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MANUFACTURING INSIGHT REPORT

Making in a digital world: re-engineering skills

4IR is a range of new technologies that are fusing the physical, digital and biological worlds, impacting all disciplines, economies and industries...[1]

Klaus Schwab, Founder and Executive Chairman of the World Economic Forum

Summary

The new technologies of the fourth industrial revolution (4IR), such as artificial intelligence (AI), cloud computing and robotics, have the potential to change the way we live, learn and do business at an unprecedented rate. 4IR will have far-reaching implications on many aspects of daily life, affecting how individuals interact with technology, and transforming where and how work is done and how things are made.

While some countries, businesses and people are well placed to embrace this change, and will take advantage of the opportunities afforded by 4IR, many are not. Founder of the World Economic Forum, Karl Schwab, who first coined the term 4IR, has concerns that “organisations might be unable to adapt; governments could fail to employ and regulate new technologies to capture their benefits; shifting power will create important new security concerns; inequality may grow; and societies fragment”.[1]

Since the First Industrial Revolution, manufacturing has been a driving force for industrial and societal transformation. 4IR has the potential to transform manufacturing into a highly connected, intelligent, and ultimately, more productive industry. From predictive analytics, augmented reality, and additive manufacturing to digital design, innovations in manufacturing can enhance organisational competitiveness and drive economic prosperity.

4IR promises to replace the manpowered shop floor with smart manufacturing facilities where tech-savvy workers, aided by intelligent robots, are creating the products of the future. Manufacturers in this modern world can’t simply be makers, they must capitalise upon technology to help them compete on a global stage. The flood of innovation in digital technologies, tools and practices, will create new tasks and occupations, and the labour market will demand new skills just as quickly as it will turn away from others.

Those companies doing well have been able to realise benefits afforded by digital transformation across the entire manufacturing value chain. They’re increasing production capacity and reducing material losses, improving customer service and delivery lead times, achieving higher employee satisfaction, and reducing their environmental impact.

In this report we look at some of the future technologies and their adoption in manufacturing. We explore the skills landscape and consider the roles that governments, educational institutions and businesses need to play in addressing the needs of the 4IR workforce.

We focus particularly on some of manufacturing’s emerging markets as the potential for new technology is most significant. We consider how the rate of change and adoption of technologies varies region-by-region and country-by-country. We also ponder how in a world still reeling from the effects from the COVID-19 pandemic, capability and skills gaps which exist now, could be further widened in the future.

This report is for policymakers, educational institutions, employers and training organisations. It outlines implications of the fourth industrial revolution on an already fragile global skills ecosystem. Drawing on industry exemplars, we propose some practical steps for the manufacturing sector, business and educational institutions.

Framing the challenge

Manufacturing drives economies around the world. According to World Bank data, in 2020 globally this equated to 15.928% of GDP[2]. The global market for general manufacturing was estimated at US$649.8bn in 2020, and projected to reach US$732.2bn by 2027[3].

But manufacturing output is not consistent around the globe. The United Nations Statistics Division suggests China accounted for 28 per cent of global manufacturing output in 2018. This is more than 10 percentage points ahead of the United States, which was overtaken as the world's largest manufacturing nation in 2010. The total value added by the Chinese manufacturing sector amounted to almost US$4 trillion in 2018, equating to nearly 30 per cent of the country's total economic output[4].

In the past, the global growth in manufacturing outputs and investment seen elsewhere had passed by many African countries. Despite manufacturing potential, the continent has remained relatively free of factories. This trend seems to be reversing with production nearly doubling between 2000 and 2016, from nearly $85 billion to approximately $158 billion (in constant 2010 prices)[5].

Similarly, the Middle East is not traditionally known for its manufacturing prowess, but many countries have ambitions to diversify economies beyond oil and gas. The United Arab Emirates is aiming to increase manufacturing share of GDP to 25% by 2025[6]. Over the last several decades, Saudi Arabia's manufacturing share of GDP increased from less than 5% to approximately 12%, as of 2016[7].

From small makers to behemoth businesses

The automotive and electronics sectors dominate the top ten manufacturers in the world, contributing billions of dollars to the global economy. Many of these companies have global supply chains, with suppliers in countries around the world each playing a critical part in the production and distribution of the final product.

The majority of businesses operating in the sector in regions such as the Baltics and across Africa tend to be small to medium (SME) enterprises. In Africa, food and beverages is the dominant manufacturing sector, followed by textiles and clothing. Successful examples of manufacturing production include automobile assembly and production in South Africa, garments in Mauritius and East Africa and consumer goods across the continent[5].

In Northern Europe, the Baltic countries of Estonia, Latvia and Lithuania are specialised in the production of low-tech goods, particularly wood and paper products as well as furniture and textile.

Ivari Soome from training provider AruCAD in Estonia: "The manufacturing sector is strong in Estonia, especially in timber and hard industries such as energy. The sector has grown fast in past years and has a lot of successful businesses.

"However, the key challenge is the lack of skilled manpower for the production industries. This holds true for the entire Baltics region, as we see the same situation in Latvia and Lithuania."

The rise of online and automated manufacturing communities creates competition from innovative startups able to use new technology to enter previously prohibitive markets. This disrupts – traditional manufacturers find their existing markets challenged by innovative organisations which undermine the domination of their products with new, often customised, solutions.

> Nigeria's manufacturing sector is still emerging and is still relying on established methods. Two key challenges are interconnected. The need to achieve process improvement that is being restricted by access to talent with the right skills to adapt these new technologies. A big opportunity for a country like Nigeria is the new cloud driven technologies that allow even small and medium sized manufacturing companies to compete with bigger companies in an affordable way. The biggest challenge currently is a skills gap that is present for both individuals in the workforce and for students who graduate from university.
>
> **Chukwubuikem Felix Amaefule, Generative CAD Services Limited**

Manufacturing share in GDP and labour force (%)[11]

	Employment			Nominal value added			Real value added		
Region	**1990**	**2010**	**2018**	**1990**	**2010**	**2018**	**1990**	**2010**	**2018**
Advanced Asia	26.1	15.4	13.9	24.5	19.9	19.7	17.9	19.7	19.9
Developing Asia	10.0	11.9	13.4	16.3	19.0	18.2	14.2	18.1	18.5
Latin America	14.1	11.0	10.3	22.0	16.5	14.9	18.7	17.1	15.4
MENA	15.9	15.0	14.5	20.5	16.8	17.5	15.9	17.4	16.6
Sub-Saharan Africa	7.2	7.2	8.4	15.4	11.4	10.4	12.7	11.4	10.9

Note: Manufacturing share (%) in employment, nominal GDP, and real GDP by region, unweighted averages. See Table 1 for the grouping of countries by region.
Source: Authors' calculations using the ETD.

The COVID-19 effect

When the COVID-19 pandemic hit, the movement of people and goods was restricted – almost overnight. In the first few months of 2020, manufacturers had to make rapid adjustment to working practices to respond to social distancing requirements and global lockdowns. Production lines stopped, livelihoods and businesses unsettled.

The many disruptions to global supply chains, production facilities and transport significantly affected the manufacturing sector. According to UN data, the pandemic hit the manufacturing sector harder than the 2007–2009 global financial crisis, resulting in a drop in production of 6.8 per cent in 2020. The share of manufacturing value added (MVA) in global GDP fell – from 2019 to 2020 – from 16.6 per cent to 16.0 per cent[8].

By the second half of 2020, most economies showed signs of recovery, led mainly by medium- and high-tech manufacturing. Fuelled by a rise in demand for computer electronics, these industries registered growth of nearly 4 per cent in the fourth quarter of 2020 compared with the same period in 2019. Conversely, global manufacturing of low-tech products saw negative growth in the last quarter of 2020 (-1.8 per cent)[8].

The pandemic has changed business practices and adoption of technology forever. Many of the tools, technologies and practices adopted (sometimes in haste) in response to the pandemic, have continued relevance for manufacturing in the future. According to a McKinsey Global Survey of executives, their companies have accelerated the digitisation of their customer and supply-chain interactions and of their internal operations by three to four years[9].

As we adapt to a new normal, manufacturing can respond with digitised, resilient operations. However, we have to acknowledge that countries and their manufacturers are starting from different points.

According to the World Economic Forum, before the COVID-19 crisis, despite the significant expansions of ICT access, ICT availability and use remained far from universal. The COVID-19 crisis has accelerated digitalisation in advanced economies and made catching up more difficult for countries or regions that were lagging before the crisis[10].

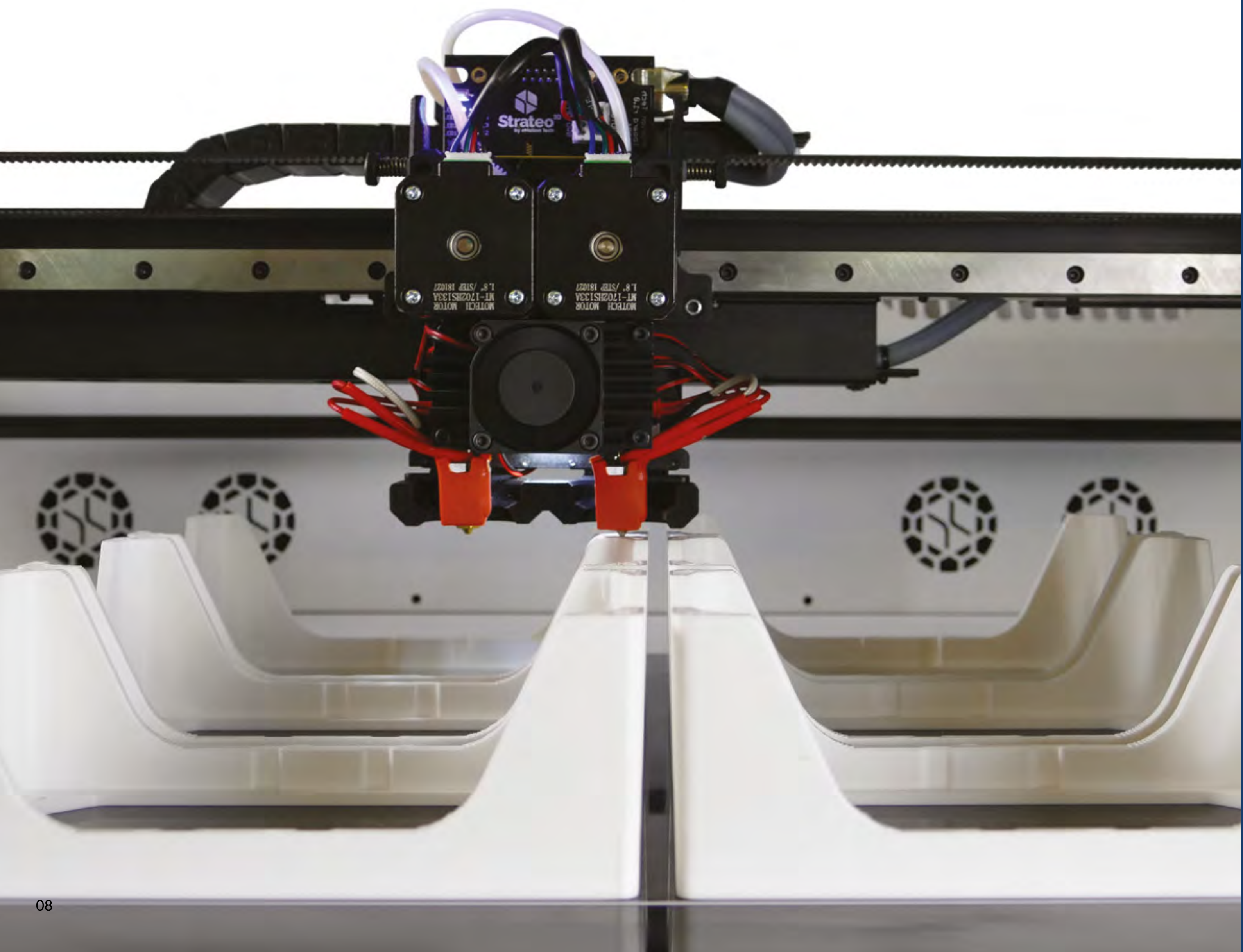
The actions taken by manufacturers during the global COVID-19 pandemic has shown that companies can start on their 4IR journey in a small way and then scale quickly. Clearly there are implications for skills. Manufacturers will need to adapt their talent strategies, and upskill existing employees to fulfil the roles the factories of the future require.

> The impact of the pandemic crisis should serve as a wake-up call for countries that need to embrace the digitalization process, incentivize companies to move towards digital business models, and invest in ICT development and digital skills.[10]
>
> COVID-19 has accelerated the need to implement an ambitious global upskilling agenda because it is forcing digitalization and automation at a more rapid pace. Rising to this challenge could result in faster progress and even larger economic benefits by 2030.[12]

A new look for manufacturing

Since the First Industrial Revolution, manufacturing has been the engine room of economic prosperity. During the Second Industrial Revolution, cities grew and factories sprawled as rapid advances in the creation of steel, chemicals and electricity helped fuel production.

The Third Industrial Revolution, or Digital Revolution, is characterised by the spread of automation and digitisation through the use of electronics and computers and the advent of the Internet. Like the three that preceded it, the Fourth Industrial Revolution brings with it significant changes in the way we make and work.



INDUSTRY 4.0 CAN UNLOCK SIGNIFICANT VALUE[15]

Example areas of value potential in Industry 4.0	Value potential
Data, computational power, connectivity • Blockchain • Cloud technology • Internet of Things • Sensors	**15-20%** inventory-holding cost reduction **15-30%** labour productivity increase
Human–machine interaction • Virtual and augmented reality • Robotics and automation (collaborative robots, automated guided vehicles) • Robotic process automation, chatbots	**30-50%** machine downtime reduction **10-30%** throughput increase
Analytics and intelligence • Automation of knowledge work • Big data, advanced analytics, and AI	**85%** forecasting accuracy improvement **10-20%** cost of quality improvement
Advanced production methods • Additive manufacturing (including 3D printing) • Renewable energy	

Advancing fourth industrial revolution

4IR sees a new generation of technologies transforming manufacturing into a more productive sector. The shop floor of the past is increasingly being replaced by smart manufacturing facilities where tech-savvy workers, aided by robots, to create products of the future. With the aid of smart sensors, artificial intelligence (AI), cloud computing and data-processing, new look manufacturing is increasing capacity, connectivity and productivity.

AI, robotics and other forms of automation are advancing at a rapid pace and have the potential to bring significant economic benefits. In 2018, PwC estimated these technologies could contribute up to 14% to global GDP by 2030[13].

Capital investment costs often slow the implementation of Industry 4.0. However, those companies already on the journey report the following benefits[14]:

- **19%** increase in efficiency in digital product development
- **17%** reduction time-to-market
- **13%** reduction in production costs over the next five years

$500 billion – $1.5 trillion

Industry 4.0 has the potential to be a powerful driver of economic growth, predicted to add between $500 billion – $1.5 trillion in value to the global economy between 2018 and 2022[19].

$12 trillion

AM could represent 2% of the $12 trillion global manufacturing industry by 2030[20].

26%

of respondents don't adopt new technology that is important to them because of a lack of in-house expertise[16].

Digital enabled factory

The digitally-enabled factory of today looks very different when compared with those of the early 21st century. Data, analytics and AI advances mean manufacturers can benefit from a plethora of available digital solutions to improve their ways of working. The returns can be significant.

Modern digital technologies can boost availability, flexibility and reliability. Applied well, technology can enable cross-functional collaboration, improve processes and change how teams work. Productivity increases, downtime reduces and customers see a range of impacts including reduced lead times and improved customer service[15].

While new technologies enable effective and efficient production processes, taking full advantage of them also requires digitisation across other parts of the business. The uptake and implementation of new technologies can pose challenges to some manufacturing businesses.

Recent research among manufacturing representatives from around the globe highlights how the sector recognises the growth potential afforded by a range of new technologies, including AI, AR, VR and digital twins[16].

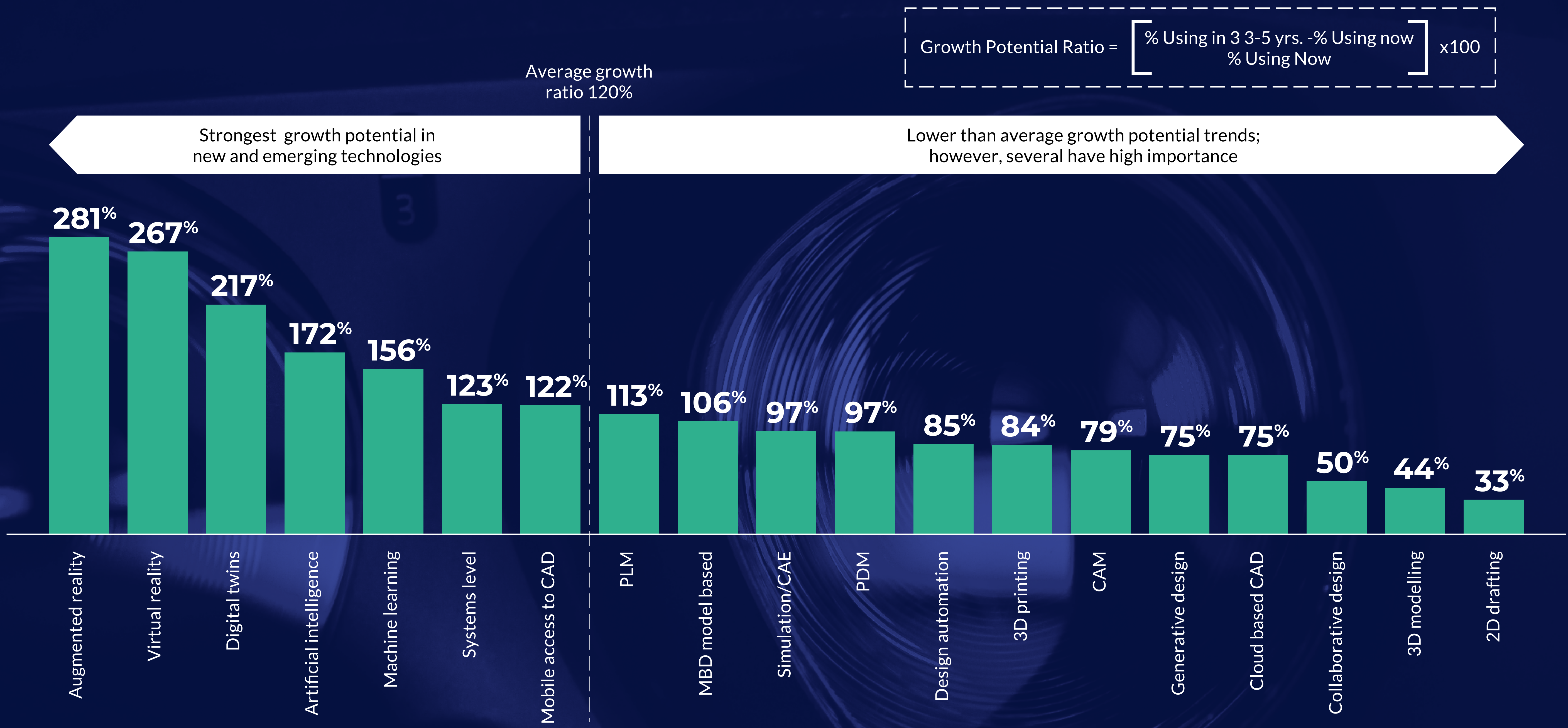
Additive manufacturing: a rising star?

Additive manufacturing (AM) – often referred to as 3D printing – is an innovative manufacturing technique used in both prototyping and in the production phase of parts, tools and final products. It is being used across a range of sectors, including aerospace, automotive and healthcare, offering companies the potential to produce parts and products rapidly and cheaply – and in remote locations. According to the World Economic Forum, 69 per cent of companies in the manufacturing sector plan to adopt 3D and 4D printing and modelling by 2025[17].

"After decades as a bit player, additive manufacturing is on the cusp of stardom. Faster machines, better materials, and smarter software are helping to make AM a realistic solution for many real-world production applications. As the technical barriers fall, the onus is on manufacturers to improve their understanding of these rapidly evolving technologies, building the skills, processes, and business models needed to make additive manufacturing shine in the industrial world," McKinsey & Company[18].

Whilst the sector broadly recognises the value associated with a range of exciting new technologies, the infrastructure and capital costs associated with deployment have often been cited as reasons for slow adoption. Other barriers to uptake include lack of in-house capabilities, highlighting a need to invest in skills and the workforce for the digital factory of the future.

Future growth potential[16]



Adding capability and capacity in MENA

MENA is known across the world as a region reliant on vast natural resources. Nations are responding to new realities, as they build economies less reliant on oil. It is widely accepted they need to adapt and transform. In general, MENA hasn't previously been recognised for manufacturing output. Is this trend reversing? World Bank data shows GDP from manufacturing has increased in the region over the last couple of years[21].

The effects of technological progress, together with the impact of the COVID-19 pandemic have contributed to a pressing challenge: how to equip people and businesses with the skills and knowledge they need to be productive and participate in a new look economy?

According to the World Economic Forum in 2017, there was growing evidence of a sizeable skills mismatch in the MENA region, as young people failed to acquire the skills needed to succeed in today's jobs, let alone those we will see in the future[22]. The region's youth enter the labour market in increasing numbers, and unemployment is high compared to global norms. The region also faces a huge challenge to bring more women into the workforce[23].

The emergence of new technologies will change the skill sets needed to succeed at work: by 2030, a higher share of professions will require university degrees, and more work activities will require socio-emotional and technology skills. Nearly 29 million jobs — about 17 per cent of current jobs — are at risk of being displaced by 2030 because of automation[23].

A recent report on digital skills within GCC countries revealed there were insufficient initiatives to improve the skills of their employees at the entry level and as they rise up the ranks. There is also insufficient interaction between employers and educational institutions, which means that they are not collaborating to meet the skill requirements for the modern workplace[24].

Debby Mashiah from TEAMCAD in Israel highlights how there is strong recognition in industry that skills in digital design, cloud, AI, CAM, are a must have for employees. She reinforces the need for partnership working between industry and education: "In the secondary/high school sector, tutors generally follow a set curriculum that leverages established technologies. This creates a significant hurdle to incorporate new workflows driven by cloud technology.

"As an industry representative we see it as our responsibility to help tutors and high schools to overcome these hurdles as it will give students better opportunities as they move on to postsecondary education or graduate through vocational programs and start working in industry."

3D printing potential

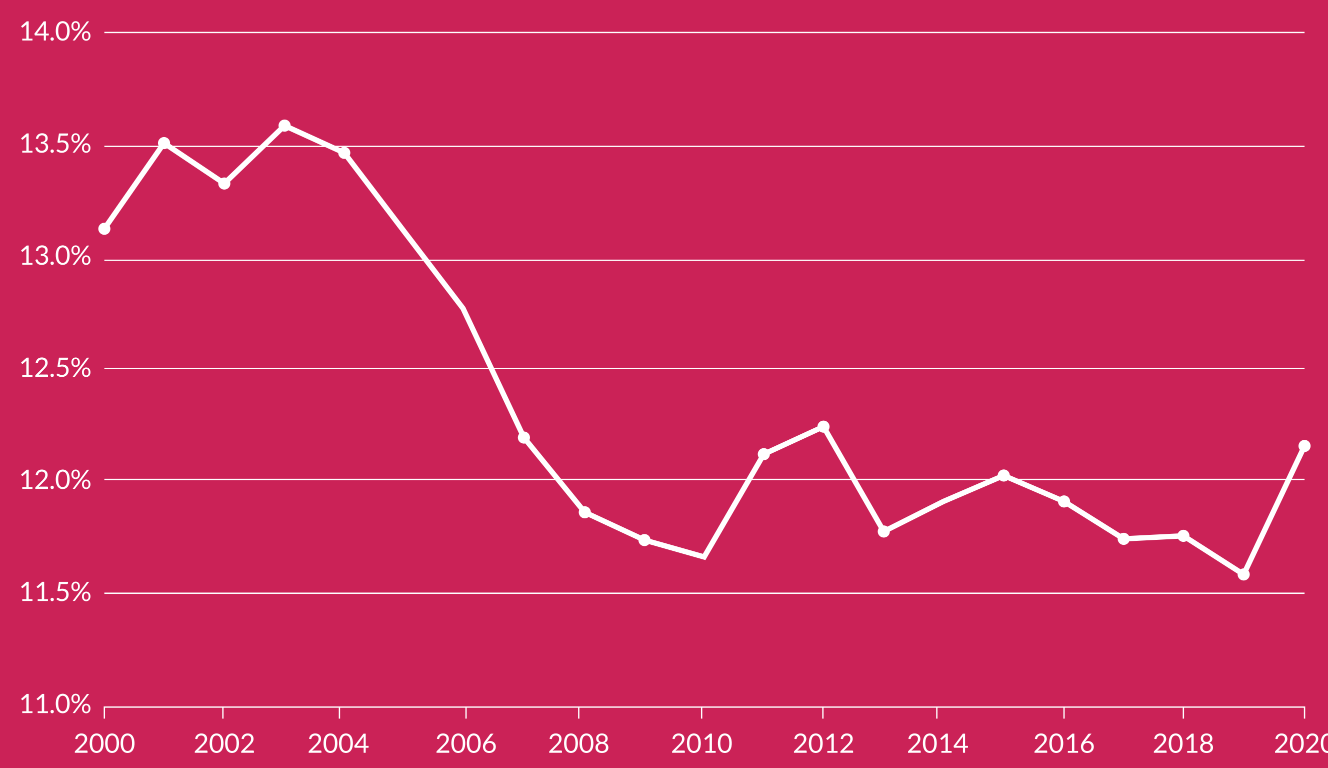
3D printing is experiencing notable growth in the Middle East, where many industries, from aerospace to construction, are willing to seize the opportunities the technology offers.

The United Arab Emirates is striving to position itself as an expert in 3D technology. In 2016, the UAE launched the Dubai 3D Printing Strategy, an initiative aimed at promoting itself as a leading hub of 3D printing technology by 2030. Particular areas of interest include the construction industry, aerospace, medical and consumer products[25].

Despite substantial growth opportunities for 3D printing in the region, the AFMG's 2020 report highlights barriers to faster adoption, including a lack of 3D printing expertise. It suggests that "overcoming these issues, for example by providing training and establishing AM programmes at local universities, will be instrumental in driving greater use of the technology in both regions".[25]

Over the next two decades, around 127 million young people are expected to enter the region's labour force[26].

Manufacturing, value added (% of GDP) – Middle East & North Africa[21]
World Bank national accounts data, and OECD National Accounts data files



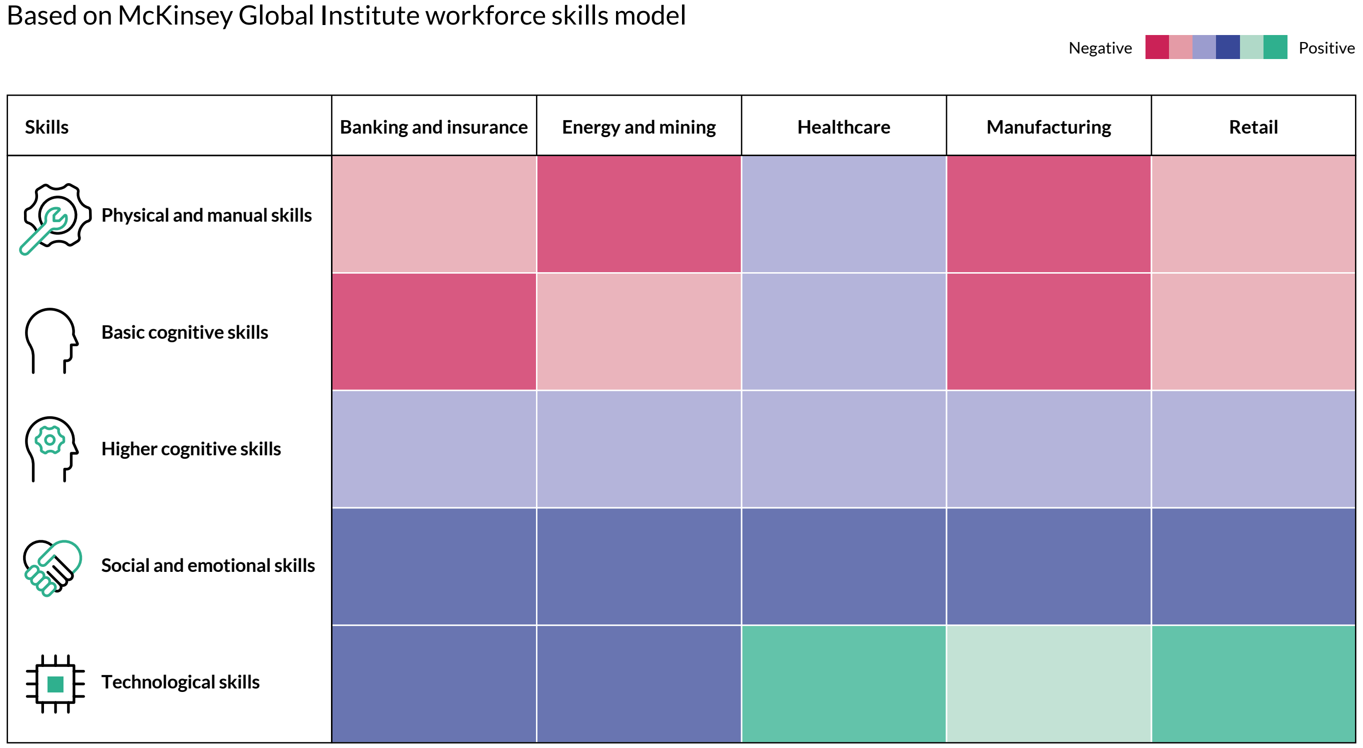
Trend watch: **AI & automation in manufacturing**

Automation continues to disrupt all aspects of manufacturing. It can be found in the form of robotic arms on production lines, cobots that assist humans in manual tasks, and robotic process automation (RPA) to automate routine business processes. In its future of jobs report, the World Economic Forum predicted that by 2022, machines and algorithms will contribute 42 per cent of total task hours, compared to 29 per cent in 2018[27].

McKinsey talks about how AI and automation should drive considerable value along the manufacturing value chain to 2030, including with predictive maintenance and automated supply chain, real-time production, and smart robotics and autonomous machines[28]. It is estimated that automation could raise productivity growth globally by 0.8 to 1.4 per cent annually[29].

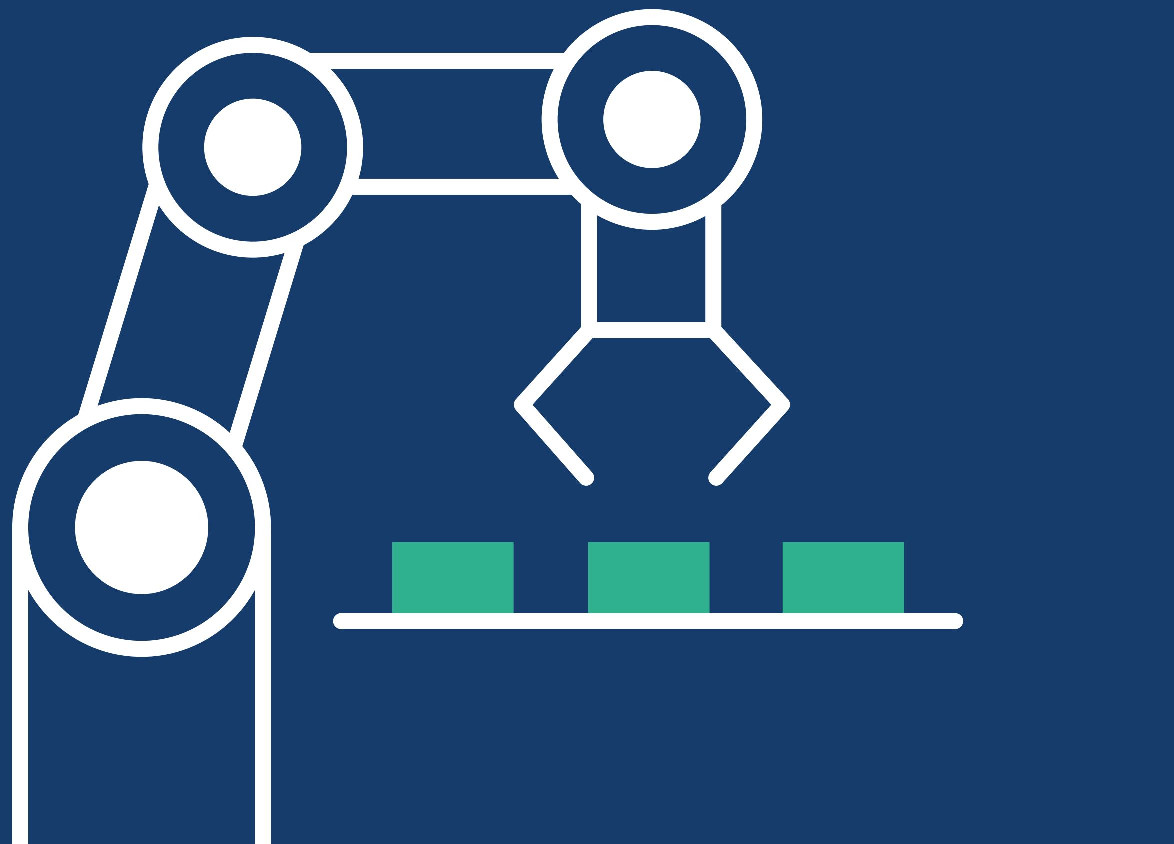
In addition, a range of benefits are predicted from the deployment of AI, including improved productivity, improved demand forecasting and scheduling and faster processes[16].

Skill shifts will vary across sectors as automation and AI are adopted[28]
Based on McKinsey Global Institute workforce skills model



Note: Based on difference between hours worked per skill in 2016 and modeled hours worked in 2030. Western Europe: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, and the United Kingdom.

By 2025, the time spent on current tasks at work by humans and machines will be equal[17]



Implications for the workforce

Functions across factories will change as a result of better analytics and increased human-machine collaboration. Roles and structures will be affected by the adoption of automation, especially manual occupations such as assembly workers.

The need for physical and manual skills overall in the sector is decreasing at more than twice the rate for the whole economy. The need for technological skills will increase, both for advanced IT skills and basic digital skills, as more technology professionals are required but also more technology-enabled jobs such as engineers are created[28].

As companies deploy automation, replacing legacy processes and systems with those that are more suited to handle newer technologies, they will need to consider the skills requirements of the new look workforce. Training will be needed to help workers acquire both the digital and softer skills which will be demanded in the future and to support for those who lose out from the impact of automation[13].

Analysis by McKinsey highlights the shifts in workforce skills that will be in demand in an automated future. The biggest change will take place in technological skills, both in advanced skills such as programming, advanced data analysis, and tech design, for example, and also in more basic digital skills relating to the increasing prevalence of digital technologies in all workplaces. Other skills will also see a significant increase in demand, including various types of social and emotional skills. A shift will take place from basic to higher cognitive skills. Demand for physical and manual skills as a predominant skill set will continue to decrease, although these skills will remain a major component of the workplace of the future[28].

45%

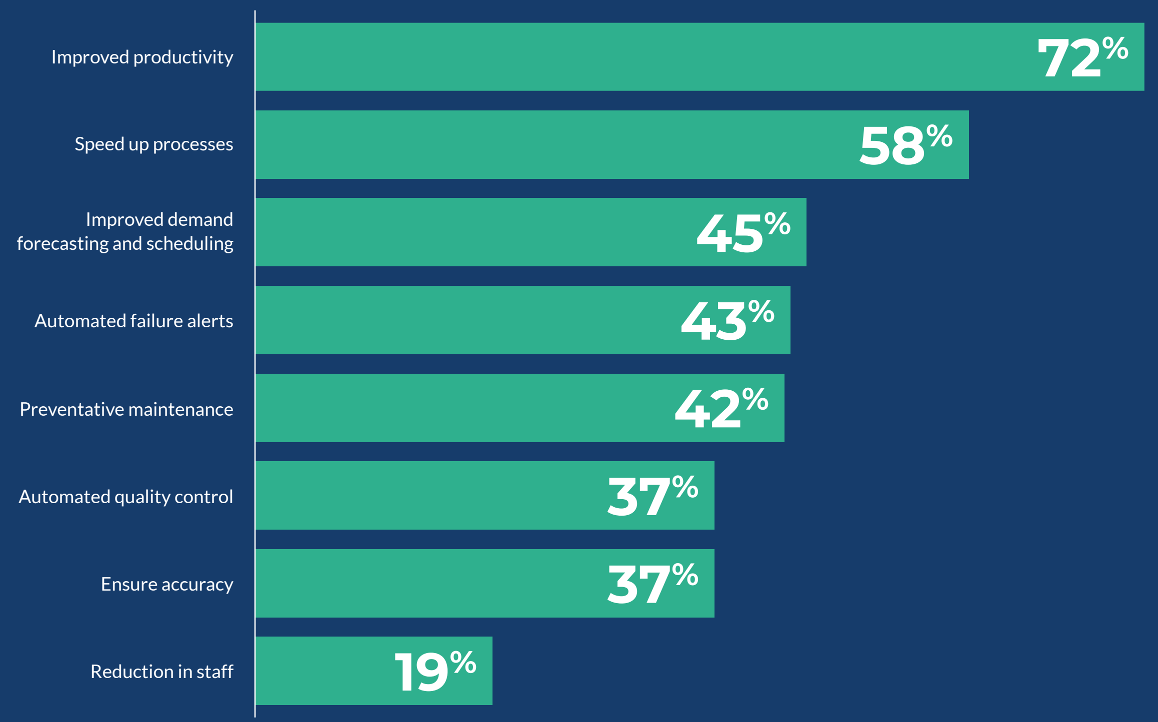
of existing jobs in manufacturing could potentially be automated by 2030[17]

> …new technologies like AI and robotics will create many new jobs. Some of these new jobs will relate directly to these new technologies, but most will just result from the general boost to productivity, incomes and wealth that these technologies will bring. As these additional incomes are spent, this will generate additional demand for labour and so new jobs, as such technologies have done throughout history[13].

Automation will boost global productivity and raise GDP[29]

G19 plus Nigeria

Envisaged benefits of artificial intelligence[16]



Defining technologies and skills

As the manufacturing sector embraces 4IR, the workforce has to adapt to the latest tools, technologies, philosophies and processes, including:

Analysis & simulation

Verification of the design through computer simulations has helped bring down the product design lifecycle time and cost significantly. Simulations not only help understand the potential failure modes but also give insights into margins available for optimisation. Analysis includes Finite Element Analysis (FEA) and Computational Fluid Dynamics (CFD)

Collaborative design

Collaborative design is where teams embrace the entire process of creating an asset, from brainstorming to allocating tasks and team members. It's a multi-pronged process that involves planning and strategy that revolves around feedback and is delivered collaboratively.

Engineering design

Engineering design is an iterative decision-making process in which the basic sciences together with mathematics and engineering are applied in order to optimally convert resources to meet a stated objective. (Science Direct)

Generative design

Generative design is an iterative design process that involves a program that will generate a certain number of outputs that meet certain constraints, and a designer that will fine-tune the feasible region by selecting specific output or changing input values, ranges and distribution (Wikipedia)

Mass personalisation

"Mass personalisation is being driven by a demand to provide the best possible customer experience, since this increases preference and can command a price premium. It is also being driven by the increasing amounts of data and insight that manufacturers have about consumers, better understanding their wants and needs" (Autodesk: Future of consumer goods manufacturing)

Product lifecycle management (PLM)

PLM is the process of managing the entire lifecycle of a product from its inception through the engineering, design, and manufacture, as well as the service and disposal of manufactured products.

Sustainable design

Sustainable design is the approach to creating products and services that have considered the environmental, social, and economic impacts from the initial phase through to the end of life and recycling of materials.

Systems engineering

Systems engineering is an interdisciplinary field of design, engineering and engineering management that focuses on how to design, integrate, manufacture and manage complex systems over their life cycles.

Additive printing and subtractive machining (CAM)

Additive manufacturing uses 3D printers, able to use many different materials, to build up complex shapes layer by layer. Subtractive machining uses CNC machines to cut down materials to the correct shape.

AI (artificial intelligence)

Artificial intelligence (AI), also known as machine intelligence, is a branch of computer science that focuses on building and managing technology that can learn to autonomously make decisions and carry out actions on behalf of a human being. (Techopedia)

Automation

Automation is the creation and application of technologies to produce and deliver goods and services with minimal human intervention. The implementation of automation technologies, techniques and processes improve the efficiency, reliability, and/or speed of many tasks that were previously performed by humans. (Techopedia)

Computer-aided design

Computer-aided design (CAD) is the use of computer-based software to aid in design processes. CAD software is frequently used by different types of engineers and designers. CAD software can be used to create two dimensional (2-D) drawings or three-dimensional (3-D) models. (WhatIs.com)

Immersive technologies

The use of Virtual Reality, Augmented Reality and Mixed Reality tools allows for enhanced visualisation of designs as well as innovative use of design data in applications such as learning and documentation.

Robots and cobots

Robotics is the design, construction, and use of machines (robots) to perform tasks done traditionally by human beings, especially in areas dangerous to human workers. Traditionally used for repetitive tasks, robots now augmented with artificial intelligence can learn and improve the tasks they perform. A cobot, or collaborative robot, is a robot intended for direct human robot interaction within a shared space. (Wikipedia)

Future manufacturing job market

The First Industrial Revolution changed the nature of work – and how we live. As manufacturing expanded, people poured into cities from the countryside to work in the new factories. Just as the First Industrial Revolution had a profound effect on society, 4IR promises to change the future of manufacturing forever – and, like its predecessor, the job market.

But unlike the First Industrial Revolution, manufacturing doesn't have the same pull as it did in the past. In more industrialised countries, many younger workers view manufacturing as a dying industry that is low paid, and offers little career progression – as a result they're put off from entering it. The sector needs to overcome this negative impression, highlighting the abundance of new opportunities it offers.

Much has been written about the potential effects of automation on workers, with widespread predictions of large-scale job losses. More nuanced research suggests that automation will indeed have a significant impact on the future job market but, rather than simple displacement, new jobs will be created as a result of new technologies and the boost to the economy these technologies will bring. The World Economic Forum's Future of Jobs 2020 Report indicated that the shift to automation would create 97 million new jobs by 2025. However, it will disrupt 85 million jobs in the process[17].

Jobs of tomorrow

Rapid innovation, technological transformation, and the flood of digital tools into the workplace mean the jobs of tomorrow are still emerging – or even not yet known. Computing is becoming faster and cheaper, fundamentally reconfiguring how humans contribute to economic output.

For many occupations, better, more intelligent machines will complement human activity, and automation promises to relieve workers of mundane, repetitive, or dangerous tasks. To adapt, workers will need to learn how to operate and coexist with new digital technologies. They will need not only new skills but also the ability to learn on the job.

Large-scale changes to job and skill demand brought about by 4IR brings fresh challenges. There are already widely reported shortfalls in digital skills and other skills of the new economy as technology disrupts labour markets. As new technologies are adopted by organisations around the world, skills shortages in digital skills and the skills needed for the jobs of tomorrow are set to become more pronounced without action.

The World Economic Forum's Future of Jobs Report 2020 projected that technological change is set to displace a range of skills in the labour market while driving greater demand for a new set of core skills such as analytical thinking, creativity and critical thinking as well as skills in the use and design of technologies ("digital skills")[17].

A team from Deloitte highlighted five roles which are representative of how manufacturing jobs will continue to evolve[30].

Beyond these roles, 4IR will disrupt production functions in factories through better analytics, increased human-machine collaboration and adoption of technologies such as additive manufacturing. It will also have an impact on product development and on marketing and sales.

To remain relevant and employable, workers are faced with the need to re-evaluate and update their skillsets. Companies face a pressing need for innovative talent sourcing, matching and development strategies; and educators face pressure to update the focus of their courses and offerings[31].

Role	Changes	New skills include
Production planner	• From reactively managing shop floor issues to analysing data insights, managing exceptions and identifying opportunities for continuous improvement • From manual processes for monitoring supply and inventory positions to using predictive analytics and digital twins to create optimised production schedules and proactively manage supply issues	• Business acumen • Continuous improvement • Data analysis and visualisation • Digital twins • Understanding of the impact of robotics and IoT sensors
Industrial engineer	• Increasing use of digital twins and other methods of automation, to create greater connectivity between manufacturing processes and optimise shop floor operations • Focus on optimising human-machine interactions	• Greater technical acumen • Design for manufacturability • Data science • Programming languages such as python and R • Implementation of technologies including co-bots, IoT sensors and digital twins
Operator	• In the future, operators will use digital tools, such as digital twins and AI "recommendation engine" support, to proactively identify and solve issues • They will be trained as generalists who can work across machines and product lines	• 3D models for model-based manufacturing • Predictive and prescriptive maintenance practices • Interpret and act on insights from digital twins • Work collaboratively with robots on automated production lines
Line leader	• Line leaders will move from manual work and reactive problem solving to proactive issue identification and prevention through automated processes and tools	• Coaching • Team management • Using real-time production data to determine root causes and prevent recurring issues • Predictive and prescriptive maintenance • Understanding of IoT, digital twins, robotics, and automated machinery
Quality engineer	• In the future, they will be able to monitor processes in real time, predict quality issues before they occur • They will trace and diagnose any issues through the use of digital twins, machine learning models, advanced analytics and the ability to embed intelligence quality controls	• Analytical thinking skills • Ability to use 3D models for model-based manufacturing • Understanding of how to collaborate during design iterations as part of an agile team • Understanding of big data, data science and machine learning

Emerging and redundant job roles[17]

Role identified as being in high demand or increasingly redundant within their organization, ordered by frequency

EMERGING		
	1	Data Analysts and Scientists
	2	Business Development Professionals
	3	Strategic Advisors
	4	Software and Applications Developers
	5	Internet of Things Specialists
	6	Big Data Specialists
	7	AI and Machine Learning Specialists
	8	Sales Representatives, Wholesale and Manufacturing, Technic ...
	9	Robotics Engineers
	10	Process Automation Specialists

REDUNDANT		
	1	Administrative and Executive Secretaries
	2	Data Entry Clerks
	3	Assembly and Factory Workers
	4	Relationship Managers
	5	Business Services and Administration Managers
	6	Accounting, Bookkeeping and Payroll Clerks
	7	Sales Representatives, Wholesale and Manufacturing, Technic...
	8	Mechanics and Machinery Repairers
	9	General and Operations Managers
	10	Door-To-Door Sales Workers, News and Street Vendors...

Trend watch: **remote working**

Before COVID-19 swept around the world, businesses had started to embrace the flexibility of remote working and tele-commuting with employees only required to travel to business premises several times a week or month. Communication and management technologies have been shown to enable the switch from office to remote work.

The global pandemic, with lockdown regulations implemented globally to contain the spread of the virus, meant many businesses had to allow staff to work from home simply to keep their doors open. For manufacturing operations this posed a challenge. The physical nature of manufacturing meant many factories were simply shut down, or were forced to operate with minimal staff on the shop floor.

But those manufacturers already on the digital transformation journey were able to keep operations going throughout. According to research by McKinsey, 94% of respondents said that Industry 4.0 technologies had helped them to keep their operations running during the worst of the pandemic[32]. According to data from the World Economic Forum, 46% of the industry has enabled remote monitoring processes to ensure visibility of production when not at the plant[33].

It has been estimated that around 50 per cent of employees will work remotely at least some of the time. To enable this, businesses need to identify the new skills that enable effective remote work, including greater digital dexterity[34].

Before the pandemic, many manufacturers on the digital transformation journey would have been interested in automation as a cost-saving measure. Now the benefits of increasing the automated workforce – and shifting the make-up of the human workforce – seem to be coming into clearer focus. This is borne out as trade volumes for industrial robots increased in many countries[35].

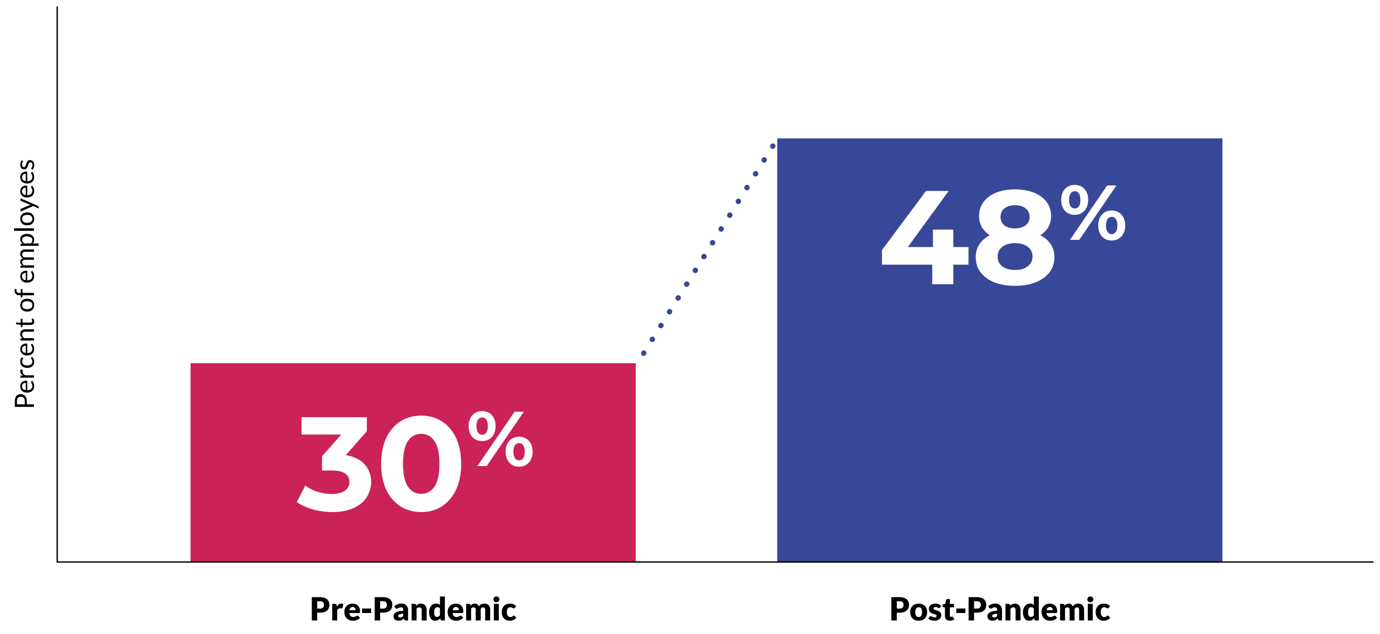
The technologies we see in factories of the future, including augmented reality and artificial intelligence, mean engineers have more insight into processes and machine performance than ever before. In turn, this means an element of diagnostic and collaborative work can be undertaken remotely.

Remote preparation

One academic institution rising to the challenge is Ivy Tech Community College, Indiana, USA. Josh Nelson, program chair, was forced to adapt the Design Technology program to a virtual environment swiftly following the COVID-19 outbreak. Students on his Manufacturing Principles & Design course continued collaborating remotely, relying heavily on Autodesk's Fusion 360 cloud technology. To continue to meet student needs during this time, the program has incorporated hybrid courses, utilisation of cloud-based technology, and asynchronous delivery to encourage working from anywhere.

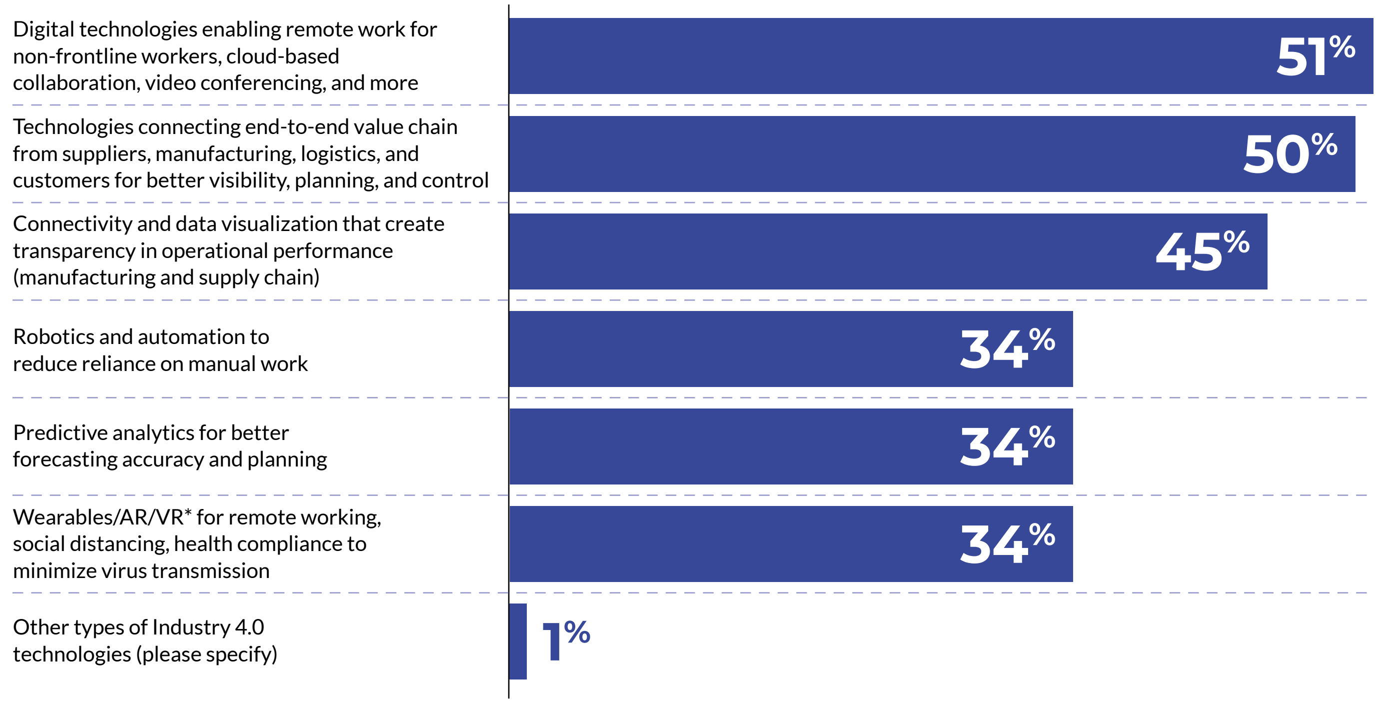
Josh Nelson: "If it were not for Fusion 360, and specifically the ability to share data and simulate CNC operations, I do not think we would have been able to continue the course. It certainly would not have been as successful."

Nearly half of employees will work remotely at least some of the time[34]



Remote work, supply-chain connectivity, and operational transparency are major focus areas for Industry 4.0 technologies[32]

Which technologies are you focusing on the most when implementing Industry 4.0 use cases?



* Augmented reality/virtual reality

The skills imperative

It has been clear for many years that manufacturing is changing radically. The workforce of the future has to evolve as manufacturers adapt to new imperatives, such as new technologies, the rise of manufacturing superpowers and changing global supply chains. New skills are needed but many of these skills are in short supply, and the gap isn't expected to narrow any time soon. It is clear that manufacturers need to invest in skills.

The risks and rewards

The cost to the global economy of not addressing skills gaps is enormous. Additional GDP potential due to upskilling, for the manufacturing sector alone in 2030 (2019 prices, billion $, % relative boost to sector GDP) could increase from 3.3% ($870bn) and 4.7% ($1210bn) assuming skills gaps are closed by 2028[12]. Research from IDC predicted that by 2022, monetary losses resulting from IT skills gaps will be US$775bn worldwide[36].

"COVID-19 has accelerated the need to implement an ambitious global upskilling agenda because it is forcing digitalization and automation at a more rapid pace. Rising to this challenge could result in faster progress and even larger economic benefits by 2030."[12]

Digital skills challenge

Manufacturing demands new IT skills due to the digital transformation of production and supply chains. But, there's already a mismatch between the available workers and the skills necessary to fill open jobs.

This lack of adequate digital skills exacerbates the risk of job losses related to automation. World Economic Forum data shows that in OECD countries, at least 14% of all jobs are at "high risk" of automation and 32% of all jobs are at "significant risk" of automation. In 16 of 27 OCED countries digital skills scores have declined over the past four years, making it more difficult for workers to transition to new roles[10].

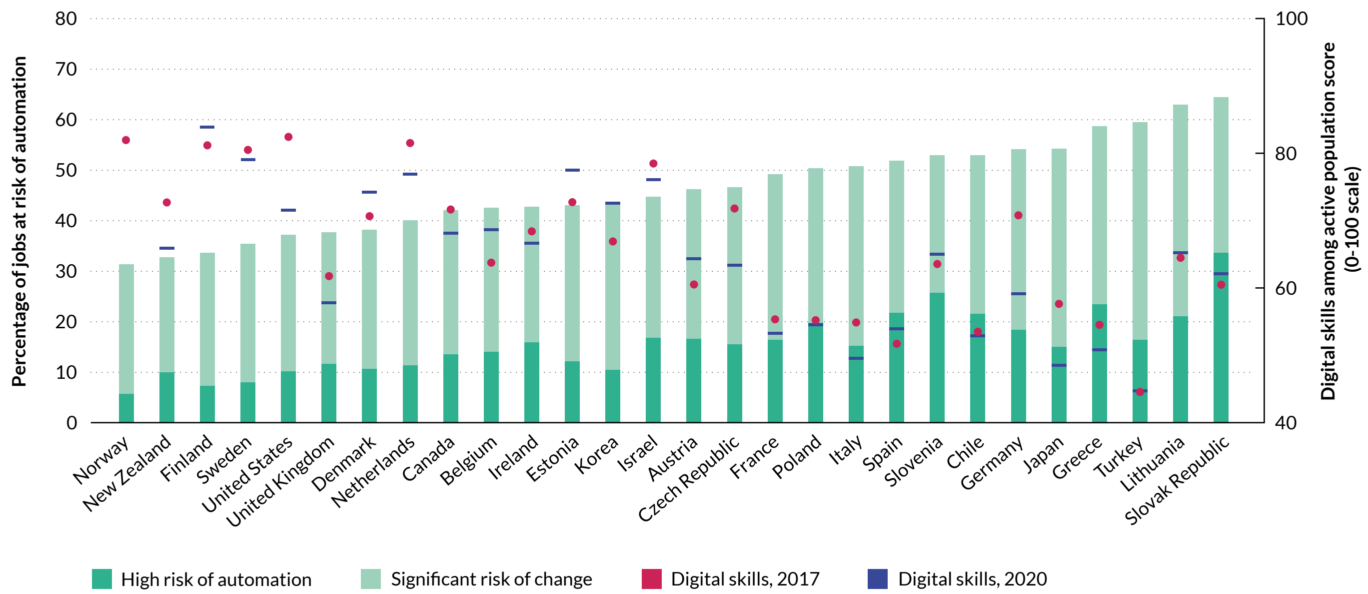
Increasingly, employers are looking for extended computer skills such as those that enable core production workers to program a CNC (computer numeric control) machine for a new job, or interact with CAD/CAM (computer-aided design/computer-aided manufacturing) and other engineering or manufacturing software.

Many producers are heavily reliant on machine-level data processing, with cloud integration of shop-floor assets (such as robots, measurement, optical recognition, machining centres etc) all connected together with visualisation and big-data analytics. Availability of AI and machine learning expertise becomes a limiting factor to organisations seeking to make real-time cloud-managed decisions governing quality control, predictive performance and optimise asset utilisation[37].

Digitalisation and computer aided design (CAD) have extended the use of advanced technologies in the manufacturing sector. Adoption of 3D modelling, generative design, additive manufacturing and virtual and augmented reality has increased the need for digital skills and the advent of new roles.

It makes sense that manufacturing executives suggested the following skills are needed for success in the 4IR: technology/computer skills, digital skills, programming skills for robots/automation, working with tools and technology, and critical thinking skills[38].

Digital skills among active population and % of jobs at risk of automation, selected economies[10]



With a GDP increase of 7.8%, Sub-Saharan Africa could enjoy one of the biggest boosts to GDP from the increase in productivity achieved through upskilling[12].

Beyond digital skills

In some emerging markets, there's a need to invest in all levels of education, addressing inequalities and expanding access to schools and training. Some countries need a demand-driven education system which is in synch with employers' needs, as well as building both STEM and ICT capacity.

For example, Africa's workforce is perceived to be lacking in skills and efficiency, a major hindrance to investment, especially in more specialised forms of production. Only two-thirds of 15-24 year olds in Africa have completed a primary education, which is roughly 20 per cent less than the world average, with less than one-in-five students continuing beyond primary school[39].

Actions to achieve transformation

To achieve the skills transformation required for the jobs of tomorrow, the World Economic Forum asserts that economies must fundamentally upgrade technical and vocational training and university education for both students and workers on an ongoing basis. It also suggests policy-makers must innovate and refresh how school curricula teach the core skills that must be seeded for innovation capability later in life through creativity and critical thinking skills[40].

Governments, working with employers and education providers, should invest in the types of education and training that will be most useful to businesses and people in this increasingly automated world. Many nations need to redouble their efforts on STEM subjects (science, technology, engineering and mathematics) at all levels. And there needs to be an increased focus on vocational training and investing in specific skills and qualifications mapped to career roles.

Academia is becoming very aware of the need for new jobs demanding new skills, and many universities and technical colleges are revamping curricula to help equip their students to succeed in new jobs.

One such example is the post-graduate degree course in Industrial Digitalisation at Manchester Metropolitan University (MMU). The multi-disciplinary nature of the course encourages students to collaborate and prepares them for a future in digital manufacturing by learning the very latest industrial digital technologies[41].

Alan Dempsey, Project Manager, MMU: "The future of how we make things is changing, and an interdisciplinary environment supports students in understanding the foundations of manufacturing. This course has enabled students to learn advanced manufacturing methodologies in an experiential, collaborative learning environment. Students on the course also have the opportunity to work with businesses, disrupting their traditional manufacturing workflow through innovation, to exploit the opportunities of Industry 4.0 whilst boosting their employability skills."

Top ten countries on ICT adoption, flexible work arrangements, digital skills and digital legal framework[10]

Adapted from the World Economic Forum
(All scores are expressed on a 0-100 scale)

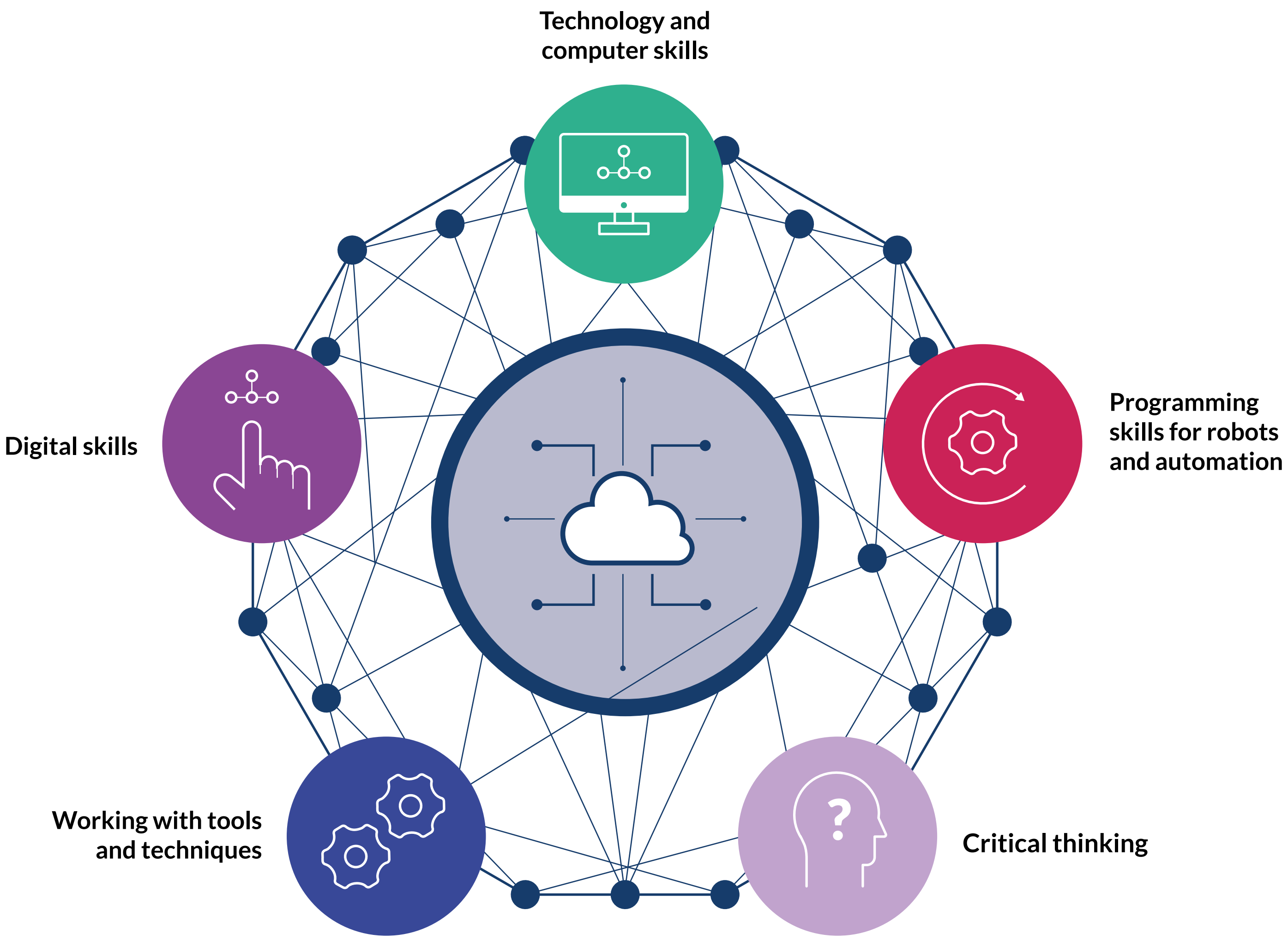
ICT ADOPTION

Korea, Rep.	93.7	Singapore	88.1
United Arab Emirates	92.3	Iceland	87.8
Hong Kong SAR	90.2	Norway	84.7
Sweden	89.7	Qatar	83.9
Japan	88.3	Lithuania	83.8

DIGITAL SKILLS

Finland	84.3	Singapore	77.3
Sweden	79.5	Israel	76.5
Estonia	77.9	Denmark	74.7
Iceland	77.6	Saudi Arabia	74.1
Netherlands	77.3	Korea, Rep.	73.0

FIVE KEY SKILLS ARE EXPECTED TO BE NEEDED TO SUCCEED IN THE FOURTH INDUSTRIAL REVOLUTION[38]



Reskilling, upskilling and education curricula updates are central to prepare workers and achieve inclusive prosperity. Participation in formal education is no longer sufficient to provide employment opportunities and build human capital. Instead, education systems should be upgraded to provide digital skills and critical thinking skills through schools and universities, as well as ongoing learning and skilling through public and private life-long learning programmes[10].

World Economic Forum

African perspective

Africa is rich in natural resources, many of which are sent elsewhere for processing or for use in production. It is also one of the fastest growing consumer markets in the world. But, to date, the continent has lagged behind the rest of the world in production capacity and capability.

Many nations have been lacking the necessary infrastructure for them to compete on a global manufacturing stage. Investment is needed in reliable and affordable power supply, transport infrastructure, and postal address systems – as well as digital infrastructure, such as high-speed internet, mobile virtual networks, and interoperable systems.

Despite such infrastructure limitations, there are some positive signs. Production nearly doubled between 2000 and 2016, from nearly $85 billion to approximately $158 billion (in constant 2010 prices)[5].

To sustain this growth, action is needed on skills across the continent to boost productivity and competitiveness. For example, the African Development Bank (AfDB) recently launched its Skills for Employability and Productivity in Africa (SEPA) action plan. It highlights the actions needed to bridge Africa's skills gap, address skills mismatch and relevance on the back of the 4IR, climate change agenda and digital transformation in the labour market[42].

"With the shortage of engineering, scientific, and digital skills in Africa, human capital remains a key constraint in preparing for the future of production shaped by the disruptive technologies of the 4IR. Absent major changes in education and training systems, this problem is likely to worsen.

"For example, enrolment [at university] is under 10% in engineering and in natural sciences, mathematics, and statistics, and under 5% in information and communication technologies. To better prepare for the future of work, education and training institutions in Africa should give more emphasis to STEM subjects, with enhanced public–private sector collaboration to ensure that skill development is in tune with labour market needs."[43]

39.6%

In 2019, internet penetration in Africa averaged 39.6% compared to a global average of 62.7%[43]

46%

of Africa's working youth perceive their skills mismatched to their jobs[45]

29%

of production workers are rated as unskilled[42]

8.7%

have access to Technical, Vocational Education and Training (TVET)[46]

230m

digital jobs are projected to be created in Africa by 2030[47]

Students typically get trained on using 3D modelling tools to design but they are not given any experience of how you manufacture these designs. This is a huge skills gap that impacts the ability to successfully operate in the manufacturing space. A designer/engineer needs to understand how to translate their design into efficient manufacturing processes of physical products.

Chukwubuikem Felix Amaefule,
Generative CAD Services, Nigeria

Developments in technology are redefining the future of manufacturing around the globe. With African business leaders already highlighting how a lack of adequate skilled workers is a major constraint to their operations, the rapid pace of digital change could mean this problem could get worse. As much of the continent's current employment is low-skilled and labour-intensive, there's a significant risk of displacement by automation.

A recent report highlighted the investment areas for critical future skills[43]:

- Job-specific digital skills, including computer programming and technology design
- Job-neutral digital skills, including data analysis and safe internet browsing
- Soft skills, including communication and analytical and critical thinking, to enable workers to adapt to different tasks in a rapidly changing technological environment
- Ancillary skills related to manufacturing that will remain important for supporting the digital economy, including physical skills that require dexterity, and lower skills such as sales, repair, and maintenance

A recent collaboration between Generative CAD Services and the Faculty of Engineering at Lagos State University saw a number of lecturers being equipped with the necessary skills to navigate today's dynamic engineering curriculum. With the need to not just up-skill but to also future-skill, the project combined academic knowledge and industry applications.

Analysis of World Bank Enterprise Survey data reveals a positive association between provision of formal training and labour productivity in manufacturing and services in Africa – labour productivity is approximately 20 per cent higher for firms that provide employee training[43].

Across the continent, governments, academia and employers alike need to play a role in increasing familiarity with the tools and technologies in use in modern manufacturing. Together they need to support businesses, students and employees to gain the skills they need to be productive, and ensure the future prosperity of the continent.

In 2030, 1.7 billion Africans will need critical products and services such as food, beverages, access to pharmaceutical products and healthcare services, education, and security, additional to other important products and services[44].

Africa is experiencing a critical shortage of both skilled technicians and highly qualified workers, particularly in science, technology, engineering and mathematics (STEM) critical to drive innovation and productivity, spur growth and create productive employment[42].

In demand careers

The manufacturing job market continues to be challenged. Demand for skilled workers seems to be increasing, employers report concerns about talent as one of the top issues affecting their business, particularly with the advent of new technologies. 63.6% of respondents in a World Economic Forum study cited skills gaps in the local labour market as a barrier to adoption of new technology[17].

Job role	Description	US salary range	US average salary
Mechanical engineer	Mechanical engineers participate in the planning and manufacturing of products by performing engineering duties and developing, designing, building and testing mechanical devices. *Mechanical engineers : occupational outlook handbook* *U.S. Bureau of Labor Statistics (bls.gov)*	$54k – $104k	$90K
Mechanical designer/ CAD drafter	Mechanical designers (sometimes called drafters) convert the designs created by engineers and architects into technical drawings. These technical drawings are then used to build structures and manufacture products. *Mechanical designer job description* *Glassdoor*	$33k – $69k	$43K
Machinist	A machinist is a trained tradesperson with the skills and knowledge to create tools, parts, and objects by operating milling and drilling machines, grinders, and lathes in a machine shop. *What is a machinist & what do machinists do?* *The Crucible*	$31k – $63k	$47K
Product design engineer	A product design engineer is a professional who uses computer-aided design (CAD) software to create, test and improve product designs for a range of consumer goods and manufacturing processes. *How to become a product design engineer* *Indeed.com*	$53 – $117K	$72K

Source: Autodesk AutoCAD Certified Professional Salary | PayScale

Manufacturing skills paths

EDUCATIONAL BACKGROUND

2+ YEARS
Vocational/ career technical apprenticeship

4+ YEARS
Bachelor or Master's degree in mechanical engineering, engineering or industrial design

COMPLEMENTARY SKILLS & PROF DEV TRAINING

Skills
- Drafting
- 3D modelling and visualization
- CNC machining and mechanical skills
- Project management

Soft skills
- Analytical and problem-solving skills
- Collaboration and people skills

Software
- Autodesk Inventor
- Autodesk Fusion 306
- CAM tools
- AR/VR tools

CAREER OPPORTUNITIES

Mechanical Designer/Drafter
Machinist

Mechanical Engineer
Product Design Engineer

Work in engineering, transport, manufacturing, construction & process companies, consultancies, research & development organisations, government & civil services

Acquiring potential in the Baltics

Located in northeastern Europe, the three Baltic countries of Estonia, Latvia and Lithuania are known for production of food and beverages, textiles, wood products and electronics, as well as machine building and metal fabrication. Estonia is the only oil producer of the three and its electronic and electrical equipment industry is relatively more developed.

To 2019, the region has experienced year-on-year growth in sectors including electronics, metal fabrication and wood production[48]. With the exception of Latvia, share of GDP from manufacturing has declined in the last couple of years. The Baltics have followed a similar trajectory to central Europe, with the region feeling the effects of the pandemic[49].

Across the region there are around 40,000 businesses in the manufacturing sector, employing approximately 430,000 people[50]. The sector is dominated by small and medium sized enterprises (SME). Research suggests resources needed to select and implement new technology in the manufacturing process are sparse in such companies[51,52].

A large number of manufacturing companies are involved in regional or global supply chains, where products manufactured in the Baltic States are used in further production processes. Baltic companies export over 65% of their production[53].

World Economic Forum data has Lithuania in the top ten countries for adoption of ICT and Estonia in third for digital skills[10]. Existing jobs at high risk of automation by the early 2030s are estimated to be around 42% in Lithuania[13]. These factors suggest that the region is starting to gear up for Industry 4.0 and growth in manufacturing output.

A recent study revealed a lack of young VET graduates available in Estonia to fill jobs in the manufacturing industry. The admission numbers in technical fields have decreased by 10% in the past six years[54].

The study highlights the need for specific skills. "The manufacturing industry needs employees who are competent in industrial product development and automation of production processes. There is a growing need for professionals who can configure and manage automated control systems, automated devices and robots, and analyse and interpret data. In addition to product development, employees lack marketing skills, as well as digital and general skills.

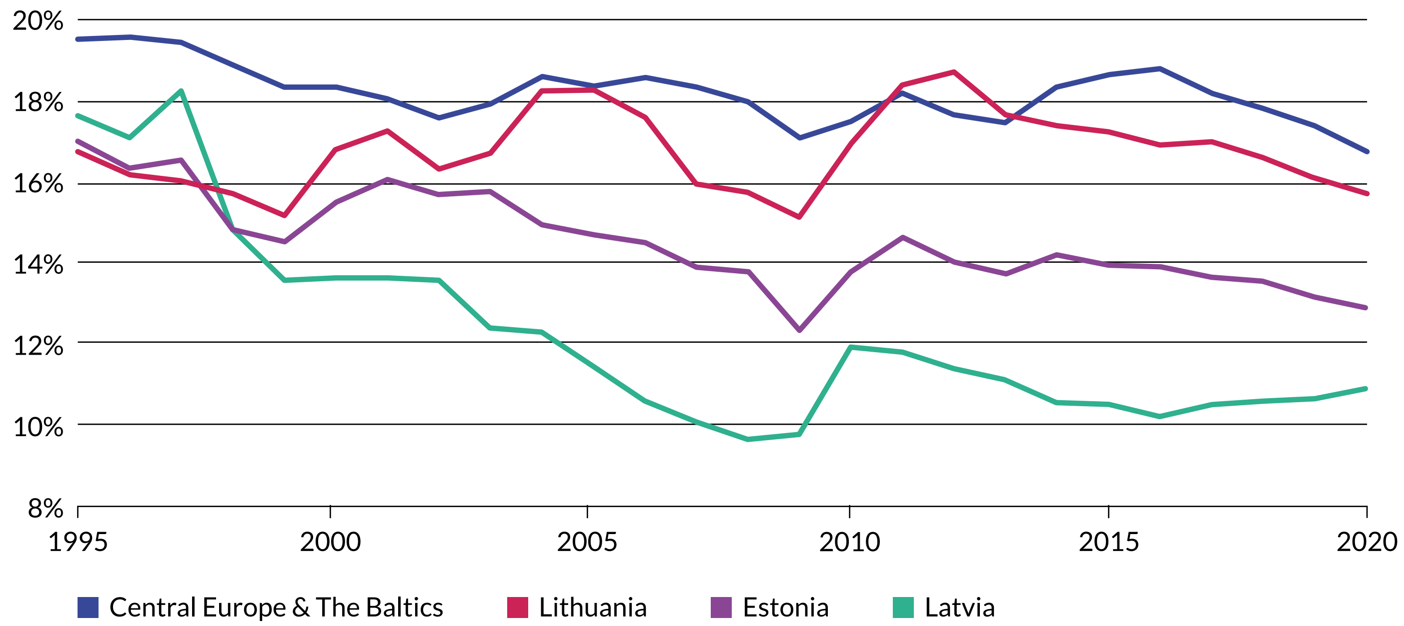
"There is an increasing need for workers with knowledge of materials technology and high-tech equipment. Employers generally consider the level of training in industry-specific skills to be good. The highest priority and biggest challenge are covering the need for ICT skills."[54]

This is borne out by Ivari Soome, Autodesk Learning Partner, AruCAD in Estonia: "A shortage of digital skills among workers remains a challenge for production industries across the Baltic region. The skills needed include coding, CAD, and CAM but there aren't enough people today to meet the demand from businesses.

"We see that the same holds true in the academic space. There aren't enough people in faculties with the in-depth skills in these areas to train sufficient with students that industry needs. The vocational schools are particularly challenged as they have not reached as far in their adoption and teaching of digital manufacturing technologies. We believe that a key answer to this is delivering training that reaches faculty so that they can pass on these skills to students."

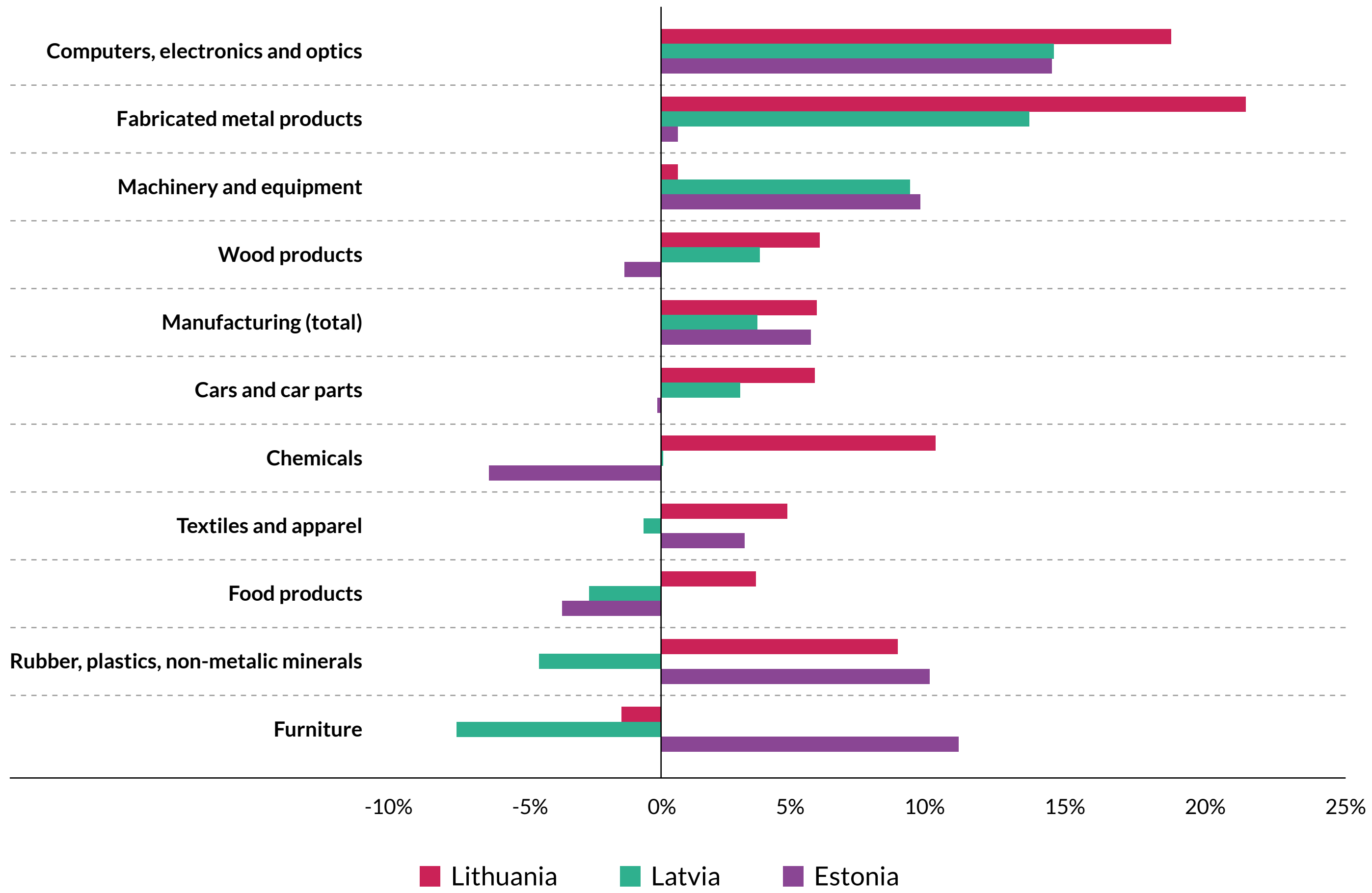
Manufacturing, value added (% of GDP) – Central Europe and the Baltics, Estonia, Latvia, Lithuania[49]

World Bank national accounts data, and OECD National Accounts data files.



Manufacturing – electronics, machinery and metal products remain the best performing sectors[48]

Manufacturing by sectors I-IV 2019, % YoY



	Estonia	Latvia	Lithuania
GDP (2020)[50]	$31.05bn	$33.48bn	$55.84bn
GDP per capita (2021)[48]	€16,260	€12,820	€14,690
Population (2021)[48]	1,330,068	1,893,223	2,795,680
Predicted revenue from manufacturing by 2025[50]	$15.19bn	$11.06bn	n/a
Annual turnover from manufacturing (2019)[50]	€13,781.2m	€9,483.7m	€23,372m
Enterprises in the manufacturing sector (2019)[50]	7,787	10,989	20,843
People employed in the manufacturing sector (2019)[50]	108,681	114,510	212,059
Global Competitiveness Index (Score & Ranking 2019)[55]	71 (31st)	67 (41st)	68 (39th)
GCI Skills Pillar (Score & Ranking 2019)[55]	79 (15th)	76 (22nd)	76 (24th)

The value of certification

Access to a highly skilled and educated workforce is critical for innovation and modern manufacturing's success. Industry-recognised certifications and credentials are essential to create a workforce that is prepared and successful in the 21st century workplace[56]. A report from Burning Glass highlighted how manufacturing has shifted decisively toward automation and robotics, and while that has hit general production workers hard, Computer Aided Manufacturing skills have become more vital[57].

The validation of skills through certification continues to have significance for professionals wherever they are on their career pathway, and for employers across the sector:

- Keeping up with advances in technology is a strong motivator, as 73% of candidates pursued IT certification to obtain necessary skills and enhance job performance[58]
- Training combined with certification has the potential to make a greater impact than training alone; the vast majority of respondents indicated that the myriad benefits they obtained through the process of becoming certified — such as earning more professional credibility or retaining knowledge for longer — exceed the benefits they would've obtained if they'd gone through training without certification[59]
- Employers who support employee credentialing programs see significant improvements in their workforce, with employees being more productive, more efficient, more fulfilled, and more loyal[59]. 66% of respondents said employees with IT certifications produce higher quality work[58]
- Certification has been shown to boost pay; 28% of candidates reported a salary uplift as a result of certification[59]
- IT certification helps employers find and hire the best talent; 60% of respondents stated that job applications with IT certifications are significantly more likely to be reviewed[58]
- 94% of decision makers worldwide said certified team members provide added value above and beyond the cost of certification[60]
- Outcomes such as increased work quality, productivity, efficiency, innovation, and the ability to mentor others are direct benefits to work processes and people, which ultimately impact business profitability. For example, decision makers estimated the return on investment for each credentialed staff member to be about US$10,000[60]

The University of Warwick has begun to augment its degree program and allow students to undertake industry-recognised vendor qualifications. These vendor qualifications validate the job readiness of the students whilst allowing them to personalize their education pathway. It also signals to an employer that the graduate has both an academic degree and specialist skills in certain technology areas.

We believe that converting the work done as part of the degree course into specialised, industrially recognised technology certifications should be the norm for our industry. For example, we put all first-years through the Fusion 360 certification. For us, it has yielded immense benefits. The students get an early opportunity to see the results of their hard work in the module whilst beginning their journey to job readiness. Lots of them left the certification sessions really pleased that they had passed as it validated their skillset.[41]

Dr Simon Leigh,
Associate Professor,
University of Warwick, UK

Addressing the skills challenge

Technological progress will continue to have a direct impact on the occupational composition of the economy, as well as the skills and knowledge necessary to perform many jobs in manufacturing.

The current global skills gap is going to worsen as the manufacturing sector races to meet these challenges over the next 30 years and beyond. The gap between what companies need to grow and the skills available is widening, and most countries are not set up with the skills infrastructure to react.

Employers across the manufacturing sector undertaking training on digital manufacturing software, such as that from Autodesk, report seeing improved efficiency, better workflows, and being able to use software to its full potential. They also talk about the importance of certification to verify competency. Students and employees also highlight how relevant certifications are valuable for career development and reinforce knowledge and skills.

Investing in the skills envisaged in factories of the future, will help to secure employability in a sector which is already on a digital transformation journey.

ACTIONS FOR CHANGE

01

Technology and talent hand-in-hand

Organisations need to ensure that they're thinking about talent as part of their digital transformation journey. Existing workers need access to training programmes, allowing them to develop the skills they need to ensure they're not obsolete in increasingly automated and digitised factories. The most effective strategies incorporate work-based learning models; programs developed through partnerships between employers and educational institutions that pair classroom learning with on-the-job learning.

02

A new mandate for education and training

Reskilling, upskilling and education curricula updates are central to equip existing and new workers for success in this Fourth Industrial Revolution. Education systems should be upgraded to provide digital skills and critical thinking skills, alongside job-specific skills, through schools and universities. With industry leading the way in deployment of new technologies, collaboration is critical.

03

Reframe the career opportunities

Factories of the future, aren't like those of the past. Young people need to be excited about the opportunities associated with engineering and manufacturing earlier in their education journey. They need to provided with opportunities to experience technologies such as generative design, 3D printing and real-time 3D. Digital skills should become a core competency for students in secondary education, as part of the STEM agenda.

Conclusions

This insight report contextualises the challenges and opportunities facing the global manufacturing sector which have significance for skills development. There's much to be done to ensure manufacturers have the skills they need to be competitive in an Industry 4.0 world.

Advances in digital manufacturing techniques hold the key to increasing productivity and improving global supply chains. However, around the world there are insufficient people with the skills needed to capitalise upon the advances in technology adoption across the manufacturing and product design sector.

It is clear, however, that the response required isn't the same around the world. Some countries need to address fundamental challenges such as access to technology and improving educational participation and attainment. Others need to improve the reputation of the sector as an employer of choice. Universally, there's a need to create the right environment time for businesses and their workforces to ensure they have the skills they need now – and in the future.

There's significant risk the sector won't move fast enough to achieve the transformation it needs. The skills gaps will widen. The job market will stagnate. Supply chains will break down. The global disparities in production output will increase.

It is clear that the time for talking is over. Governments, employers, academia and industry need to take collective responsibility to equip businesses and workers with the skills they need to make the most of the opportunities ahead.

How are you going to help skill the factories of the future?

Engineers and manufacturing professionals of the near future will need to be proficient in flexible networked systems of design and decision which link not only departments within their own companies, but also dozens of outside suppliers, collaborators and assistants. These networks will be dynamic and deep – requiring a fundamental understanding of how and when to share intellectual property and demanding a more rigorous data-based description of manufacturing, intent and branding which will be shared inter-company via the cloud. Manufacturers will profit not from keeping their designs a secret – but by being more effective at having them produced just in time, where they are needed.

Mikey Wakefield, Autodesk

About the Autodesk learning program

With Autodesk courses and certifications, businesses can gain the knowledge and skills needed to create high-quality, innovative products and to succeed in manufacturing.

Autodesk Authorized Training Centers (ATCs) are Autodesk preferred training providers who can help with employee professional development. They work with Autodesk Certified Instructors (ACIs) who are recognized for their product mastery and instructional skills. ATCs work with employers to evaluate business needs and adapt their training to workflow and processes. ATCs offer flexible delivery methods from classroom to instructor-led virtual training to ensure that your team gain the required skills in a way that minimizes business interruption.

Authorized Academic Partners (AAPs) are Autodesk preferred service providers to the academic market that help with faculty professional development and add value to programs and courses. AAPs can offer comprehensive end-to-end service packages that combine training with access to Autodesk software and curriculum resources. They embed Autodesk professional certification within their courses, which are of value to faculties and students. AAPs can support and recognize students by rolling out projects, competitions, and extra-curricular training activities.

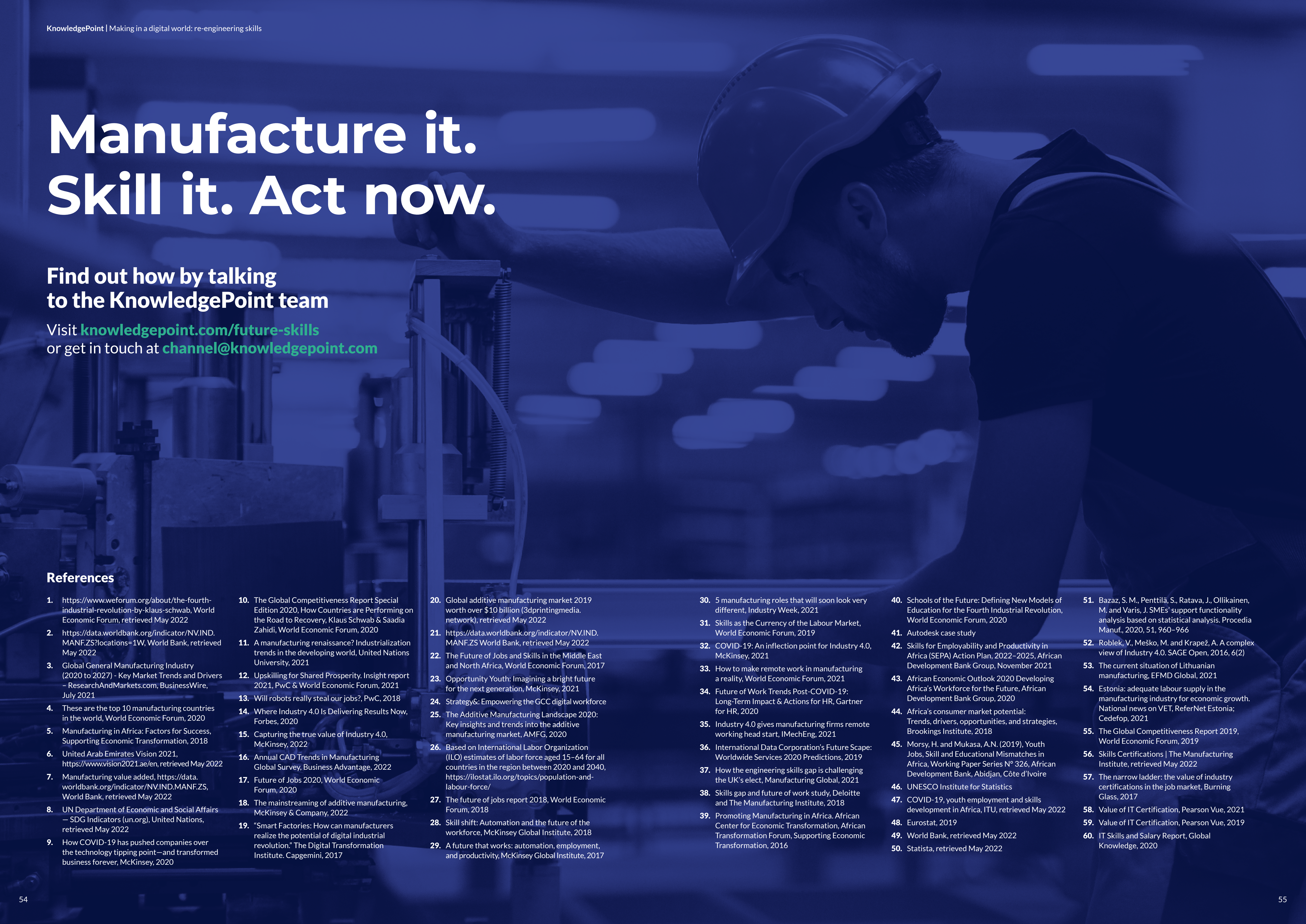
AUTODESK Learning Partner

About KnowledgePoint

KnowledgePoint adds value to learning organisations by delivering a range of learning support services. From learning materials management to administrative services and global training network management, we make life easier for our learning industry partners.

Our customers are training and learning organisations and teams; they design, create and deliver learning programmes. We work in partnership with them, providing practical solutions which support these efforts. In doing so, we make a real difference to them and their learners. We help them achieve positive learning experiences and outcomes, boost customer and learner satisfaction, and realise cost and resource efficiencies.

As the Autodesk Learning Partner Distributor for the EMEAR territory, we manage the training partner network including recruiting, onboarding, and providing ongoing support and enablement to academic and commercial learning partners.



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