Time for Industry 4.0:
The next stage in the data revolution

Contents

Data empowerment is the next frontier in Industry 4.0

Manufacturers around the world face many challenges in the coming years, from the digital transformation of the global economy to the race to net zero carbon emissions, not to mention supply chain constraints and labour shortages, as well as the adoption of new technologies. Those manufacturers who are slow to adapt will find themselves losing business to those competitors willing to push forward.

Those corporations that show business agility and operational resilience in the face of new disruptions - including rapid shifts in customer demand, pressure from investors, driving sustainability, reducing costs or boosting automation - will not only survive but thrive.

The global pandemic has been a valuable lesson, manufacturers have had to be flexible and nimble. It's shown them what the 'art of the possible' is and how they can solve real-world business problems.

But this is only just the beginning. The fourth industrial revolution, Industry 4.0, or 4IR, is transforming how businesses manufacture and deliver products. It is not just happening in small pockets, but across global supply chains. It is being facilitated by greater automation, robots, sensors, IoT and Edge devices, 5G networks, digital twins, cloud computing and machine learning and artificial intelligence.

Yet one of the great strategic opportunities for manufacturers today involves the use of data. Some CEOs and industry leaders have more actionable data on their personal fitness tracker than they do for their business; this needs to change.

Many manufacturing lines still look similar to those that operated a decade ago. Maintenance is manual, workers monitor machinery, setups for different product lines are done by hand. In reality, manufacturing is behind many other sectors. Legacy systems are rife. There are many proofs of concept or minimum viable products with Industry 4.0 that haven't been scaled up or fully realised.

US$3.7 trillion
in value by 2025 (McKinsey)[2]

37%
managed to scale data-driven use cases (BCG)

In a survey of over 1,300 manufacturing executives by BCG only 17% said they had captured satisfactory value from data and analytics. Only 39% managed to scale data-driven use cases beyond the production process of a single product.[1] The potential for a step change is huge. In fact, Industry 4.0 could create up to US$3.7 trillion in value for global manufacturing by 2025,[2] according to McKinsey.

Leaders in manufacturing get this. They are already spearheading a data-driven revolution. It's not just about sweating capital assets more efficiently, data has the potential to drive productivity, new products and services, as well slash carbon emissions. A single digital system run on data represents the next step change gain for manufacturers. It could drive new growth and profitability.

As we come out of of this period of uncertainty, manufacturing is seeing renewed investment and interest.

This is an exciting time for the sector, globally. Innovation is high on the agenda. Companies that have already adopted 4IR are seeing the benefits right now, not in the future.

Data, particularly Big Data, is at the heart of this process - you can't improve what you don't measure - it is at the core of smart manufacturing. Artificial Intelligence is helping manufacturers unlock real-time operational visibility. In turn businesses can achieve improved process reliability and performance.

These are exciting times. This briefing paper will help manufacturers navigate Industry 4.0 and think about how to start, accelerate and future-proof their journey to digital transformation.

Many talk about becoming 'data-driven,' yet few have articulated it well. Businesses need to take a different approach. This starts with a focus on tangible business value – understanding where data can be used to drive new insights and how those insights can be applied to achieve business objectives or address key challenges.

ROBIN MEEHAN,
CO-FOUNDER AND MD, INAWISDOM

> "These are exciting times. This briefing paper will help manufacturers navigate Industry 4.0 and think about how to start, accelerate and future-proof their journey to digital transformation."
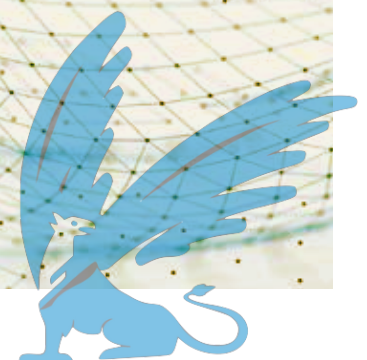
Introduction:
What is happening now:
An age of constant disruption

After over two years of unprecedented challenges, with many sources of disruption, manufacturers have had to react rapidly and decisively to survive. Rising raw material costs, supply chain challenges, workforce issues and transportation, as well as logistics challenges, are still creating ongoing hurdles.

At the same time, the wholesale shift online and the further rise of ecommerce with numerous lockdowns has directly affected how manufacturers operate. No business is immune to the automation and digital revolution that Covid-19 has been accelerating. Many companies are now on some form of trajectory to transform in order to achieve a competitive advantage. In the process they are becoming more data empowered.

The focus is therefore on faster development and innovation when it comes to new products, the aim is better customer satisfaction and addressing changing market demand, reducing manufacturing costs, increasing revenues, as well as offering products at lower prices. Predicting the next rapidly evolving trend or speedy shift in consumption patterns also matters.

In the wake of COP26, the UN climate change summit, and ESG pressures, particularly from investors, sustainability is now firmly under the spotlight - how manufacturers can reduce their emissions, energy consumption and waste in the production processes is in focus - again, data holds the key.

Introduction:
Drivers of change

Investment is now moving into smart manufacturing at pace. Spend will grow from US$345 billion in 2021 to more than US$950 billion in 2030, according to ABI Research.[3] This is an almost tripling in outlay, as manufacturers advance their digital transformation initiatives. Investments will go into the likes of autonomous mobile robots, asset tracking, simulation and digital twins.

There is also now a growing emphasis on production efficiency and reducing operation costs among manufacturers. They are looking to build up their operational resilience, as well as minimise inefficiencies, increase the quality of products, and reduce their environmental impact.

At the same time leadership is evolving. There is a greater realisation that digital systems and data hold the key to business success. When 'every business is a software business' as the saying goes then those who are involved with data and digital empowerment are elevated to the boardroom.

Executive sponsorship is vital for Industry 4.0. The chief information and chief digital and data officer now have more prominent roles within a business. It is no longer a role that is focused on dealing with IT systems and keeping tech systems running. Digital and data empowerment are core company assets that have strategic importance.

There is also now a greater understanding amongst manufacturers that leveraging emerging technology is merely table stakes in order to remain competitive. Many start-ups don't have legacy infrastructure, machines or ageing assets they need to sweat. The forefront of innovation goes way beyond technology adoption, which is increasingly being democratised.

Gamechangers in manufacturing

▶ More manufacturers are bringing in people and leadership from other sectors where the digital and data agenda is more advanced.

▶ Firms are employing 'heads of innovation' to seek out emerging technology solutions, the aim is to find the best fit and trial these within the business.

▶ Cross pollination of skills from other sectors will accelerate the manufacturing sector in the next 18 months.

▶ Companies that have already adopted Industry 4.0 are seeing the advantages right now, not in the future.

▶ The global pandemic saw a dip in investment. Post-Covid there will be fresh investment in manufacturing plants geared towards Industry 4.0. and data.

> " The technology is all there and ready to go when it comes to Industry 4.0. Organisations are looking at this as a technical challenge. It's not. It's a business challenge."
>
> ANDY FISHER,
> MANUFACTURING LEAD, INAWISDOM

Introduction:
The growing industrial automation ecosystem

A growing number of manufacturers are sharing their operational data with partners and suppliers as part of their Industry 4.0 strategy. Industrial data holds great potential.

72% of manufacturers are considering sharing information with other manufacturers to improve their operations, according to a survey by the World Economic Forum and BCG among nearly

1,000
manufacturing managers.[4]

Data derived from machinery and plants can offer insight to others. It can allow manufacturers to optimise processes. Leading companies in the automotive industry are already collaborating to achieve this.

The fact is smart automation, connectivity and data analytics can add further intelligence throughout the manufacturing lifecycle. This data can also be shared so that efficiencies are achieved for all those using similar machinery and systems.

Some organisations such as Intel do this internally through their 'Copy Exactly!' methodology. The company controls virtually every manufacturing variable in its fabrication plants, especially with any rollout of Industry 4.0. capabilities. This means if it optimises manufacturing processes in one factory it can do this throughout its global network of factories, such is the consistency of it's operations.
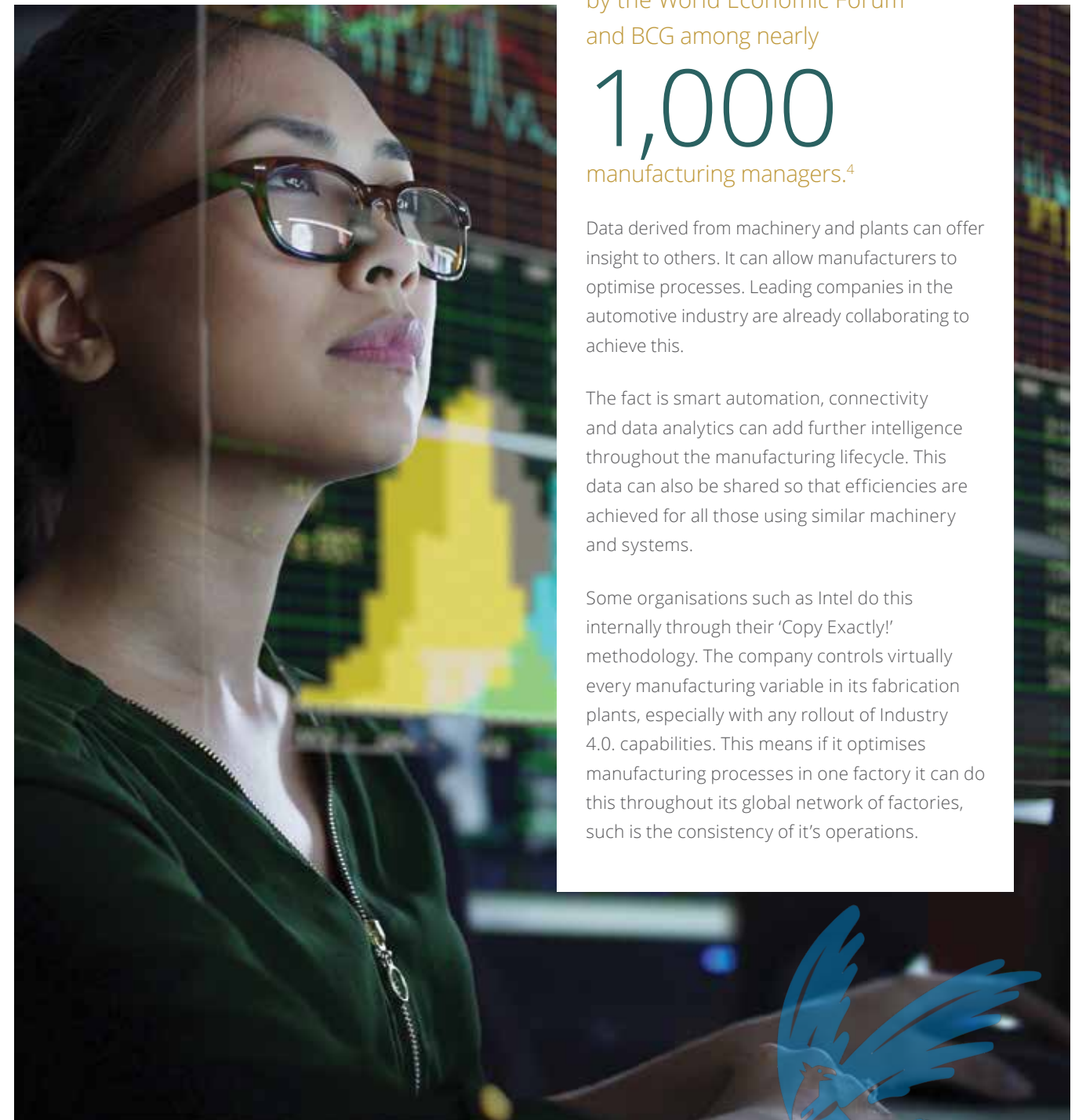
Introduction:

The role of the cloud and digital transformation

Digital transformation is giving manufacturers a renewed appetite for using data they were already producing. This can better inform decisions in real-time

It can also be used for artificial intelligence and machine learning tools to create operational, service, product and supply chain intelligence.

The prevalence of the cloud has also opened up new opportunities with data and Industry 4.0. It is a key enabler. It provides manufacturers with elastic, flexible and scalable computing power that is on-demand. It is serving as a key foundation for Industry 4.0 technologies. The cloud allows manufacturers to have real-time visibility of their data and in some cases their supply chain partners.

Industry 4.0 combined with digital transformation can be a gamechanger. For instance, Schneider Electric's smart factory used IoT connectivity with power meters and predictive analytics. Energy use fell by 26%, CO_2 emissions by 30%, and water use by 20%, according to McKinsey.[5]

> "Right now, manufacturing is a really dynamic industry because of where technology is. The digital and data agenda is now accelerating quickly in this sector."
>
> ANDY FISHER,
> MANUFACTURING LEAD, INAWISDOM

The cloud now empowers Industry 4.0

> "The cloud has become critical for predictive maintenance, forecasting and automated quality control with some forward-thinking manufacturers. When large volumes of data are localised within on-site servers it's difficult to train machine learning models on these silos. Centralising data in the cloud makes artificial intelligence, machine and deep learning exercises a lot easier. IoT data and computer vision can also be accessed via the cloud more easily as well.
>
> In fact, a suite of ready, affordable services are now available to manufacturers. It is all about visibility and understanding why things are happening based on data insights. Asset tracking, predictive maintenance and condition-based maintenance are all key use cases for manufacturers, as is overall equipment efficiency.
>
> There is no doubt that we are moving closer to the idea of real-time visibility via the cloud, not just in manufacturing plants but across global supply chains. This is very important. Manufacturers want to make the most of their assets. They also want to free up their resources so they can start to concentrate on real business outcomes and challenges, not deal with machinery, IT and the daily grind of maintenance, security and operations.
>
> With AWS, we help customers to accelerate their journey to modernise. We want to ensure they can optimise operations, reduce the infrastructure heavy-lifting, and unlock the value trapped in their data through real-time analytics and predications, at scale."
>
> MARWAN TAREK,
> MANAGER, SOLUTIONS ARCHITECTURE
> AT AMAZON WEB SERVICES (AWS)

Chapter 01:
Challenges and Issues

The technological evolution is happening within manufacturing. This is a positive step change. However, there are some misgivings and challenges that need to be addressed, these are not insurmountable but are worth understanding in order to facilitate quick progress.

Challenges and Issues:
Barriers to change - Sector level

Cultural adoption barriers are the hardest to overcome. Many manufacturers look at this as purely a technical problem it's not, often it's a cultural problem. This attitude is industry wide. The innovation agenda needs to change across global manufacturing.

Legacy equipment is a major barrier to Industry 4.0 deployments. Many manufacturers are using tools and assets that are decades old. However, it doesn't mean that equipment cannot be fitted with state-of-the-art sensors.

The manufacturing industry is also struggling to scale Industry 4.0 initiatives involving big data and data analytics. Automation is not necessarily prioritised where labour is low cost. The adoption of technology in manufacturing processes still remains slow across some sectors and regions. A skills and labour shortage is likely to drive more adoption of Industry 4.0 over time, especially if it provides a competitive advantage.

*"*There can be a big disconnect between wanting to do a project, because the manufacturer has seen all this latest, greatest tech, and doing it. But with new tech savvy workforces coming through, and companies investing more in digital innovation, this should become less of an issue. The benefits are immense and organisations are starting to recognise this and use outside expertise to achieve internal progress."

ANDY FISHER,
MANUFACTURING LEAD, INAWISDOM

Challenges and Issues:
Barriers to change - Business level

Many manufacturers have a minimal viable product or Industry 4.0 concept that they've developed in-house but they have yet to adopt it at scale. Some organisations struggle to prove an attractive return on investment or ROI and move beyond pilot-testing.[6] Yet these are easy barriers to overcome with the right processes, people and technology in place.

The adoption of Industry 4.0 also needs buy-in from the executive level, from management and then effectively rolled out across functional teams. For many organisations there's C-suite level buy in, but then it's not always articulated by business units, that actually need to engage in processes.

Industry 4.0 technologies do not occur in a silo. It involves business processes, management and people, as well as systems and platforms.

At the same time, many businesses have legacy systems that need overhauling.

There is a misconception that the cost and time needed to adopt Industry 4.0 technology and systems is exorbitant. This is not the case. It is now more affordable than ever. There is also a belief that there needs to be a complete overhaul of systems, machinery and processes for this type of technology to work. This is also not the case. Industry 4.0 can start small, be iterative and then scale when the ROI is realised.

> "
> Manufacturers often don't have a business case for Industry 4.0 or a way of approaching a tech provider to shape a solution. This is where we often help; prioritising and identifying the best use cases, then rapidly creating a proof of value. It means you can innovate in parallel with business as usual "
>
> ROBIN MEEHAN, MD, INAWISDOM

Challenges and Issues:
Barriers to change – Process level

Vast amounts of data currently sit under-leveraged in silos within manufacturing production lines. The data exhaust is palpable, so is the lack of actionable data. It can often be difficult to pull out business insights for a single production process. With too much data it can often be overwhelming. The fact is, making sense of data can be one of the biggest issues when a company starts a project without knowing what they are trying to solve.

Businesses often have KPIs - key performance indicators for their business, but they aren't joined up, particularly with the manufacturing processes. It is one thing to have a great digital strategy, a more customer-centric approach and digitalised supply chains, however this needs to be fully aligned with what is going on with the manufacturing or supply chain processes.. By leveraging the right partners and technical know-how, this can be easily addressed.

> "
> The big fear of companies that are going through a digital transformation is having lots of data that they think has zero value, this is just not the case. Nearly all data has value, unlocking it and turning it in to business-ready insight is where the real benefit lies. It's what we help businesses achieve"
>
> ROBIN MEEHAN,
> MD, INAWISDOM

Chapter 02:
A roadmap for a real evolution

Opportunities - Business level

Factory Optimisation

For many businesses the lowest hanging fruit, when it comes to rolling out Industry 4.0 -enabled projects, involves optimising manufacturing processes. Manufacturers need to make things, better, faster, quicker or more sustainably. Capital assets in manufacturing can cost vast sums of money. The full utilisation of assets is therefore vital, with little or no downtime for maintenance or reconfiguring.

Asset utilisation can be a very powerful cost-saving exercise. Sweating the assets that a business has invested in is crucial. It saves money and time. There is also an immediate return on investment. Projects of this nature can be discrete and easy to achieve. Marginal gains from these projects can have an outsized effect when rolled out at scale across multiple pieces of machinery or across a number of factories.

This can involve predictive maintenance or optimising servicing where data allows businesses to know when exactly a piece of machinery needs repair. With sensors and more data on machinery, manufacturers can start to predict failure patterns before they happen. The asset can provide data feedback in real-time, which can be analysed.

"Smart" asset management is gaining traction in particular industries such as utilities, as well as oil and gas where large scale machinery and equipment is also business critical, as it is in manufacturing. Being able to predict repair or failure in machines leads to repair prevention or equipment failure. This has an enormous effect on the bottom line and the uptime of operations.

Top opportunities for Industry 4.0

Processes
▸ Predictive maintenance
▸ Optimal servicing
▸ Real-time monitoring
▸ Dynamic repairs

Outcomes
▸ Prevent unscheduled downtime
▸ Improve productivity
▸ Lower cost of maintenance
▸ Boost operations

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You need a strong vision as to why you want to implement Industry 4.0. What does the business need to prioritise? What are your top use cases for speed to value ? This needs to be articulated in a very concrete way. Focus on the business outcomes not the technology."

ROBIN MEEHAN,
MD, INAWISDOM

"
In many companies, the actual asset health is unknown, while relevant data is often being collected and handled by different systems. This leads to considerable amounts of avoidable downtime and inefficiency, which can be overcome with better data sharing and exploitation – a driving force of Industry 4.0."

ANDY FISHER,
MANUFACTURING LEAD, INAWISDOM

A roadmap for a real evolution:
Energy and Resource Use

Energy consumption right now is a huge issue - since prices have skyrocketed in some markets. Shifting the profile of energy use for assets is a significant priority. IoT sensors offer an enormous opportunity to track the usage of energy for machinery.

Power management and energy efficiency matters within factories. Industrial facilities are among the main consumers of energy. Proactive energy consumption capabilities can now be achieved with Industry 4.0 and data empowerment.

COP 26, climate change and ESG issues are driving change in the manufacturing sector. The sustainability agenda is increasingly important. According to the International Energy Agency,[7] industry accounts for 73% of coal, 42% of electricity and 37% of global natural gas consumption. Collected by sensors, interpreted with data analytics, and plugged into predictive models, this information can lead to significant energy savings and emissions reductions.

Advocates of IoT and Industry 4.0 have identified energy efficiency as a significant potential benefit. For instance, the American Council for an Energy Efficiency Economy estimated potential savings of 12 to 22% of all energy consumed, while McKinsey suggests 10 to 20% energy savings. These are significant numbers.[8]

Data also allows manufacturing sites to adjust demand due to energy pricing and availability, refine temperature management and even reduce R&D costs. For instance, by enabling virtual testing and modelling of machines, processes, and plants with digital twins. Machines can also be reconfigured, so production schedules are aligned to use energy when it is cheaper or when renewable sources are available. It is not just energy use, reducing waste and resource use are also increasingly important.

12-22%
estimated potential savings of
of all energy consumed

American Council for an Energy Efficiency Economy

A roadmap for a real evolution:
Supply Chain Optimisation

The digitisation of the supply chain is allowing manufacturers to track the entire movement of parts and products in real time across the globe. Predicting demand more accurately helps businesses optimise their inventory, which results in cost reductions. This can require long-term investment but the pay-offs can be huge

For instance, machine learning can improve forecasting accuracy by up to 20%, potentially leading to a 5% decrease in inventory costs and revenue increases of up to 3%.[9]

Greater transparency and accuracy are key terms here. Real-time asset tracking is crucial, it allows manufacturers to predict supply chain disruptions, lost sales and unnecessary costs. Advanced machine learning algorithms can now help predict demand for a particular item more accurately by analysing data.

The aim is to create 'intelligent supply chains,' they can in turn learn to recognise risks and change their supply chain parameters to mitigate these issues, such as ordering parts or supplies from different countries and factories. In turn this will provide much more business agility.

A roadmap for a real evolution:
Opportunities – Technology level

Industry 4.0 is a blanket term. It describes a toolkit of technology advances and new business models that can transform manufacturing processes, all empowered by data and data analytics. Not every innovation will be deployed by every manufacturer. Once a greater digital and data-driven infrastructure is rolled out, the possibilities to rapidly test and try data use cases and theories out are endless.

Working out what is right for you and what gives you the best return on investment is vital. Industry 4.0 involves understanding more about what your machines and factory space are capable of and then optimising. The following technologies are part of the Industry 4.0 framework:

▸ IoT, Internet of Things devices and sensors

▸ Edge and Cloud Computing

▸ Big data and data analytics

▸ Artificial Intelligence and Machine Learning

▸ Virtual Reality and Augmented Reality

▸ 3D printing automation

▸ Enterprise Resource Planning and Servitisation

The power of edge computing in Industry 4.0

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Manufacturers need more functionality and intelligence close to their machines, the so-called edge, where production actually happens. This is what an edge device does. This allows companies to save, process and analyse data locally, right at the production line.

Edge computers are integrated on the factory floor with IoT devices such as accelerometers, temperature sensors and machine vision sensors to make sense of production activity.

It's truly allowing machines to be more autonomous, since functional capabilities can now happen right where production is occurring. Processing most of the data at the edge and bringing the most important data to the cloud makes sure that your systems are not overwhelmed. It also speeds up analysis and action and enables 'Inference on the Edge' - which is necessary for sensitive or critical data analysis in real time. Deploying IoT and edge devices can reduce cloud traffic by 97%.

The power of edge computing can also help improve operations on the factory floor, boost visibility on your machinery and lead to less unscheduled downtime, as well as fewer interventions from maintenance crews.

Different machines can also be connected. In fact, edge computing is enabling innovative new ways to connect unconnected systems. It can also interact directly with your enterprise resource planning (ERP) system. And with machine learning, edge computing now allows manufacturers to make decisions in real-time and conduct predictive maintenance.

Another benefit is workload consolidation, where organisations can place several different functionalities on to one platform (AI, connection to third party systems, cloud, MES). It's truly a game changer.

We recognise security is of concern. Nowadays systems are of course very secure but the issue is taken very seriously. Data can also be anonymised when it is directed to the cloud; adding another layer of protection.

At the same time as these advancements, private 5G networks are quickening the pace by which IoT sensors, edge computing and the cloud can exchange information. This allows manufacturers to address production issues in record time. It is all about making the factory smarter.

KRZYSZTOF ORNOCH, TECHNICAL SALES SPECIALIST, MANUFACTURING LEAD, INTEL

What can we learn from Intel's rollout of Industry 4.0

Intel is applying predictive maintenance in its chipmaking factories to monitor the health of its fan filter units, which are needed to purify the air inside factory machines. It is deploying Industry 4.0 technology including sensors and edge computing. The aim is to reduce unscheduled downtime, be proactive when it comes to maintenance, and alert technicians when there are potential problems.

Detecting the state of repair of these units used to be a manual process, predicting failures and faults used to be difficult. Now sensors -- accelerometers -- detect vibrations in the fan unit. Baseline data is sent to the cloud. Any anomalies can
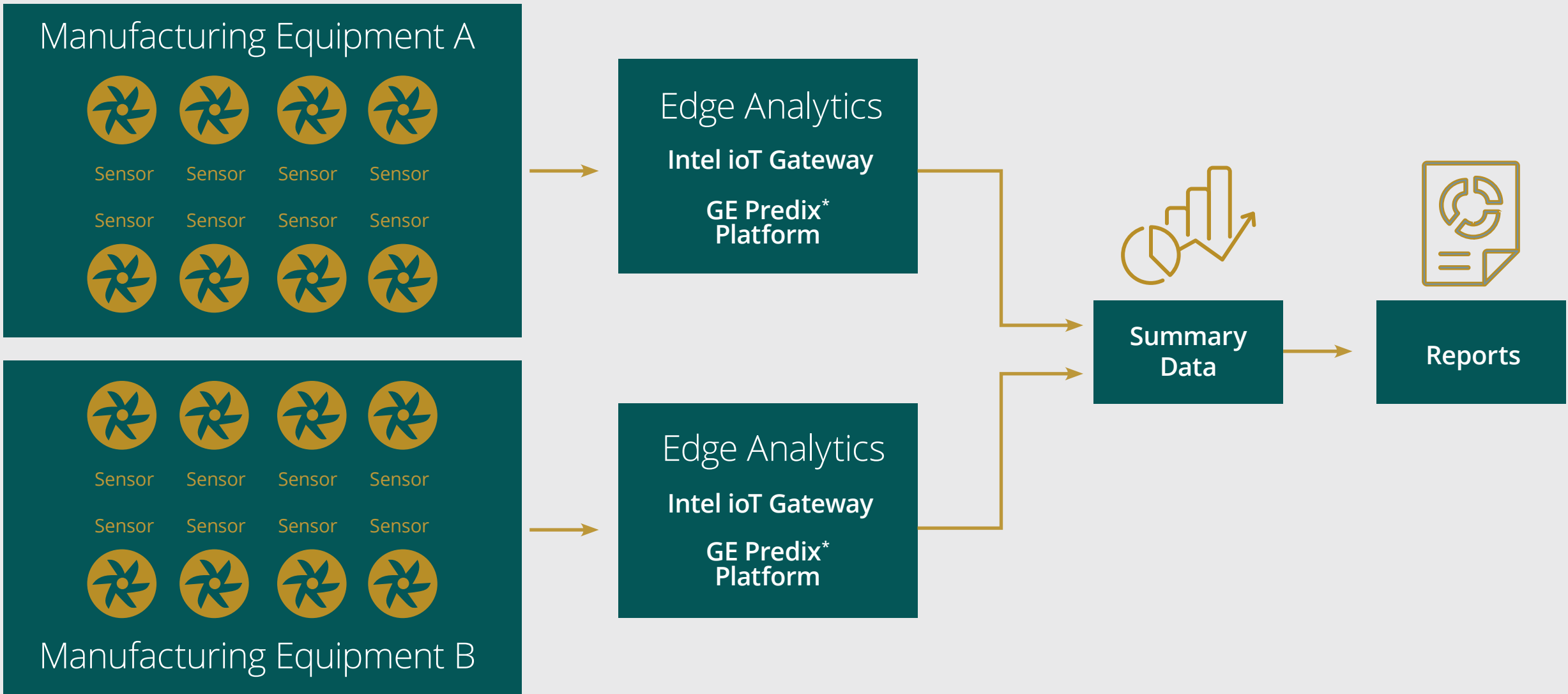
be detected. Edge computing and analytics makes sure data processing happens at the edge, while summary data is sent for reporting.

Intel employed machine learning algorithms to generate real-time alerts. When fan units vibrate more than they should it shows that there is a fault that needs looking at. This is flagged to an engineer. This allowed the chipmaker to better predict the health of its fan units. The key to the success of this project was to start small, prove that the concept could work, realise a ROI and only scale once all the parameters were controlled and set..

Topline ideas for implementing a technology project in Industry 4.0

▶ Start small, realise successes, then scale

▶ Focus on a specific challenge that is discrete and needs attention

▶ Be very clear what value will be realised with implementing Industry 4.0

▶ Prove ROI with the initial investment, since roll out can be expensive

▶ Understanding the data is key. Actionable data is vital

▶ Scaling up creates its own issues, copying the exact parameters matters

▶ Once developed, Industry 4.0 concepts can then be rolled out to different machinery

LUCY ELEY, IT REGIONAL ENGAGEMENT MANAGER FOR EUROPE, INTEL

Manufacturing Equipment A

Sensor · Sensor · Sensor · Sensor
Sensor · Sensor · Sensor · Sensor

Edge Analytics

Intel ioT Gateway

GE Predix* Platform

Manufacturing Equipment B

Sensor · Sensor · Sensor · Sensor
Sensor · Sensor · Sensor · Sensor

Edge Analytics

Intel ioT Gateway

GE Predix* Platform

Summary Data

Reports

Did you know?

6 billion
Points of IoT sensor data per day per factory

300% ↓
reduction in unscheduled downtime

97% ↑
Increase in fan unit uptime[10]

A roadmap for a real evolution:
What are the key benefits of Industry 4.0?

If companies can take advantage of Industry 4.0 technologies, to better visualise and analyse the data they hold, then this can affect multiple manufacturing processes. The potential value of Industry 4.0 is US$3.7tn for manufacturers and suppliers by 2025, according to McKinsey.[11] This demonstrates significant potential benefits.

Key benefits include improved quality, precision and efficiency in manufacturing. This can also be applied throughout the supply chain. Industry 4.0 also gives manufacturers the opportunity to engage with customers and improve service through the product lifecycle. This is because manufacturing products, in time, can be more personalised once production lines are increasingly digitalised.

In this process, manufacturers can also move beyond just selling a product. Industry 4.0 allows businesses to offer a servitisation model.

Top benefits for manufacturers

- The ability to build better products

- Reduce overall manufacturing and supply chain costs

- Manage equipment and predictive maintenance better

- Increase revenue

- Offer products at lower prices

- Decrease time-to-market of new solutions[12]

- Drive service improvements to the end customer

"It's important to understand that automation does not replace humans. Instead, machines (AI) execute what they do best, and humans perform more complex intellectual tasks, such as forming strategies or applying creativity. Thus, the combination of AI and existing knowledge workers essentially creates a massive number of new, 'virtual' knowledge workers that can develop more products and shorten time to market, with an increase in quality and improved features."

ITAY YOGEV, INTEL IT VICE PRESIDENT AND GENERAL MANAGER OF ARTIFICIAL INTELLIGENCE

"Data will define the future of factories. How they are managed, how competitive they are. How processes are optimised, how bottlenecks will be resolved. This is why Industry 4.0 is so important."

ITAY YOGEV, INTEL IT VICE PRESIDENT AND GENERAL MANAGER OF ARTIFICIAL INTELLIGENCE
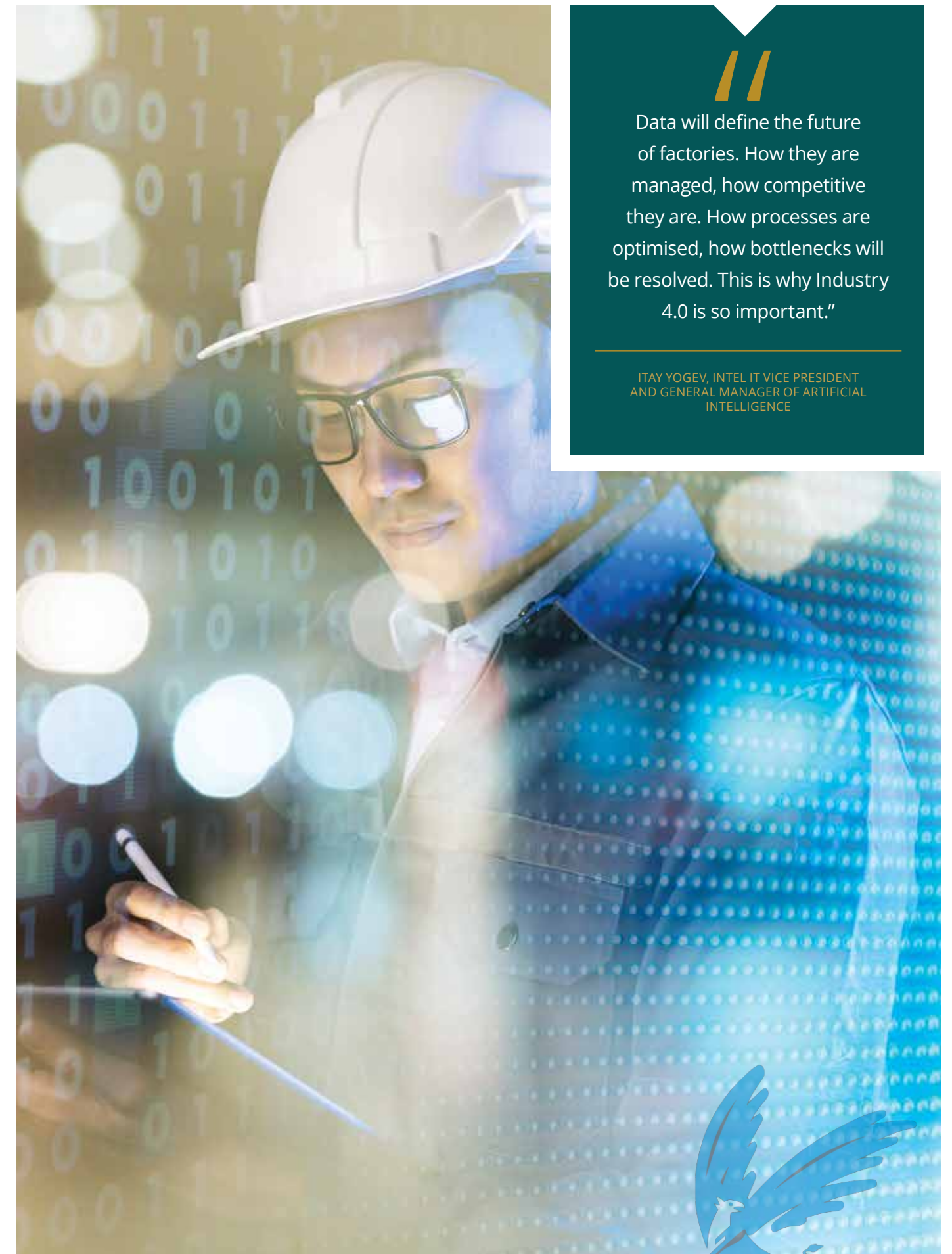
A roadmap for a real evolution:
How do start implementing Industry 4.0 in your business?

A.
Start with a data inventory

Everything with Industry 4.0 starts with data. When starting out, work out what data you have from machinery, tooling and factory floor. This can involve ventilation, heating, gas, water, electricity, various meters, production lines and building management systems. You need a holistic approach, you must assess all assets. It is time for a data audit. This is a discovery process.

B.
Work out mission critical data

Manufacturers produce a lot of data. Work out what could be measured with the right sensors in the right places, which data is mission critical or would be mission critical if you could get hold of it. This could be from certain machines, from energy use or HVAC systems. What data is critical to saving the business money? Can an IoT-enabled environment – consolidating sensor data – better inform your operations?

C.
Focus on business outcomes

What KPIs - key performance indicators - do you want to shift? For many in manufacturing it is an optimisation problem. Manufacturers want to make things, better, faster, quicker or more sustainably. For others it involves reducing costs from outlays whether it be in energy, raw materials or labour. You need a strong vision as to what real business outcomes you want to achieve.

D.
Work out what can be improved

Work out what data controls the things you want to improve. Look to transform a specific system in a smart and flexible way. This can involve using and processing existing data or it could involve installing new sensors on a production line to create new data. The key is to start small and also look to modify a single process, machine or system so that it can be controlled. If you put rubbish data in you get rubbish data out. Prove the case, then repeat.

E.
Make the business case for the project

Plan big, but implement small, plan tactically and strategically. It is also worth focusing on an Industry 4.0 project that is easy to scale up and where it is easy to control the variables and where there is a defined return on investment. Work out what will add real value. Look for early and easy gains. You don't want to wait several years for an ROI. By this time the technology will have changed.

F.
Implement the Industry 4.0 project

Execute for success. Leverage the power of the cloud and flexible infrastructure. Leverage technology partners and experts to get proven results quickly, while involving and upskilling your own systems engineers to implement the Industry 4.0 project. Make sure it is delivered in an agile way, iterating and learning as it is implemented. Modelling for Optimisation (MO-OP) is crucial here. You need to use data insights at scale, perfecting and evolving systems as time progresses. It's imperative you create the right infrastructure at the beginning to allow trialling and refining as you progress and develop.

How does Inawisdom approach Industry 4.0 for success?

Inawisdom are laser-focused on the discovery piece. We help manufacturers in the early consultation phase identify their KPIs. It is something we have a lot of experience doing. The initial meeting with an organisation is crucial. It is all about working out the 'art of the possible.' We then look to design a minimum viable product (MVP) for the manufacturer or move their MVP on with our experience.

The key thing is to demonstrate business value. The aim of Inawisdom is to show businesses where the return on investment will be. We get involved from realising a glorified proof of concept right up to the very end when manufacturers have something that can be implemented globally."

ANDY FISHER
MANUFACTURING LEAD, INAWISDOM

A roadmap for a real evolution:
The role of artificial intelligence and machine learning

The key goal for a manufacturer is to make the most of the data they are producing. Machine learning (ML) and Artificial Intelligence (AI) can leverage data so that it provides insights and is actionable, both are needed if Industry 4.0 is to work effectively in an organisation.

It is about turning a manufacturer from a myopic and reactive organisation to one that is predictive and proactively able to make smarter and faster business decisions, whether it is maximising the utilisation of operating equipment, driving energy and resource efficiencies, or supply-chain optimisation.

The fact is a lot can be achieved at speed today. Traditional data-driven IT projects used to be long-term, long-cycle investments, now within weeks manufacturers can generate ML and AI models, as well as data insights that can revolutionise their business.

At the same time tech powerhouses like AWS and Intel are making cloud and digital tools both accessible, affordable and scalable. They are the engines enabling AI and ML models to be deployed rapidly, securely and cost-effectively. AI is already making an impact by predicting when machines need maintenance or repairs. This enables manufacturers to make changes that reduce the risks to their assets.

In some manufacturing sectors it is highly competitive, markets change swiftly, there is a lot of complex tooling and systems, which have a lot of moving parts. In order to drive innovation and improve profitability, manufacturers now need all the advantages that AI and ML can give them.

Successfully implementing AI and ML in manufacturing requires businesses to shift the culture so that it is more data-driven. This involves collecting data and developing proof of concepts that can provide meaningful insights that help people do their job better. Businesses need to demonstrate the value of data before launching AI/ML models. Employee and executive level buy-in is also crucial in this process. If the business demonstrates how these technologies actually improve business as usual and create an effective, as well as productive environment, it can drive adoption and acceptance.

Using AI and ML in Industry 4.0 projects requires a significant understanding of how it is best used and where, to get the best results. Therefore, it is important that manufacturers collaborate with specialists and trusted partners in this field to reap results.

Most manufacturers don't have the necessary skills and knowledge in-house. After many years of AI and ML models being a distant aspiration for most manufacturers around the globe, today these technologies are real, readily available and affordable. By utilising best-in-class expertise in the first instance, you can guarantee a successful outcome. At the same time, many offer skills transference and training to help bring the project and ownership in-house, post deployment.

Data is rapidly becoming the next battleground in the war on efficiency and productivity in manufacturing, businesses have to be well equipped in this process.

> " Quality control is often a very manual process. If automated it can bring a lot of efficiency into manufacturing process.
>
> It's also about addressing real business problems. Accelerating artificial intelligence and machine learning today is making the impossible, possible, not in the future, but right now."
>
> ANDY FISHER, MANUFACTURING LEAD, INAWISDOM

How Inawisdom can help manufacturers become data-led

Start small and scale. The key point here is to support customers to get them beyond the inertia point, helping them discover the value of basic and advanced data analytics then progress to AI/ML. The aim is to accelerate a proof of concept, prove the value, then implement. This can be achieved within weeks, as specified adjacent .

> " We've seen significant performance improvements, including seven figure sums ploughed directly into the bottom line of businesses or a 70 to 80 percent shift in key metrics with a relatively small investment. Gains come quickly because of the richness of data and the power of the cloud."
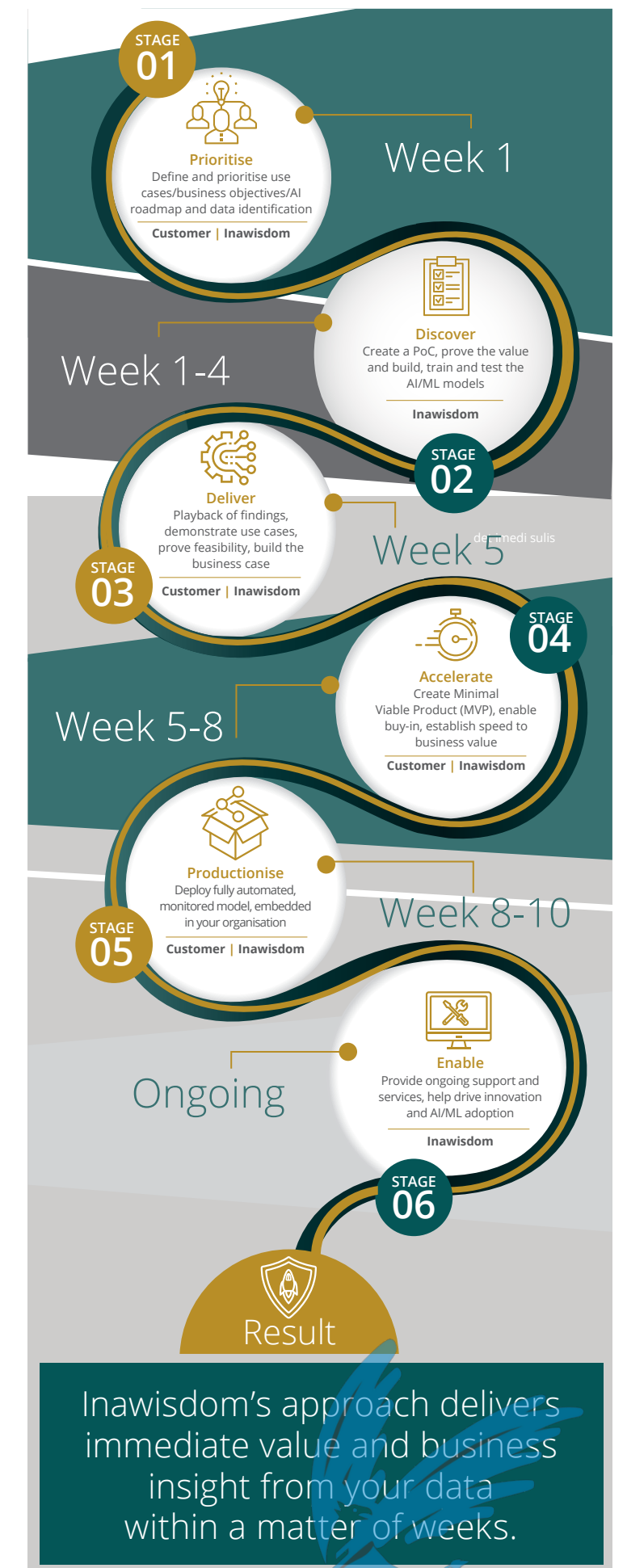>
> ROBIN MEEHAN, MD, INAWISDOM

> " Companies that have already adopted artificial intelligence and machine learning are seeing the advantages right now. Not in the future."
>
> ANDY FISHER, MANUFACTURING LEAD, INAWISDOM

> " Businesses need to know what the art of the possible is. The technology is all there and ready to go. In the next 12 months, we will see a lot of projects that are getting off the ground start to be executed in full."
>
> ANDY FISHER, MANUFACTURING LEAD, INAWISDOM

STAGE 01 — Prioritise — Define and prioritise use cases/business objectives/AI roadmap and data identification — Customer | Inawisdom — **Week 1**

STAGE 02 — Discover — Create a PoC, prove the value and build, train and test the AI/ML models — Inawisdom — **Week 1-4**

STAGE 03 — Deliver — Playback of findings, demonstrate use cases, prove feasibility, build the business case — Customer | Inawisdom — **Week 5**

STAGE 04 — Accelerate — Create Minimal Viable Product (MVP), enable buy-in, establish speed to business value — Customer | Inawisdom — **Week 5-8**

STAGE 05 — Productionise — Deploy fully automated, monitored model, embedded in your organisation — Customer | Inawisdom — **Week 8-10**

STAGE 06 — Enable — Provide ongoing support and services, help drive innovation and AI/ML adoption — Inawisdom — **Ongoing**

Result — Inawisdom's approach delivers immediate value and business insight from your data within a matter of weeks.

The impact of machine learning on chemical production

JM

Johnson Matthey, a global leader in sustainable technologies, has almost 60 years of experience in producing formaldehyde, the base chemical for many types of industrial products. The London-listed company provides formaldehyde producers with technology, complete plants and high-performance catalysts. They have offered long-term technical support to around 200 plants around the world. They also have an active R&D department that is focused on constant improvements in plant performance.

Formaldehyde can be produced in many different ways depending on whether you are focused on yield, energy consumption or reducing waste. All have their own costs and variables.

With a focus on digital transformation across the business and wanting to lead the way in applying innovation to manufacturing processes, Johnson Matthey implemented an advanced data and ML project with Inawisdom, in their formaldehyde sector. This project was to optimise the manufacturing processes, through mass data capture and analysis from hundreds of different sensors taken from across the global plants.

Factors such as power consumption, methanol input and steam pressure were all collected and analysed and the findings shared in an online portal – offering real-time insights to other plants across the world. These insights help predict when a reactor should be stopped and reloaded – positively affecting downtime, maintenance and productivity. Advanced machine learning algorithms and predictive analytics were leveraged to great effect - optimising the formaldehyde production process. The result - a significant, positive impact across the business.
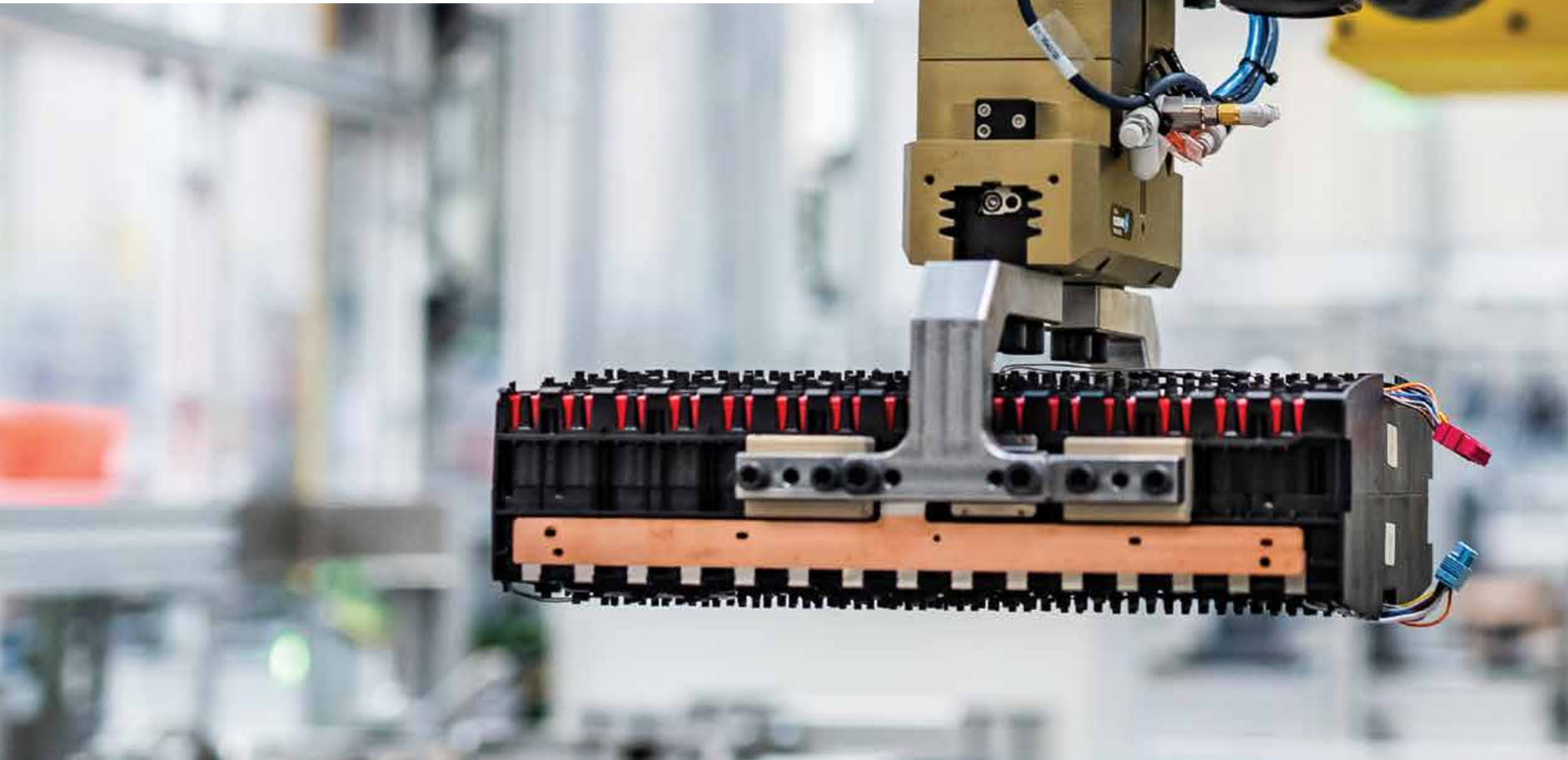
> As a global leader, we have chosen to drive a digital agenda and use our data more effectively to impact the way we do business. Johnson Matthey wants to have a positive impact on the world and by taking advantage of emerging technologies we are able to better improve processes and drive efficiencies that transform manufacturing production. We are expanding our use of AI and Machine Learning across the business as we have seen incredible results already from utilising these on key processes."

RICHARD HEAD,
HEAD OF INNOVATION - JOHNSON MATTHEY
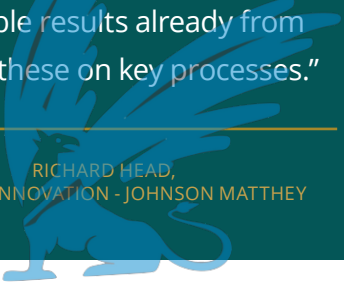
Chapter 03:
Tackling the future

Tackling the future
What is the blueprint for future success?

In a post-pandemic world, with labour issues, supply chain crunches, fierce competition and ever-evolving customer demands, many manufacturers are asking themselves -- how flexible are we? How able are we to meet changing demand? How efficient, robust and resilient are our operations? And how are we able to weather future disruptive events that may have an unprecedented impact on business?

The fact is, for every manufacturing business, standing still is not an option: data, technical, process, cultural and operational changes are all now essential to maintaining competitive advantage. The issue for many small- to medium-sized manufacturers is - how can I tap into the benefits of data and Industry 4.0 developments without the costs and risks inherent in large-scale solutions?

The fact is the blueprint for success doesn't have to be something big. Small-scale digital and data-led solutions are readily available. Concentrating on projects that add specific value, are discreet and boost operations is key. This involves targeted investment. Results can be seen in a matter of weeks, not months.

Lots of low-cost technologies are now available. The key issue is to establish an original business case for change. Is there a solid business case for adopting a specific element of Industry 4.0? How is this going to be measured? What are the the productivity gains? Is it going to save costs? Is it related to operational efficiency or energy savings? Or is it focused on keeping up with competitors in the market?

There is no one-size-fits-all solution. Working with legacy IT infrastructure is also crucial. Industry 4.0's technology and data

benefits are now very clear; what is needed is your commercial model that enables the acceleration of adoption.

And with the computation power of the cloud and AI as well as ML algorithms, a lot can be achieved. Learnings can be used to optimise processes in factories in affordable ways that were not possible up until several years ago. Huge gains await manufacturing firms that make the change. Investment made in this area will handsomely pay off.

The fact is, that next phase that companies are readying themselves for is Industry 5.0, where people and automated systems will work together. New data-enabled technologies are in the offing. These are stoking the flames of innovation further.

" We have a strong methodology for helping our manufacturing clients on their journey of becoming more data-led, data-enabled. It is the future."
ROBIN MEEHAN, MD, INAWISDOM

Time for Industry 4.0: The next stage in the data revolution

Areas of technology to watch

Private 5G networks -

can support new multiple use cases and services, such as ultra-HD video surveillance with increased predictability, better coverage and the ability to support a lot more data. Industrial 5G is the gateway to an all-encompassing, wireless network for production, maintenance, and logistics. Expect ultra-reliable transmission, and extremely low latencies will allow significant increases in efficiency and flexibility.

Computer vision -

Allows computers and machines to 'see' the physical world by enabling them to extract, process, and analyse information from images and videos. AI cameras now exist as well. They use artificial intelligence to make sense of visual material. For instance, spotting whether a human has health and safety equipment on or PPE.

Digital Twins -

Real time data-led simulations can help manufacturers achieve new levels of innovation, efficiency and productivity. Digital twins of factory operations or machinery can predict when maintenance is needed or when breakdowns will occur, or optimise processes. They are fuelled by data in real-time that is constantly optimising and re-optimising the model. Digital twins can also be used before a real machine is put into operation in order to save costs.

Augmented Reality -

Manufacturers are superimposing virtual elements constructed from CAD and other data onto views of real objects and machines. It is this superimposition of the virtual upon the real that differentiates AR from VR. This can be used to support the maintenance activities of employees with visual access on the spot to product guides. AR can also be used to provide contextual information about machinery in real-time, in real-space. It can also be used for training.

AI + ML techniques -

We're not just talking about intelligent decision making in real-time. AI and ML are being used in tandem with many other technologies on the factory floor. For instance, deep-learning can be used with image-augmentation to maximise the efficiency of visual inspection systems in manufacturing when it comes to quality control, as well as health and safety. Its use in machine or computer vision will be significant. It can also be used in supply chain management including predicting demand and reducing waste and energy use. Expect more when it comes to Product Lifecycle Management and so-called Lights-Out Factories where AI and ML use means minimal human intervention. This lets companies reduce costs particularly with lighting.

Quantum computing -

This is expected to help develop breakthrough products that will disrupt and redefine manufacturing. Product development, chemical discovery and process optimisation are areas where quantum computing works best. Modelling is its preferred use case, since this type of computing, as opposed to classic computing, can optimise systems, products and processes at a much faster rate. Combined with simulations, such as digital twins, a lot more will be achieved.

> By embracing new technologies, new data and new ways of working, UK manufacturers have an opportunity to reinvigorate the sector. Those that fully embrace Industry 4.0 stand to benefit the most. The time is now."
>
> ROBIN MEEHAN, MD, INAWISDOM

Did you know?

Greater digitalisation of the industry could add

£455 billion

to the UK economy, improve productivity by

25%

and increase manufacturing sector growth by between

1.5–3.0% per year.

(Source: the Made Smarter Review)[15]

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About Inawisdom

Inawisdom was founded in 2016 and is a leader in AI
Artificial Intelligence (AI) and Machine Learning (ML).
They are specialists in advanced analytics, BI/MI and
Data Science, providing full-stack Amazon Web Services
(AWS) Cloud and Data Services, working with global
organizations across UK and EMEA. Inawisdom is an
AWS Premier Services Partner, a Machine Learning
Global Launch Competency Partner and also holds
further competencies in DevOps, Financial Services
and Data and Analytics. In 2020 Inawisdom was
acquired by Cognizant.

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