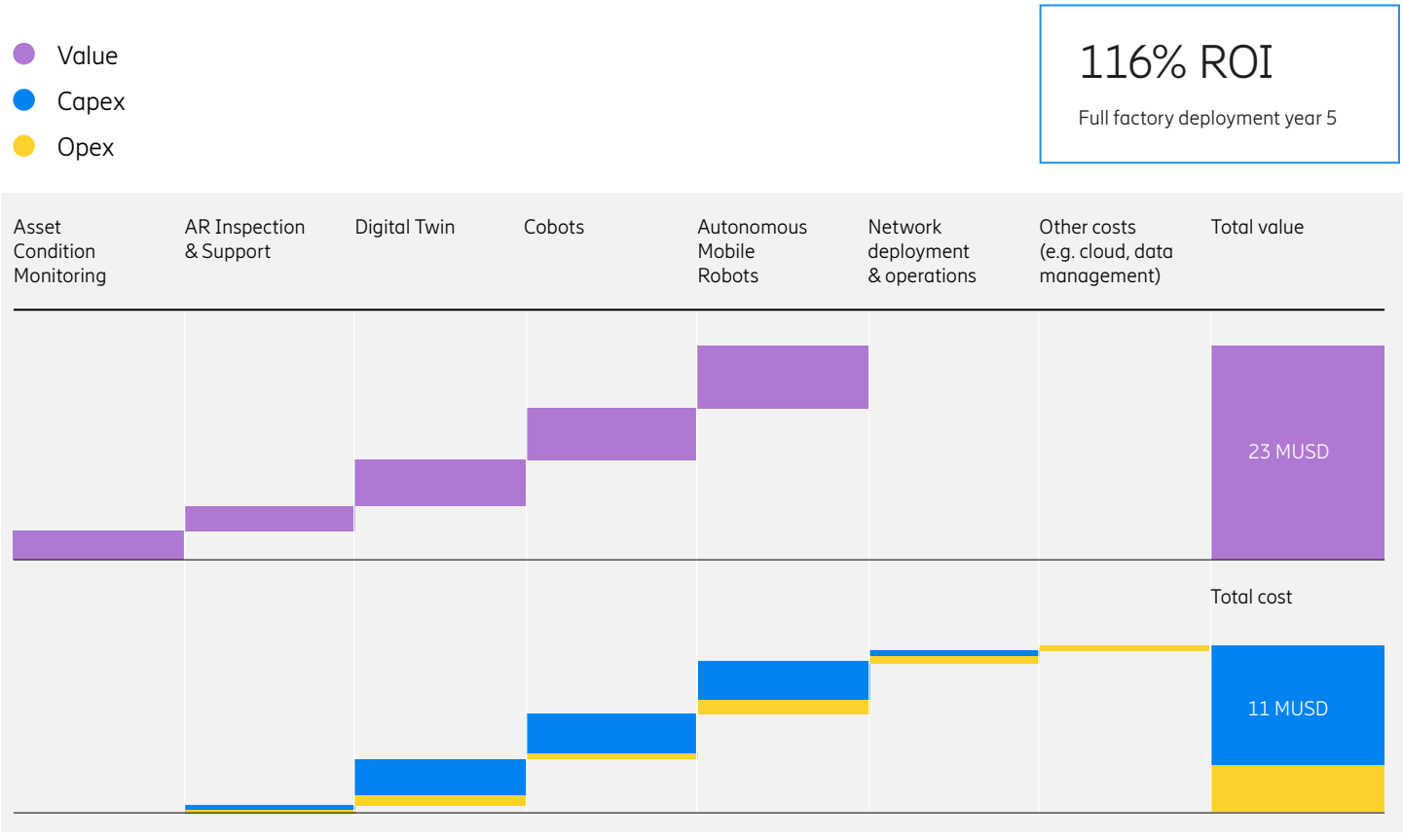
The pick of the use cases

Getting started? Choose AMRs.

AMRs are the most fruitful place to start, as they provide the largest benefit, and are the most mature of the five use cases. The AMR use case alone can justify the initial investment in a 5G-ready private cellular network, which can then provide connectivity for the remaining four.

The breakdown of how much each use case accounts for the total value when all five uses cases are deployed is as follows:

- AMRs: 26%
- Cobots: 25%
- Digital twin: 24%
- Asset condition monitoring: 15%
- AR for inspection and support: 10%



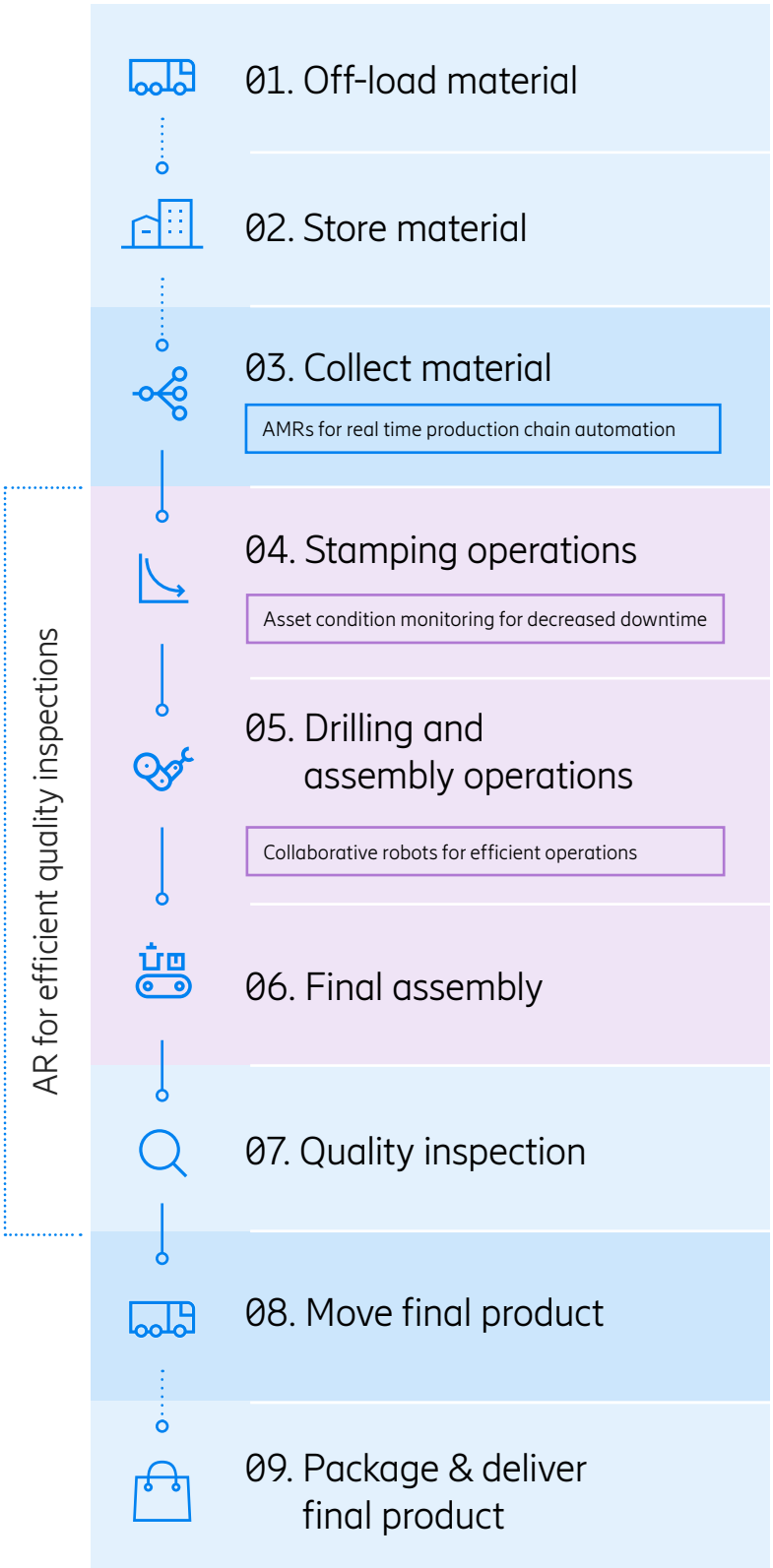
Source: Ericsson, Arthur D. Little

Combining the use cases

Working in unison

Here's what it might look like with all five use cases working together in our baseline factory.

Digital twin use case is active in all steps of the smart manufacturing process.



01

AMRs

An AMR collects material once it is unloaded and stored, based on an order given through the cloud. It moves the material through the production environment to the stamping machine in the most efficient way possible.

02

Asset condition monitoring

The stamping machine contains sensors that are wirelessly connected to a facility-wide asset condition monitoring system within the private network, so an alert will sound any time there's an issue that requires the attention of maintenance. An AMR picks up the work-in-process (WIP) product, moving it through each operational step.

03

Cobots

Meanwhile, some of the factory cobots will conduct drilling and assembly tasks, while others perform in-machine quality inspections, alerting personnel whenever a part or product is out of spec.

04

Augmented Reality

Once the product is ready for final assembly and quality inspection, an AMR will move it to the last stage, where quality engineers will use AR glasses to inspect the final product to ensure it conforms to requirements. AR glasses are also used throughout the facility to assist with a wide variety of tasks, from offloading to troubleshooting and operator support.

05

Digital twin

And in the background, the digital twin is active throughout all steps of smart manufacturing: updating the virtual model and performing "what-if" analyses to further optimize operations.

Final word

The smart money is on smart manufacturing.

While there are many potential smart manufacturing use cases, our research indicates that the five discussed here are the most mature and best place to start.

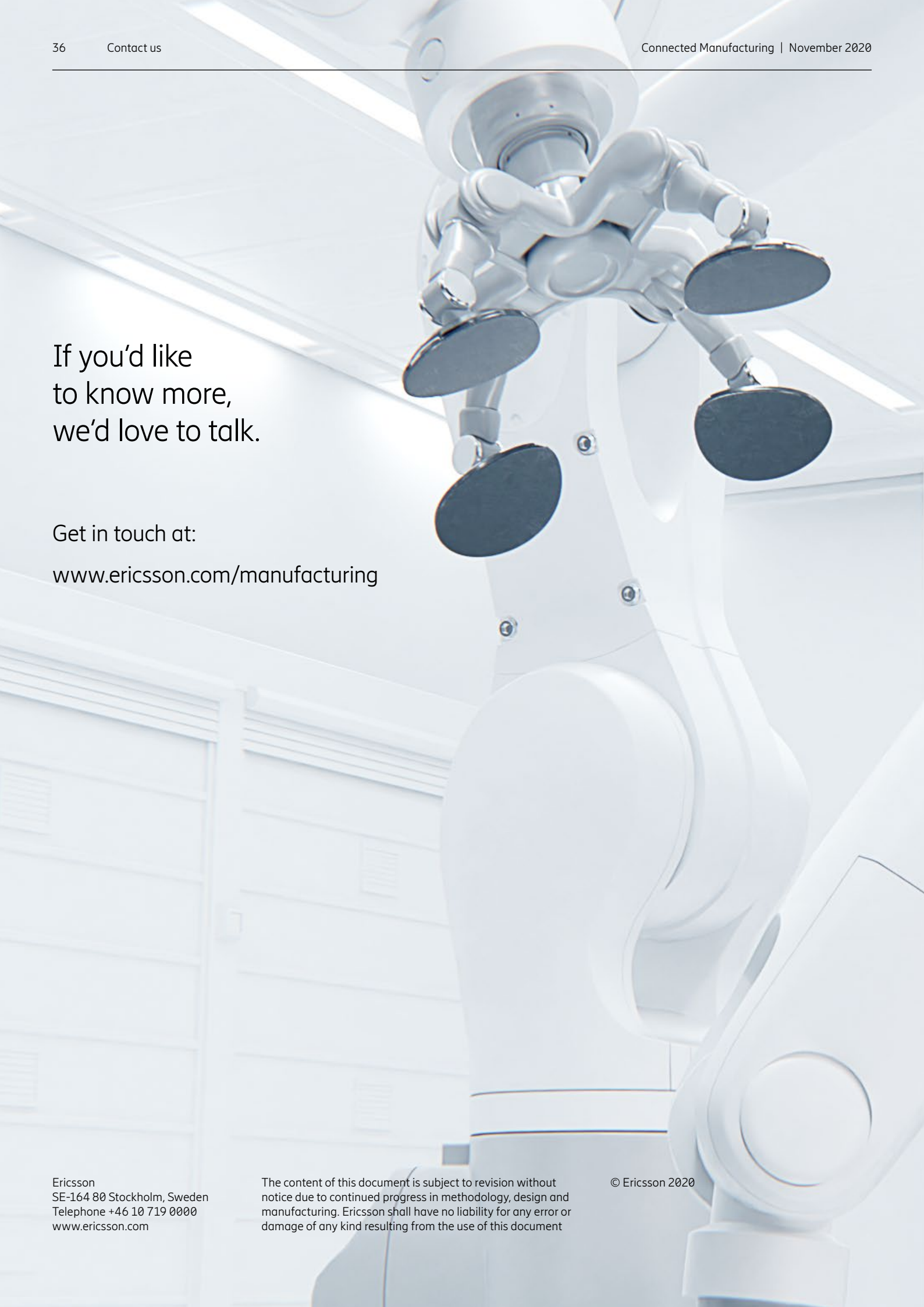
It's clear that smart manufacturing's financial benefits are significant. All use cases should pay for themselves in three to five years, and if all five are deployed together, they provide payback within two years.

The benefits are not only financial, but also social and environmental. Smart manufacturing creates a substantial triple bottom line that includes improved safety for workers and a more responsible environmental impact through reduced scrap and emissions.

These five use cases represent a huge leap forward for manufacturing. And they all rely on a solution facilitated by Ericsson – the fast, reliable, secure connectivity that only a 5G-ready private cellular network can provide.

And this is the tool that will give you a competitive advantage by allowing you to make smart manufacturing a reality.

"All use cases should pay for themselves in three to five years, and if all five are deployed together, payback within two years".



If you'd like to know more, we'd love to talk.

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