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The Manufacturers' Organisation

DEMYSTIFYING DIGITALISATION:

THE MANUFACTURERS' GUIDE TO DATA-DRIVEN DECISIONS

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INTRODUCTION

This guide is aimed at manufacturers who are considering an investment in digital technologies. It demystifies digitalisation and presents the case for implementing technologies and processes that can address manufacturers' problems and create growth opportunities. This guide provides methods for companies to overcome barriers to successful digitalisation and reap the rewards of their investment: increased productivity, efficiency, working towards net zero goals and profitability.

This approach provides manufacturers with a helpful, five-step process to digitalise their factories, from vision to optimisation. To illustrate how this can be accomplished, we have included a case study from NGF Europe Limited with the support of Amazon Web Services (AWS), which has successfully digitalised its business and is now enjoying the resultant benefits.

DIGITALISATION IN UK MANUFACTURING

The UK manufacturing sector has undergone a significant transformation over the last five years. Driven by a global pandemic, technological innovation, environmental awareness and economic change - manufacturers have been increasing investment in digital technologies and processes to make their operations cleaner, greener, safer, and more productive. The sector is now more competitive than ever, creating higher-paying jobs requiring increased skill levels and developing better products.

But what does digitalisation in manufacturing really mean? Are firms already doing it? And if so, what stage of their digital journey have they reached?

Let's delve into the topic of digitalisation in the UK manufacturing sector.

WHAT DOES DIGITALISATION IN MANUFACTURING MEAN?

In its simplest form, digitalisation is a process by which companies embed technologies into their business to drive change. This change can be applied to processes or projects or, increasingly, a combination of the two.

Many people associate digitalisation in manufacturing with the fourth industrial revolution (4IR). 4IR has typically focused on advanced analytics, connectivity, communication, big data and automation. 4IR has created what has become known as the 'smart factory'.

The smart factory is a change from more traditional types of automation to a fully connected and flexible system. Within smart factories, the use of big data, additive manufacturing and analytics has quickly become the norm, and technology is evolving at a fast pace. The Internet of Things (IoT) has enabled factories to connect digitally, linking machines not just across a single factory shop floor, but also across multiple locations and delivering different types of industrial data, to provide global context and enable businesses to address operational risks and opportunities.

Manufacturers are now able to receive real-time data thanks to the integration of sensors in factories. Having access to real-time data is important for all businesses to boost agility, improve performance and productivity, apply corrective measures, if needed, and enhance awareness. Companies who have digitalised their businesses have data around maintenance requirements at their fingertips, allowing them to improve their processes which, as we explore later in this guide, can deliver tangible business benefits.

ARE MANUFACTURERS ALREADY DIGITALISING THEIR BUSINESSES?

Make UK's wider research[1] reveals that manufacturers are increasingly digitalising their businesses. Looking at the four key stages of digitalisation, we can identify where companies are on their digital journey.

This guide aims to demystify digitalisation from start to finish and provide support to the manufacturers who do not know where to start, as well as those already on their digital journeys.

Pre-conception: Companies who are not considering digitalisation within their businesses.

Make UK research reveals that almost one in five (18%) manufacturers are at this stage. This is the cohort of companies who need the most support.

Conception: Businesses who are thinking about digitalisation.

25% of UK manufacturers are currently at this stage. At this stage, companies are exploring their options, which may include digital tools, guidance, and support

[1]In 2022, Make UK published a report, 'Digital adoption: the missing link in productivity', which used survey data provided by over 200 manufacturers.

for successful implementation, as well as strategies for maximising the benefits. They may seek advice from impartial sources, including peers and competitive intelligence on how to successfully digitise their own business operations.

Evolution: Firms who are transforming their businesses through digitalisation.

Almost half of the manufacturers we surveyed in 2022 said they were at this stage. Arguably, this is the most intensive stage for companies that have set out a strategy they are beginning to implement. They are driving change and are using digital technologies to produce data-driven operational efficiencies and increase innovation.

Revolution: Manufacturers who are reaping the benefits from successful digitalisation.

Less than one in ten (8%) UK manufacturers are currently at this stage. These companies have moved from setting out a vision and strategy to optimising the tools they have employed. They are the 'smart factories' within the manufacturing sector.

Overall, manufacturers are pressing ahead with their digital journeys, and those that set out a vision and an early strategy will likely be reaping the benefits of doing so. However, too many manufacturers remain in the pre-conception and conception phases. Manufacturers in these cohorts need to gain a better understanding of the case for digitalisation, which we address in the next section of this guide.

THE CASE FOR DIGITALISATION

WHY SHOULD MANUFACTURERS DIGITALISE?

Manufacturers are natural problem solvers. As well as providing solutions, they also find new opportunities. The same is the case for digitalisation. Digitalisation can solve problems within a manufacturing business and create new opportunities. While not an exhaustive list, below are some of the reasons why manufacturers should embed digital technologies in their businesses.

Solving Problems

Digital transformation is changing how businesses operate, offering unprecedented opportunities for cost savings and increased efficiency. Manufacturers can streamline operations, reduce waste, and eliminate inefficiencies by leveraging the latest digital transformation tools and technologies, which improves their sustainability and helps reach net zero goals.

Reducing costs to the business

We know that costs, labour, and skills are manufacturers' top priorities. With reduced costs topping the table as the main benefit behind adopting digital technologies, many manufacturers see it as an investment that pays for itself.

67% of respondents[2] said that their past investment in digital technologies paid off and they were better prepared to weather the storm such as global pandemics, supply chain volatility and labour shortages.
Wider Make UK research found that over half (56%) of manufacturers cited implementing digital technologies reduced costs and improved productivity, with 62% reporting energy cost savings.

Tackling the labour shortage

The manufacturing industry suffers from acute labour shortages: there are circa 70,000 live vacancies in the sector, and we expect this to grow further. Manufacturers require access to both long-term skilled labour and immediate labour to fulfil orders and continue operations. An extremely tight labour market and high turnover in the sector are putting significant pressure on firms to pay more and offer better benefits to retain their existing talent. It is becoming harder to recruit the skills needed today.

Digitalisation can alleviate the labour shortage by replacing low-skilled, manual and often repetitive tasks with automation.

Driving efficiencies

Smart factories mean more intelligent, efficient processes which will keep manufacturing relevant, successful, and competitive.

Manufacturers have made specific electricity and gas cost savings, too. 42% of firms surveyed have saved between 2-19% on electricity, while 34% have saved the same on gas.

Improving safety in the workplace:

Manufacturing automation and digital workplace tools can help businesses stay on track and meet new and existing equipment and safety guidelines for employees in a post-pandemic world.

Workplace injuries have decreased significantly in the last 50 years. With even more of a focus on digital workplace safety with the assistance of automated tools, that number could decrease further. Today, manufacturing companies can assign laborious, dangerous tasks to robotic devices and heavy items can be lifted using equipment, reducing the risk of worker injuries.

For example, connected sensors allow manufacturers to monitor factory operations in detail to improve efficiency and productivity, perform predictive maintenance, increase safety, and improve quality control.

[2]In 2022, Make UK published a report, 'Digital adoption: the missing link in productivity', which used survey data provided by over 200 manufacturers.

Creating new opportunities for the manufacturing workforce

Digital transformations are changing the manufacturing industry, impacting processes, productivity, and people. The right technology can improve decision-making, offer opportunities for upskilling and cross-functional collaboration, attract and retain better talent, and enhance workplace safety and employee satisfaction.

Bringing digitalisation and other aspects of 4IR into the manufacturing space is making the industry a more attractive workplace for the next generation of future employees and retaining the best, experienced staff.

Moreover, increased investment in digital technologies will create demand for highly skilled and, therefore, better paid jobs.

More than a third of companies (37%) said that job opportunities had increased within their business, while more than four in ten companies (42%) said they needed higher-level skills as a result.

We may finally see the end of the long-held conviction that manufacturing is a low-skilled industry: the sector could become increasingly competitive with traditionally "desirable" sectors for staff and graduates.

Increasing productivity

Digital manufacturing allows manufacturers to streamline processes, decrease the need for manual inventory, enhance quality, accelerate time to market, provide data driven operation of machinery with the use of predictive maintenance, respond to customer demands quickly, and expand their product offerings. When asked about productivity, 40% of manufacturers experienced increased productivity after implementing digital tech.

Manufacturers understand which digital tools and technologies can boost their business. 75% of manufacturers believe IoT very strongly impacts productivity gains in their business. These tools are faster and smarter; they can run on the live data fed into their software.

Offering better quality products to customers

Throughout every stage of production, IoT sensors can monitor product quality by detecting defects or deviations from specifications early on. This enables manufacturers to take corrective actions promptly, reducing waste and ensuring that only high-quality products reach the market. Digitalisation provides data-driven product investment. This digital intervention improves process knowledge, reducing scrap and wastage and delivering better quality products, satisfaction, and loyalty of customers.

Providing better service to customers

Make UK research shows that 58% of manufacturers, after investing in digital technologies, move faster and produce new critical components.

IoT enables mass customisation by allowing manufacturers to collect data on customer preferences and usage patterns. This data can be used to tailor products to individual customer needs, leading to higher customer satisfaction and loyalty.

IoT can provide end-to-end traceability of products, making it easier to track and recall products if quality issues arise. It can also help to avoid order bottlenecks and is especially important in industries like food and pharmaceuticals, where safety and compliance are paramount.

Improving sustainability

There are wider benefits around sustainability, too. For example, by implementing sensors such as usage meter readers, businesses can become more sustainable and improve waste production energy efficiencies within a manufacturing business. These benefits are now being realised across the sector. Around a third (34%) of

manufacturers said that digital adoption improved energy efficiencies, and a third said process improvements contributed to reducing emissions. All of which are vital in achieving the sector's net zero ambitions.

Enabling innovation

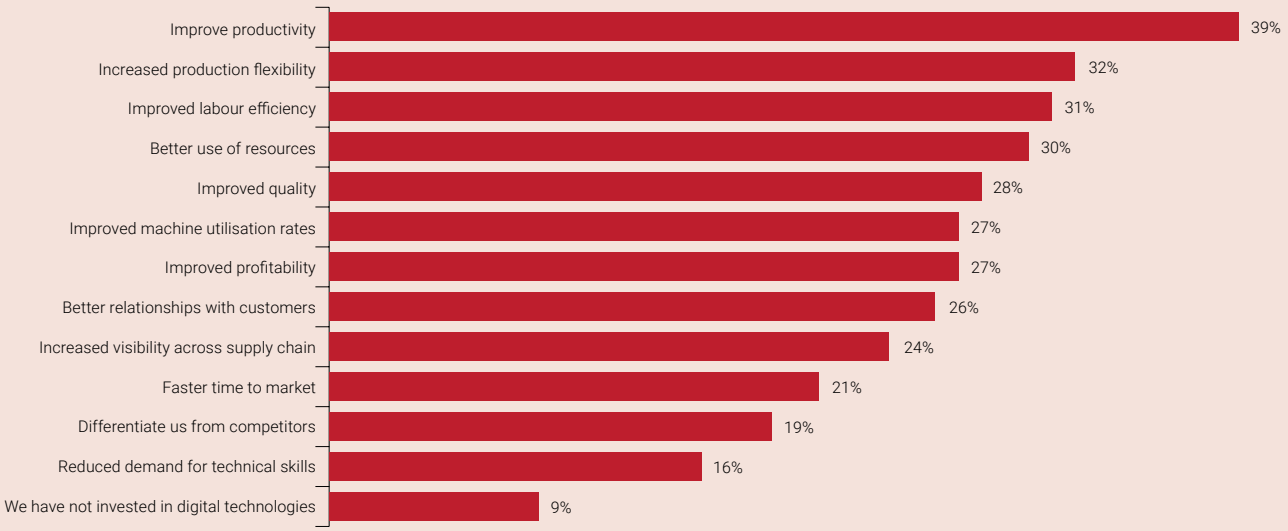
Digitalisation allows businesses to continually learn and adapt, whilst gathering data and feedback from users and systems. This information can be used to amend and evolve products and services in response to changing customer needs and market dynamics.

Digital tools and technologies enable rapid prototyping and testing of ideas and concepts. This iterative approach to innovation allows companies to quickly experiment with new features or products when using 3D printing or simulation. Manufacturers can gather feedback and make necessary adjustments before a full-scale launch.

26% of manufacturers experienced faster time to market, better quality, and better relationships with customers improving their overall competitiveness. In the current economic climate, it is vital for businesses to stay ahead of their competitors.

Manufacturers we surveyed in 2022 identified many of these benefits. Improved productivity was the most cited benefit, followed by increased production flexibility and improved labour efficiency.

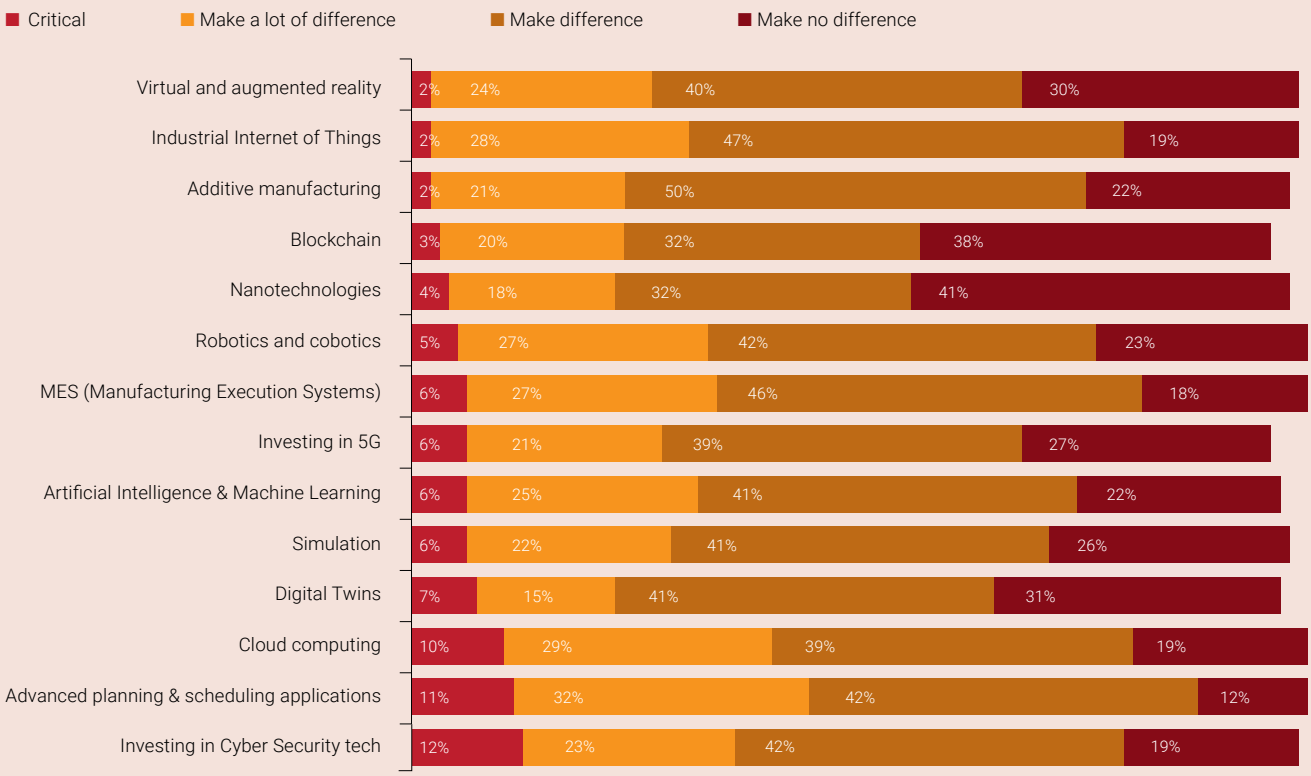
Chart 1: Increased productivity tops the benefits of adopting digital technologies



Source: Innovation Monitor (2022), Make UK/Infor

Productivity improvements are a key metric for setting out the business case and return on investment. In 2022, we looked at which digital technologies made the most impact regarding productivity improvements. Advanced planning and scheduling applications came out on top, closely followed by Cloud Computing and IoT.

Chart 2: Digital technologies and tools that most improve productivity



Source: Innovation Monitor (2022), Make UK/Infor

WHAT IS THE BUSINESS CASE FOR INVESTMENT?

A key stage in digitisation is building a business case to justify the investment in digital tools and technologies. Every investment comes at a cost, but with digitalisation, the returns can be quantified on a case-by-case basis. There is potentially a myth around how long it takes for a return on investment, as 75% of manufacturers we surveyed expect to see a return in 1-5 years. However, this will be dependent on the type of digital tool and technologies manufacturers are implementing and the problem they are trying to solve.

Additionally, a well-planned and cost-effective pilot project can provide reliable data to support decisions on digitalisation and capital expenditures. In the next section, we explore what digital tools and technologies are available to manufacturers and how these can be deployed effectively across the manufacturing business.

WHAT DIGITAL TOOLS AND TECHNIQUES ARE AVAILABLE TO MANUFACTURERS?

The fourth industrial revolution has brought digital advancement and unprecedented digital transformation. There is now an array of digital technology vendors in the marketplace, meaning manufacturers can choose from hundreds of solution-focused tools and technologies to improve their processes. These include:

- **Analytics and intelligence:** big data, Artificial Intelligence (AI) and Machine Learning (ML), Generative AI, Digital Twins and advanced analytics
- **Production method advancements:** Additive manufacturing
- **Human to machine and machine to human interaction:** Industrial robots, Collaborative Robots (Cobots) and Robotic process automation
- **Data and connectivity:** IoT, blockchain, cloud technology and sensors

HOW CAN THESE BE APPLIED ACROSS A MANUFACTURING BUSINESS?

Implementation of digital technology solutions is not limited to the shop floor. From the production line to the back office and the board room, digitalisation can be integrated and used across the whole manufacturing business. When we talk about a 'smart factory', we include smart buildings – sustainable, fully digitalised buildings with the required infrastructure. Another common myth is that digitalisation is focused solely on driving efficiencies, improvements, and productivity on the shop floor. In fact, Make UK research shows that digitalisation is more likely to first be implemented in the back office, HR, payroll and project management, before then being integrated across the entire manufacturing workplace.[3]

There is an increasing focus on the use of digital technologies in production areas such as equipment maintenance, with 45% of businesses introducing new digital tools and manufacturing infrastructure. This is likely driven by both the market and readily available products such as AI and ML and tools such as IoT that can be implemented behind predictive maintenance.

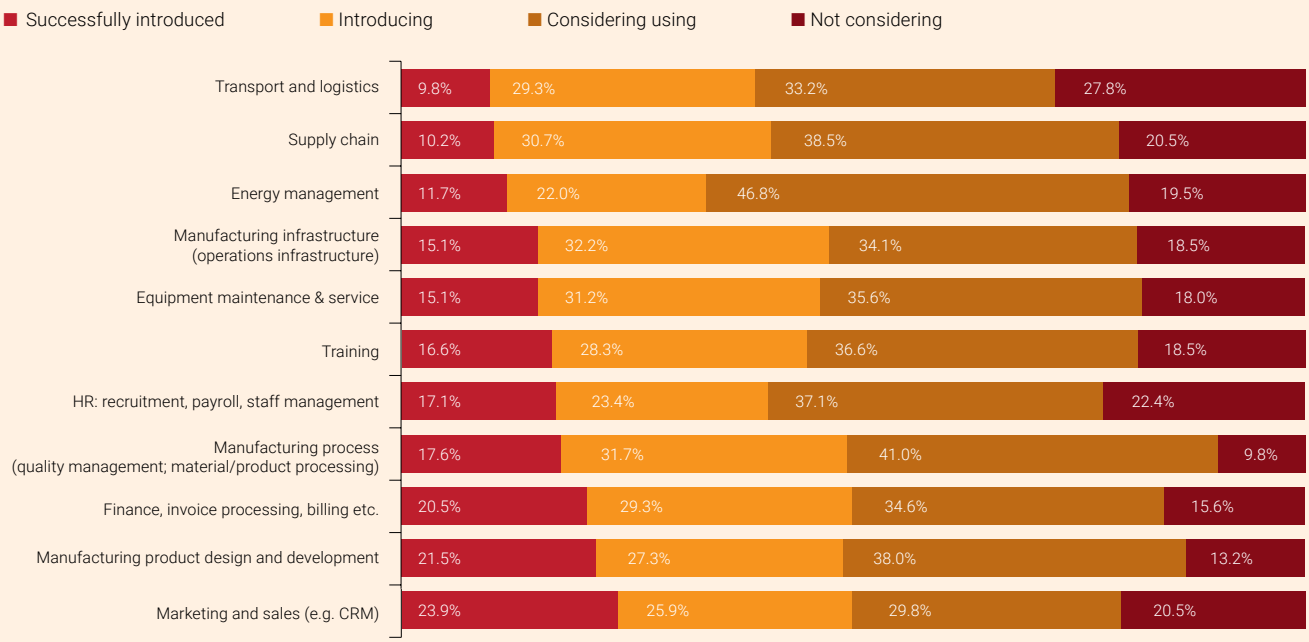
Three in ten (30%) manufacturers are using digital technologies for supply chain management, and a further 40% are considering it. Recent developments proved to manufacturers that better visibility and control of their supply chain are important, and digital technologies can play a critical role.

[3]Make UK, Innovation Monitor (2022), Digital Adoption: The Missing Link in Productivity Growth | Make UK

Surprisingly, given rising energy costs and the need for companies to reduce consumption, manufacturers are not yet adopting digital technologies for the purposes of energy management – which would help them monitor and, subsequently, reduce consumption.

That said, almost half of manufacturers' businesses are considering using these technologies to manage energy efficiency. They may need support to understand which tools work best for the problems they are trying to solve.

Chart 3: Spread of digitalisation across the business



Source: Innovation Monitor (2022), Make UK/Infor

OVERCOMING BARRIERS TO SUCCESSFUL DIGITALISATION

WHAT BARRIERS MIGHT MANUFACTURERS NEED TO OVERCOME ON THEIR DIGITAL JOURNEY?

With so many benefits to digitalisation, one may question why manufacturers aren't taking advantage of this exciting opportunity. The truth is that some face barriers. These barriers typically fall into four overarching categories: Skills, Funding, Knowledge and Expertise, Culture and Leadership.

Skills: Access to skills is a significant barrier for manufacturers to digitalise.

To take advantage of digital technologies, manufacturers must continue to adjust their talent strategies to reflect the need for digital skills to be obtained and refreshed throughout an employee's career. This may range from basic digital literacy and the ability to use information and communication technology across different workforce roles as part of day-to-day operations, to more advanced technical skills needed as automation increases and to deploy major new technology as part of the production. More than 70% of manufacturers are prioritising digital skills for investment both now and over the coming years, with areas such as IT and software management, cyber security and data analysis identified as related areas where demand is expected to increase between now and 2030.

But it's not just technical skills that are needed. The acceleration of digital technologies is taking over businesses around the globe. The market is vast and can be confusing. Not all solutions will fit every business, and it is difficult for businesses to navigate what is right for them. Support around where to start and what is needed is crucial and cited by 30% of survey respondents to encourage manufacturers to invest in digital technologies to help them decarbonise.

Manufacturers are pragmatic: before they invest, 46% would like to understand the potential return on investment for these types of new digital technologies.

Funding: As set out earlier in this guide, many manufacturers develop a business case for future investment to digitalise their processes. This involves budgeting for digital tools, technologies and techniques for their business to grow. While the business case can be strong, the costs associated with such investment, particularly during tough economic conditions, can mean that funding, or indeed access to finance, is a barrier to digitalisation. In fact, 70% of manufacturers cited access to funding as an obstacle.

One way of addressing this is to ensure that a company is making the strongest business case possible, citing the quantifiable returns on investment. The other is looking at what financing options are available. This might be loans from a bank. It also might be programmes of support such as Made Smarter, where grants are available; or tax reliefs, for example, utilising the annual investment allowance, full expensing and/or the R&D tax relief scheme.

Knowledge and expertise: Almost half of manufacturers said they would accelerate digital adoption if they had access to impartial specialist technical advice. 45% would like more information and guidance on how to adopt digital technologies. Over two-fifths want peer-to-peer programmes, including learning best practices.

Manufacturers agree that encouraging digital adoption in Small to Medium Enterprises (SMEs) is hard work. It is unlikely to happen by just waiting for the SMEs themselves to act. SMEs need the spare capacity, or the additional skills required to undertake digital transformation - even if they have identified this as a strategic necessity. And – as Make UK's research shows – SMEs can be confused by the range of options, technologies and services being marketed to them. This means that a concerted effort by 'digital ambassadors'

- with the relevant technical, process and change management expertise - is needed to create relationships with SMEs and provide impartial advice. Regional SME advisory services must be strengthened to include technical, process and change management expertise linked to industrial digitalisation.

Culture and leadership: Buy-in from employees is a fundamental part of the digitalisation journey. However, manufacturers must first obtain buy-in from leaders and managers, which is still cited as a barrier to digital adoption. Likewise, business cultures that don't embrace change can prove problematic, as it is a fundamental change that digitalisation seeks to achieve.

These are perhaps the hardest challenges to overcome because much of this is internal. Embedding a culture of change must come from the top and be cascaded across the business. We explore this in the following section of the report.

A Make UK survey from 2021, "Cyber Security the last line of defence", has shown that just under half of manufacturers have been the victim of cybercrime in the last 12 months. Of those companies that experienced an attack, 63% said it cost them up to £5,000, while almost a quarter (22%) revealed a cost to their business of between £5,000-25,000. It is unsurprising to see 1 in 8 manufacturers agree that Cyber Attacks deter them from digital adoption. This fear is understandable. However, the existing risks of mal-intended access to old, often vulnerable machines and processes, and lack of operational tech software back-ups could lead to lengthy, unplanned downtime.

Our research shows that digital technologies are making a positive impact on cyber security. More manufacturers understand that the multiple millions invested in security by the market-leading hyper scalers afford far more security than any individual company could manage. These companies invested in technologies such as computing, storage and 5G private networks, while others created resilient platforms to store data more securely and access expanded capacity.

Overcoming existing operational and future cyber risks can be achieved with well-designed IT and OT networks with firewalls. External audits of equipment, machines and control systems help to identify security or safety risks.

A DIGITALISATION SUCCESS STORY: NGF EUROPE

NGF Europe Limited is a subsidiary of the NSG Group, one of the world's leading manufacturers of glass products. NGF Europe is at the forefront of the design, manufacturing and marketing of specialised glass cord products used in synchronous drive applications. Primarily used in the automotive industry, NGF Europe cord is also used in belts for domestic appliances as well as industrial machinery, office equipment and power tools.

To accelerate its digital transformation journey, NGF Europe embarked on several smart manufacturing projects to gain real-time monitoring capabilities across its production site. These capabilities allow the company to reduce equipment downtime, improve production efficiency (OEE) and reduce waste.

THE CHALLENGE

One specific project at NGF Europe required multiple key parameters to be captured across various machines and sent to AWS for further analytics and long-term storage in the company's cloud database. Because the St. Helens factory has been in production since the mid-1990s, machinery dating back to this era is still being used.

Connectivity - such as OPC-UA - is an issue with this older machinery and one case in point is the coating baths, which draw thin cords of glass fibre through a bath of liquid latex. To ensure consistent coating bath levels, NGF Europe needed an accurate and reliable solution. NGF Europe had multiple requirements for an IIoT-to-Cloud solution:

1) Selected hardware, like gateways and sensors, needed to stand up to harsh environmental conditions like heat and a dusty environment, commonly found in glass manufacturing sites.
2) The solution had to be easy to use while being flexible enough to fit most IIoT use cases and scalable within the St. Helens factory.
3) The solution had to seamlessly integrate into AWS IoT Core and AWS IoT SiteWise – a managed service that enables the collection, organisation and analysis of data from industrial equipment at scale.
4) Most importantly, the solution needed to meet the strict IT security and safety requirements of NGF Europe.

THE SOLUTION

In its search for an easy-to-use and scalable IIoT to cloud solution, NGF Europe was introduced to CloudRail by AWS. CloudRail's global hardware partner, IFM Electronics, assisted NGF Europe in selecting the right sensors for each case. A laser-distance sensor, for example, was selected for measuring the depth of the liquid in the latex bath. Once NGF Europe's production engineers and maintenance team completed the wiring project, the CloudRail connectivity solution was easily installed. Then, with just a few clicks, the liquid latex bath sensor was not only connected to AWS IoT Core, but it was also sending dashboarding data and real-time production information to the shop floor. Since CloudRail functions as a Plug&Play solution for industrial sensors, it is easily accessible to IT staff and production engineers. The NGF Europe team connected the machines to AWS

IoT SiteWise, where all assets are managed. Furthermore, CloudRail's edge computing functions were used to trigger the locally installed LED light when certain thresholds are reached, to indicate how much dip is in the bath.

NGF Europe is now ready to deploy at scale additional solutions including Energy Optimisation with the AWS partner Crowley Carbon, Digital Twins for factory monitoring with AWS IoT TwinMaker alongside AWS IoT Partners Matterport and the Industrial IoT System Integrator Storm Reply. NGF Europe is also using Artificial Intelligence on top of its data (through the AWS Industrial AI service Amazon Lookout for Equipment) to avoid unplanned downtime by automatically detecting abnormal equipment behaviour.

"I REALLY APPRECIATED THE SEAMLESS CONNECTIVITY TO THE AWS SERVICES. IT REDUCED SET-UP TIME AND ALLOWED US TO RUN FAST POCS TO IDENTIFY PROMISING PROJECTS. USING THE EDGE COMPUTING FUNCTIONALITY ALLOWED US TO CREATE A LOCAL FEEDBACK LOOP WITH A STACK LIGHT, WITHOUT REQUIRING ADDITIONAL PLCS OR OTHER IOT TECHNOLOGY."

Peter Lai, Continuous Improvement & 4IR Manager – NGF Europe Limited.

THE BENEFITS

Having successfully implemented the project, the laser-distance sensors functioned as an advanced operator alerting system. Custom Grafana dashboards give a real-time overview of both levels and make it easy to track asset conditions for process leaders and production operators.

In addition to the dashboards, local feedback loops with LED lights warn if machines or processes enter critical states, like low filling levels. This has allowed NGF Europe to implement processes to proactively refill the latex in the baths- preventing the waste of materials and increasing production efficiency. The reduced effort of checking baths manually by factory operators has led to increased job efficiency and allows operators time to attend to other critical tasks. The CloudRail solution enabled NGF Europe not only to connect machines and sensors quickly to AWS, but also to save time when trialling and testing, during their proof-of-concept stage. Using CloudRail's Device Management Cloud (CloudRail.DMC), all updates and security patches are rolled out remotely with just a few clicks.

"CLOUDRAIL WAS RECOMMENDED TO US BY AWS AS A FAST, SCALABLE, AND SECURE WAY OF CONNECTING OUR ASSETS TO THE CLOUD. WE ARE ABSOLUTELY IMPRESSED WITH HOW SEAMLESSLY WE WERE ABLE TO ACQUIRE IIOT DATA WITH CLOUDRAIL, EVEN FOR MORE COMPLEX USE CASES AND OLDER MACHINES."

Peter Lai, Continuous Improvement & 4IR Manager – NGF Europe Limited.

CONCLUSION

With CloudRail, NGF Europe can quickly connect machines to AWS IoT for the implementation of IIoT projects including digital and smart manufacturing initiatives. NGF Europe can assess potential IIoT projects in a PoC within hours. This allows the company to then focus on projects with the most business value, which can then be rolled out across the site. This proof of concept was scaled from one machine to several others within the area. The projected cost savings from just this project alone are over £12k a year in waste reduction of raw materials.

TOP TIPS:
LESSONS LEARNED FROM MANUFACTURERS WHO HAVE DIGITALISED THEIR BUSINESSES

When we surveyed manufacturers who had been through their digitalisation journey, they shared lessons learned. Here is what they told us:

UNDERSTAND
WHAT DIGITAL TECHNOLOGIES ARE AND HOW TO USE THEM

HAVE A CLEAR VISION FROM THE OUTSET

HAVE A PLAN FOR TRANSFORMATION
THROUGH A SERIES OF SMALL STEPS

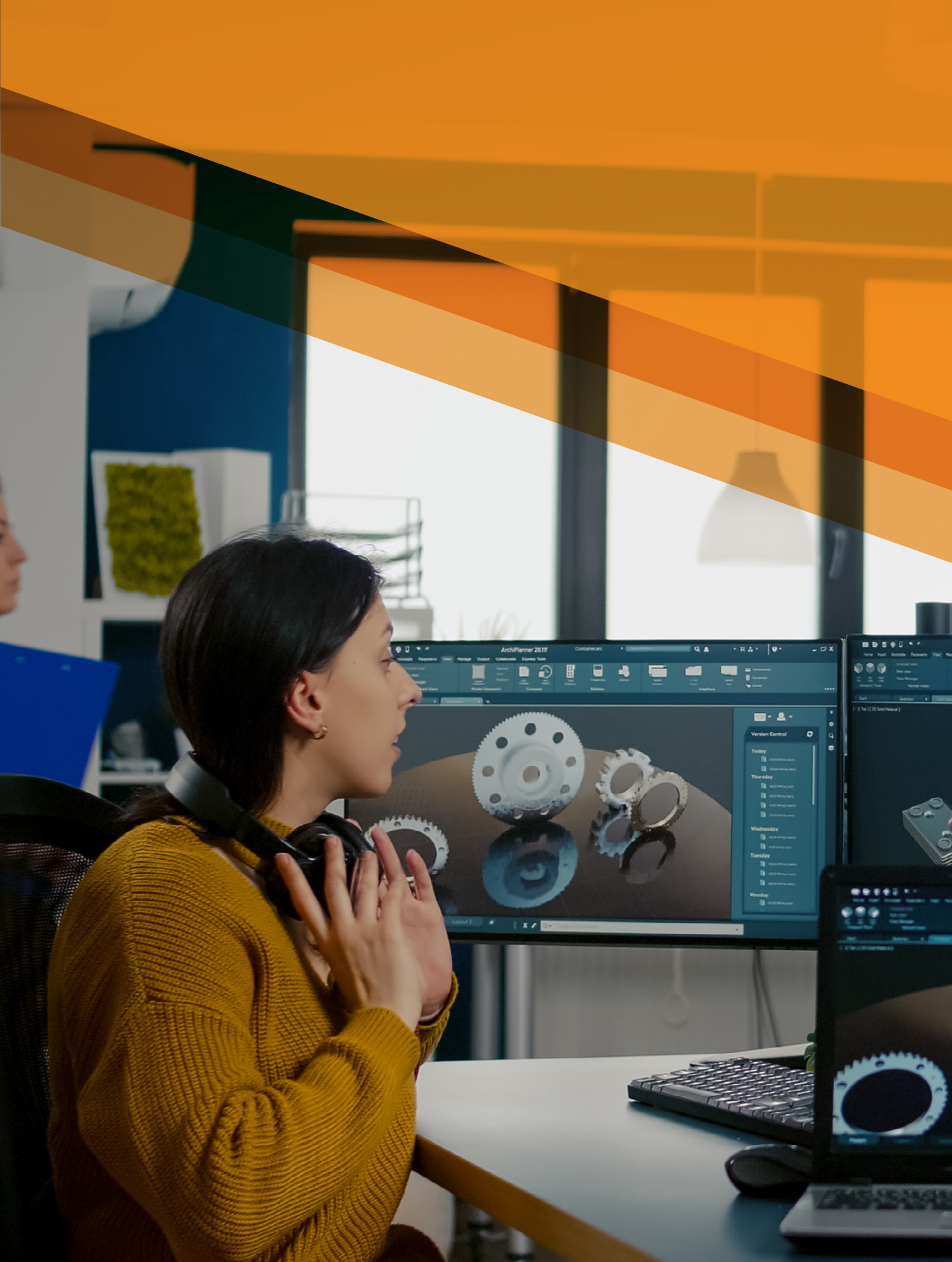
HAVE THE NECESSARY SKILLS OR A WAY TO ACCESS THEM

USE THE SUPPORT
THAT IS ALREADY OUT THERE

PLAN TO MEASURE AND ASSESS THE IMPACT OF THE INVESTMENTS

KNOW HOW TO MAXIMISE
THE INVESTMENT AND REALISE THE OPPORTUNITIES

With this in mind, Make UK, together with AWS, have set out five steps for manufacturers to digitalise their factories for the future, from vision to optimisation.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FROM VISION TO OPTIMISATION

The five steps a manufacturing business should take to digitalise their factory for the future.

STEP 1: VISION, STRATEGY, AND PLANNING

This is the time for manufacturers to create their own digital roadmap. This involves process mapping and value mapping, looking at the bottlenecks, identifying quality challenges, unplanned downtime, defining issues and seeking digital solutions.

This step will help companies address the fear of beginning a digitalisation process by defining goals, understanding current digital capabilities, and creating an implementation plan (from budgeting to resource allocation to timeline setting).

This is also the time to set Key Performance Indicators (KPIs) to help with monitoring and evaluation post-implementation.

Question to ask:	Business owner:	Action required:
How will IT and Operational Technologies (OT) teams collaborate?	Project sponsor, tech director, Managing Director – operational technical role, decision maker. Cross, multi-discipline team – all depending on the size of the company.	Facilitate a workshop to understand both sides' concerns and use external help to deliver solutions to reassure both.
What access to machine and process data is available?	Head of automation/ controls/engineering	Create an asset register with a control system and protocols available.
What business process improvements are expected over the next 3-5 and 5-10 years?	All department heads; Finance, Supply chain, Maintenance, IT, OT, Operations, R&D, Engineering	Develop a framework for a single digital transformation project that can be used for all business objectives.

Continuous improvements should be planned at this stage. Every milestone should be assessed when planning how to gather feedback from users and customers. Evaluate the process of what works and what doesn't.

STEP 2: TECHNOLOGY ASSESSMENT AND ADOPTION

The next step is to explore existing technologies, systems, and infrastructure to determine what needs to be updated or replaced and how. An external expert may help with this.

Digital technologies should be researched, and digital tools considered for application to processes and machines. System integration was, and still can be, a barrier for manufacturers to fully digitalise their businesses. For example, a factory might have several machines with one type of control system and network and other machines with different vendors or controls and networks.

The challenge here is (by using commercially available products) to unify the connectivity between a multitude of machines into a common data server with sensible data naming conventions, such that the same data can be used by the different software tools required by different departments (e.g., quality software tools, maintenance planning software, energy monitoring software, etc.)

This barrier can be mitigated by currently available technologies. IoT tools can be connected to any type of machine. Even a 50-year-old tool connected by sensors to the cloud and using appropriate software, can analyse collated data and provide necessary information for evidence-based decision making.

Having the right partners in place to assist can avoid the problem of deploying five different digital systems and process networks for five different business needs when one would suffice.

Question to ask:	Business owner:	Action required:
Does the company have the rights and access to the software inside existing new/old machines and processes?	Operations director, plant engineer, head of automation	Create a depository and database of all software source code, or conduct an external audit for software availability.
Is any of the machine computing or control system hardware and software current or obsolete?	Head of controls or automation	Conduct an audit of all OT assets with regard to age and level of support of all hardware and software.
Does the business have company-wide OT standards for controls, automation, networking and data conventions?	Operations director, plant engineer, head of automation	Understand which standards for controls, networking and data are best adopted without tying the business to a single source.
Does the company have machines and assets requiring upgrade, which could support the business if process data was also available?	Head of operations	Have a plan for any machine, controls or software upgrades, which will be 'digitalisation ready' when upgraded.

STEP 3: ESTABLISHING GOVERNANCE AND SUPPORT PROCESSES TO SECURE SUCCESS

This phase involves identifying people and responsibilities and building the infrastructure for the investment. This step also involves evaluating your knowledge of data. Digital technologies generate vast amounts of data. Businesses must establish effective data management practices. This includes data collection, storage, analysis, and interpretation to derive actionable insights and make data-driven decisions. It's crucial to connect all these aspects together at the very beginning.

Question to ask:	Business owner:	Action required:
Is there a network architecture knowledge to build a cyber secure infrastructure that bridges both business networks and industrial process networks?	IT manager	Understand and adopt a secure firewall / DMZ architecture to enable both the sharing of IT/OT data as well as improve cyber security.
Does the company have a digitalisation standard that is provided to suppliers of all new capital equipment purchases at the time of RFQ?	Head of procurement, Head of operations	Seek specialist advice on what topics and specifications should be included in that standard.
Is there a developed standard for data storage, networks and asset/data naming conventions?	IT manager / OT manager	Seek specialist advice on what topics and specifications should be included in that standard.

STEP 4: IMPLEMENTATION AND EXECUTION

This stage of implementation and execution should involve change management aspects of running a business.

Successful digital transformation requires managing the people side of the journey. Change management involves providing support, training, and communication to employees to ensure they understand the benefits of digitalisation and are willing and capable of adopting new technologies. Digital transformation often involves improving internal and external communication and collaboration. This may involve implementing collaborative tools, project management systems, and digital platforms to streamline workflows and enhance teamwork.

Question to ask:	Business owner:	Action required:
Has the company harnessed operational insight from machine operators and other shopfloor staff as part of the digital roadmap?	Engineering roles, multifunctional teams across the business, MD, engineering director	Facilitate a workshop across stakeholders and affected shopfloor workers (who often have insight that would be helpful to the digitalisation journey).
Is there a plan to explain to staff how and why the company is commencing a digital transformation journey and how companies that do this well become more successful and employ more people?	MD, Senior, head of engineering	Create a change management plan that explains how this is intended to improve the business's sustainability and long-term future security.

STEP 5: OPTIMISATION AND INNOVATION

In this final step, it is important to keep identifying and tracking specialist innovations as crucial for staying competitive and being prepared for future industry shifts.

Companies often invest in research and development efforts or collaborate with research institutions to explore and harness these innovations when they reach maturity.

The approach to digitalisation, the motivation behind it, and awareness of emerging specialist innovations should align with a business's strategic goals and its industry's evolving landscape.

Question to ask:	Business owner	Action required:
Would the company rather reiterate the pilot project across other lines and business units, or extend the digitalisation on the same line? (e.g., adding maintenance to the pilot project of productivity)	Managing director, general manager, VP	Understand the ROI of reiteration of the same scope across the business or extending the scope of one line or business unit.
Is the company looking at digitalisation to showcase advancements or to improve the business's efficiency?	Managing director, general manager, VP	Understand the basics and foundations of a digital roadmap before establishing how innovations (e.g., AR, AI, AM) can help the business
Are there specialist sector innovations that are at the research and feasibility stage?	Head of innovation, R&D, and manufacturing	Look to team up with academia who will want to collaborate with 'real' industry

TOP TIPS:
PILOT PHASE

1. Often, until data is collected, it is impossible to tell its value. Take the plunge with a low-cost pilot project (implementing low-cost sensors), that should provide the best return for the least investment. Just imagine: if you could save 15% of costs, would it be worth it?
2. Nominate a 'digital champion' within the business, even when working with external consultants/engineers.
3. Go vendor agnostic. Don't go down a road that cannot be scaled with different hardware and software vendors.
4. Outsource the skills you don't have, then upskill your teams once you know what skills you need.

TOP TIPS:
ENGAGING YOUR EMPLOYEES IN THE DIGITAL JOURNEY

1. Build a cross-departmental and shopfloor-to-top-floor team.
2. Embrace the insights from the frontline and shopfloor teams.
3. Celebrate success.
4. Avoid the blame game. Set forth clear responsibility and accountability of senior managers.

CONCLUSION

The opportunities brought forth by new technologies are vast. The impressive numbers showcasing increased productivity and enhanced efficiency speak for themselves. It's not just statistics that provide evidence of the benefits of digitalisation; there are also numerous success stories. Many manufacturing companies are eager to share their experiences of venturing into the realm of the unknown.

Embracing change can be daunting, given the abundance of new products and solutions flooding the market. NGF, a company generously sharing its experiences in the featured case study, worked with 40 AWS re/Start apprentice students to conduct research and discover the best product available, ultimately leading them to the implemented solution. While digital technologies often have a reputation for being expensive, especially for smaller firms, the key to cost management is to start small. Take incremental steps, acquire one sensor at a time, and gradually scale up the process. Connecting digital technology to the cloud can profoundly impact real-time data analysis.

IoT (Internet of Things), encompassing sensors and smart meters, generates copious amounts of data and is usually more cost-effective compared to other digital technologies. This data can greatly advance analytics, and AI can extract valuable insights. Manufacturers can leverage AI-driven algorithms to optimise processes, enhance product design, and make data-driven decisions.

Learning from peers is invaluable. Attend webinars, participate in networking events, and explore local universities—be an innovation and digitalisation enthusiast.

VIEWPOINT

In today's economic and geopolitical climate, and with the advent of industry disrupters, manufacturers are under immense pressure to remain relevant, and even viable. Many are turning to technology to retain their competitive advantage.

The fourth industrial revolution and Industrial Internet of Things (IIOT) are catalysing companies to take a fresh look at their technical infrastructure and embrace digital transformation to reduce costs, speed time to market, optimise production, increase operational safety and meet sustainability objectives. In fact, recent Make UK research found that over half (56%) of manufacturers cited implementing digital technologies reduced costs and improved productivity, with 62% reporting energy cost savings.

However, not knowing how and where to get started, coupled with an in-house technical skills gap, can create barriers for adoption.

Encouragingly, Make UK's research reveals that manufacturers are already realising the importance of digitalising their businesses – with 82% citing they are either in conception, transformation or completion phases of their digital transformation.

MAKE UK, in collaboration with Amazon Web Services (AWS), is proud to provide this guide to help the British manufacturing sector on its continued path to digital transformation by providing clarity around the definition of digital transformation, outlining the potential business benefits, and setting forth clear next steps and considerations. Thus, providing a foundation upon which manufacturers can make an informed decision about their own readiness for digitalisation.

NGF Europe, supported by AWS, illustrates the steps they took to successfully implement a digital strategy to move toward its goal of becoming a 'smart factory' – including challenges identified, technology solutions adopted and quantifiable results.

Today, AWS and its wide network of expert partners help leading manufacturers transform their operations with the most advanced set of cloud services, including Artificial Intelligence (AI), Machine Learning (ML), Internet of Things (IoT), Robotics, Edge Computing, Digital Twins and Analytics. AWS allows you to focus your resources on optimising productivity, improving quality and tangible outcomes, creating new smart products, and improving operational efficiencies across the value chain.

You can learn more about AWS's commitment and expertise within manufacturing, learn practical ways to achieve smarter, faster and more responsive operations and hear first-hand from other manufacturing customers who have started on their own digitalisation journeys.

Make UK is backing manufacturing – helping our sector to engineer a digital, global and green future. From the First Industrial Revolution to the emergence of the Fourth, the manufacturing sector has been the UK's economic engine and the world's workshop. The 20,000 manufacturers we represent have created the new technologies of today and are designing the innovations of tomorrow. By investing in their people, they continue to compete on a global stage, providing the solutions to the world's biggest challenges. Together, manufacturing is changing, adapting and transforming to meet the future needs of the UK economy. A forward-thinking, bold and versatile sector, manufacturers are engineering their own future.

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Amazon Web Services (AWS) is the world's most comprehensive and broadly adopted cloud platform, offering over 200 fully featured services from data centres globally. Millions of customers—including the fastest-growing start-ups, largest enterprises, and leading government agencies—are using AWS to lower costs, become more agile, and innovate faster.

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With AWS, you can leverage the latest technologies to experiment and innovate more quickly. We are continually accelerating our pace of innovation to invent entirely new technologies you can use to transform your business.

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