Accelerating value from data-driven manufacturing

How insights from data analytics and enhanced collaboration can propel manufacturers to a more sustainable and profitable future

Cambridge English Dictionary

Definitions

Data

information especially facts or numbers, collected to be examined and considered and used to help decision-making, or information in and electronic form that can be stored and used by a computer.

Analysis

the act of studying or examining something in detail, inn order to discover or understand more about it, or your opinion and judgement after doing this.

Insight

(the ability to have) a clear,deep, and sometimes sudden understanding of a complicated problem or situation

Table of Contents

Abstract

1 Short-term Data

This form of data is considered important to collect but with a short shelf-life. For example, sensors can detect the optimum speed of a production line or that a specific product meets pre-determined quality control criteria. Sensors are also used to alert operators and/or halt equipment automatically when they sense danger, such as an operative using a tool in an incorrect or hazardous way. Sensor data can also tell a manufacturer how much a piece of machinery is being used, which could enable it to charge a customer for its use on a specific project.

2 Long-term Data

Information collected over a much longer period of time is long-term data. One of the best examples of this type is certification or accreditation data. While all certification programs are different, a typical certification program has a join and renew date, and requirements for attaining and retaining the certification.

Long-term data from the monitoring of factory equipment over a specific period can assist manufacturers in making improvements to their assembly plants. This usage-based design process is also important in enabling equipment makers to improve the performance of their products.

3 Redundant Data

Research carried out by machine learning company, Fero Labs, found that a staggering 98% of data collected by UK manufacturers is currently discarded as they do not have the processing capacity to integrate it into their operations. This remarkable finding has the negative effect of costing business millions of pounds in avoidable downtime and maintenance expenditure.

Similarly, a large proportion of manufacturing databases are filled with useless data. This is information that is collected with the intent of using it but subsequently discarded, due to a number of reasons, such as irrelevance, going out of date, or lack of skilled people and technology to interpret it.

For humans, data has become almost as important as oxygen, as it's become critical to our existence. At least half of the planet's population, some 3.7 billion people, are now using the internet. It is estimated that 5.6 billion online searches are made every day and the world's largest search engine, Google, processes more than 63,000 searches every second.

We are living in the Information Age, as data impacts every area of our lives, to the point where the socio-economic and geo-political functioning of the world is underpinned by a reliance on data. Its generation is exponential with around 2.5 quintillion bytes of data being produced globally every day. To put this into perspective, almost 90% of all the data ever produced by mankind has been created in only the past two years and the rate of growth continues to accelerate. The total sum of data generated by 2025 is expected to be over 175 zettabytes, that's equivalent to one trillion gigabytes. It's no wonder then that the term 'Big Data' has become part of our lexicon, as data is fundamental to the shaping of our future.

Whilst data can be interpreted in different ways, for the purpose of this whitepaper, which considers its usage within a manufacturing context, data can be categorised into three types:

Introduction

For manufacturers, the challenge of ensuring that production efficiency is improved to the point that's right first time, every time, is critical towards the ultimate goal of achieving zero defect manufacturing and all of the associated cost and sustainability benefits.

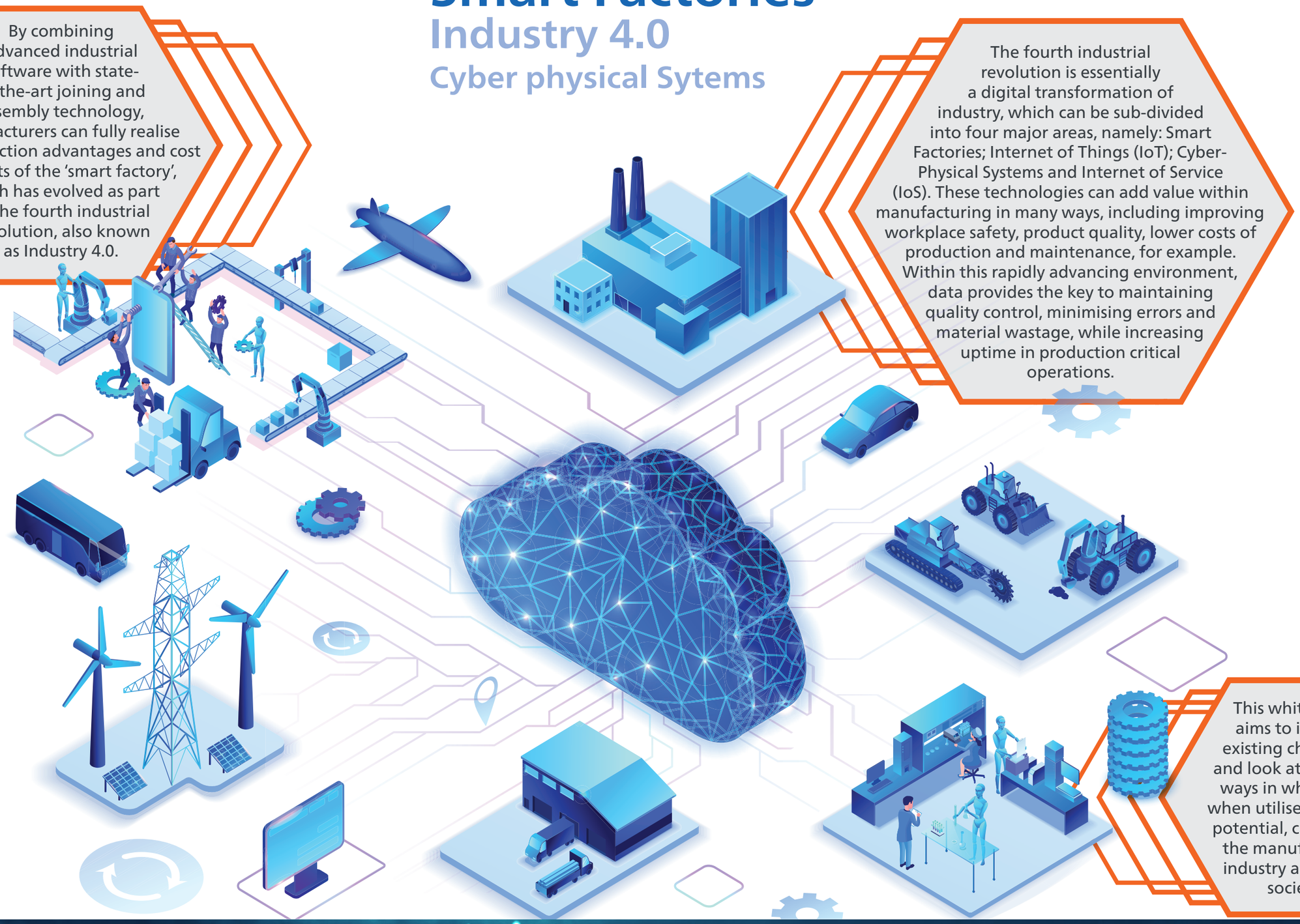
Smart Factories

Industry 4.0

Cyber physical Sytems

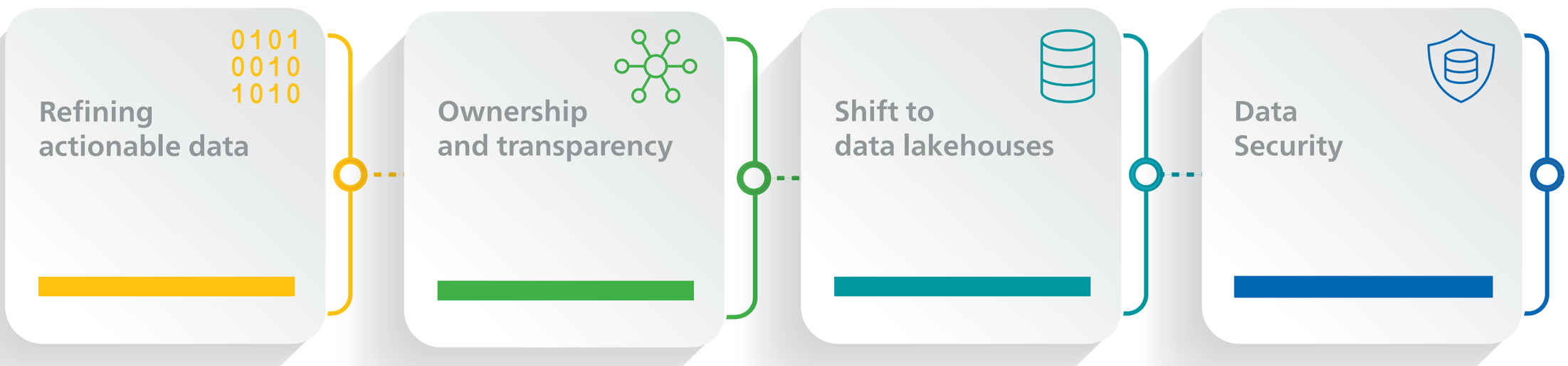
By combining advanced industrial software with state-of-the-art joining and assembly technology, manufacturers can fully realise the production advantages and cost benefits of the 'smart factory', which has evolved as part of the fourth industrial revolution, also known as Industry 4.0.

The fourth industrial revolution is essentially a digital transformation of industry, which can be sub-divided into four major areas, namely: Smart Factories; Internet of Things (IoT); Cyber-Physical Systems and Internet of Service (IoS). These technologies can add value within manufacturing in many ways, including improving workplace safety, product quality, lower costs of production and maintenance, for example. Within this rapidly advancing environment, data provides the key to maintaining quality control, minimising errors and material wastage, while increasing uptime in production critical operations.



This whitepaper aims to identify existing challenges and look at the many ways in which data, when utilised to its full potential, can benefit the manufacturing industry and wider society.

The challenges with data



Refining actionable data

The exponential growth in the amount of data being created is a problem for industry and in particular, companies of immense scale, such as aircraft and vehicle manufacturers. There is literally so much data that businesses are drowning in it, making the task of knowing where to start a huge challenge. Raw data is widely seen as a commodity, much like oil or gold, but it is unusable unless it is properly processed. According to Matthew Scullion, CEO and founder of Matillion, a data integration company, "Data is like iron ore and steel. Just like you need steel to build a bridge, to gain analytical insight, you need analytics-ready data. Data starts off like ore and needs refining, cleaning and embellishing with metrics to make it actionable."

To all intents and purposes, every company is essentially a data mine, but there is a wide chasm between those that are refining it effectively and those that either don't have the skills or external partnerships to realise its benefit, or those that have not made the cultural shift into recognising the power of data to transform their business operations.

Ownership and transparency

Having transitioned into a digital economy over the past two decades, we are now living in a data-led economy. However, very few companies can claim to be truly data-driven as culturally, many within industry feel that anything to do with data should be the preserve of the IT department.

For organisations to harness the value of refined data and turn this into profitability, they need to become more transparent internally and forward-looking. While companies generally appreciate that data is an asset, few are actively engaged in turning that data into an economic asset that delivers value. Viewing data as a critical asset, such as 'data as a service' or 'data as a product' is therefore a mindset that needs developing in the boardroom.

According to Theos Evgeniou, professor of decision sciences and technology management at INSEAD, "Business leaders need to understand the 'art of the possible' with data and this means having data leaders at C level. Senior executives should really be engaging to define which measures, metrics and data points would help them make decisions. Identify your top business goals and ask what data you require to achieve them. The data is often there to be used but leaders are not asking the right questions."

Achieving success, therefore, cannot be done in isolation, as data does not exist in a vacuum. Companies need to create 'data ecosystems' that make sense of data in a specific business context, which cannot be the responsibility of 'technical' personnel alone. Every decision-maker needs to be onboard. It's well documented that internal silos and territorial disputes regarding ownership of material can and do choke off a company's ability to harness data proactively and move forward. The issue of data ownership sits at the heart of corporate governance and not in an IT department.

Shift to data lakehouses

The inexorable rise in the quantity of data and the diversity of devices which create it, has posed another challenge, that of storage and control. Limited standardisation of data means that substantial systems integration work is needed to combine data from multiple sources. A study of 200 large-scale companies, carried out by Matillion, found that, on average, more than 1,000 different computer systems were being used to extract data with some systems dating back over 30 years.

Industry research suggests that approximately 30% of stored data is found in internal data centres, 20% in third-party data centres, 19% in edge data centres or remote locations, 22% in cloud repositories, and 9% in other locations. This distribution is not expected to change significantly in the short-term future, indicating that enterprise storage environments will remain dispersed and complex.

The term 'data sprawl' reflects how business data has become so scattered with the increase in smartphone apps and computing on the move. Almost certainly, since 2020 this data sprawl has accelerated with millions more people working from remote locations as a result of the global pandemic, which has added to the complexity of data management.

Another buzzword that has come to the fore in business language is 'data lakehouse.' This is an evolution of the historic 'data silo', which then morphed into 'data warehouse' and latterly, 'data lake', which as the name suggests, is a vast pooling of native information, waiting to be analysed. In an attempt to gain control of unstructured data by blending analytics and decision-making on an industrial scale, data lakehouses are seen as a solution. These have the capacity to help businesses to process big data much faster and enable insights to be extracted in a more practical way, as Leila Seith Hassan, head of data science and analytics at Digitas UK, explains:

"A lakehouse combines the high speed performance of a data warehouse on a scale enabled by lake technology. This gives business leaders the ability to access data and use it for decision-making without having to extract it and put it somewhere else first."

The process of planning, developing and deploying a data lakehouse, however, is not straightforward or cheap but then it does have the potential for an organisation to become truly data-driven.

Data Security

Following a number of high profile corporate security breaches and theft of data over the past few years, it's not surprising that data security is now rated one of the highest priorities for businesses.

Data breaches lead to direct financial losses, regulatory fines, reputational damage and lost customers. These can happen in numerous ways, including DDOS (Distributed Denial of Service), malware or ransomware attacks, all of which are designed to overwhelm systems, gain access to customer and payment data or in the case of ransomware, hold companies to ransom for millions.

Such is the potential threat to companies from cyber-criminals, a culture of fear can often pervade boardrooms and IT departments of many organisations. However, in order to extract value from data being generated, there needs to be a balance struck in how data is managed, as this often involves support from third parties, such as equipment suppliers.

For example, in its partnerships with manufacturers, which involves the collection and analysis of data from smart tool applications (see Exemplar below), Atlas Copco is very clear to explain that data is only transferred one way, i.e. 'pulled' from smart tooling and integrated controllers for the purpose of analysis. Data is not stored once a project is complete. Only tool data, result data and tightening traces are collected.

The biggest myth about data security is that it's an issue concerning technology. Actually, it's an issue about people. Encrypting company systems is a basic necessity but the real challenge is educating users on how data should be managed, stored and protected. This involves 'buy-in' across the organisation, rather than the preserve of a few privileged executives. A culture of transparency does not mean compromise in confidentiality but rather an understanding of responsibility, for the benefit of the business.

Data trends in manufacturing

01

The internet of things (IoT)

In broad terms, IoT refers to the billions of physical devices around the world that are now connected to the internet, all collecting and sharing data. This has been made possible by advances in silicon chip and sensor technology and the ubiquity of wireless networks. These devices can communicate real-time data to linked networks without any human intervention.

Whilst a PC or smartphone isn't generally considered an IoT device, a wireless thermostat in the home, a smartwatch or even a dishwasher could be considered IoT devices, as they have been enabled to be 'connected' from previously having only a manual and isolated application.

Furthermore, this concept has now evolved into the Industrial Internet of Things (IIoT), where interconnected devices are used in manufacturing and industrial settings to collect data that can be used to enhance the manufacturing process. Smart tooling would fall into this category.

02

5G networks

The fifth generation of mobile data network technology (5G) will enable manufacturers to connect their IIoT technology and leverage data within devices far more effectively. Upgrades in speed over 4G networks will supercharge manufacturer networks with the potential to be 100 times faster than existing technology. Theoretically, speeds could reach up to 20 Gbps with the roll-out of high-band 5G.

Just as important is latency, which is the time it takes for a packet of information to travel between two points. Latency in 4G networks is currently about 50 milliseconds, while 5G networks are expected to shrink that to one millisecond. Reducing latency will be critical for many applications where 5G will allow connected devices to rely on the cloud for processing of data, such as self-driving cars that might use 5G to let a cloud-based AI make real-time navigational decisions.

03

Predictive maintenance

In a manufacturing context, predictive maintenance refers to the use of sensor data and artificial intelligence (AI) to detect failure patterns in machinery and components. The idea is that by understanding when a machine or part is likely to fail, manufacturers can take preventative action and maintain their equipment more effectively. (See Exemplar below).

04

Digital twins

Digital twins can be used to simulate any physical process or object. For example, in a manufacturing setting, a digital twin could be used to simulate a new product's dimensions or create a digital replica of the equipment on the factory floor to see how the machinery operates under certain conditions. Digital twin technology can even be used to visualize and simulate an entire supply chain.

05

Extended reality & metaverse

Extended reality technologies such as augmented and virtual reality will play an increasingly important part in manufacturing, from enhanced product design, better production planning, augmenting human abilities on assembly lines, and more immersive training. As more of the world extends into the metaverse, more opportunities will arise for manufacturers.

06

Automation & dark factories

Thanks to developments in AI and machine learning, machines are now capable of carrying out significantly more tasks that were previously undertaken by humans. Automation can bring many advantages to manufacturers, including higher productivity (machines don't get tired), greater accuracy and consistency and lower costs. In future, it is expected that we may see more entirely automated factories, or so-called 'dark factories', which are fully automated sites where production happens without any human intervention on site.

07

Robots & cobots

One of the key enablers of automation is the use of robots, which have revolutionised the global automotive manufacturing and pharmaceutical industries, for example. Robotic technology has developed into the logistics arena with the rise of AGVs (Automated Guided Vehicles) and robot product picking in warehouses, but not all robots are intended to replace human workers.

Collaborative, intelligent robots or "cobots" are specifically designed to work alongside humans. Unlike traditional industrial robots, cobots are not placed behind guards or in cages, but are able to work safely around people, helping to move operators away from mundane and repetitive activities into areas that demand human dexterity and decision making.

08

3D printing

As 3D printing becomes more cost-effective, efficient, and scalable, manufacturers will increasingly have the ability to make products using 3D printing methods, which use fewer materials and create less waste than traditional manufacturing methods. This technology will help to drive innovation by allowing rapid prototyping. For example, Airbus has been using 3D printing technology for more than 15 years, making it something of a 3D printing pioneer in the manufacturing industry.

09

Web 3.0 & blockchain technology

With the emergence of Web3.0 and distributed computing technology such as blockchains and NFTs (non-fungible tokens), there will be opportunities for manufacturers to better monitor their supply chains and even automate many of the transactions along their supply chains. Many of the products that will be manufactured in the future will be sold with NFT digital certificates.

10

Smart & sustainable products

The emergence of smart connected IoT devices isn't just changing how products are manufactured but what types of products are manufactured. These days it seems there are "smart" versions of everything from vacuum cleaners to toilets, and the trend for smart products shows no sign of slowing down. Therefore, manufacturers will increasingly have to explore ways of giving customers the intelligent products they demand.

On top of this, the global socio-economic issue of climate change has seen a sea-change in the need to become more responsible consumers. As a result, customers will increasingly gravitate towards products that are more sustainable, reusable, and recyclable, following a resurgence of the circular economy.

Unlocking the value of data

As we've seen the process of data collection is now mainstream and easy. Extracting intelligence from this data is the hard part and an area in which manufacturers tend to struggle. Whilst becoming adept at collecting data, manufacturers have been slow to capitalise on its value. If data is perceived to be the new oil or gold, then insights from data could be seen as the new diamonds.

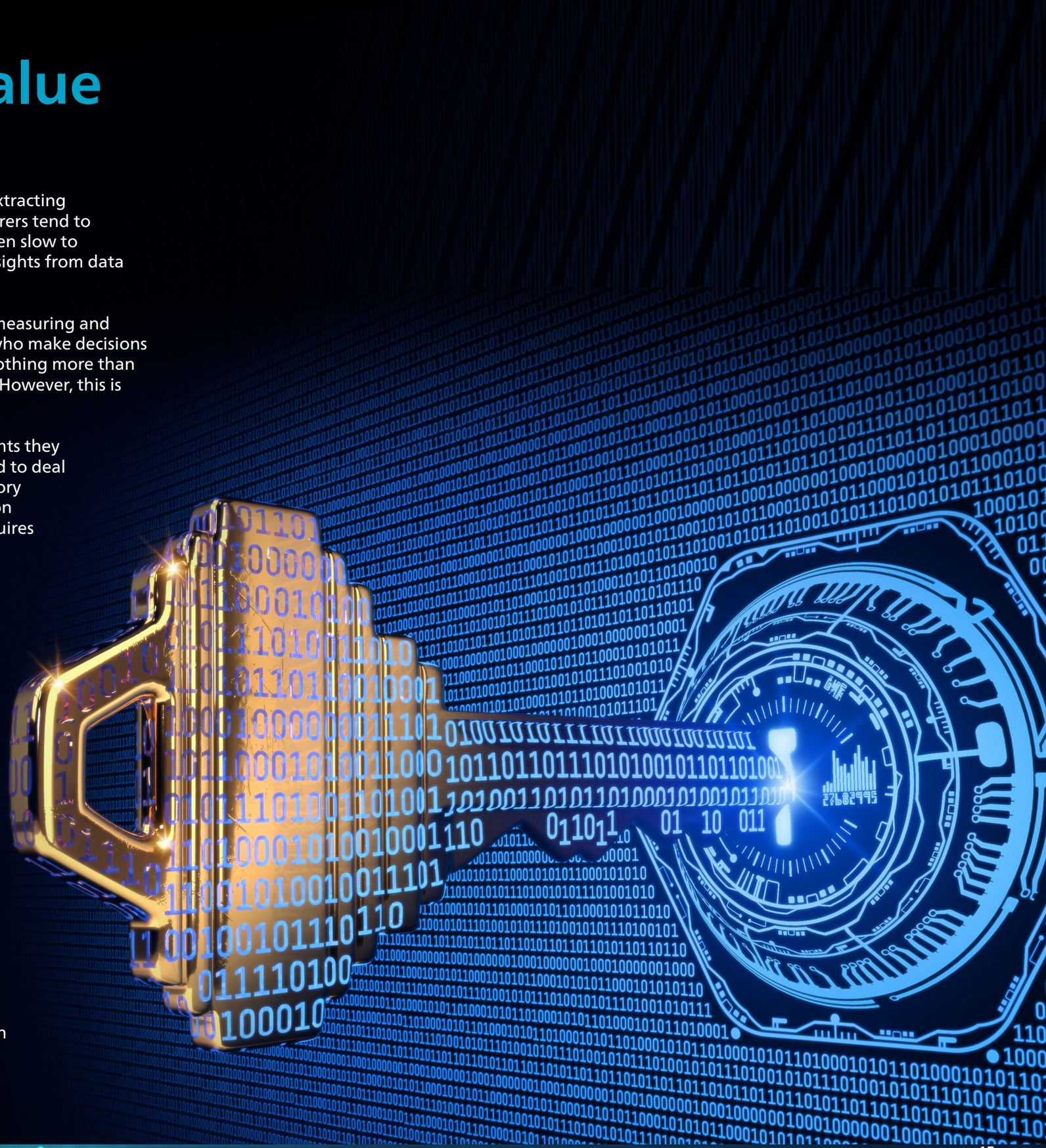
Being able to identify production challenges accurately through real-time measuring and having the ability to make this information accessible and visible to those who make decisions is the first step to leveraging meaningful value. Even if they choose to do nothing more than monitor the stream of data coming in, there is immediate value to be had. However, this is only scratching the surface of the true benefits to be gained.

The first step to unlocking value is for business leaders to define what insights they are trying to gain. To smartly collect and sort through data, enterprises need to deal with challenges of overlapping tools, to ensure that data is "clean." If a factory is flooded with tens of thousands of un-coordinated IoT devices deployed on different platforms, for example, this task becomes very difficult, which requires the need for a carefully considered data ecosystem.

With so many connected assets, manufacturers see the value in collecting operational data. However, the raw data collected is not providing the solution it was intended to offer; that of a decision-making engine for achieving improvements, cost reductions and ultimately, higher and more sustainable profits.

In addition to overall improved financial performance, the key areas where manufacturers can make significant developments from data insights, include:

- Increase in 'first time right time' production quality
- Better employee productivity
- Speed in identifying potential line issues and the prediction of error trends
- Error-proofing to minimise downtime and rework trends
- Sustainability – enhanced waste reduction and energy management
- Creating commercial advantage through enhanced market reputation and customer acquisition
- Improved regulatory compliance and customer acquisition



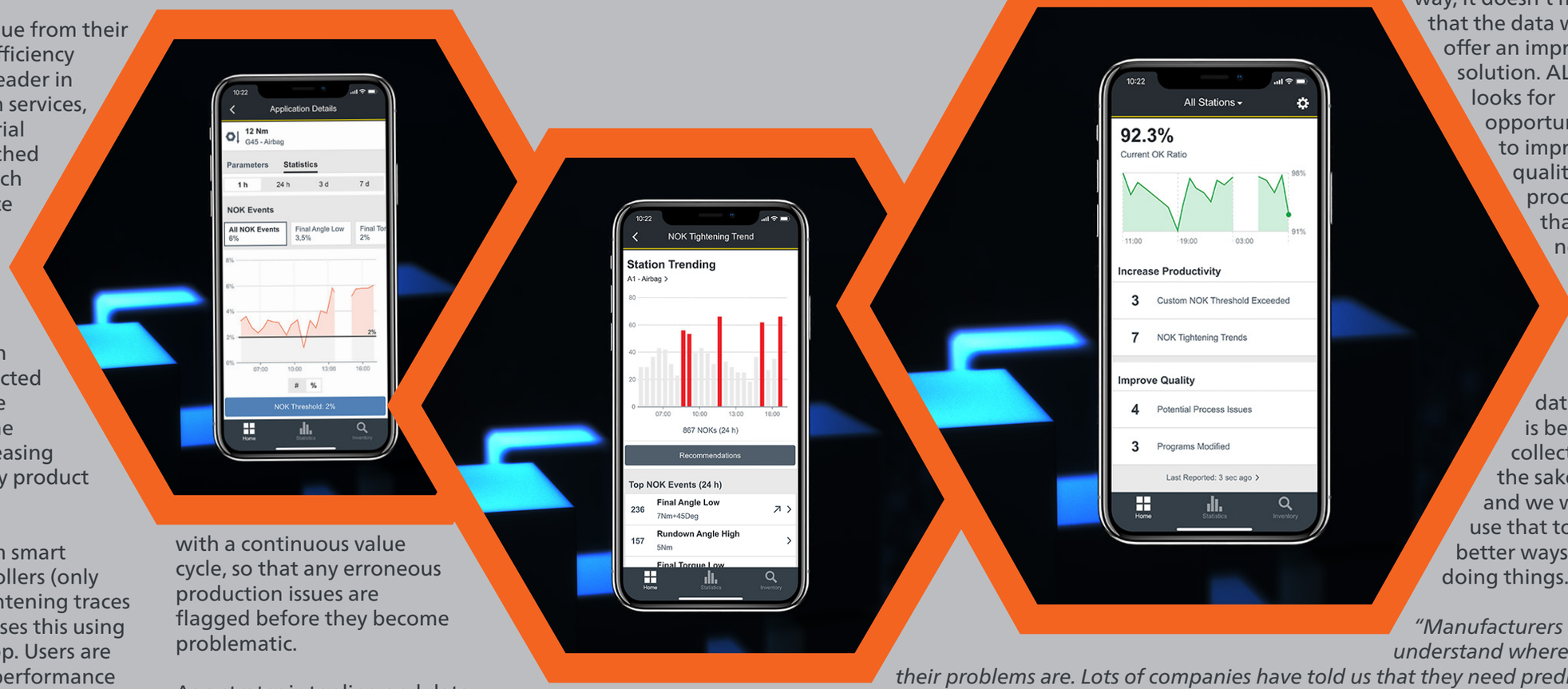
Exemplar: ALTURE®

To help companies extract value from their data, reduce costs, improve efficiency and productivity, the global leader in smart tooling and data driven services, Atlas Copco Tools and Industrial Assembly Solutions, has launched a pioneering application, which harnesses artificial intelligence (AI) and machine learning to identify risks in production before they occur.

The ALTURE® app (**ALT**ernate Fut**URE**) is the latest evolution of Atlas Copco's Smart Connected Assembly philosophy with the objective of error-proofing the production line, thereby increasing throughput by avoiding costly product rework or downtime.

Using raw data captured from smart tooling and integrated controllers (only tool data, result data and tightening traces are collected), ALTURE® analyses this using AI and an algorithm in the app. Users are provided with real-time line performance notifications, as well as any 'Not OK' (NOK) tightening trends and recommendations for process improvement. Feedback from over fifty of Atlas Copco's global customers during a 12-month trial confirmed that the smartphone app was the simplest and fastest means of delivering real-time information, enabling personnel on the shop floor to counterstrike any emerging issues.

For manufacturers, the challenge of increasing throughput that's right first time, every time, towards zero defect production, is what Atlas Copco's primary mission is focused on achieving. With the introduction of ALTURE®, which interrogates data in real time using AI, Atlas Copco can provide customers with a continuous value cycle, so that any erroneous production issues are flagged before they become problematic.



As a strategic tooling and data services partner for some of the world's leading manufacturers across numerous sectors, Atlas Copco is at the forefront of innovating assembly solutions which deliver safer and more cost-efficient productivity. ALTURE® represents the next level in harnessing machine learning to support manufacturers in achieving their sustainability goals by reducing material wastage and unnecessary energy consumption, thanks to the power of data.

An example of this was demonstrated by a US-based customer of Atlas Copco, whose senior leaders believed that they were already maximising their data and that their operations were as lean and efficient as they could be. After a three-month trial of ALTURE®, however, the company saved around $300,000 in downtime and maintenance costs.

The real challenge, explains Steven Meazey, VP of Marketing - Service, at Atlas Copco Industrial Technique, is in convincing manufacturers of the value of a system like ALTURE®.

"We believe that there's always more than one way of working," he says. "Just because you're doing something one way, it doesn't mean that the data won't offer an improved solution. ALTURE® looks for opportunities to improve quality and processes that may not be so obvious. There is so much data that is being collected for the sake of it, and we want to use that to unlock better ways of doing things."

"Manufacturers must understand where their problems are. Lots of companies have told us that they need predictive maintenance but when you look into the data you realise that their actual issue is with excessive reworking. Data helps uncover problems and lays out a plan of action. Many lack the resource and knowledge to properly analyse the data, meaning they're wasting a vital resource."

The development of data driven services for maintenance, quality and process optimisation has reached a level where, as demonstrated by applications such as ALTURE®, failures can be predicted well before a problem arises, and potential quality issues detected even though the process has been performing within specification.

Performing maintenance as accurately as possible eliminates unnecessary downtime for scheduled maintenance and can prevent serious equipment trouble by detecting changes in performance that indicate a potential failure. Estimates indicate that a manufacturer can reduce maintenance costs by 5 to 10 percent and increase output by 3 to 5 percent by avoiding unplanned outages. It is estimated that the proactive use of data could also reduce worker injuries in factory environments by 10 to 25 percent, saving industry as much as USD 225 billion per year by 2025.

The need for collaboration

In terms of creating a continuous value cycle, data is not the be all and end all, however. It has become increasingly recognised within the manufacturing sector that there needs to be a shift towards collaborative partnerships, to enable organisations to remain at the forefront of their industry. Of course, collaboration does present particular challenges, as highlighted above in regard to data security, for example but ultimately, successful and powerful business collaborations are built on strong relationships and trust, just as they are between individuals.

Businesses can benefit in many ways from collaborating with others, from expanding networks and insights, to accessing new talent pools, techniques, processes and funding, improving productivity and faster growth, not to mention the potential for reducing overheads.

As a concept, collaboration is not new, but greater competition as a result of globalisation has seen collaborative partnerships being formed in order to maintain market share and competitive advantage. In addition, collaborative frameworks have also been developed to help companies work together. For example, the BS11000 collaborative business relationships tool became an international standard in early 2016, that provides an eight stage framework aimed at enabling organisations to collaborate effectively for mutual benefit.

The need for collaboration has been brought into sharper focus since the Covid-19 pandemic. Whilst manufacturers were already relocating factories due to economic tensions around the world, the pandemic's impact on workforce dispersal and the escalating cost of transporting goods around the world has necessitated a renewed purpose for collaboration.

New digital technologies, increasing connectivity, the drive for innovation, a greater focus on services and changes in customer demands are all factors which demand a push towards more collaborative models. As a result, traditional linear contracts linking participants in the supply chain are making way for more flexible behavioural commercial relationships.

Whilst there are issues such as information ownership, management and licensing of intellectual property (IP) to contend with, a shift to a more open approach and focus on what can be gained rather than what can be lost from the relationship will help companies make a success out of collaboration. As a result, a firm's reputation as a trustworthy collaborator will become so commercially important that the risks of one party breaching this trust will be significantly mitigated.

Finally, in respect of data itself, the proliferation of information will require manufacturers to harness tools and systems that will help their workers use data to maximum effect in solving problems and making better decisions. By connecting people better, data can be turned into actions that generate tangible value. For example, an operator who wants to troubleshoot a piece of equipment can share real-time machine data with a remote expert to get precise guidance, rather than having to wait for someone to be flown in.

Conclusion

As highlighted in this whitepaper, when manufacturers come to fully appreciate and harness the power that properly scrutinised data can have on their operations, and artificial intelligence and machine learning technologies continue to mature, there is certainly the potential for the industry-wide wastage of data to be lessened significantly.

Organisations must look to capture the right data, identify it, store it correctly, and provide it to decision makers in a usable way. With proper identification and classification, automated processes can manage data through its useful period, and then delete or archive it when it is no longer needed. This data pruning lowers costs and avoids clogging systems. However, as data management solution technology advances, companies can consider capturing more data, which can be utilised for improving their artificial intelligence or machine learning.

With sustainability taking centre stage, organisations across every industry are now recognising the responsibility and scrutiny being placed on them by governments, consumers, and society at large to become much more environmentally responsible.

From waste, resource usage, carbon emissions and recycling, for example, organisations will increasingly turn to data-driven solutions to optimise efficiency and productivity with a stated objective to significantly reduce environmental impact.

Information is therefore the next battleground in the war on efficiency and productivity but manufacturers in particular, have the tools at their disposal to realise the true value that data can deliver.

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