

Enabling smart manufacturing in Africa

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Contents

Executive summary .. 4

1. Manufacturing in context .. 8

1.1 The evolution of global manufacturing .. 9

1.2 Africa in the global context .. 11

1.3 Key factors for competitive manufacturing in Africa .. 13

2. The transition to smart manufacturing .. 17

2.1 Defining smart manufacturing .. 18

2.2 Smart manufacturing technologies .. 19

2.3 The role of mobile operators in the manufacturing value chain .. 24

3. Assessing the smart manufacturing opportunity in Africa .. 28

3.1 Understanding the role of digital technologies in value chains .. 29

3.2 The rationale for smart manufacturing in Africa .. 31

3.3 The economic impact of smart manufacturing in Africa .. 36

3.4 Evaluating the potential of smart manufacturing .. 38

3.5 Country deep dives .. 40

4. Realising the potential of smart manufacturing in Africa .. 64

4.1 Key considerations for accelerating smart manufacturing in Africa .. 65

4.2 Call to action: strategic recommendations for stakeholders .. 67

4.3 Key areas for stakeholder collaboration .. 73

Appendix .. 75

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Executive summary



Africa's manufacturing output in the global context

Manufacturing serves as a pathway to economic growth, job creation and integration into global supply chains for emerging economies. The global manufacturing landscape has evolved considerably over the last two decades. Traditional manufacturing countries, particularly in the western hemisphere, have seen manufacturing output stagnate or in some cases decline, driven by rising labour costs, shifts in consumer demand towards services, and competition from new manufacturing hubs around the world. Most of these new hubs have emerged in Asia Pacific, which accounted for just over half of global manufacturing output at the end of 2024.

According to data from the United Nations Industrial Development Organization (UNIDO), Africa accounted for 1.9% of global manufacturing output in the fourth quarter of 2024. However, this figure does not represent the continent's manufacturing potential, given its significant competitive advantages such as abundant natural resources, cost-effective labour and expanding consumer markets. Despite these advantages, Africa's capacity to increase production output remains constrained by macroeconomic and structural challenges that impede the growth and competitiveness of its manufacturing sector. These include inadequate infrastructure, limited access to financing and persistent skills shortages. These all contribute to higher production costs.

The smart manufacturing opportunity for Africa

Many African governments are taking steps to develop their manufacturing sectors, with the aim to support economic growth, create employment and reduce dependence on exports of raw materials. Smart manufacturing offers opportunities to enhance production output and international competitiveness.

This approach involves integrating digital technologies at various stages of the manufacturing value chain. At its foundation, smart manufacturing utilises artificial intelligence (AI) and advanced connectivity such as 5G to coordinate functions including supply chain management, production, distribution and customer service through a single digital platform.

Smart manufacturing is a key element of Industry 4.0, which has been included in national industrial plans across Africa to increase productivity and industrialisation, and facilitate participation in global markets. This aligns with the African Union's Agenda 2063 – a framework outlining socioeconomic and industrial development goals for the continent over 50 years. Considering the challenges affecting the competitiveness of manufacturers in Africa, smart manufacturing offers possibilities for operational efficiency, quality control, flexibility, cost reduction, data-driven decision making and sustainability.

The use of mobile networks for connectivity and digital transformation contributed 8.1% to Africa's manufacturing GDP in 2024, amounting to $47 billion in added value. This reflects the role of mobile connectivity in automating manufacturing processes and enabling real-time analysis of data. By 2030, mobile technologies are forecast to contribute approximately $60 billion (7.9% of manufacturing GDP) to Africa's smart manufacturing sector. These figures indicate the scale of smart manufacturing's economic role within Africa, including changes to industrial structures, economic activity and international engagement.

Fulfilling this potential requires coordinated efforts from multiple stakeholders, each playing distinct but complementary roles to build the infrastructure, capabilities and ecosystem needed to develop and implement smart manufacturing processes.

Table 1: Key steps for stakeholders to advance smart manufacturing in Africa
Source: GSMA Intelligence

Stakeholder	Key measures
Governments and policymakers	• Integrate Industry 4.0 objectives into national industrial strategies and embed clear digital transformation goals and metrics into national development plans, sectoral masterplans and export strategies. • Drive regulatory reform to foster innovation and digital integration. • Implement targeted financial incentives for small and medium-sized manufacturers, to encourage adoption of smart manufacturing. • Facilitate inter-ministerial collaboration to align policy formulation and implementation, considering the cross-cutting nature of smart manufacturing. • Establish clear data protection frameworks, cybersecurity protocols and intellectual property protection to build trust in smart manufacturing. • Implement enabling regulations for investment in advanced connectivity infrastructure, especially in special economic zones (SEZs) and other manufacturing locations. • Support local research institutions and startups, given the important role they play in developing affordable, context-specific solutions that address the unique challenges faced by local manufacturers. • Facilitate investment in renewable energy and off-grid solutions to improve access to affordable and reliable energy for value-chain players.
Manufacturers	• Develop digital transformation roadmaps with a strategy to adopt smart manufacturing practices that address key operational challenges. • Build a strong digital foundation with entry-level solutions before transitioning to more advanced solutions. • Design and implement smart manufacturing technologies in new factories from the outset. • Leverage multistakeholder partnerships to share learnings and best practices in implementing smart manufacturing technologies. • Facilitate clear and effective internal communication on the transition to smart manufacturing to ensure staff engagement and support.
Investors and development partners	• Provide low-cost funding for early-stage innovation. • Recognise the social impact dimension of smart manufacturing.
Connectivity providers	• Focus 5G and fibre network deployment on industrial hubs to capitalise on smart manufacturing opportunities. • Provide additional services beyond connectivity to enhance value propositions for manufacturers. • Leverage private 5G networks for applications requiring superior performance pending 5G SA deployment. • Implement a hybrid strategy to leverage 4G connectivity where 5G is not yet accessible.

Technology providers	• Customise solutions to local needs and constraints to ensure relevance for local manufacturers. • Develop modular solutions to ease adoption barriers (including cost) for small and medium-sized manufacturers. • Create value-added services and flexible financing models. • Incorporate sustainability and circular economy principles to help local manufacturers comply with international standards.

The need for stakeholder collaboration

Beyond individual initiatives and actions by stakeholders to promote smart manufacturing adoption in Africa, collaboration is necessary across the following areas to leverage synergies and minimise redundant efforts:

- **Address the awareness gap.** Bridging the awareness gap is essential to foster acceptance, dispel misconceptions and accelerate the adoption of digital solutions. This requires efforts by stakeholders, particularly governments, connectivity providers and development partners. Awareness campaigns should also incorporate training on cybersecurity best practices to help mitigate vulnerabilities as digital adoption advances.
- **Reskill and upskill the workforce.** Digitalisation and automation could result in job displacements. This is an important consideration for stakeholders, particularly governments in Africa (who may be concerned about the social impact) and factory workers (who may lose their roles to automation). Reskilling and upskilling factory workers and the wider workforce are crucial steps to mitigate this challenge. This will require joint efforts by stakeholders to equip vulnerable workers with new skills and capabilities with greater relevance in the digital era.
- **Develop smart manufacturing strategies and applications collaboratively**. Developing and implementing smart manufacturing practices typically requires the involvement of multiple stakeholders. Governments, private-sector entities, manufacturers and investors need to work together throughout the stages of the smart manufacturing agenda, including national strategy formulation, co-investment in required infrastructure and testbeds, and cooperation to expand market access for local manufacturers.
- **Promote the development of a smart manufacturing ecosystem.** A key objective of collaboration is to establish an environment that facilitates effective connections between stakeholders, enabling them to tackle shared challenges and uncover new opportunities. In Africa, such partnerships between prospective ecosystem participants are often underdeveloped, which can impede progress in adopting smart manufacturing technology and result in the inefficient use of resources. Addressing this limitation is essential to realise synergies across the manufacturing value chain.

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1. Manufacturing in context

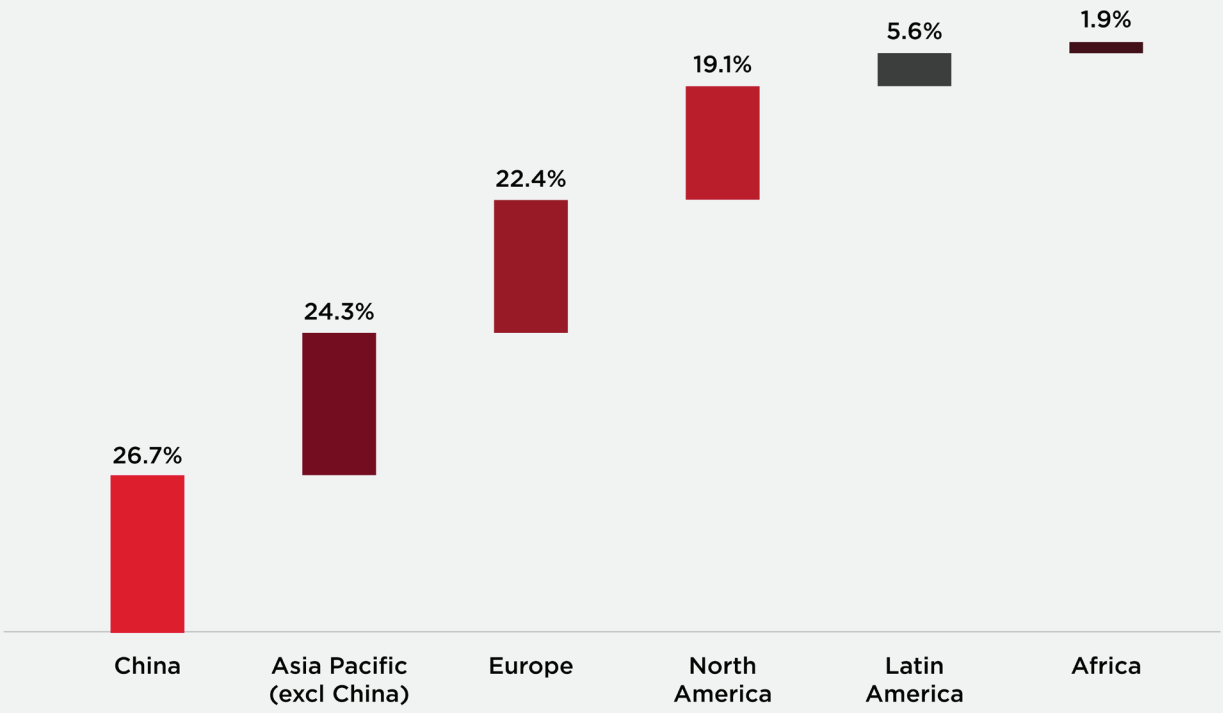


1.1 The evolution of global manufacturing

Manufacturing is a cornerstone of modern economies, driving growth, innovation and job creation. It contributes significantly to GDP, fosters technological advancements and supports the supply chains critical for global trade. By producing goods domestically, countries can reduce their reliance on imports, enhance economic resilience and create highly skilled, high-wage jobs that bolster incomes. These factors have become critical in the context of global economic uncertainty and shifting geopolitical dynamics, with countries around the world increasingly striving to build more resilient, sustainable and inclusive economies.

The global manufacturing landscape has evolved considerably over the last two decades. During this period, traditional manufacturing countries, particularly in the western hemisphere, have mostly seen relative stagnation and, in some cases, declines in manufacturing output. This has been driven by factors including rising labour costs, shifts in consumer demand towards services, and competition from new manufacturing hubs around the world. Most of these new hubs have emerged in Asia Pacific, which accounted for just over half of global manufacturing output at the end of 2024 (see Figure 1).

Figure 1: Share of global manufacturing value added (MVA), Q1 2025
Source: UNIDO



For emerging economies, manufacturing serves as a pathway to economic growth, job creation and integration into global supply chains. It also contributes to industrial diversification, particularly in resource-reliant economies, and export-led growth. Governments across emerging economies have outlined measures to realise the socioeconomic benefits of manufacturing, including the following:

- In India, the Make in India initiative aims to develop the country into a significant manufacturing hub and increase the sector's GDP contribution to 25%.[1] By 2024, a decade after the initiative's introduction, the Indian government reported several achievements, including attracting $667.41 billion in foreign direct investment (FDI) and increasing electronics production from 58 million units in 2014 to 330 million in 2024.[2]
- Vietnam is strategically developing its manufacturing sector and intends to increase the sector's GDP contribution to 30% by 2030, up from 25% in 2024.[3] The growth in manufacturing is driving export expansion; Vietnam's total exports reached $405.5 billion in 2024 – an increase of 14.3% compared to the previous year, driven by manufactured goods such as electronics, textiles and footwear.[4] In 2024, the manufacturing sector accounted for nearly 67% of total registered FDI, equivalent to $25.6 billion.[5]
- In 2023, the government of Benin launched Farm to Fashion – a €550 million initiative designed to reform the cotton industry by localising the processing of raw cotton into finished garments. The programme aims to create 300,000 jobs by 2030, increase exports by up to $10 billion within 10 years, and expand the country's manufacturing output fivefold.[6]

Despite the shift to automation, manufacturing remains a major contributor to job creation. According to the UN, the manufacturing sector accounted for around 13.6% of the global workforce in 2021.[7] The figure is higher in export-oriented countries such as China and Vietnam. As part of the Make in India initiative, the government of India anticipates manufacturing to create up to 100 million jobs. A key outcome of the impact of manufacturing jobs is the associated investment in human capital to meet the demand for skilled labour and improvements in social infrastructure, resulting in an overall enhancement in livelihoods.

1 www.makeinindia.com

2 "10 Years of Make in India", Government of India Press Information Bureau, September 2024

3 Vietnam Manufacturing Tracker: Update to July 2025, Vietnam Briefing, 2025

4 "Vietnam Trade Data: A Growing Landscape in 2024, Tendata", April 2025

5 "FDI attraction in 2024", Ministry of Planning and Investment of the Socialist Republic of Vietnam, January 2025

6 "Cutting its cloth: can a new industrial revolution transform Benin's economy?", The Guardian, March 2023

7 unstats.un.org/sdgs/report/2023/goal-09/

1.2 Africa in the global context

Africa contributed less than 2% to global manufacturing output in the fourth quarter of 2024. However, the current state of manufacturing in Africa does not reflect the continent's potential, considering its key manufacturing competitive advantages. These include its abundant natural resources, cost-effective labour and growing consumer markets. For example, critical minerals such as cobalt, lithium and copper are essential for high-tech industries, while significantly lower labour rates than most other regions make Africa attractive for labour-intensive industries such as textiles and footwear.

With nearly 20% of the global population, Africa presents a ready market for domestic manufacturers, while the region's geographic location creates opportunities to supply markets in Europe as well as Asia and the Americas.

Table 2 highlights the differences in growth drivers between the manufacturing sector globally and in Africa.

Table 2: Manufacturing growth drivers: global context versus Africa context
Source: GSMA Intelligence

Growth driver	Global context	Africa context
Digitalisation	Adoption of Industry 4.0 technologies to improve efficiency and competitiveness	Early-stage digitalisation in industries such as fast-moving consumer goods (FMCG) in a few countries
Supply-chain resilience	Diversification and regionalisation to reduce risk and dependence on global chokepoints	Weak logistics and input dependencies hinder resilience, though the African Continental Free Trade Area (AfCFTA) and emerging SEZs offer opportunities
Government incentives	Strong government support in industrial policy, innovation funding and infrastructure investment	Momentum is growing through national industrial plans, but implementation, funding and coordination remain uneven
Sustainability and green technology	Strong push towards decarbonisation and circular manufacturing models	Awareness is growing in a few countries, but levels of implementation remain low



Africa's ability to leverage the manufacturing growth drivers is hindered by a range of macroeconomic and structural challenges, which ultimately constrain its growth and competitiveness. These challenges (shown in Figure 2) ultimately lead to higher production costs relative to major manufacturing hubs around the world.

Figure 2: Factors limiting Africa's manufacturing competitiveness
Source: GSMA Intelligence



1.3 Key factors for competitive manufacturing in Africa

Many governments in Africa are working to enhance their manufacturing sectors, recognising their potential to drive economic growth, create jobs and reduce reliance on raw material exports. However, realising this potential depends on factors that underpin the development of a competitive manufacturing sector (see Figure 3).

Figure 3: Factors for competitive manufacturing
Source: GSMA Intelligence



Industrial policies and incentives

Government policies are critical to the success of the manufacturing sector, shaping its growth, competitiveness and sustainability. Consequently, governments across Africa are implementing national development plans and industrial strategies that align with global trends around digitalisation, sustainability and green industrialisation. While the levels of ambition and implementation capacity vary, the focus is generally the same. Pan-African frameworks, such as the African Union's Agenda 2063 and the Action Plan for the Accelerated Industrial Development of Africa (AIDA), underscore the importance of structural transformation and industrial upgrading. These frameworks envision a continent where manufacturing contributes significantly to economic growth and job creation, moving the economy away from primary commodity dependence.[8]

Incentives and subsidies, such as tax exemptions and grants, are important elements of government policy to boost the manufacturing sector. They reduce operational costs and encourage investment in modern technologies. For example, Morocco offers several tax incentives for automotive sector industrial zones such as the Tanger Automotive City and Atlantic Free Zone, including a five-year exemption from corporate tax as well as exemptions from VAT and customs duties, and simplified foreign exchange transactions. This has been credited with helping to grow the country's automotive manufacturing output from less than 50,000 vehicles annually a decade ago to 570,000 in 2023.[9]

Reliable and sustainable energy

Access to reliable and affordable electricity is crucial for manufacturing due to the energy demands of production machinery. This is a significant challenge in many African countries, where frequent power outages can disrupt operations, damage equipment and force manufacturers to rely on fossil-fuel generators. This reliance can increase the cost of electricity, reducing the global competitiveness of African goods.

Bridging the energy gap is essential to improve manufacturing output. There is an opportunity to harness the region's vast renewable energy potential. According to the International Energy Agency (IEA), Africa has 60% of the world's best solar resources but only 1% of installed solar capacity. By scaling up this opportunity and other renewable energy sources (such as geothermal, hydro and wind), renewables could account for more than 80% of new power generation capacity on the continent this decade.[10] See Figure 4.

Several African nations are making significant strides to enhance access to reliable energy for their manufacturing sectors. Ethiopia, for instance, is harnessing its hydropower capabilities to fuel industrial parks such as Hawassa and Bole Lemi, which are home to textile and garment manufacturers. Additionally, the World Bank's Distributed Access through Renewable Energy Scale-Up (DARES) platform supports mini-grid solar projects to supply off-grid power to rural manufacturing areas.

Meanwhile, South Africa has recently approved its inaugural renewable energy masterplan. This aims to establish a new manufacturing industry in renewable energy and battery storage value chains, with an ambition of adding 3–5 gigawatts of renewable energy capacity each year until 2030.[11]

Global and regional market access

Beyond domestic consumption, a vibrant manufacturing sector needs global demand for its products. This requires export-oriented strategies and trade partnerships to enhance global market share. In 2021, the African Union launched the AfCFTA to create a single market for goods and services across 54 African countries, unlocking a market of 1.3 billion

8 For more information, see www.au.int/agenda2063/overview

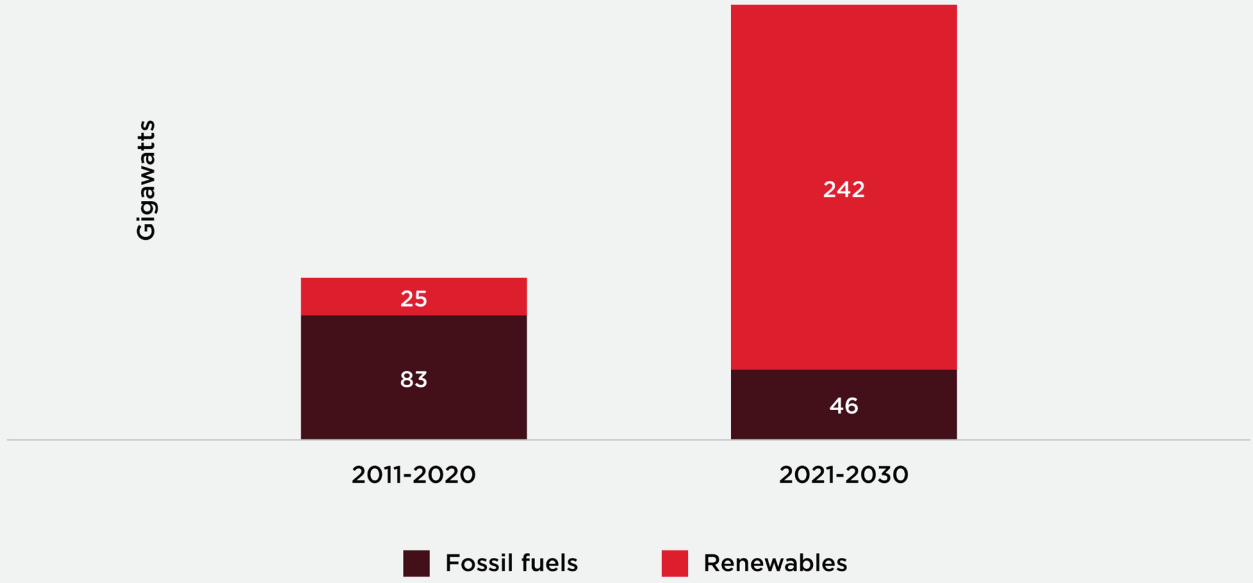
9 "Morocco's EVs tread fine geopolitical line", fDi Intelligence, February 2025

10 Africa Energy Outlook 2022 Key findings, IEA, 2022

11 South African Renewable Energy Masterplan (SAREM), South Africa Department of Mineral Resources and Energy, 2023

Figure 4: Power generation capacity additions in Africa in the Sustainable Africa Scenario (Gigawatts)

Source: IEA



people and a combined economy of $3.4 trillion. This would boost intra-African trade by reducing tariffs and non-tariff barriers, enhance economies of scale, and support manufacturing by reducing trade barriers and harmonising regulations. The AfCFTA could raise Africa's exports to the rest of the world by 32% by 2035, and increase intra-African exports by 109%, led by manufactured goods.[12] To realise this potential, implementation of the AfCFTA needs to accelerate, addressing challenges around inconsistent regulation and bureaucracy.

Meanwhile, several African countries have made strides in exporting manufactured goods to global markets, leveraging competitive advantages such as low labour costs and strategic trade agreements. For example, Morocco has emerged as a major exporter of vehicles to the EU, benefiting from the EU-Morocco Association Agreement, which established a free trade area between the two markets. In 2024, Morocco exported automotive products worth €15.1 billion to the EU, making it the largest exporter to the EU market by value, ahead of China and Japan.[13] Morocco has a target of producing 1 million vehicles annually by the end of 2025, while focusing on environmentally responsible production practices to align with the demands of the European market.

Supply chain infrastructure

Resilient and efficient supply chains ensure timely access to raw materials and components. This includes diversified sourcing, digital supply chain management and strong logistics networks. Africa's natural resources form a strong basis for the supply of raw materials for manufacturing across several industries, such as textiles, FMCG and pharmaceuticals. However, poor transport networks (particularly between rural and urban areas) and inefficiencies in port clearance can disrupt the timely delivery of raw materials and finished goods.

Additionally, non-tariff barriers such as bureaucratic customs procedures and inconsistent regulations remain major hindrances to intra-African supply chains. That said, major port upgrades and expansions are underway in key coastal countries, aimed at improving efficiency and reducing turnaround times (e.g. Port of Tanger Med in Morocco,

12 "The future of African trade in the AfCFTA era", Brookings, February 2024

13 "Tanger Med increases vehicle exports from Morocco in 2024 with majority heading to Europe", Automotive Logistics, February 2025

Durban in South Africa, Mombasa in Kenya, Lekki Deep Sea Port in Nigeria, and the Mediterranean Sea port of Arzew in Algeria). Tanger Med, for example, has become a significant transshipment hub, with a capacity of 9 million twenty-foot equivalent units (TEUs).

Human and financial capital

A highly trained and adaptable workforce and continuous education to keep pace with evolving manufacturing processes are essential to sustain growth. At the same time, access to affordable financing creates opportunities to expand manufacturing operations and invest in modern technologies. Across Africa, stakeholders are making efforts to address the skills and financing gaps to mitigate their impact on manufacturing output, including the following:

- South Africa's Manufacturing, Engineering and Related Services Education and Training Authority (merSETA) funds training programmes tailored to manufacturing needs in various industries.
- In Rwanda, the government has partnered with international organisations and universities to offer specialised training in biotechnology and supply chain logistics, to support its emerging pharmaceutical industry, including BioNTech's mRNA vaccine production facility in the country.
- The African Development Bank (AfDB) plays an important role in providing affordable financing facilities for investment in the manufacturing sector. The organisation plans to invest up to $3 billion over the next decade in the development of pharmaceutical products as part of efforts to industrialise Africa and lessen the continent's reliance on imports.[14]
- In Nigeria, the Bank of Industry and the Central Bank's intervention funds offer single-digit-interest loans to priority sectors, including manufacturing.
- In Egypt, the government's Industrial Modernisation Centre and Central Bank of Egypt have launched programmes providing low-interest loans and credit guarantees for manufacturers to adopt digital tools, improve supply chain management, and enable firms to compete in regional markets under the AfCFTA.

Additionally, foreign direct investment (FDI) remains a major source of funding for manufacturing in the region. For instance, South Africa recorded FDI inflows of ZAR96.5 billion ($5.5 billion) in 2023, with the manufacturing sector attracting the largest share of inward investment (38.5%).[15]

Advanced technology and innovation

The adoption of digital technologies, such as automation, AI and the industrial Internet of Things (IIoT), plays a crucial role in boosting productivity and improving efficiency in manufacturing processes. Beyond direct application in factories, digital technologies can address challenges in the other key factors for competitive manufacturing in Africa, enhancing the overall outlook for the region's manufacturing output. For instance, digital technologies can facilitate the upskilling and reskilling of staff, and help ease logistical bottlenecks in inefficient supply chains. Additionally, digital technologies can optimise resource use, reduce waste and energy consumption, and enable manufacturers to align with global sustainability goals. Further development of Africa's manufacturing sector to increase output requires reconsidering production processes. This could be achieved through the integration of digital technologies across the value chain, from raw material extraction to production and distribution of finished products. This approach is generally referred to as smart manufacturing.

14 "Africa gets shot in the arm as African Pharmaceutical Technology Foundation gets underway", European Investment Bank, December 2023

15 South Africa Economic Outlook – Unlocking Foreign Direct Investment (FDI) as a driver of business and economic development, Strategy&, 2024

2. The transition to smart manufacturing



2.1 Defining smart manufacturing

The history of manufacturing can be traced back to early societies, where tools were made from materials such as stone and wood. Manufacturing shifted from handcrafting to machine-based mass production during the industrial revolution but still depended significantly on manual labour. Automation and computers were introduced in the latter half of the last century, but manufacturing systems worked independently with limited interoperability, real-time data exchange and adaptability. Industry 4.0 ushered in the concept of smart manufacturing, leading to a significant increase in industrial output with the integration of advanced digital technologies in production processes. The Industry 5.0 era has recently emerged as an evolution of Industry 4.0, enhancing the impact of digital technologies by prioritising well-being, sustainability and resilience (see Figure 5).

Smart manufacturing can be broadly defined as the integration of advanced digital technologies such as AI into every layer of the manufacturing process. It has gained momentum in recent years, as organisations look to capitalise on the opportunities that emerging digital technologies provide to boost productivity and enhance efficiency. As of February 2025, China had established more than 30,000 basic-level, 1,200 advanced-level and 230 excellence-level smart factories as part of a nationwide drive to accelerate industrial digitalisation, according to the Ministry of Industry and Information Technology (MIIT).[16] In 2024, 92% of respondents in a survey of manufacturing companies in the US expected smart manufacturing to be the main driver for competitiveness over the next three years,[17] while 88% of respondents to a UK survey said they had invested or plan to invest in smart manufacturing technologies.[18]

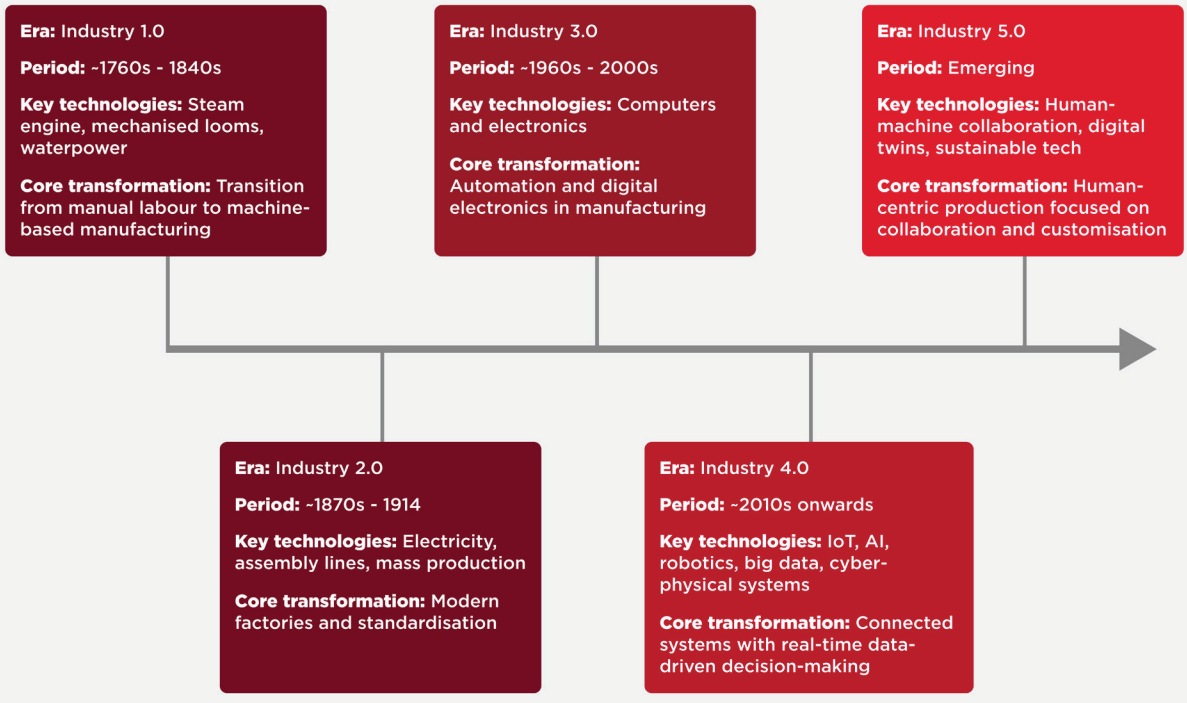
16 "China Accelerates Smart Factory Development With Over 30,000 Digitalized Facilities", Metrology News, February 2025

17 2025 Smart Manufacturing and Operations Survey: Navigating challenges to implementation, Deloitte Insights, 2025

18 "Smart Manufacturing 2024 report highlights technological evolution", The Manufacturer, April 2024

Figure 5: The evolution of manufacturing

Source: GSMA Intelligence



2.2 Smart manufacturing technologies

At its core, smart manufacturing leverages data and connectivity to bring together all aspects of the manufacturing process under a single platform – from supply chain management and production, to distribution and customer service. This holistic approach offers an end-to-end, cohesive view of the entire operation, integrating physical machinery with connected sensors and software to predict, control and improve performance, as well as facilitating more informed decision-making and fostering innovation.

2.2.1 AI as an enabler of smart manufacturing

AI is a cornerstone of Industry 4.0, integrating with IIoT, robotics, big data, cloud computing and other smart technologies to create interconnected, intelligent factories. For example, in Zimbabwe, AI-based smart silos use IIoT sensors to monitor grain quality and automatically adjust ventilation, humidity and storage conditions to help prevent spoilage. This use of IIoT technologies in agricultural processing allows for predictive maintenance and helps maintain storage conditions, which can reduce grain production losses.

Modern manufacturers use AI to automate repetitive tasks, augmenting human workers throughout the manufacturing process – from initial product design to product assembly and post-production quality control. In a fiercely competitive manufacturing environment, AI helps manufacturers manage costs and boost productivity and output while creating high-quality products. According to Rootstock's 2025 State of AI in Manufacturing Survey covering the US, UK and Canada, more than 77% of manufacturers have implemented AI solutions, while 82% intend to increase their AI budgets in 2025.[19]

The scope of AI applications in smart manufacturing is continuously evolving with advancements in the technology. For example, the recent emergence of generative AI (genAI) – a subset of AI that creates new content, designs or solutions based on patterns in data – is increasingly transforming manufacturing processes, such as product design and prototyping, supply chain management, and training and documentation. The wide range of solutions enabled by AI means the technology can be applied across large and small manufacturing settings. Examples of AI applications in smart manufacturing include the following:

- **Predictive maintenance** – AI analyses sensor data from factory equipment to predict failures before they occur, reducing downtime and maintenance costs. In the US, General Motors uses sensors to monitor the health of various components in its factories and applies AI to analyse this data in real-time. This system has helped it avoid unexpected breakdowns and ensure its manufacturing plants operate at their best efficiency.
- **Quality control** – AI-powered computer vision systems inspect products for defects in real-time and with greater accuracy than

19 "Rootstock's AI Survey Shows 82% of Manufacturers Increasing AI Budgets for 2025 with Rising Need for AI-Ready ERP Solutions", Rootstock, January 2025

human inspectors, ensuring consistent product quality. In South Africa, SABMiller uses AI-driven quality control systems in its brewery operations to monitor production data. These systems detect variations in parameters such as fermentation temperature and ingredient ratios in real time to help maintain beer quality.

- **Supply chain management** – AI helps manufacturers forecast demand, optimise inventory and streamline logistics by analysing historical and real-time data. Procter & Gamble (P&G) uses advanced big data analytics to enhance the efficiency of its global supply chain. Through systematic analysis of data from suppliers, warehouses and retailers, P&G has achieved reductions in inventory costs and improvements in product delivery times.
- **Robotics and automation** – AI enables robots to perform complex tasks and adapt to varying environments. Collaborative robots ('co-bots') work alongside people, improving precision, increasing production speed and minimising errors associated with manual processes. Tesla's Gigafactories rely on AI and robotics for vehicle assembly, battery production and overall factory automation.
- **Process optimisation** – AI optimises production parameters, such as temperature and speed, to maximise efficiency and minimise waste. Siemens uses AI to monitor and optimise the performance of its gas turbines, compressors and generators, employing a cloud-based platform to collect and analyse data from sensors, while machine-learning algorithms are used to predict maintenance needs and optimise operations.
- **Digital twins** – AI can power the simulation of physical systems to optimise efficiency or test new configurations. Nestlé uses AI to implement digital twin solutions in its food processing plants to manage production lines. For example, a digital twin of a coffee production line is used to simulate changes to roasting parameters, lowering energy consumption and maintaining consistent product quality across different facilities.
- **Energy management** – AI optimises energy consumption in factories by analysing usage patterns and optimising operators. ABB partners with Ndustrial, a company that provides an AI-driven energy management solution for industrial customers, offering precise visibility into energy intensity.

In addition to AI, several other intelligent technologies are increasingly being used in manufacturing processes to improve performance. For example, blockchain is being used to enhance supply chain transparency and security by monitoring raw materials from origin to finished product, and documenting regulatory compliance. In Ethiopia, the coffee industry uses blockchain to track beans from farms to global markets.

Augmented reality (AR) and virtual reality (VR) are also seeing growing application, especially in maintenance and training scenarios. They can be used to guide technicians through complex repairs by overlaying instructions and training workers on virtual assembly lines in order to reduce errors. General Electric has piloted AR technology to train technicians in its healthcare division in Kenya, specifically in maintaining medical equipment such as MRI machines. The AR headsets deliver step-by-step instructions to improve accuracy and reduce training time. Meanwhile, Pfizer has created a virtual replica of its production lines to train staff on drug manufacturing processes to improve efficiency.

2.2.2 Connectivity as an enabler of smart manufacturing

In smart manufacturing, connectivity is critical to enable automation, real-time data exchange and technologies such as AI, IIoT and blockchain. It can facilitate the integration of sensors, software, control systems and human operators in manufacturing operations. Connectivity for smart manufacturing encompasses wired and wireless networks, with varying characteristics and capabilities:

- **Fixed and Wi-Fi networks** – These include fibre, ethernet networks that enable secure and reliable broadband connectivity, and the transfer of large volumes of data generated.
- **Mobile networks (public or private)** – 4G/5G networks can connect factories with their surrounding ecosystems and help optimise manufacturing variables. With a private network, the network is used exclusively by devices authorised by the end-user organisation, such as a manufacturing plant.
- **Satellites** – These can provide connectivity in remote locations and satellite-based positioning systems, such as Global Positioning System (GPS) and Global Navigation Satellite System (GNSS) for precise tracking.

Table 3: Comparative analysis of the main connectivity networks
Source: GSMA Intelligence

	Fixed and Wi-Fi	Mobile (4G/5G)	Satellite
Mobility and flexibility	Reliable connectivity for stationary equipment such as centralised servers. Wi-Fi offers limited handover and coverage for mobile devices.	Seamless connectivity for moving assets such as drones, wearables, autonomous guided vehicles (AGVs) and robots.	Offers connectivity in rural or remote factories without terrestrial infrastructure but limited mobility for fast-moving assets.
Latency and reliability	Sub-millisecond (ms) latency and high reliability via dedicated connections. Ideal for real-time quality control and precision manufacturing but susceptible to physical damage.	5G offers ultra-low latency (1–10 ms) and high reliability. Ideal for robotic control and other real-time applications but susceptible to interference, network congestion and other extreme conditions.	Moderate (20–50 ms for LEO satellites) to high (600+ ms for GEO satellites) latency. Ideal for non-time-critical applications such as data backhaul but susceptible to atmospheric interference.
Bandwidth and data throughput	Fibre offers extremely high bandwidth (10–100 Gbps). Ideal for high-resolution video streams and large-scale data transfers but limited to fixed assets.	5G provides high bandwidth (up to 10 Gbps), supporting data-intensive applications such as AR/VR, though actual speeds depend on spectrum and network conditions.	Offers lower bandwidth (50–500 Mbps) than fixed or mobile connections. Adequate for remote IoT aggregation but vulnerable to peak-time bottlenecks.

	Fixed and Wi-Fi	Mobile (4G/5G)	Satellite
Scalability and device density	Scalable for fixed devices through extra ports or switches but needs physical infrastructure, which can be expensive and time consuming to install.	5G enables massive IoT – up to 1 million devices per square kilometre – and supports network slicing, making it suitable for dense sensor networks.	Limited device density due to bandwidth constraints and higher latency.
Coverage	Reliable within cabled areas, but physical nature makes deployment in large or remote sites expensive.	Covers large factories or outdoor areas; indoor sites may need small cells.	Global coverage, suitable for remote locations without terrestrial networks, but may need extra equipment for better indoor use.
Advanced technologies	Ideal for stationary uses such as computer vision and video analytics, but not optimal for distributed technologies.	Supports highly mobile technologies, such as AR/VR, distributed IIoT sensors and drones.	Supports remote IoT and data backhaul for non-time-critical applications.
Interoperability	Established standards for fixed systems, including Wi-Fi and ethernet.	Global 3GPP standards ensure compatibility across devices and vendors.	Compatible with IP-based systems, but vendor-specific solutions may vary.
Cost and infrastructure	High upfront cost for cabling and trenching, but low operational cost once installed.	High initial costs for base stations and spectrum, but lower overall costs by avoiding extensive cabling.	Minimal terrestrial infrastructure lowers deployment costs in remote areas but is less economical for urban factories.

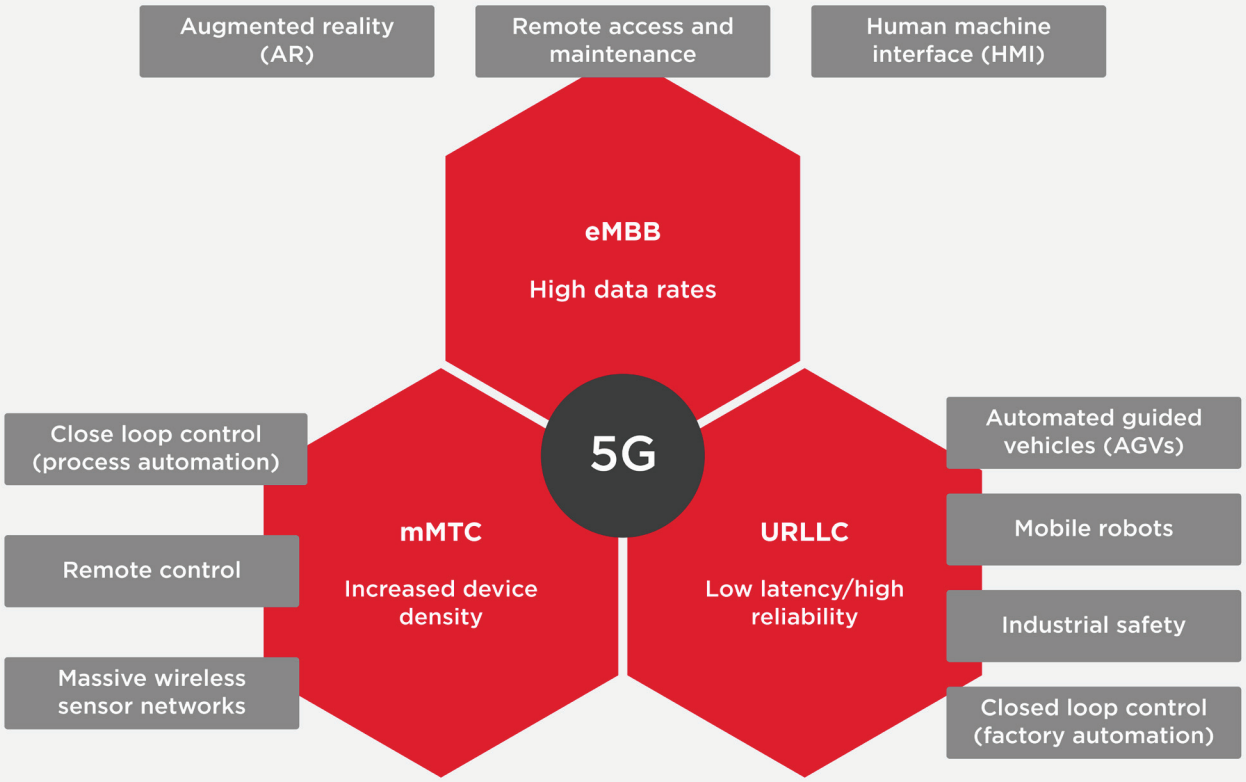
Complementing connectivity networks in a smart manufacturing environment is other digital infrastructure that supports the storage, processing and analysis of data, and the integration of new, advanced technologies with traditional manufacturing systems. This includes data centres for storing and processing large datasets, running AI/ML workloads, and hosting virtual models of physical assets, as well as industrial gateways and protocol converters that connect older machinery to IoT platforms, enabling digital transformation without replacing equipment.

Spotlight: 5G in smart manufacturing

Since its introduction in 2019, 5G has been integrated into various aspects of smart manufacturing, leveraging the technology's capabilities (see Figure 6). From 2024, mobile operators in some advanced markets, such as China, began deploying 5G-Advanced, an evolution of 5G that offers improved uplink performance and even lower latency (sub-1 ms in some cases), enabling advanced digital twins and mission-critical applications requiring deterministic communication.

5G public networks, managed by mobile operators, offer connectivity across large areas using licensed spectrum. Manufacturers use public 5G, or a dedicated slice of it where 5G standalone (5G SA) is available, to link factory devices with external networks and cloud infrastructure. In recent years, there has been growing momentum behind 5G private networks, which are dedicated networks established on-site at manufacturing facilities, using licensed or unlicensed spectrum. Private 5G is typically customised for specific requirements, providing secure, adaptable and controlled connectivity

Figure 6: 5G and its industrial use cases
Source: GSMA Intelligence

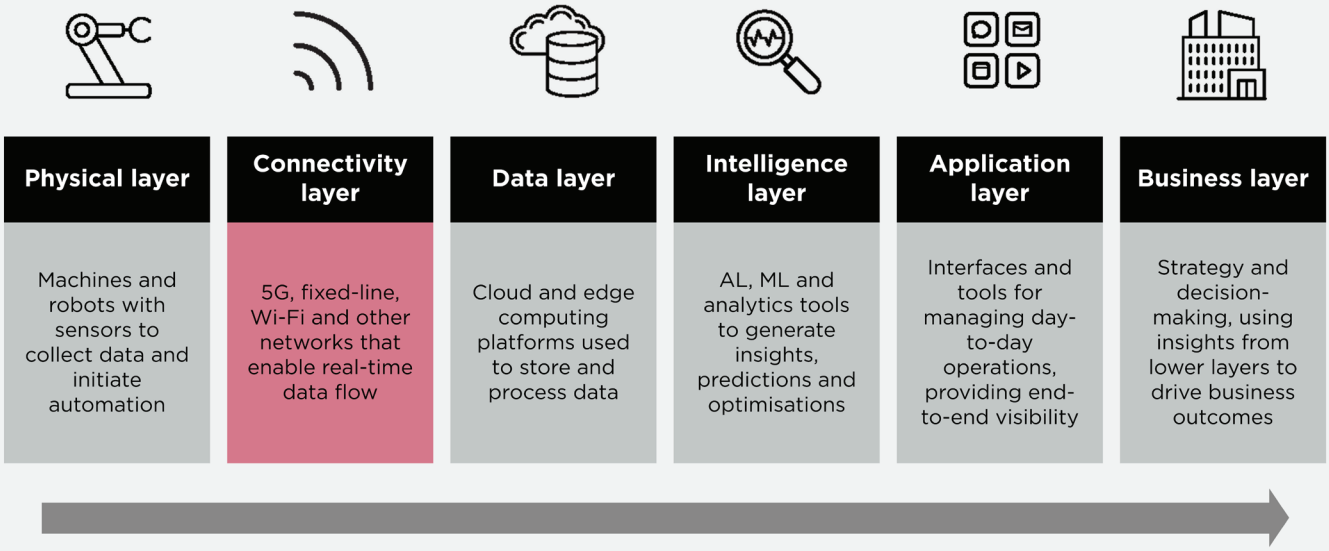


In many smart manufacturing scenarios, private 5G networks are selected for their reliability, security and performance, which can be tailored for high-density, latency-sensitive environments such as automotive or semiconductor manufacturing. However, public 5G networks could be suitable for smaller manufacturers that may not have the resources to invest in dedicated networks and require multi-site connectivity or integration with cloud services. Some manufacturers adopt a hybrid approach, using private 5G for essential on-site operations and public 5G for external connectivity, to manage costs.

2.3 The role of mobile operators in the manufacturing value chain

The smart manufacturing value chain comprises several interconnected layers and processes that enable a digitally enhanced and data-driven manufacturing ecosystem (see Figure 7). It integrates physical production assets with digital technologies to create value at every stage of the production process, from raw materials to finished products and strategic decision-making.

Figure 7: Smart manufacturing: layers of the value chain
Source: GSMA Intelligence



2.3.1 Core connectivity providers

As providers of connectivity, mobile operators have been the key players in the connectivity layer, using their existing (sometimes purpose-built) mobile and fixed-line networks to serve the manufacturing sector. According to insights from the GSMA Intelligence Operators in Focus: Manufacturing and Industrial Sectors Survey 2024, almost 95% of operators already offer traditional mobile and/or fixed connectivity services to companies in the manufacturing and industrial sectors, with larger operators more likely to offer services to manufacturing and industrial sectors than smaller ones.[20] Although 5G technology has been around for less than decade, its importance to the manufacturing sector is demonstrated by the fact that it is now the most popular connectivity service provided to manufacturers (see Figure 8).

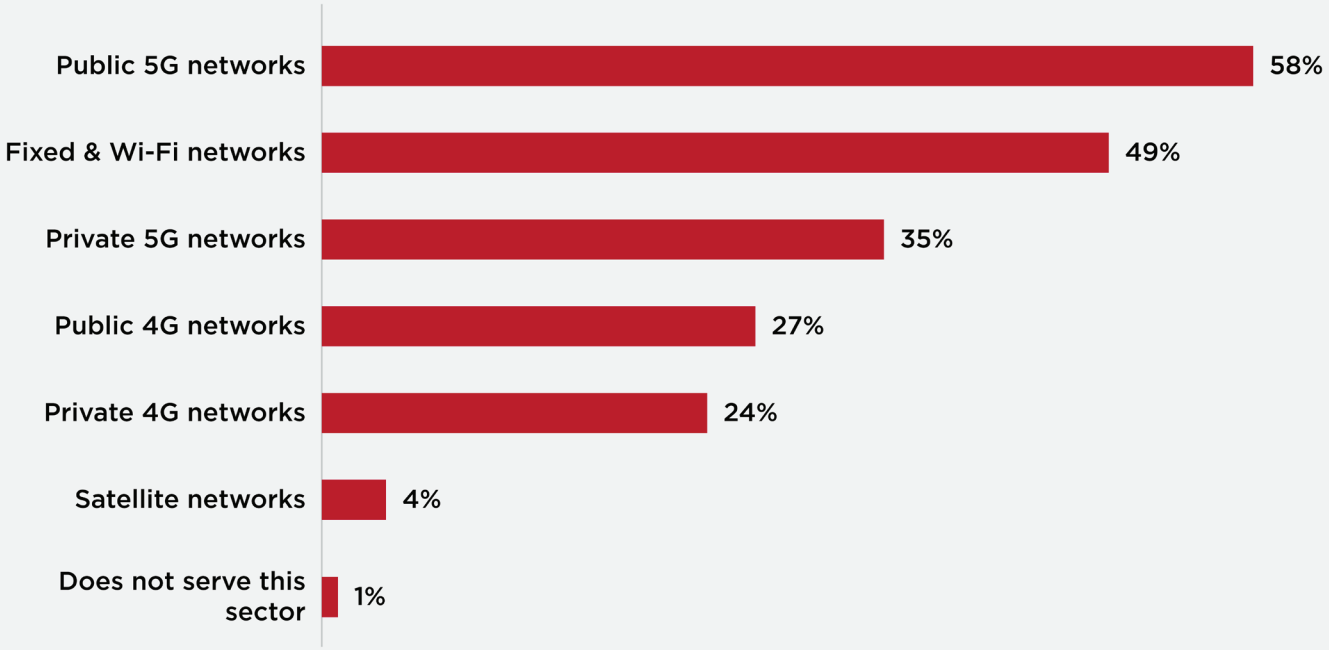
An increasing number of operators are providing, or intend to provide, connectivity solutions to manufacturing companies through private 5G networks. Although 4G was predominant during the initial phase of private network implementation, 5G has now

20 How manufacturing, production and industrial companies work with telcos to accelerate their digital transformation, GSMA Intelligence, 2024

Figure 8: Connectivity services offered to manufacturers

Which connectivity services do you provide or plan to provide to companies in the manufacturing sector?

Source: GSMA Intelligence Operators in Focus: Manufacturing and Industrial Sectors Survey 2024



become the preferred choice, as evidenced by a greater proportion of operators currently offering 5G private networks than those providing 4G. However, the continued availability of both 4G and 5G private networks suggests the two technologies will coexist, with 4G often serving as an entry-level solution in certain scenarios. Satellite connectivity remains a niche service among operators, with fewer than 5% of survey respondents indicating they offer or plan to offer such services to the manufacturing sector.

Operator case study: Singtel

In June 2022, Singtel partnered with Hyundai Motor Group to deploy 5G solutions at its Innovation Centre in Singapore, leveraging Singtel's technologies such as campus networks, slicing, MEC and Paragon. Launched in February 2022, Paragon – an all-in-one platform for 5G, MEC and service orchestration – will allow Hyundai's electric-vehicle (EV) factory to manage/analyse the EV manufacturing process and network performance in real-time. It will also support Hyundai's new capability that allows customers to personalise their chosen vehicle and watch it being manufactured live via their smart device.

2.3.2 Services beyond connectivity

While traditional mobile and fixed connectivity services remain foundational, an increasing number of mobile operators are expanding their offerings beyond basic connectivity. They now provide services within the data and intelligence layers. Key offerings include cloud and edge computing, cybersecurity, IoT solutions, and managed or professional services. These initiatives allow operators to diversify their revenue streams in response to the commoditisation of traditional voice and data services.

Digital transformation across industries such as manufacturing presents significant opportunities for mobile operators to create additional value in the enterprise segment by leveraging core assets such as network intelligence and the advanced capabilities enabled by 5G and next-generation networks. Other strategic drivers include competitive differentiation, allowing operators to stand out for their enterprise solutions, and enabling government policies that emphasise the role of operators and the services they provide in accelerating the digital transformation of society.

Expanding beyond connectivity requires a defined strategic approach and investment. Investments may present challenges for smaller operators, particularly when competing with established solution vendors and systems integrators. In this scenario, some operators are partnering with other ecosystem participants to help expand into additional layers of the value chain. Such collaborations allow operators to engage with industrial partners, cloud providers and systems integrators to provide end-to-end smart manufacturing solutions. For instance, Deutsche Telekom has partnered with Siemens and Amazon Web Services (AWS) to jointly provide edge computing and industrial IoT solutions over 5G, covering the connectivity, data, intelligence and application layers of the smart manufacturing value chain.

Figure 9 presents the primary services beyond connectivity that operators currently provide or plan to offer in the manufacturing sector, as indicated by findings from the GSMA Intelligence Operators in Focus: Manufacturing and Industrial Sectors Survey 2024.

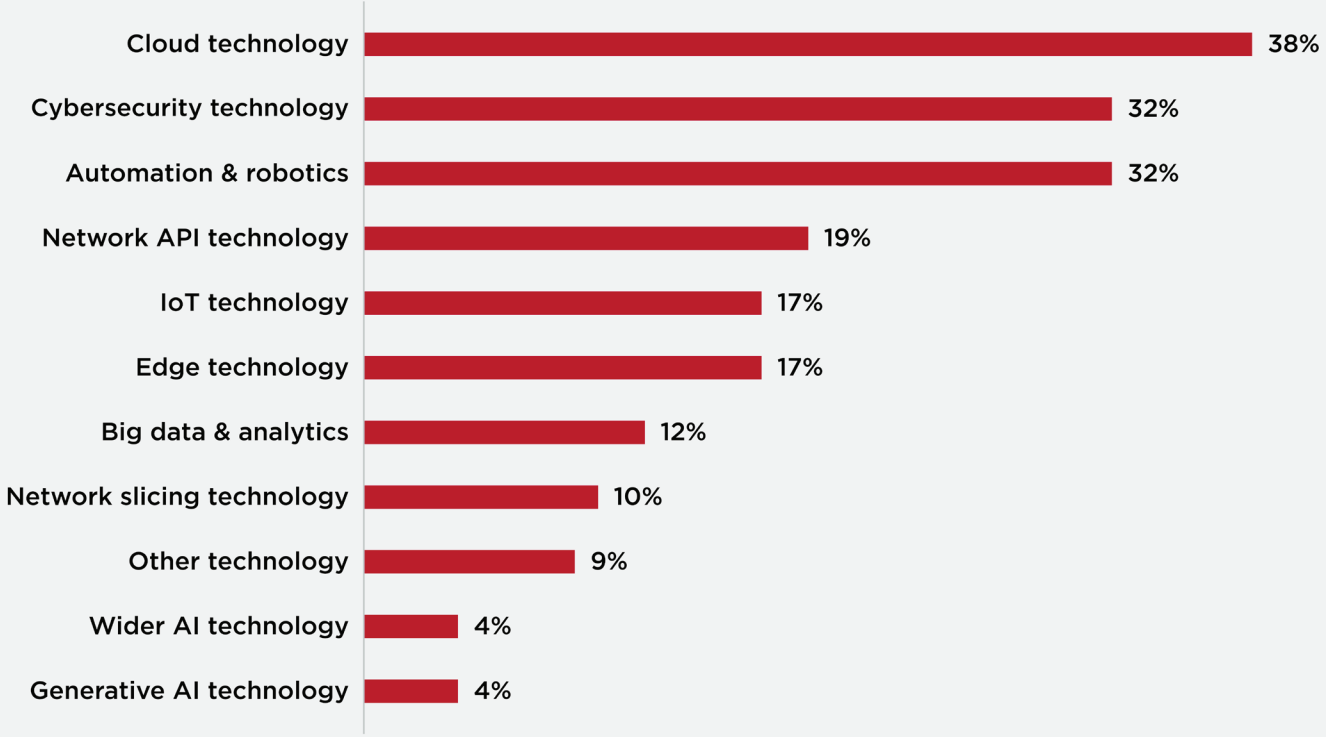
While cloud computing, cybersecurity, automation and robotics remain prominent among the services beyond connectivity that operators currently offer or plan to introduce to companies in the manufacturing sector, network APIs are emerging as particularly significant. Mobile operators, developers and channel partners are intensifying their efforts to leverage network capabilities, delivering tangible benefits across the entire ecosystem.

Widespread adoption, development and use of network APIs depend on standardisation, interoperability, security and scalability, requiring sustained collaboration from all stakeholders. For instance, Vodafone is opening its 5G networks to application developers and enterprises, working alongside firms such as Ericsson and other industry participants to foster innovation in manufacturing.

Figure 9: Services beyond core offered to manufacturers

Which services beyond core do you provide or plan to provide to companies in the manufacturing sector?

Source: GSMA Intelligence Operators in Focus: Manufacturing and Industrial Sectors Survey 2024



GSMA Open Gateway in smart manufacturing

The GSMA Open Gateway initiative, which aims to harness the capabilities of mobile networks worldwide by providing access through standardised APIs, now has 21 APIs in operation. Several of these APIs support use cases that can enhance manufacturing applications. Examples include the following:

- Application credential management APIs streamline the process of securely provisioning and managing device identities, ensuring only authorised devices can access certain applications.
- Asset-tracking tracking APIs provide real-time visibility of the location and status of equipment and materials, improving inventory management and reducing downtime.
- Quality-on-demand (QoD) APIs enable manufacturers to ensure consistent connectivity quality via dynamically requesting a standard of QoS that defines priority, data rate, latency, packet loss rate, etc.
- Network resource booking APIs allow for the efficient allocation and scheduling of network resources, optimising connectivity and performance for critical manufacturing operations.

3. Assessing the smart manufacturing opportunity in Africa



3.1 Understanding the role of digital technologies in value chains

The rapid shift towards smart manufacturing globally is indicative of its role in enhancing production output in an increasingly competitive global economy. In Africa, the journey to smart manufacturing is still nascent, and in some countries has yet to begin. However, the question for manufacturers and other stakeholders in the manufacturing sector on the continent is not whether they will adopt smart manufacturing practices, but when and how they will implement these technologies and strategies. Ultimately, the integration of smart manufacturing is essential to ensure the competitiveness and long-term sustainability of Africa's manufacturing sector.

Policymakers in several countries across the continent recognise this imperative and have outlined national strategies to harness digital technologies to boost productivity and industrialisation, and integrate into global markets. Many of the efforts explicitly reference Industry 4.0, smart manufacturing and digital transformation as ways to leapfrog traditional industrial development paths. This forward-looking approach seeks to bypass older, less efficient industrialisation models, allowing African economies to build competitive, digitally native industries from the ground up, in line with the African Union's Agenda 2063 – a strategic framework for the socioeconomic transformation of the continent over 50 years.

Translating these strategies into tangible gains and realising the full potential of smart manufacturing in Africa will require a deeper understanding of how digital technologies can be embedded across specific manufacturing value chains (from raw material sourcing to final product delivery) to optimise operations and increase competitiveness.

Digital adoption in African manufacturing value chains

The development of regional manufacturing value chains across Africa offers a strategic entry point for digital transformation. Rather than viewing production as isolated within national borders, several African countries are increasingly interconnected across stages of the value chain – from raw material production to processing, assembly, logistics and export.

The regional value chains demonstrate how multiple countries contribute different strengths to a shared manufacturing ecosystem. Digital solutions, whether in traceability, inventory management, automation or quality control, can amplify efficiency and coordination across borders. Understanding these interlinkages provides a roadmap for technology providers to identify which countries align with specific parts of the value chain, and where their products and services are most applicable.

Example 1: tea and coffee

The tea and coffee sectors in countries such as Kenya and Ethiopia are vital to East Africa's economies and export earnings. Their value chains – from farm to cup – are complex and offer several points where digital technologies for monitoring, quality control, logistics and payment can add significant value.

Farm level

Producers (exporters): Kenya, Ethiopia, Rwanda

Processing

Local processing hubs: Ethiopia, Kenya, Uganda

Logistics

Export gateways: Kenya (Mombasa), Tanzania (Dar)

Regional transit hubs: Uganda, Rwanda

Commercial

Exporters: Ethiopia, Kenya

Value-added speciality packaging: Rwanda, Uganda (limited re-exporting)

Example 2: Cotton and textiles

Cotton farming and textile manufacturing, which are critical sectors in countries such as Egypt, Tanzania and Burkina Faso, also stand to benefit from smart manufacturing integration.

Farm level

Producers (exporters): Burkina Faso, Mali, Benin, Chad, Sudan

Ginning

Local ginning hubs: Tanzania, Zambia, Nigeria

Manufacturing

Processing and manufacturing hubs: Egypt, Ethiopia, Morocco, Tunisia

Importers of semi-processed cotton or fabric: Kenya, Ghana

Distribution & sales

Exporters of finished products: Morocco, Tunisia, Ethiopia

Regional re-export and trade: South Africa, Kenya

Example 3: Automotive

The automotive sector is gaining momentum in countries such as South Africa, Morocco and Kenya, and offers significant potential for digital integration across the manufacturing value chain.

Material extraction

Democratic Republic of Congo (cobalt), South Africa (platinum, manganese), Zambia (copper), Zimbabwe (lithium)

Manufacturing

Manufacturing hubs: South Africa, Morocco, Egypt

Importers of raw materials: Morocco, Tunisia, Egypt

Assembly

Assembly plants: South Africa, Morocco, Egypt, Kenya, Ghana, Nigeria, Ethiopia

Kit importers: Nigeria, Kenya, Rwanda

Distribution

Exporters: South Africa, Morocco

Regional hubs for re-export: Kenya, Ghana

Example 4: Pharmaceuticals

The pharmaceutical sector is expanding across Africa, with strong manufacturing and research & development (R&D) hubs in countries including South Africa, Egypt, Morocco and Nigeria offering growing potential for digital integration and regional value chain collaboration.

Raw material

Importers of active pharmaceutical ingredients and excipients: South Africa, Nigeria, Kenya, Egypt

Manufacturing and formulation

South Africa, Egypt, Morocco, Tunisia, Kenya, Nigeria, Ethiopia, Ghana, Uganda, Rwanda

Regional logistics

Exporters: South Africa, Egypt, Kenya, Morocco, Nigeria

Importers: Ghana, Côte d'Ivoire, Rwanda, Tanzania

Retail and delivery

Nigeria, Kenya, Ethiopia, Ghana

3.2 The rationale for smart manufacturing in Africa

The rationale for smart manufacturing in Africa is rooted in the need to overcome the structural and macro challenges that raise production costs, affect the quality of products, and limit competitiveness. The following scenarios describe common manufacturing processes in Africa, highlighting some of the challenges holding back the sector and the potential for smart manufacturing practices to help address them.

Operational efficiency

Scenario – In a factory using outdated inventory processes, manual stock tracking often leads to errors, overstocking or shortages. This causes production delays, machine downtime due to missing materials, higher costs and reduced output.

Smart manufacturing opportunity – IoT sensors can automate raw material tracking, while AI analytics can monitor inventory and predict demand to prevent errors and stock issues, increasing production. Predictive maintenance also helps reduce equipment failures and improve efficiency.

Example – The Gibela rail manufacturing facility in Gauteng, South Africa, has implemented digital technologies including IIoT, manufacturing operations management (MOM) systems, and advanced control systems to optimise operations and improve real-time decision-making, resulting in increased productivity.[21]

Quality and consistency

Scenario – A maize processing plant using outdated equipment and manual quality checks faces inconsistent flour texture and purity, leading to customer complaints, regulatory issues and a loss of market share to competitors.

Smart manufacturing opportunity – Automated systems in smart manufacturing can instantly detect deviations, reducing defects. For instance, computer vision for flour quality inspections during production can boost consistency, lower re-work costs and increase competitiveness. Improved quality also ensures compliance with international standards, which is vital for exports to other markets.

Example – In 2024, a palm oil processing plant in Lagos, Nigeria, implemented computer vision to improve quality control. Using cameras and AI algorithms to inspect palm oil for colour consistency and impurities during production, the plant reduced rejections and realised greater consistency of finished products.[22]

Flexibility and customisation

Scenario – A furniture manufacturer faces limited flexibility and difficulty accommodating custom orders because of manual processes and fixed assembly lines.

Smart manufacturing opportunity – Flexible manufacturing systems (FMS) and digital

21 "Navigating discrete manufacturing in South Africa through digitalisation", Engineering News, July 2025

22 Mohamad Akmal Mohamad Zaki, Jecksin Ooi, Wendy Pei Qin Ng, Bing Shen How, Hon Loong Lam, Dominic C.Y. Foo, Chun Hsion Lim, Impact of industry 4.0 technologies on the oil palm industry: A literature review, Smart Agricultural Technology, Volume 10, 2025

tools, such as computer-aided design (CAD) integrated with computer numerical control (CNC) machines, enable manufacturers to reconfigure production lines quickly to fulfil custom orders.

Example – In Ethiopia, the Hawassa Industrial Park has adopted FMS to improve its textile and garment production processes. The park also uses CAD and automated cutting machines to allow it to rapidly customise clothing designs based on customer specifications. This system enables small-batch production and has contributed to Ethiopia attracting global brands.

Cost reduction

Scenario – A steel fabrication plant faces high production costs compared to competitors in regions with stable power, due to frequent grid outages, forcing it to rely on expensive diesel generators. Manual welding processes further increase labour costs, shrinking profit margins and reducing competitiveness.

Smart manufacturing opportunity – IoT-enabled energy management systems can optimise power consumption by prioritising grid electricity when stable and scheduling high-energy tasks during periods of lower electricity costs, which can reduce the use of diesel generators. Automated welding robots can also be used to reduce labour costs and improve operational efficiency.

Example – In regions with less stable power grids, smart energy management systems in factories can adjust production schedules or connect with renewable energy sources. Studies on smart microgrids in rural areas of Rwanda[23] show that real-time tracking and optimisation of energy use can support cost management and maintain a continuous power supply, which is relevant to manufacturing operations.

Data-led decision making

Scenario – In a textile factory relying on paper records and manual checks, machine performance and material usage are tracked inaccurately. This results in overproduction of less popular designs and wasted raw materials.

Smart manufacturing opportunity – Integrating a manufacturing execution system (MES) with AI analytics offers accurate insights into demand trends, helping minimise excess inventory and reduce production costs.

Example – For Africa's often fragmented supply chains, real-time visibility and predictive analytics are vital. On-demand analysis of data, raw materials and logistics helps manufacturers optimise production, inventory and shipping, reducing waste and ensuring prompt delivery. In Zimbabwe, AI-powered grain silos use IoT sensors and automated controls to monitor conditions in real time, helping cut post-harvest losses and boost food reserves, which benefits food security and price stability.[24]

Sustainability

Scenario – A leather tanning factory uses outdated chemicals, producing excessive wastewater and releasing untreated, highly polluted effluent into local rivers, exceeding environmental limits and damaging aquatic ecosystems.

23 Smart Micro Grid Energy System Management Based on Optimum Running Cost for Rural Communities in Rwanda, Energy Engineering, 2024
24 "Zimbabwe commissions grain silos based on AI", TV BRICS, June 2025

Smart manufacturing opportunity – Automated wastewater treatment helps meet environmental standards, minimises ecosystem damage, and supports Africa's drive for sustainability. Smart systems monitor material flow, enable waste reduction and optimise recycling through automated sorting, benefitting the environment and generating potential revenue from recycled materials.

Example – In South Africa,[25] several projects are exploring ways digital technologies can support waste reclaimers by boosting waste diversion and streamlining operations. These initiatives highlight how smart manufacturing can blend recycling and circular economy principles – for instance, using advanced material sorting so recovered resources can be reused in production, which helps cut down on waste and reduces the need for new raw materials.

Competitive advantage

Scenario – A soap manufacturing factory with limited market reach is unable to adapt to consumer preferences or compete in international markets.

Smart manufacturing opportunity – Incorporating data analytics to monitor consumer preferences and market trends facilitates targeted product development, positioning the factory to compete effectively with larger regional firms.

Example – Morocco is emerging as an advanced manufacturing hub, notably with Benteler's new Industry 4.0 smart factory in Kenitra.[26] The facility, which produces automotive chassis and body parts, demonstrates how integrating advanced technology can drive efficiency, attract foreign investment and elevate national competitiveness in high-value industries.

Resilience

Scenario – A coffee processing factory that depends on a single, ageing supply chain for raw coffee beans experiences a shortage of materials when flooding disrupts its main supplier. The interruption halts production for several weeks and leads to significant revenue losses.

Smart manufacturing opportunity – Data analytics can monitor multiple suppliers in real-time, enabling dynamic sourcing to mitigate production disruptions.

Example – Considering Africa's vulnerability to internal and external shocks, smart manufacturing can provide important protection. In Nigeria's pharmaceutical sector, blockchain is being tested in supply chains to improve transparency and security – key to fighting counterfeiting.[27] This focus on digital solutions aims to make supply chains more resilient, improving manufacturers' ability to source materials and distribute products during disruptions.

25 Assessing waste management performance in smart cities through the 'Zero Waste Index': case of African Waste Reclaimers Organisation, Johannesburg, South Africa, Frontiers in Sustainable Cities, 2025

26 "Benteler starts work on advanced manufacturing plant in Morocco, boosting job creation and integrating Industry 4.0 technologies", Automotive Manufacturing Solutions, June 2025

27 The role of Blockchain technology in ensuring pharmaceutical supply chain integrity and traceability, Finance & Accounting Research Journal, 2024

The smart manufacturing opportunity for MSMEs in Africa

Micro, small and medium-sized enterprises (MSMEs) form the backbone of Africa's economies. MSMEs account for 90% of businesses and more than 50% of employment in Africa. They are considered the main drivers of economic growth, creating jobs and alleviating poverty.[28] Yet, many MSMEs face structural and operational challenges that limit their ability to scale and compete in increasing digital and global value chains. Legacy systems, supply inefficiencies and limited market reach often constrain growth – precisely the areas where smart manufacturing can drive transformational impact.

Smart manufacturing presents a timely opportunity for MSMEs to enhance their competitiveness by integrating digital and modular technologies into operations. The potential lies not in adopting complex, capital-heavy systems, but in deploying modular, scalable and cost-effective solutions tailored to local needs. These could include sensor-based tools to monitor machine health and reduce downtime, mobile-enabled inventory and workflow tracking, cloud-based enterprise resource planning (ERP) systems, or AI-powered platforms for demand forecasting and production planning. By adopting such tools, MSMEs can reduce waste, improve quality and respond faster to market shifts, ultimately boosting margins and market reach.

Connectivity is at the heart of many of these solutions. This positions telecoms operators as key enablers in the smart manufacturing ecosystem – not only through infrastructure but also by contributing to the development of an ecosystem that enables the adoption of digitalisation among MSMEs. This can include partnerships with local technology providers to co-develop sector-specific platforms, offering access to cloud services and digital tools through affordable pricing models, and supporting upskilling and digital literacy training.

While the potential is clear, unlocking the full benefits of smart manufacturing for MSMEs requires targeted support to close some persistent gaps. In many cases, entrepreneurs may not yet be fully aware of how digital solutions can apply to their operations or how to take the first step. Even where interest is strong, access to affordable financing, technical skills and tailored advisory support can make the difference between interest and implementation. Improving MSME access to capital will require more innovative financing mechanisms, such as pay-as-you-go digital solutions, results-based financing and concessional loans, as well as de-risking models such as credit guarantees or blended finance that lower the perceived risk for private investors and lenders. Public-private partnerships, digital finance platforms and development

28 Enhancing MSME Resilience in the Context of Regional Integration Mechanism and Digitization, Sylvanus Kwaku Afesorgbor, 2024



finance institutions also have roles to play in piloting scalable financing models that make digital transformation viable for small manufacturers. Addressing these areas presents a compelling opportunity for governments, industry players and development partners to create enabling environments through accessible training, smart financing and practical demonstrations that equip MSMEs to successfully adopt and scale smart manufacturing solutions.

Momentum is already building. In Ethiopia, a recent collaboration between Ethio Telecom and a local technology provider led to the development of Zoorya, a digital platform tailored to MSMEs. Zoorya supports production planning, inventory tracking and performance monitoring, placing affordable smart manufacturing capabilities in the hands of small-scale producers. The model offers a blueprint for how context-aware, locally driven partnerships can deliver accessible and scalable solutions.

By adopting modular smart manufacturing solutions within a supportive ecosystem, Africa's MSMEs can enhance operational efficiency, lower investment costs, accelerate time-to-market, and adapt more easily to changes in market demand. These translate into unlocking greater resilience, growth and market opportunities in the digital age.

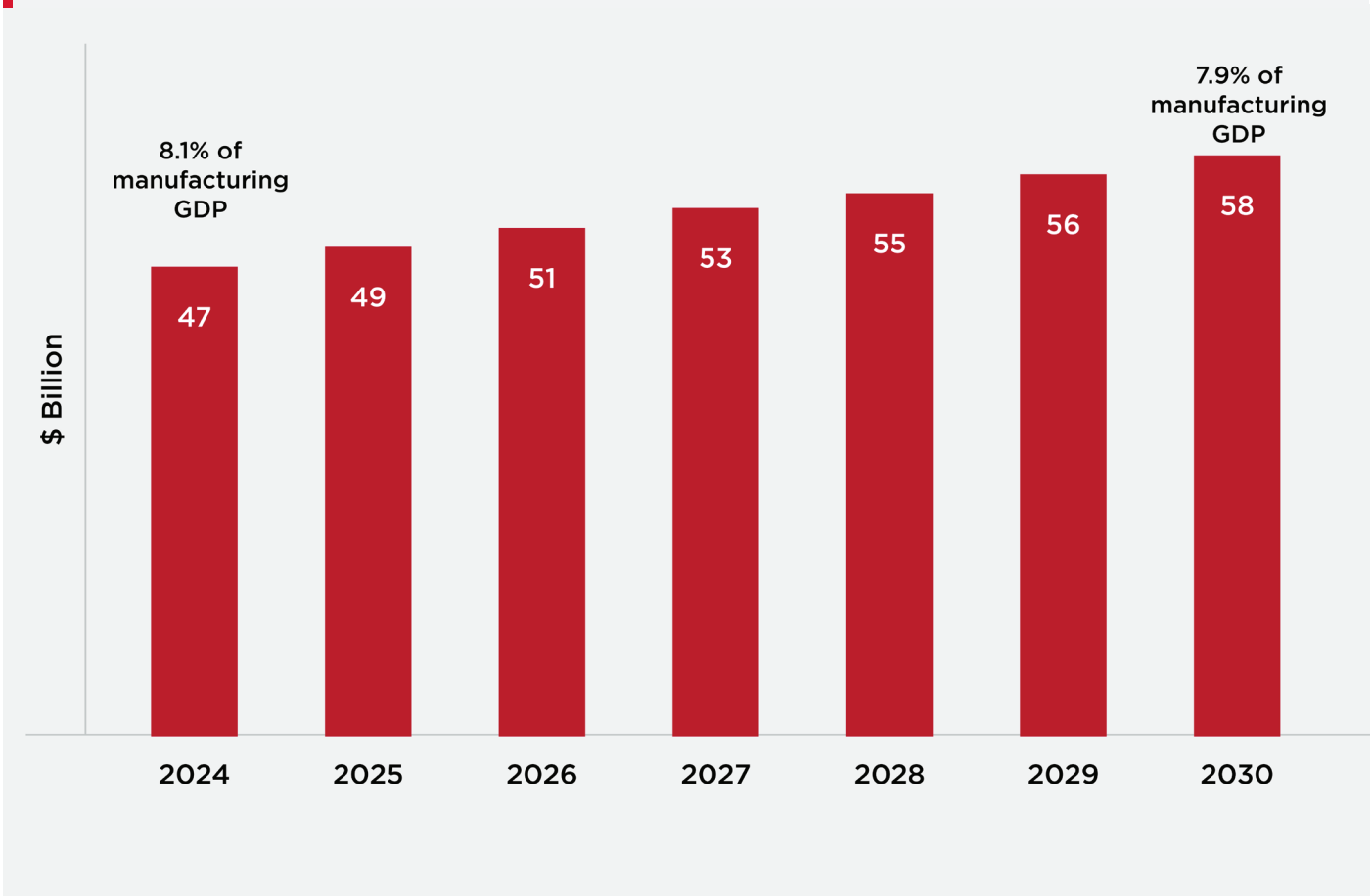
3.3 The economic impact of smart manufacturing in Africa

The integration of smart manufacturing practices is associated with improvements in manufacturing output and global competitiveness, as well as potential effects on GDP and economic growth. In Africa, mobile connectivity serves as the main form of advanced connectivity and acts as an enabler for smart manufacturing. The impact of mobile technologies can be categorised into two main areas:

- basic connectivity, which involves the use of mobile networks for communication and operations
- digital transformation, which includes advanced technologies such as 5G, IoT sensors and AI-powered systems.

According to GSMA Intelligence analysis, mobile-enabled technologies and services accounted for 8.1% of Africa's manufacturing GDP in 2024, representing $47 billion in value added. This figure underscores the impact of the integration of mobile-driven solutions in manufacturing sectors across African nations, including enhanced connectivity, automation and real-time data analysis. By 2030, mobile technologies are projected

Figure 10: Economic impact of mobile from smart manufacturing in Africa, 2024–2030
Source: GSMA Intelligence





to contribute approximately $60 billion (7.9% of manufacturing GDP) to Africa's smart manufacturing sector. From 2025, this contribution is expected to grow at a CAGR of 3.6%.[29] However, this will lag the overall manufacturing GDP growth rate of 4.2%, due to limited adoption of advanced technologies such as 5G, IoT and AI.

Smart manufacturing in Africa has the potential to alter the continent's industrial landscape, contribute to growth and enhance the resilience and international position of African economies. Although automation could reduce low-skill jobs, it can also increase demand for skilled labour in sectors such as robotics, data science and systems engineering. This shift can prompt investment in science, technology, engineering and mathematics (STEM) education, vocational training and entrepreneurship related to technology-enabled manufacturing services. Additionally, growth in the manufacturing sector through advanced digital technologies can help attract FDI in local economies, foster development around industrial clusters and support innovation among startups and research institutions.

29 Compound annual growth rate (CAGR) measures the mean annualised growth rate for compounding values over a given time period.

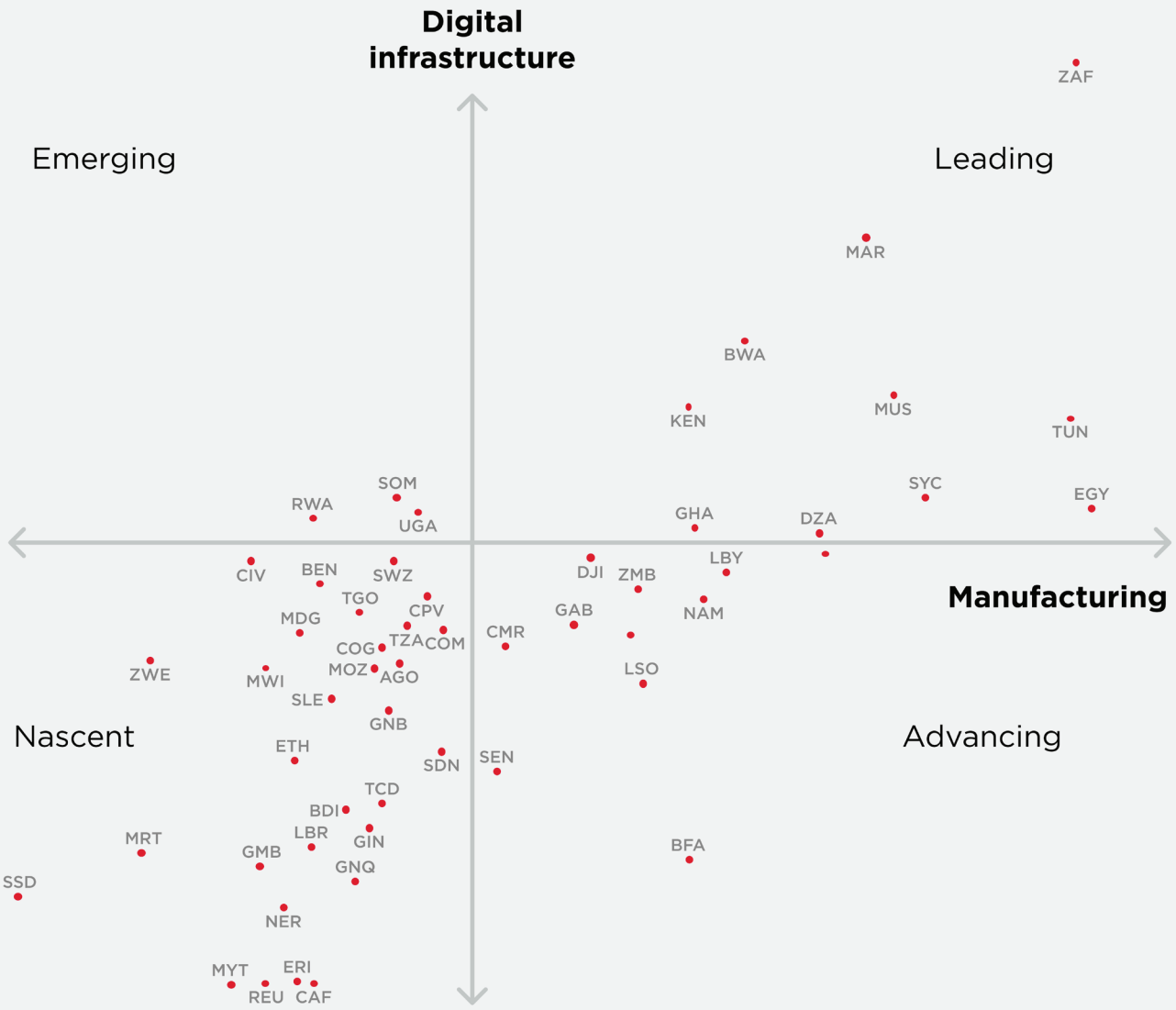
3.4 Evaluating the potential of smart manufacturing

GSMA Intelligence has developed an index that measures the readiness of African countries to adopt smart manufacturing practices (see Appendix for the methodology). The index is based on the following factors: current manufacturing capacity, digital infrastructure, human capital, policy environment, and preparedness to adopt Industry 4.0 technologies. Based on their index scores, the countries have been grouped into four categories defined in Table 4 and illustrated in Figure 11.

Table 4: Smart manufacturing readiness categories
Source: GSMA Intelligence

Category	Index	Definition	Key characteristics
Leading	55+	Strong manufacturing base Advanced digital infrastructure High readiness to adopt smart manufacturing technologies	Established industrial ecosystem Active Industry 4.0 policies Early adoption of smart tech Skilled workforce
Advancing	40–55	Moderate readiness Improving industrial and digital infrastructure Growing policy and investor interest in smart manufacturing	Developing digital base Emerging innovation hubs Expanding manufacturing zones
Emerging	30–40	Limited but growing manufacturing capacity and digital readiness Require targeted investment to unlock potential	Youth-driven labour force Interest from foreign investors Potential for growth with proper support
Nascent	<30	Underdeveloped manufacturing ecosystems and digital infrastructure Need foundational investment and support to initiate smart manufacturing	Infrastructure and skills gap Early-stage initiatives or sector-specific potential (e.g. agro-processing).

Figure 11: Mapping African countries by smart manufacturing readiness
Source: GSMA Intelligence



3.5 Country deep dives



South Africa

Connectivity

4G coverage	5G coverage
99%	59%

Smart manufacturing

economic impact by 2030

GDP	% GDP
$8.7bn	10.2%

Top 3 manufacturing sectors

- Automotive
- FMCG
- Chemicals

Policy landscape: The Presidential Commission on the Fourth Industrial Revolution (PC4IR), launched in 2020, outlines national priorities including industrial digitisation, AI and data infrastructure development. It is operationalised through the DTIC's Sector Masterplans, which include digital transformation goals for key industries such as automotive, steel and chemicals. The Reimagined Industrial Strategy encourages localisation of production and high-tech foreign investment, while the Council for Scientific and Industrial Research (CSIR) Smart Factory Programme provides R&D infrastructure and testbeds. Data governance is strengthened under the Protection of Personal Information Act, helping firms align with international standards on digital security and privacy.

Manufacturing landscape: South Africa hosts industrial clusters spread across Gauteng, KwaZulu-Natal, Eastern Cape and Western Cape. These regions support diverse sectors such as automotive, FMCG and chemicals, and include modern export-focused facilities. SEZs such as Dube TradePort and Coega SEZ offer plug-and-play infrastructure and incentives to tech-enabled manufacturers.

South Africa's manufacturing sector is diverse, with companies including Sappi (pulp and paper manufacturing), Sasol (chemicals and energy), Brands (food, beverages and tobacco), Barloworld (industrial equipment) and ArcelorMittal South Africa (steel).

Smart manufacturing landscape: South Africa's smart manufacturing landscape is shaped by a growing ecosystem of adopters, enablers and innovators. As of 2023, IoT investments in the manufacturing sector alone reached $327 million, primarily supporting predictive maintenance and condition-monitoring use cases.

In Gauteng Province – home to the largest concentration of manufacturing activity in South Africa – IoT implementations span more than 67,000 industrial assets across approximately 430 facilities, managed under a $2.4 billion ecosystem. These deployments have contributed to a 32% productivity increase in facilities using IoT technologies.[30]

30 South Africa IoT Market Valuation – 2026-2032, Verified Market Research, 2025

Industrial players including Toyota South Africa Motors, Aspen Pharmacare and SABMiller are embedding automation, robotics and cloud-based production monitoring to align with global quality and traceability requirements. Meanwhile, multinationals such as Siemens, ABB and Schneider Electric are expanding local operations to supply integrated smart systems and offer factory-level digital upgrades.

To date, 5G has been launched by three telecoms operators in South Africa, creating opportunities to implement advanced digital solutions. South Africa also benefits from localised cloud and data infrastructure, with AWS, Microsoft Azure and Vantage Data Centres providing industrial cloud platforms.

Innovation support is provided by the CSIR, which operates the Digital Manufacturing Precinct (DMP) in Johannesburg. The DMP provides shared facilities for SMEs and researchers to test and validate smart technologies. Other hubs such as JoziHub and the Tshimologong Precinct support startup-led innovation in AI, IoT and low-cost automation tailored to African factory environments.

Competitive outlook: South Africa's competitive strength in smart manufacturing is driven by a robust policy environment, investment in skills and strategic investments in infrastructure. The Industrial Development Corporation allocated ZAR9.6 billion ($500 million) between 2020 and 2023 to support the industrial sector,[31] while R&D investment reached 0.61% of GDP, enabling factory innovation and prototyping.[32]

South Africa is integrating Industry 4.0 skills into its Technical and Vocational Education and Training (TVET) system through partnerships with merSETA and Festo, establishing 4IR training labs in four TVET colleges (Maluti, Ekurhuleni East, Waterberg and Atlantis), offering hands-on learning in robotics, mechatronics and industrial automation. South Africa's Department of Higher Education and Training, with support from Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Huawei, Cisco and other partners, has launched seven 4IR Centres of Specialisation, while GIZ's Digital Skills for Jobs and Income II programme (2024–2027) aims to train 2,000 graduates and provide career services to 500 students each year in digitally enabled sectors.[33]

Core challenges include infrastructure reliability (load-shedding disrupts operations), prohibitive retrofit costs for older factories, cybersecurity vulnerabilities, and SME access to finance and skilled talent, limiting scalability outside major metro areas.

Case study: Jendamark and MTN Business – 5G private network for smart manufacturing

In 2023, MTN Business signed a memorandum of understanding with Jendamark, a South African-based company specialising in powertrain, catalytic converter and EV systems manufacturing, to pilot 5G-enabled smart manufacturing solutions in its operations. The collaboration aims to demonstrate how 5G can enable advanced ICT and manufacturing systems, including use of IIoT, robotics and automation technologies to optimise factory processes and efficiency.

Through this proof-of-concept setup, Jendamark is exploring how industrial-grade connectivity, supported by MTN's ultra-low-latency 5G private network, can transform modern factory operations. The goal is to support new smart factory capabilities such as digitalised production lines, real-time sensors and automation control, AI-enabled quality monitoring, and remote machinery integration – all enabled over a secure private network environment.

31 "IDC posts historic funding and investment activity for the year ended 31 March 2023", Industrial Development Corporation of South Africa (IDC), September 2023

32 "HSRC survey results show signs of recovery for R&D spending in South Africa", Human Sciences Research Council, November 2024

33 "Creating digital career paths for South Africa's youth", GIZ, August 2024

Tunisia

Connectivity

4G coverage	5G coverage
98%	16.8%

Smart manufacturing

economic impact by 2030

GDP	% GDP
$1.1bn	9%

Top 3 manufacturing sectors

- Electrical and electronic components
- Textile and garments
- Mechanical

Policy landscape: Tunisia's digital and industrial transformation is guided by the Digital Tunisia 2020 and Industry 4.0 Strategy 2023–2027 roadmaps. The Ministry of Industry, Mines and Energy, together with GIZ and other development partners, launched the National Industry 4.0 Strategy in 2023 to accelerate industrial competitiveness and innovation through the integration of digital technologies such as IoT, automation and AI. The strategy includes fiscal incentives for smart equipment adoption, SME digital audits, and the creation of a national network of Industry 4.0 advisors. Tunisia is also a signatory to AfCFTA and has bilateral agreements with the EU, creating regulatory alignment pressure on digital traceability and industrial standards. Digital governance frameworks are evolving, with recent initiatives focusing on cybersecurity and e-commerce laws. However, further clarity is needed to support cross-border industrial data exchange.

Manufacturing landscape: By 2024, manufacturing accounted for approximately 25% of Tunisia's GDP and accounted for 18% of employment.[34] The country is a leading exporter of electrical components, mechanical parts and textiles to Europe. Industrial activities are heavily concentrated in the coastal governorates of Tunis, Sfax and Sousse. The electronics and automotive component sectors are particularly prominent, with companies such as Leoni, Coficab and Yazaki operating large production sites. Tunisia's industrial zones, including Sousse Technology Park and El Fejja Industrial Zone, offer dedicated infrastructure for high-tech manufacturing, supported by customs facilitation and plug-and-play utilities. However, challenges persist around logistics costs, energy reliability and bureaucratic procedures that affect SME growth and competitiveness.

Smart manufacturing landscape: Smart manufacturing in Tunisia is nascent but growing, particularly among export-oriented firms in the electronics and automotive sectors. The National Industry 4.0 Strategy has catalysed the introduction of pilot projects in collaboration with GIZ, including digital maturity audits, IIoT implementation support and SME training programmes.

34 Tunisia Trade Fact Sheet, Trade Unions in the AFCFTA, 2024

Adopters such as Leoni and Coficab are integrating robotics, data-driven quality control and predictive maintenance to meet EU compliance standards and enhance operational efficiency. Operator Tunisie Telecom (along with private ISPs) is expanding fibre connectivity in industrial zones. 5G launched in 2025. Universities and R&D institutions such as the National Institute of Applied Sciences and Technology are collaborating with manufacturers to co-develop low-cost automation and simulation tools tailored to local needs. However, most SMEs remain in the early stages of adoption, with fragmented access to expertise, funding and digital infrastructure outside major industrial clusters.

Competitive outlook: Tunisia's competitive outlook for smart manufacturing is shaped by several interlinked opportunities and structural challenges. The country has a strong technical education system producing engineers and mid-skilled technicians, particularly in mechatronics and electronics, supported by institutions such as Instituts Supérieurs des Études Technologiques.

However, there remains a gap in applied digital manufacturing skills such as industrial data science, systems integration and cybersecurity. Cost-effective labour and proximity to EU markets are major strengths, but firms face hurdles in digital upskilling, complex administrative processes and a lack of industrial digital finance instruments. Energy reliability is a growing concern, with frequent outages prompting manufacturers to invest in backup power systems, which increases costs.[35] Nonetheless, Tunisia's stable export demand, especially in high-value sectors including auto-electronics, creates pressure and an incentive to scale digital capabilities for competitiveness and traceability compliance.

Case study: STMicroelectronics Tunisia – smart electronics manufacturing

STMicroelectronics' semiconductor fabrication plant in Tunisia is one of Africa's technologically advanced manufacturing facilities. The plant leverages AI-driven quality control, real-time production data analytics and automated material handling to achieve high yield and minimise defects, which are critical in semiconductor manufacturing. The integration of these smart manufacturing techniques has helped maintain strict environmental standards, underscoring the factory's commitment to sustainability. The facility also functions as a national flagship, showcasing Tunisia's capacity to compete in specialised, high-value manufacturing. The presence of STMicroelectronics helps stimulate knowledge transfer and the development of supplier networks, further embedding Industry 4.0 capabilities within Tunisia's industrial ecosystem.

35 "Tunisia suffers nationwide power cut", Africanews, August 2024

Morocco

Connectivity

4G coverage	5G coverage
99%	24.5%

Smart manufacturing

economic impact by 2030

GDP	% GDP
$3.4bn	8.2%

Top 3 manufacturing sectors

- Automotive and auto parts
- Aerospace
- Textiles and apparel

Policy landscape: Morocco's strategic push towards digital transformation is anchored by the Digital Morocco 2030 strategy, launched in 2024. It commits MAD11 billion (around $1 billion) to accelerate national digital transformation, including developing 3,000 startups, expanding digital jobs to 240,000, and training 100,000 digital professionals annually. The strategy emphasises cloud sovereignty, AI adoption and digital infrastructure development across all sectors, including manufacturing.[36]

The Industrial Acceleration Plan (2021–2023) complements this agenda, focusing on manufacturing modernisation, SME industrial upgrading, and integration into global value chains. The regulatory framework includes Morocco's Personal Data Protection Law (09-08) and legislation supporting e-governance and digital signatures. In parallel, the Ministry of Industry and Digital Transition has announced plans to launch Jazari Institutes, in partnership with the United Nations Development Programme (UNDP), to develop AI, automation and robotics talent for future industries.

Manufacturing landscape: Morocco's manufacturing sector benefits from industrial corridors such as Tangier Automotive City, Kenitra Atlantic Free Zone, Casablanca Midparc and Agadir agro-industrial hubs. These zones support integrated value chains, export-ready facilities and global OEMs including Renault, Stellantis and Boeing Suppliers. The automotive sector tops Morocco's industrial exports at $14 billion in 2023, with production capacity of 700,000 cars annually.[37] Morocco hosts 147 aerospace plants operating across areas such as engineering, assembly, wiring and avionics, with exports totalling $2.2 billion in 2023. These supply global manufacturers including Boeing and Airbus.[38]

Smart manufacturing landscape: Smart manufacturing adoption is gaining traction among Morocco's export-oriented manufacturers. In the automotive and aerospace sectors, digital twins, real-time quality control systems and collaborative robots are used to meet European market standards. The Moroccan government, in collaboration with Boeing, has established the

36 For more information, see "Morocco Unveils 2030 Digital Strategy", We Are Tech Africa, September 2024.
37 "Morocco expects more EV battery investments, minister says", Reuters, April 2024
38 "Brazil's Embraer pledges investment in Morocco's aerospace sector", Reuters, October 2024

African Centre of Manufacturing Excellence, which focuses on advanced manufacturing, Industry 4.0, automation and materials, fostering innovation and technological advancement in the Moroccan aerospace sector.[39]

Meanwhile, Renault's Tangier plant integrates AI-based defect detection, automated logistics and energy-efficient robotics, and Stellantis Kenitra incorporates Industry 4.0 modules across its production line.

Morocco has a well-developed 4G network but 5G adoption is still emerging. With the government's recent 5G spectrum tender announcement, rollout is expected to accelerate. The transition to 5G will be a key enabler for smart manufacturing by providing faster, more reliable connectivity that is essential for Industry 4.0.

Innovation hubs such as Technopark Casablanca, Maroc Numeric Cluster and Nokia's EMEA Innovation Hub in Salé support IoT pilots, robotics startups and 5G testbeds for industrial use cases. Cloud services are provided by Oracle, AWS and local hosts. Data centre capacity is growing, with more than 25 commercial centres supporting business continuity and remote industrial monitoring.

Competitive outlook: Morocco's strengths in smart manufacturing lie in its export-led industrial zones, well-established OEM presence and strong policy coordination across ministries. Its proactive digital strategy, high-speed fibre deployment and growing pool of technology talent offer a supportive foundation for smart manufacturing. Industrial players such as OCP, Renault and Boeing Suppliers have the resources and incentives to pioneer digital transformation and serve as models for broader sector adoption.

However, key constraints persist. Smaller manufacturers outside SEZs often lack access to affordable automation, skilled technicians and connectivity, creating a digital divide. Vocational education reforms are underway, but the pace of reskilling is not yet aligned with demand in manufacturing. Energy reliability is uneven in inland zones, and while broadband coverage is high, industrial fibre penetration lags outside export clusters. Fragmented institutional coordination across digital and industrial agencies can also slow project execution, particularly for SMEs.

Case study: OCP Group – digital transformation in phosphate processing

OCP Group, a phosphate rock producer, provides an example of smart manufacturing adoption in a resource-intensive sector. The company has implemented advanced IoT sensors, AI-driven process optimisation and predictive maintenance systems to significantly enhance operational efficiency while minimising environmental impact. Its centralised digital control platform provides real-time monitoring of equipment health and resource consumption, enabling proactive management that boosts production capacity and reduces water and energy use. OCP's digital transformation aligns with Morocco's sustainability ambitions and offers a blueprint for other heavy industries to leapfrog with Industry 4.0 technologies, enhancing competitiveness and environmental stewardship at the same time.[40]

39 For more information, see "Morocco and Boeing launch Africa's first advanced manufacturing research hub", 7News Morocco, October 2024.

40 For more information, see the conference paper: Smart Factory Implementation in Moroccan Phosphate Industry, SYMPHOS 2019, 5th International Symposium on Innovation and Technology in the Phosphate Industry, June 2020.



Egypt

Connectivity

4G coverage	5G coverage
99%	14.3%

Smart manufacturing

economic impact by 2030

GDP	% GDP
$9.4bn	7.2%

Top 3 manufacturing sectors

- Chemicals and petrochemicals
- Construction materials
- FMCG

Policy landscape: Egypt's digital and industrial policies are anchored by two core frameworks: the Egypt Vision 2030 and the Digital Egypt Strategy. The Ministry of Communications and Information Technology (MCIT) leads the country's digital transformation agenda, with specific programmes targeting Industry 4.0 enablers such as AI, IoT and cybersecurity. In 2022, the MCIT and the Ministry of Trade and Industry launched the Industry Digital Transformation Initiative in partnership with the Federation of Egyptian Industries and UNIDO, aimed at increasing digital technology adoption among SMEs.[41] The initiative provides digital maturity assessments and supports the integration of automation, ERP systems and real-time data tools.

Egypt's AI Strategy (2021) lays the foundation for embedding machine learning into sectors such as manufacturing, logistics and utilities. The General Authority for Investment and Free Zones oversees investment facilitation, offering incentives for technology-enabled manufacturing operations in industrial zones. Meanwhile, legislation such as the Personal Data Protection Law (2020) helps align Egypt's data governance with global standards, supporting secure industrial digitalisation.

Manufacturing landscape: Manufacturing accounts for about 16.5% of Egypt's GDP and employs more than 3 million people.[42] The sector is anchored in the Greater Cairo region, Alexandria and the Suez Canal Economic Zone (SCZone), which host both state-led and private industrial clusters. SCZone has attracted high-tech FDI, supported by tax incentives, upgraded infrastructure and strategic access to European, Gulf and African markets. In 2023, Egypt attracted $10 billion in net FDI inflows. The manufacturing sector received approximately $3.34 billion, making it the second-largest recipient after services.[43]

Egypt is among Africa's top producers of fertilisers, cement, textiles and electronics. Global firms such as Schneider Electric, Jushi Group (fiberglass) and Samsung operate manufacturing facilities in the country, often integrated into global value chains. Domestically, firms such as ElSewedy Electric and Elaraby Group are among the leading digital adopters, investing in automation and data platforms to improve efficiency and traceability. The rise of export-oriented industrial zones has driven a shift towards quality certification, smart packaging and production line monitoring.

Despite these advancements, bottlenecks persist in logistics and energy. Port congestion, regulatory complexity and bureaucratic procedures increase operational costs for manufacturers, while some industrial zones face intermittent electricity and water supply disruptions that undermine productivity.

Smart manufacturing landscape: Egypt's smart manufacturing ecosystem is at a formative stage, with digital adoption led primarily by

41 For more information, see "ITIDA Teams Up with UNIDO to Mainstream Industry 4.0 Technologies in Egypt's Manufacturing Sector", ITIDA, June 2021.

42 "Egypt allocates EGP 100.7 billion to manufacturing industries sector in FY2023/24", Ahram Online, December 2023

43 "Services account for nearly 60% of Egypt's FDI inflows in FY2022/2023: CBE", Ahram Online, December 2023

large industrial players and multinationals. Most domestic manufacturers continue to operate within Industry 2.0 or 3.0 paradigms, relying on basic automation or manual processes, especially among SMEs. Early adopters are concentrated in chemicals, electronics and textiles, where companies face stringent global standards that require automation, quality tracking and data analytics.

Egypt became one of the first African countries to implement the Smart Industry Readiness Index (SIRI), with certified assessors evaluating digital maturity across firms in sectors such as pharmaceuticals, plastics and garments. These efforts mark an important shift from awareness building to structured capacity development and digital implementation. Local startups such as NIOTEK and Garment IO are developing IoT and industrial analytics platforms tailored to manufacturing. However, access to capital, limited factory-level connectivity and a fragmented SME support environment have slowed broader uptake.

Fibre-optic expansion in key industrial corridors is underway, led by Telecom Egypt. The four major mobile operators (Vodafone Egypt, Orange Egypt, e& Egypt and Telecom Egypt) all simultaneously launched 5G services. Egypt's smart manufacturing is supported by major global cloud providers including Oracle, Microsoft Azure, AWS, Google Cloud, Huawei, IBM and SAP, which offer cloud, AI, IoT and Industry 4.0 solutions. Huawei and SAP have local data centres, while others provide services via regional hubs and partnerships.

Egypt is advancing local cloud initiatives emphasising data sovereignty and privacy. Telecoms operators such as Vodafone Egypt and Telecom Egypt offer cloud and edge computing services tailored to SMEs and manufacturers. Growing public-private collaborations and local startups are also developing cloud-native applications suited to Egypt's industrial needs, helping diversify and strengthen the cloud ecosystem critical for growth in smart manufacturing.

Competitive outlook: Egypt's competitive outlook for smart manufacturing is shaped by strong industrial foundations, proactive public policy and its strategic location, but is constrained by structural and operational challenges. On the workforce front, in Egypt, more than 750,000 students graduate annually from TVET programmes,[44] but curricula often lag Industry 4.0 requirements. In response, MCIT and GIZ have launched training programmes on robotics, data analytics and mechatronics through the Applied Technology Schools initiative and the Digital Egypt Builders programme.

Energy reliability is both a risk and an opportunity. While Egypt is a net electricity exporter and has invested heavily in renewable energy, industrial zones continue to report fluctuations in power supply that deter investment in sensitive equipment. Logistics constraints include outdated customs procedures and last-mile inefficiencies, limiting adoption of just-in-time and smart supply chain systems.

Access to finance is a further barrier. While development banks such as EBRD have supported digital transformation loans for manufacturers, many SMEs report limited awareness or capacity to apply for these instruments. Lastly, industrial digital adoption is uneven, with multinational firms pulling ahead while smaller manufacturers in Upper Egypt and Delta regions lack infrastructure, digital exposure and tailored technical support.

Case study: Egypt Industry 4.0 Academy – addressing the skills gap

The Egypt Industry 4.0 Academy is a public–private partnership designed to bridge the country's critical workforce skills gap for smart manufacturing. It offers practical training in AI, robotics, IoT and data analytics to new graduates and incumbent workers, combining classroom learning with hands-on factory experience. Partnering with manufacturers including Elsewedy Electric and Juhayna, the Academy equips trainees with the skills to manage automated production lines and digital quality systems. The programme prepares a skilled labour pool to support Industry 4.0 adoption and helps smaller firms benefit from digital transformation. By aligning education with industry needs, the academy plays a vital role in accelerating Egypt's shift to a competitive, technology-driven manufacturing sector.

44 https://tvetegypt.org/tvet



Nigeria

Connectivity

4G coverage	5G coverage
84%	17.8%

Smart manufacturing

economic impact by 2030

GDP	% GDP
$4.8bn	8.2%

Top 3 manufacturing sectors

- Agro-processing (food, palm oil, cocoa)
- Cement
- Construction materials

Policy landscape: Nigeria is advancing its digital transformation through coordinated policies that integrate industrial modernisation with digital infrastructure development. The National Digital Economy Policy (2020–2030) outlines goals for smart manufacturing, IoT and industrial digitalisation to enhance productivity. This strategy is complemented by the Nigeria Industrial Revolution Plan, which promotes local content, automation and capacity building in manufacturing. The National Information Technology Development Agency introduced a framework that supports Industry 4.0-readiness across sectors, including digital adoption benchmarks and IoT licensing provisions. Additionally, telecoms operators are collaborating with the government and partners such as GIZ and the Small and Medium Enterprises Development Agency of Nigeria to provide industrial automation training and pilot deployments for SMEs.

Manufacturing landscape: Nigeria has the second-largest manufacturing sector in Sub-Saharan Africa, contributing approximately 9% to GDP[45] and 80% of total employment.[46] Key manufacturing clusters include the Lagos–Ogun corridor, Kano, Kaduna, Aba and Port Harcourt, with major industries such as food and beverages, cement, textiles, petrochemicals and light engineering.

Manufacturers leading operational modernisation include Dangote Cement, Nigerian Breweries, Guinness Nigeria and West African Portland Cement. These firms are leveraging advanced production controls and centralised logistics. Unilever Nigeria and Nestlé Nigeria are examples of FMCG companies with high levels of automation and digital traceability. The automotive manufacturing industry is evolving through local assembler partnerships but remains small relative to other sectors.

Smart manufacturing landscape: Smart manufacturing adoption in Nigeria is growing but remains uneven. A 2024 GSMA report[47] estimates that digitalisation of the manufacturing sector potentially would add NGN5 trillion in industry value-add, equivalent to 3.3% of the sub-sector's value-add by 2028. This would result in additional employment in industry of about 465,000 people by 2028.

MTN and Airtel have commercially launched 5G networks in Nigeria and are expanding coverage primarily within urban and industrial hubs. This targeted rollout supports the enhanced connectivity demands of manufacturing facilities concentrated in these areas. Airtel and Glo are partnering with OEMs and systems integrators to offer sensor-based monitoring for manufacturing clients in industrial zones.

45 "Manufacturing sector contributes 9% to GDP in 5yrs", Vanguard, June 2023
46 "'Manufacturers generate 80% of employment in Nigeria", Vanguard, December 2024
47 Collaborative Action Needed to Boost Digitalisation in Nigeria and Support Economic Growth, GSMA, 2024

Cloud and data infrastructure are emerging across industrial clusters. Nigeria's cloud infrastructure is growing rapidly, supported by global providers such as AWS and Microsoft Azure and boosted by major local investments including MTN Nigeria's tier-3 data centre in Lagos and a $685 million increase in national data centre funding.[48] Key local players include MainOne, Rack Centre and Airtel Nigeria, which is expanding cloud and edge services alongside its 5G network. Emerging providers such as CloudFlex also offer hybrid cloud solutions for SMEs and manufacturers. These developments strengthen Nigeria's cloud ecosystem, improving availability and data sovereignty, and enabling wider smart manufacturing adoption.

Innovation is beginning to take root. Business incubators in Lagos and Aba are piloting industrial apps, and the Centre for the Fourth Industrial Revolution (C4IR) Nigeria serves as a hub for public–private collaboration. Despite this progress, many manufacturers still operate largely manually, with only pockets of smart systems in place.

Competitive outlook: Nigeria's pathway to smart manufacturing combines strong demand-side conditions driven by its large and rapidly growing population of more than 220 million people, with abundant mineral and agricultural resources that supply key raw materials for manufacturing sectors. The country's strategic position and natural resource base present significant opportunities to attract FDI. However, several structural challenges constrain advancement. Although Nigeria has made progress in telecoms infrastructure, 5G coverage remains limited and digital payments adoption lags regional peers such as Kenya.

The country's workforce faces a critical skills gap, with the educational system struggling to meet industry demands for digital and technical competencies, especially in industrial IoT, robotics and automation. Vocational training programmes have yet to adequately address these emerging needs. Policy fragmentation across manufacturing, ICT and trade ministries further complicates cohesive implementation of smart manufacturing initiatives. Additionally, persistent power supply issues raise operational costs and disrupt connectivity, while cybersecurity frameworks are still developing, impacting trust in digital systems.

Informal cross-border trade remains significant, but efforts are underway to formalise it, which could enhance regional market integration and supply chain reliability.[49] Without a unified national strategy that aligns infrastructure investment, workforce development, FDI attraction and digital governance, Nigeria risks a fragmented industrial future where only large enterprises benefit from smart manufacturing advances, leaving SMEs and the wider industrial base behind.

Case study: MTN Nigeria's IoT-as-a-service – enabling SME-scale smart manufacturing

MTN Nigeria is advancing smart manufacturing by delivering IoT-as-a-service in selected areas. This provides small and medium-sized manufacturers with affordable access to IoT solutions such as fleet tracking, inventory monitoring and remote diagnostics over its NB-IoT network. Instead of high upfront costs for private networks, SMEs subscribe to these services, enabling rapid technology adoption.

As well as enterprise connectivity, MTN Nigeria is implementing smart city and smart utilities projects, deploying IoT-enabled smart meters and fostering an IoT innovation hub in Lagos and Abuja. MTN's platform, branded "IoT by MTN," supports fleet management and asset tracking solutions with pan-African reach, highlighting the operator's commitment to industrial IoT expansion.

48 "Nigeria's data centre investments surge to $685m", The Nation, July 2025

49 "Stakeholders move to formalise informal cross-border trade", The Guardian, July 2025



Kenya

Connectivity

4G coverage	5G coverage
98%	38%

Smart manufacturing

economic impact by 2030

GDP	% GDP
$1.3bn	7.8%

Top 3 manufacturing sectors

- Agro-processing (tea, coffee, dairy)
- Textiles
- Plastics and chemicals

Policy landscape: Kenya's industrial digitisation is supported by its Vision 2030 and Bottom-Up Economic Transformation Agenda (BETA), which incorporate digitalisation across manufacturing, agriculture and services. The Big Four Agenda – operationalised through the Manufacturing Priority Agenda (2023–2025) by the Kenya Association of Manufacturers – emphasises energy stability, SME development, tax reform and digital productivity. The government's Buy Kenya – Build Kenya policy and streamlined tax regulations aim to support domestic manufacturers in enhancing competitiveness. Meanwhile, tax incentives and streamlined regulatory processes within SEZs such as Athi River Export Processing Zone and Tatu City SEZ aim to attract technology-enabled investments.

Manufacturing landscape: Manufacturing contributes approximately 10.3% to GDP in Kenya, employing a wide network of firms clustered around Nairobi, Mombasa, Naivasha and Athi River. Key sectors include agro-processing (tea, dairy, fruit), including companies such as Brookside Dairy and Del Monte Kenya; cement, including Bamburi Cement; and FMCG, with the likes of Bidco Africa, Unga Group and Haco Industries expanding regionally. Industrial parks and SEZs such as Naivasha and Tatu City provide enhanced infrastructure, logistics links and tax benefits that support export-ready manufacturing.

Smart manufacturing landscape: Adoption of smart technologies in Kenya remains nascent but is gaining momentum among leading firms. A University of Nairobi thesis (*Fourth Industrial Technology and Lean Manufacturing in Kenya*) highlights significant uptake of cloud robotics, IoT and cyber-physical systems at Almasi Beverages in Eldoret, which showed strong correlation with increased lean manufacturing efficiencies. Automation providers such as Siemens, ABB and Schneider Electric are present locally, offering smart technologies including robotics and energy management systems to manufacturers. Technology firms and cloud integration are evidenced by growing interest from global providers such as AWS and Microsoft. Kenya's cloud and data infrastructure is bolstered by strong local initiatives such as IXAfrica's NBOX1 data centre in Nairobi, which includes a new Kenya Internet Exchange Point (KIXP) to improve regional connectivity. This development is part of a broader surge in data centre investments across Africa, reflecting increasing demand for scalable, low-latency cloud services to support sectors (including manufacturing) and digital innovation.

Telecoms providers are also evolving their networks. Safaricom, Airtel and Telkom have launched commercial 5G, improving the backbone for private industrial connectivity.

Incubators and innovation hubs in Nairobi and Konza Technopolis are nurturing solutions for digital agriculture, manufacturing and automation. However, smart manufacturing uptake remains concentrated in large-scale processors and multinationals, with SMEs still depending on manual or partially automated systems and ad-hoc cloud or IoT pilots. The Nairobi Industrial Area remains a key manufacturing cluster where many firms are beginning to integrate digital tools and automation.

Competitive outlook: Kenya's pathway to smart manufacturing is supported by a relatively mature industrial ecosystem and strong government policy intent. National strategies such as Vision 2030, the Bottom-Up Economic Transformation Agenda and the Big Four Agenda underscore the importance of manufacturing modernisation through value addition and technology adoption. Policy enablers such as SEZs, tax reform and export incentives have helped attract investment in agro-processing, cement and FMCG industries.

Local firms such as Bidco, Unga, Bamburi and Brookside are beginning to integrate digital systems such as ERP, IoT sensors and automation for quality control and logistics, creating proof points for broader industry uptake. Kenya's regional leadership in fintech and digital ID systems offers indirect infrastructure advantages, including secure digital payments, traceability tools and digital procurement platforms that can support factory operations and supply chain modernisation.

However, adoption remains uneven. SMEs struggle with access to finance and lack tailored support for digitisation. Technical and vocational education systems are not yet fully aligned with emerging skills needs in industrial automation, data analytics or AI-driven maintenance. Without coordinated action to embed digital incentives into sector-level policies (particularly for manufacturing sub-sectors such as textiles, food and construction materials), smart manufacturing could remain the domain of large, export-oriented firms.

Case study: Bidco Africa – automation for resilience and scale

Bidco Africa, one of Kenya's largest manufacturers of edible oils, beverages and personal care products, has undergone a multi-phase smart manufacturing transformation. Recognising inefficiencies in its legacy production systems, Bidco invested in automation across its Thika plant, introducing programmable logic controllers, real-time quality monitoring sensors and AI-powered inventory forecasting systems. These allow Bidco to anticipate bottlenecks, reduce human error and optimise raw material inputs. The integration of digital dashboards and analytics platforms has also enabled management to oversee production remotely and make real-time decisions. As a result, the company has significantly reduced operational downtime and waste while increasing output without increasing energy consumption.

Bidco's journey reflects how a manufacturer can leapfrog stages of industrial development by adopting scalable, modular smart technologies without requiring complete plant overhauls.



Ghana

Connectivity

4G coverage	5G coverage
99%	15.4%

Smart manufacturing

economic impact by 2030

GDP	% GDP
$0.9bn	3.4%

Top 3 manufacturing sectors

- Agro-processing (cocoa, beverages)
- Pharmaceuticals
- Textiles

Policy landscape: Ghana's digital transformation is guided by the Digital Ghana Agenda, which aims to expand nationwide broadband access, improve public service delivery, and support digital innovation across sectors. Complementing this, Ghana's National Digital Economy Policy (2020–2030) sets clear objectives for integrating ICT and IoT into economic sectors such as manufacturing and agriculture. The Ghana Investment Promotion Centre and Ghana Free Zones Authority offer tax incentives and duty exemptions to manufacturers investing in smart technologies and digital infrastructure. These policy measures combined create an enabling environment for industrial digitisation and digital inclusion.

Manufacturing landscape: Manufacturing contributes around 24.5% to Ghana's GDP, with major operations in food and beverages, chemicals, textiles, cement and electronics. Accra, Tema, Kumasi and Takoradi serve as manufacturing hubs. Manufacturers include Twellium Industrial (beverages), Printex (textiles), Dzata Cement, and Mahindra's assembly operations in Ghana, offering examples of domestic investment in industrial capacity. FDI is strong in chemicals and FMCG, but smart technology uptake remains limited to well-established firms. Industrial zones host foreign and local companies, but power reliability, logistics and connectivity remain uneven across the region. The major industrial corridors of Tema, Accra, Kumasi and Takoradi host both multinational operations and homegrown enterprises in sectors ranging from agro-processing and pharmaceuticals to garments and consumer goods. Initiatives such as the Dawa Industrial Zone and the Ghana Free Zones Authority have attracted new investment in light manufacturing and value-added processing.

Smart manufacturing landscape: Smart manufacturing adoption in Ghana is growing, mainly in larger firms. For example, Twellium operates seven production lines with European-built, high-speed bottling systems, though evidence of IoT integration is limited. The textile firm Printex employs automated printing lines. Some digitisation has occurred in cement via firms including Dzata and Mahindra's assembly lines. Telecoms players MTN, Telecel and AirtelTigo are rolling out infrastructure critical for IoT and smart factory connectivity. IoT pilot programmes

in agriculture and smart city initiatives show potential but have yet to scale within manufacturing. Startup hubs such as MEST and iSpace are incubating promising Industry 4.0 solutions.

Competitive outlook: Ghana's competitive position in smart manufacturing is shaped by robust telecoms infrastructure, strong industrial policy incentives and a vibrant digital skills ecosystem. Ghana's 5G strategy stands out for adopting a single wholesale network (SWN) model, diverging from the multi-operator approach seen across most of Africa and globally. Malaysia, a rare precedent, has since moved to a dual network model, citing limitations of the SWN. The success of Ghana's smart manufacturing ambitions will therefore hinge on how efficiently and inclusively this centralised 5G infrastructure is deployed.

The Digital Economy Policy incentivises manufacturers to integrate smart tools, while investment incentives support capital-intensive upgrades. Government-tech incubators are stimulating local innovation in IoT and analytics.

Momentum is being hampered by several constraints. Unreliable power supply affects more than 70% of SMEs[50] Furthermore, Ghana's SME sector demonstrates low levels of technology readiness. A national survey of 300 SMEs found that less than 5% had adopted advanced technologies such as IoT or AI; most firms relied on simpler tools such as social media, mobile banking or basic e-commerce, and faced major barriers including lack of finance, limited absorptive capacity and inadequate infrastructure.[51]

While TVET institutions are expanding, many still face outdated curricula and limited training infrastructure for digital and automation-related disciplines[52]. Technical universities are also rolling out new courses in mechatronics and industrial systems. With sustained investment and stronger industry-education linkages, Ghana has the potential to gradually bridge its skills gap and enable more inclusive smart manufacturing adoption.

Case study: Kasapreko Ghana – digital retrofits at scale

Kasapreko, a Ghanaian beverage producer, has integrated advanced digital systems to optimise operations and enhance quality control. The company deployed the Carboscan system, a first-in-Ghana technology that enables real-time monitoring of CO_2 production critical for beverage carbonation and product consistency. The digital retrofit enhances precision and waste reduction in production processes.

While specifics such as percentage gains in energy efficiency or downtime reduction have not been publicly disclosed, Kasapreko's investment in real-time data capture reflects a broader shift towards automation and smart manufacturing processes within legacy factory environments. The Carboscan deployment underscores the validity of retrofitting existing lines with targeted Industry 4.0 tools, even outside formal industrial parks, to raise productivity standards in competitive sectors.

50 "70% of SMEs' productivity lost to power crises in Central Region", ModernGhana, April 2024

51 Quaye, W., Akon-Yamga, G., Akuffobea-Essilfie, M., & Onumah, J. A. (2024). Technology adoption, competitiveness and new market access among SMEs in Ghana: What are the limiting factors? African Journal of Science, Technology, Innovation and Development, 16(7), 1023–1037

52 For more information, see www.ctvet.gov.gh.



Zambia

Connectivity

4G coverage	5G coverage
100%	35%

Smart manufacturing

economic impact by 2030

GDP	% GDP
$0.5bn	6.2%

Top 3 manufacturing sectors

- Agro-processing (maize, dairy, meat)
- Food and beverages (FMCG)
- Chemicals

Policy landscape: Zambia's digital and industrial development is guided by the Eighth National Development Plan (8NDP, 2022–2026), which emphasises value addition in manufacturing, industrial upgrading and the adoption of digital technologies, particularly in agro-processing and trade logistics. While Zambia does not yet have a dedicated Industry 4.0 strategy, the Smart Zambia Institute, operating under the Office of the President, leads national ICT coordination and oversees e-government, digital identity systems and digital infrastructure upgrades.

In 2024, Zambia began developing its first National AI Strategy in partnership with the European Union. This includes early-stage planning for AI use in manufacturing, digital skills development and the formulation of data governance frameworks. Tax incentives for capital investment, including customs exemptions and accelerated depreciation, are available to firms in multi-facility economic zones (MFEZs), which aim to attract technologically advanced manufacturers.

Manufacturing landscape: Zambia's manufacturing sector accounts for approximately 9% of GDP and is concentrated around Lusaka and the Copperbelt, particularly in the Lusaka South and Chambishi MFEZs. These zones support activities in agro-processing, packaging, chemicals, cement and FMCG production. Export processing is geared towards regional markets under the COMESA and AfCFTA frameworks, with some firms leveraging traceability systems to meet international quality standards.

Zambia is also seeing moderate levels of FDI in light manufacturing and agro value chains. Notable multinational and regional players include Trade Kings Group (FMCG), Zambeef (agro-processing), Lafarge Zambia (cement) and 260 Brands (food and beverages). While these companies have begun experimenting with digital systems, automation remains limited outside a few urban factories.

In terms of infrastructure, MFEZs offer road access, utility provision and customs services. However, grid reliability issues continue to affect operations. Zambia's electricity access stands at around 80%, but recurring shortages (despite its hydropower base) can disrupt production. Recent infrastructure upgrades to corridors connecting Lusaka and Ndola, and border crossings have improved logistics, but last-mile delivery inefficiencies persist.

Smart manufacturing landscape: Zambia's smart manufacturing ecosystem is still in its infancy. A 2023 UNIDO survey found that less than 15% of manufacturers reported any use of industrial automation, and adoption of advanced technologies such as IoT, robotics or AI was even lower. The landscape is best characterised as fragmented, marked by a few 'digital islands' rather than sector-wide transformation.

Early adoption is visible in a handful of larger firms. Trade Kings and Zambeef have introduced automated packaging, inventory-tracking and sensor-based quality monitoring systems, particularly for high-volume production lines.

Telecoms operators such as MTN and Airtel are expanding 4G and launching 5G services, which could support private network deployments in industrial parks, but commercial-scale industrial 5G rollout has yet to occur.

Zambia's public data centre landscape remains underdeveloped, with most manufacturers relying on on-premises data storage. Cloud services are sourced from international providers, and adoption is low due to cost and inconsistent connectivity. Donor-backed initiatives such as GIZ's Make-IT programme are engaging SMEs to pilot low-cost automation, digital inventory systems and ERP platforms in the agro-processing sector.

Competitive outlook: Zambia's path to smart manufacturing is supported by several structural advantages, including abundant clean energy, a growing digital economy and targeted policy shifts. The country's strong agro-industrial base creates near-term use cases for digital tools such as traceability systems, cold chain optimisation and automated packaging lines. Donor partnerships with GIZ, the EU and UNIDO have begun to build technical capacity and digital awareness across firms and institutions.

The Smart Zambia Institute is laying the foundation for digital infrastructure through connectivity expansion, e-governance systems and a digital economy blueprint. At the same time, the youthful population (with more than 60% under the age of 25) offers a long-term demographic dividend, especially as programmes such as TEVETA and the University of Zambia begin integrating basic digital and engineering skills into curricula.

Several constraints are slowing progress, however. Technical training programmes are not yet aligned with Industry 4.0 demands. Skills in robotics, industrial IT and systems integration remain rare. Outside major cities, SMEs face severe barriers to finance, making capital-intensive upgrades difficult. Connectivity gaps, particularly in fixed broadband and data centres, limit the deployment of cloud-enabled solutions and IIoT networks. Legacy infrastructure and high import costs for smart equipment also discourage firms from retrofitting plants.

Without a coordinated, national Industry 4.0 strategy and stronger private-sector uptake, Zambia risks falling behind its regional peers in digital industrial transformation.

Case study: Trade Kings automates FMCG production

Trade Kings, one of Zambia's largest FMCG manufacturers, offers an example of early smart manufacturing integration. In 2021, the company began upgrading its production lines for detergents and packaged foods, introducing automated packaging, centralised control systems and digital quality assurance.

The upgrades boosted production throughput by reducing downtime and human error. To ensure effective operation of the new systems, Trade Kings partnered with international vendors to train more than 200 staff members in digital machine maintenance, remote monitoring and smart operations management.

This case illustrates how large domestic manufacturers can lead Zambia's transition towards Industry 4.0 by combining technology investment with local workforce upskilling. It also highlights the value of aligning smart manufacturing with the needs of the country's core industrial strengths in food and consumer goods.



Cameroon

Connectivity

4G coverage	5G coverage
96%	NA

Smart manufacturing

economic impact by 2030

GDP	% GDP
$1.1bn	7%

Top 3 manufacturing sectors

- Agro-processing (cocoa, beverages)
- Construction materials (cement, steel)
- Chemicals and plastics

Policy landscape: Cameroon's policy direction for industrial transformation is shaped by the Vision 2035 strategy and the National Development Strategy 2020–2030, which prioritises structural transformation and digital integration across all economic sectors. Manufacturing modernisation is a central pillar, though no dedicated Industry 4.0 roadmap currently exists.

The Ministry of Posts and Telecommunications oversees digital transformation through the National Broadband Development Program, aiming to expand fibre-optic networks and ICT capacity, particularly in industrial zones. In parallel, the Ministry of Mines, Industry and Technological Development (MINMIDT) implements the Industrialization Master Plan, which identifies digital technology as a cross-cutting enabler for competitiveness and export-readiness in priority sectors including agro-industry, timber and chemicals.

Cameroon's Digital Economy Strategy promotes smart infrastructure and enterprise-level digitalisation, with some early alignment around the AfCFTA digital trade agenda. However, challenges in institutional coordination and resource allocation have slowed tangible progress with factory digital transformation policies.

Manufacturing landscape: Manufacturing accounts for about 9% of Cameroon's GDP, concentrated in Douala, Yaoundé, Bafoussam and the southern industrial corridors. The sector is largely dominated by agro-processing, cement, wood transformation, beverages and light consumer goods. Public-private efforts have developed industrial platforms such as the Kribi Industrial Port Complex and the Douala-Bonabéri Industrial Zone.

Manufacturers include major domestic firms such as Société Anonyme des Brasseries du Cameroun (SABC) in beverages, Dangote Cement Cameroon, Société Nationale de Raffinage (SONARA) in oil processing, and Producam, a cocoa processing firm. These firms have begun integrating digital technologies for automation in bottling, inventory control and basic ERP systems.

Cameroon offers strong investment potential in manufacturing due to its diversified economy, bilingual workforce, and strategic position as a trade gateway to Central Africa. Key opportunities exist in agro-processing, infrastructure-linked industries and digital enablers such as broadband and data centres. However, growth is constrained by outdated infrastructure, complex administrative procedures, and inefficiencies in state-led sectors. Industrial incentives include tax relief through the Cameroon Investment Promotion Agency, which also supports digital equipment acquisition through investment and access to industrial zones.

Despite some modernisation, factory operations remain mostly semi-automated, with digital tools concentrated among large, export-oriented firms. Infrastructure gaps and high operating costs are limiting broader technology uptake.

Smart manufacturing landscape: Smart manufacturing in Cameroon is emerging but remains highly uneven. While automation and

basic ERP systems are present in large firms, adoption of advanced Industry 4.0 tools such as IoT, AI-based analytics and robotics is limited. A 2022 diagnostic by MINMIDT revealed that less than 10% of manufacturers had adopted any form of digital automation, with most applications focused on packaging and logistics.

Companies including SABC and Nestlé Cameroon have implemented automated bottling lines and warehouse tracking systems, while agro exporters such as Olam have adopted remote quality monitoring for cocoa and coffee exports. However, SMEs largely lack the capital, skills and infrastructure to engage in smart manufacturing. There is no national IIoT network or formalised support framework for factory-level innovation. Some innovation is beginning to emerge through university-linked incubators and donor-supported programmes such as ActivSpaces and Zixtech Hub, which promote local solutions in agro-processing and small-scale automation.

The introduction of 5G trials by Camtel in 2023 offers possibilities for private industrial connectivity, especially for remote monitoring and digital logistics. Cloud services are limited but growing, with data largely hosted abroad or on-site due to infrastructure limitations and a lack of local tier-3 data centres.

Competitive outlook: Cameroon's competitive landscape for smart manufacturing is shaped by several enabling and constraining forces. Industrial zones such as Kribi and Bonabéri offer infrastructure and logistics links to major seaports, which attract high-volume processors with digital scaling potential. The growing focus on AfCFTA-aligned trade compliance is also encouraging firms to adopt traceability systems and digital quality controls.

However, there are considerable challenges. Access to skilled talent in automation, data science and factory IT remains low. Technical training programmes, though expanding, are heavily concentrated in Yaoundé and Douala, with little reach in rural industrial zones. The Ministry of Employment and Vocational Training has initiated reforms to integrate digital manufacturing modules into vocational curricula, but implementation is still nascent.

Power reliability is another major barrier. While national electrification stands above 60%, outages and voltage fluctuations are common, especially outside urban centres. These disruptions discourage investment in sensitive equipment such as robotics and digital sensors. Furthermore, the high cost of imported industrial technologies and weak SME financing mechanisms hinder widespread adoption.

Overall, while Cameroon has laid some policy and infrastructure groundwork, a lack of institutional alignment, skills depth and targeted industrial innovation programmes continues to constrain its competitive readiness for smart manufacturing.

Case study: Cameroon – digital coffee traceability platform

Cameroon's coffee sector is piloting a digital traceability platform to meet the EU's Deforestation Regulation and modernise its agro-processing value chain. Launched in 2024, the system combines blockchain, satellite imagery, IoT sensors and AI to enable farm-to-export tracking across more than 5,000 smallholder farmers in the Littoral and West regions.[53] This multi-technology approach allows exporters and processors to monitor crop origins, health and productivity in real time, enhancing compliance and product quality.

The platform provides processors with predictive analytics and digital dashboards, improving decision-making and enabling integration across upstream and downstream supply chain activities. The initiative is led by the Ministry of Posts and Telecommunications in partnership with the Ministry of Agriculture, and international development actors.

The platform illustrates how, in resource-constrained environments, strategic use of digital infrastructure and public-private partnerships can drive transformation and offer replicable models for broader smart manufacturing uptake across food and beverage processing industries.

53 "Transforming Cameroon's Coffee Supply Chain with Digital Innovation", International Centre for Trade Transparency & Monitoring, June 2024



Senegal

Connectivity

4G coverage	5G coverage
98%	14%

Smart manufacturing

economic impact by 2030

GDP	% GDP
$0.6bn	5.4%

Top 3 manufacturing sectors

- Agro-processing (seafood, peanuts)
- Cement and construction materials
- Chemicals and pharmaceuticals

Policy landscape: Senegal's digital and industrial transformation is guided by two flagship frameworks: the Vision Senegal 2050 national transformation agenda, and the Digital Strategy: New Deal Technologique.

Vision Senegal 2050 focuses on the structural transformation of the economy through industrial development, innovation and export competitiveness. As part of this plan, the Ministry of Industry and Commerce is leading industrial modernisation, notably through the establishment of smart factory models in priority value chains such as food, textiles and chemicals.

The New Deal Technologique, coordinated by the Ministry of Communication, Telecommunications and the Digital Economy, outlines plans to expand connectivity, strengthen digital skills and integrate digital services into production systems and public administration. It includes commitments to support local start-ups, deploy digital infrastructure in industrial zones, and develop online government service platforms.

In parallel, the industrial park development strategy focuses on creating digitally equipped economic zones, such as Diamniadio and Sandiara.

Legal and regulatory reforms such as the Data Protection Law and the establishment of the Commission for the Protection of Personal Data are strengthening digital trust and governance, setting the foundation for a more enabling environment for smart manufacturing innovation.

Manufacturing landscape: Senegal's manufacturing sector contributes approximately 14% to GDP and 23% to employment[54] with strongholds in agro-processing, cement, textiles and pharmaceuticals. Industrial activity is concentrated in Dakar, Thiès and Rufisque, with key infrastructure investments taking place in the Diamniadio Industrial Park and emerging hubs in Kaolack and Sandiara.

Agro-processing remains the dominant manufacturing segment, led by companies including La Laiterie du Berger (dairy), Kirène (bottling) and Sonacos (oil processing), which have started integrating automation and digital quality control systems. The pharmaceutical sector has also seen increased investment, including the state-backed initiative to build Senegal's first vaccine production plant (MADIBA project) by the Institut Pasteur and partners, which is expected to employ smart manufacturing techniques for bioprocessing.

FDI in manufacturing has grown, particularly from French, Turkish and Chinese firms, driven by Senegal's investment incentives and proximity to West African markets. The Economic Partnership Agreement with the EU and membership in ECOWAS and AfCFTA offer manufacturers broader market access and regulatory alignment opportunities.

Smart manufacturing landscape: Smart manufacturing in Senegal is nascent but advancing through flagship initiatives and digital enablers. According to a 2022 ITU-UNIDO assessment, most firms in the industrial sector remain at low-to-intermediate levels of digital maturity, with limited integration of automation, sensors or real-time data systems. Uptake of Industry 4.0 tools is currently concentrated among larger firms in sectors with strong export orientation or quality assurance requirements.

54 Senegal Trade Fact Sheet, Trade Unions in AFCFTA, 2024

Diamniadio Industrial Park is the country's most advanced digital manufacturing hub, offering tenants access to broadband, integrated logistics and energy-efficient infrastructure. Firms operating in the park have adopted IoT-based systems for inventory tracking, digital production planning and automated quality control. The park's masterplan includes a fibre-optic backbone and partnerships with telecoms providers to enable smart grid and factory connectivity.

Senegal's telecoms operators Sonatel (Orange), Free and Expresso are expanding fibre and mobile broadband services in industrial zones. Sonatel and Free have launched 5G, with early pilots in health and logistics, though industrial adoption is still limited. Cloud computing is growing through local data centre projects by Sonatel and West Africa Data Centres, but most manufacturers still rely on local servers or hybrid storage due to cost and latency concerns.

Innovation support is provided by the General Delegation for Rapid Entrepreneurship of Women and Youth, which funds tech-enabled industrial startups, and local hubs such as CTIC Dakar and FabLab UGB, which prototype low-cost IoT and automation tools. However, scaling remains a challenge due to fragmented support and limited links between industry and the technology ecosystem.

Competitive outlook: Senegal's smart manufacturing outlook is supported by growing policy momentum, regional integration and a growing pool of young, tech-aware talent, but is constrained by digital gaps, skills shortages and cost barriers. The government has prioritised ICT education at secondary and tertiary levels, with support from partners such as GIZ and the African Development Bank, leading to the integration of digital skills modules in vocational institutions.

Nonetheless, the skills pipeline for Industry 4.0 technologies remains weak. Most training institutions do not yet offer specialised programmes in mechatronics, robotics or data science for manufacturing. This creates constraints for firms attempting to digitalise operations. Meanwhile, SMEs face high capital costs for automation equipment and limited access to affordable credit or leasing schemes. The country's TVET system focuses on traditional trades and lacks comprehensive training in automation, robotics and data integration. Despite digital platforms such as Ejàng and donor-supported training reforms, vocational curricula remain outdated, under-resourced and misaligned with industrial demand. Power supply remains generally reliable in Dakar and key zones, but rural industrial areas face intermittent outages that limit digital integration.

Senegal's participation in AfCFTA and ECOWAS creates a strong incentive for export-oriented firms to adopt digital compliance, traceability and automation systems. With strategic investment in skills and infrastructure, Senegal could position itself as a regional hub for smart, sustainable manufacturing.

Case study: Diamniadio Industrial Park - a digital-ready manufacturing hub

Diamniadio Industrial Park, part of Senegal's Emerging Senegal Plan, is a flagship initiative designed to accelerate industrialisation through modern infrastructure and digital integration. Established in late 2018 and supported by UNIDO and the government, the park is already operational with manufacturing firms from multiple countries creating early success in jobs and industrial investment.

The park's forthcoming Digital Technology Park is being developed with significant backing from the African Development Bank (€5.01 million in additional financing in 2022), with a total of over €73 million to support ICT infrastructure, a tier-3 data centre, incubator facilities and connectivity enhancements.[55] The infrastructure supports real-time operations, smart utility management and the digital tools needed for modern manufacturing ecosystems.

By April 2025, the industrial zone, linked with nearby Sandiara SEZ, had created more than 1,500 confirmed jobs, with companies such as C&H Garments employing up to 600 local people using standardised production lines. Another notable resident, Industrie des Boissons du Sénégal, has integrated a solar power plant and efficiency measures in partnership with UNIDO.[56]

55 "Senegal: African Development Bank provides an additional €5.01 million for the Diamniadio Digital Technology Park", African Development Bank, December 2022

56 "Senegal's new industrial park open for business", UNIDO, November 2018



Rwanda

Connectivity

4G coverage	5G coverage
99%	5%

Smart manufacturing

economic impact by 2030

GDP	% GDP
$0.2bn	6.3%

Top 3 manufacturing sectors

- Agro-processing (tea, coffee, fruit)
- Construction materials
- Light manufacturing (packaging, consumer goods)

Policy landscape: Rwanda's strategic vision for digital transformation is led by Vision 2050, which places digital innovation and industrial upgrading at the core of its national development trajectory. The government emphasises the role of advanced technologies in driving economic productivity and inclusive growth, integrating industrial policy within the broader Smart Rwanda Master Plan and National Digital Talent Policy.

The Ministry of Trade and Industry (MINICOM), in collaboration with the Rwanda Development Board, implements the National Industrial Policy, which includes goals for digital factory operations, innovation-led manufacturing, and integration with regional value chains. In addition, the Ministry of ICT and Innovation coordinates the National Broadband Strategy, which focuses on reducing the usage gap, expanding access to digital tools and promoting enterprise-level digital adoption. In 2023, Rwanda also initiated its AI Policy Framework, aiming to promote safe and inclusive use of AI across sectors including manufacturing. Regulatory support for data privacy is provided under the 2021 Data Protection and Privacy Law, aligned with international standards for cybersecurity and personal data handling.

Manufacturing landscape: Manufacturing contributed approximately 22% to Rwanda's GDP in 2023. The economy is heavily dependent on this growing sector. Primarily and fully manufactured exports from Rwanda have found a big market in the EAC region due to their high quality and the strategic positioning of the country.[57] Kigali, Huye and Rubavu serve as the main industrial zones, supported by growing infrastructure in the Kigali Special Economic Zone (KSEZ) and the Bugesera Industrial Park. KSEZ is Rwanda's flagship manufacturing hub, hosting domestic firms and foreign investors in food and beverages, pharmaceuticals, textiles and light engineering. The pharmaceuticals and biotechnological sector is expanding rapidly, supported by targeted government initiatives and donor partnerships such as the GIZ Strengthening Pharmaceuticals programme, which aims to enhance local production capacity and regulatory standards

Companies including Inyange Industries and Sulfo Rwanda Industries have modernised production through semi-automated bottling, quality control scanners and digital warehouse tracking. The opening of Rwanda's first car assembly plant by Volkswagen in 2018 marked a milestone in the country's industrial diversification and signals growing automotive manufacturing capabilities.

Rwanda's manufacturing sector has attracted increasing levels of FDI, particularly from East Asia and Europe, supported by political stability, zero-tolerance corruption policies, and incentives such as tax holidays and streamlined licensing via the Rwanda Development Board.

In 2024, Rwanda achieved record-breaking investment inflows totalling $3.2 billion, marking a 32.4% increase on 2023 levels, according to the Rwanda Development Board annual report. Manufacturing including agro-processing emerged as the leading sector, capturing approximately $1.35 billion, or 43.6% of total registered investments. These investments are projected to create more than 22,500 jobs in manufacturing alone, from a total of 51,600 jobs anticipated across all sectors from these projects.[58] [59]

57 For more information, see Rwanda Development Board's Products directory – Manufacturing sector.

58 "2024 Annual Report Highlights", Rwanda Development Board, April 2025

59 "Rwanda saw a 32% increase in investment in 2024", Zone Yetu, April 202

Smart manufacturing landscape: Smart manufacturing adoption in Rwanda is at an early but strategic stage. The government has prioritised digital integration in SEZs, especially in KSEZ, which has been upgraded with high-speed fibre, cloud-based industrial monitoring systems, and solar microgrids to support green, digital-ready production. Companies in the zone, such as Inyange, have adopted IoT-driven quality control and digital sensors to reduce waste and meet export standards.

While automation remains low among SMEs, efforts are growing to digitalise operations through embedded technology in packaging, refrigeration and logistics.

The Kigali Innovation City (KIC) ecosystem, hosting Carnegie Mellon University Africa and multiple incubators, supports industrial R&D and start-up-led innovation in areas such as machine vision and smart logistics. While limited in scale, companies emerging from KIC are prototyping solutions such as low-cost IoT devices for factory monitoring and AI-powered supply chain optimisation.

Telcos MTN and Airtel have launched limited 5G in Kigali, enabling early trials of industrial connectivity. Local data hosting remains limited, but regional providers and government infrastructure (e.g. IremboGov) are beginning to offer more enterprise-grade cloud services to manufacturers.

Competitive outlook: Rwanda's competitive outlook in smart manufacturing is being shaped by strong policy coherence, expanding digital infrastructure, and a relatively tech-literate youth population. However, it is constrained by industrial scale, capital access and talent availability. Public investment in smart industrial zones, broadband coverage and skills development reflects a proactive approach to enabling Industry 4.0 foundations.

Rwanda's small domestic market size and land-locked geography significantly impact its manufacturing competitiveness. High logistics costs – driven by dependency on neighbouring countries' ports – are raising input and export prices, making it more difficult for firms to scale production or invest in capital-intensive smart technologies. These structural challenges compound the difficulties faced by SMEs, which already lack the financial resources and technical expertise to adopt even basic automation or digital tracking tools.

However, adoption is largely concentrated among a few medium-sized firms with export incentives. Most SMEs lack the financial resources and technical expertise to adopt basic automation or digital tracking tools. The absence of a national Industry 4.0 strategy means implementation remains fragmented, with firms relying on individual capacity rather than coordinated support systems.

Skills remain a bottleneck. While tertiary institutions such as the University of Rwanda and CMU Africa provide advanced digital training, the vocational education system has not yet fully aligned with manufacturing digitalisation needs. There are shortages of systems integrators, factory IT specialists and technicians trained in robotics or sensor calibration.

Energy availability is relatively stable compared to regional peers, thanks to Rwanda's investments in off-grid solar and hydro. However, the cost of electricity remains high for industrial consumers, limiting the feasibility of energy-intensive smart manufacturing equipment. Overall, Rwanda's institutional commitment, innovation ecosystems and regional trade alignment offer a promising foundation. To scale, broader upskilling and SME inclusion will be key.

Case study: Kigali Special Economic Zone – smart infrastructure for export growth

The Kigali Special Economic Zone (KSEZ) exemplifies Rwanda's vision for technology-enabled industrial growth. The zone offers a fully serviced industrial platform with fibre connectivity, automated customs processes, and smart grid energy infrastructure. Firms such as Inyange Industries have adopted IoT-enabled monitoring systems, real-time production analytics and digital quality control platforms to enhance efficiency and reduce waste. These tools have contributed to operational gains, including a reported 15% improvement in productivity and faster compliance with regional export standards.

Beyond infrastructure, KSEZ integrates capacity building by partnering with universities and local institutions to provide tenant firms with tailored digital skills training, accelerating technology adoption among employees. The model shows how a policy-aligned industrial park can act as both a catalyst and a prototype for broader smart manufacturing expansion across Rwanda.

Ethiopia

Connectivity

4G coverage	5G coverage
74%	10%

Smart manufacturing

economic impact by 2030

GDP	% GDP
$8.7bn	10.2%

Top 3 manufacturing sectors

- Textile and garments
- Leather and footwear (packaging, consumer goods)
- Agro-processing (coffee, cereals, oilseeds)

Policy landscape: The 10-Year Development Plan (2021–2030) and the Homegrown Economic Reform Agenda position manufacturing and digitalisation as core growth pillars. Complementary initiatives such as the Made in Ethiopia movement further support local production visibility and align with broader industrialisation goals.

The Ministry of Industry and the Industrial Parks Development Corporation are leading efforts to integrate ICT into production systems, but there is as yet no dedicated national Industry 4.0 or AI strategy. Ethiopia's Digital Transformation Strategy (2020–2025) focuses on broadband expansion, e-government and the creation of a digital economy, with industrial applications gradually emerging through pilot projects. In 2024, Ethiopia initiated discussions with UNIDO and the World Bank to align industrial policy with 4IR frameworks, including data governance and cybersecurity standards. Regulatory progress has also been made on customs digitisation and e-logistics for exporters.

Manufacturing landscape: Ethiopia's manufacturing sector represented 4.6% of GDP and contributed 5% of total employment in 2023.[60] The country has prioritised light manufacturing to drive exports and job creation. Key industrial parks such as Hawassa, Bole Lemi, Kombolcha and Dire Dawa serve as the anchors of this strategy, attracting more than $740 million in foreign investment.[61] These parks offer plug-and-play infrastructure, customs facilitation and access to logistics corridors. Hawassa Industrial Park, for example, is home to global apparel manufacturers including PVH Corp and provides consistent power, fibre connectivity and ESG-compliant waste systems.

Ethiopia's FDI-driven manufacturing includes textile and garment production, food processing, cement and pharmaceuticals. Manufacturers include Yirgalem Addis Textile, AYKA Addis and Derba MIDROC Cement. Chinese, Turkish and Indian investors dominate the industrial park landscape, particularly in apparel and leather value chains. Meanwhile, state-owned Metals and Engineering Corporation (METEC) and Marathon Motors have introduced basic automation in machinery and automotive assembly. However, outside the park system, SMEs dominate and tend to be informal and low-tech, resulting in a dual-speed manufacturing economy. Infrastructure challenges persist, particularly intermittent power supply and logistics inefficiencies around the Port of Djibouti, which raise input costs and affect lead times.

Smart manufacturing landscape: Smart manufacturing in Ethiopia remains concentrated within industrial parks and select firms. At Hawassa Industrial Park, tenants including PVH Corp and Arvind Ltd use digital dashboards, automated cutting and energy management systems to meet global standards. Cement and packaging firms such as Derba MIDROC and East African Packaging Industries have also adopted smart process controls, though these remain exceptions.

Connectivity in industrial zones is gradually improving, with fibre and dedicated backup power in place. The entrance of Starlink in 2024 has enabled high-bandwidth pilots in remote zones, though costs remain prohibitive for SMEs. Ethiopia's digital manufacturing ecosystem remains nascent, with few local technology providers focused on industrial automation. However, early-stage innovators such as iCog

60 Ethiopia Working Paper Series: Can Ethiopia Become a Manufacturing Powerhouse? UNDP, 2023

61 Ethiopia Working Paper Series: Can Ethiopia Become a Manufacturing Powerhouse? UNDP, 2023

Labs and Robera Solutions are experimenting with AI and robotics applications relevant to manufacturing, including prototype quality-inspection tools.

Recent developments in digital infrastructure could support future industrial transformation. In 2023, the World Bank launched a knowledge exchange initiative with South Korea to help shape Ethiopia's digital economy, focusing on cloud, cybersecurity and digital platforms for enterprises.[62] Meanwhile, Raxio Group is building Ethiopia's first carrier-neutral tier-3 data centre in Addis Ababa, which is expected to support local cloud and enterprise hosting needs.[63] These developments lay the groundwork for more advanced industrial data services, though their direct application to manufacturing remains limited for now.

Ethio Telecom is advancing enterprise digitalisation with cloud-based solutions hosted on its TeleCloud platform, offering ERP, IoT tracking and collaboration tools aimed at sectors including manufacturing.[64] Its Zoorya platform integrates ERP, point-of-sale and fiscal systems, targeting 10,000 enterprises over two years.[65] This marks a shift towards enabling manufacturers to access scalable digital tools without heavy infrastructure investment.

Competitive outlook: Ethiopia's potential in smart manufacturing is shaped by a mix of strengths and persistent structural challenges. On the positive side, the country benefits from abundant hydropower resources, which offer a low-carbon energy base for future digital factories. It also has one of the largest young populations in Africa (more than 70% are under 30 years old), providing a potential long-term workforce for digitally enabled manufacturing. In addition, strong political support for industrial parks and export-led production has improved physical infrastructure and foreign investment attraction.

However, these gains are offset by substantial constraints. Electricity reliability is a major barrier, with frequent load fluctuations affecting automation-sensitive production. Industrial fibre coverage remains limited outside park zones, and mobile data affordability is restricting broader adoption of connected tools. Most firms lack access to financing for capital equipment upgrades, and the local banking sector remains conservative in supporting technology investments. The education system has not yet aligned technical and vocational curricula with Industry 4.0 skills, leaving a shortage of technicians and engineers capable of deploying or maintaining smart systems.

Ethiopia's industrial sector has also been affected by the suspension from the African Growth and Opportunity Act in 2022, which resulted in the exit of 18 foreign firms and more than 11,000 job losses in the apparel sector, weakening investor confidence in the country's export-led industrial strategy.[66] The absence of a national industrial digitalisation strategy limits coordination and resource targeting across sectors.

Case study: Hawassa Industrial Park – digitally managed apparel hub

Hawassa Industrial Park (HIP) is Ethiopia's flagship industrial zone, built with 52 factory sheds and originally hosting around 20 international companies, including major apparel exporters such as PVH Corp and Arvind Ltd. At its peak, HIP employed more than 35,000 workers, predominantly women, positioning it as a model for large-scale light manufacturing.[67]

HIP features integrated IT systems that support operational efficiency, including centralised power monitoring, automated data collection for utilities, and digital platforms that enable remote management and reporting across park facilities.[68]

However, the 2022 suspension from the African Growth and Opportunity Act triggered a significant shift. Anchor buyers exited the park, operations halted and employment numbers reportedly declined. While HIP still generated export revenue of $32 million between October 2022 and January 2023 and continues to attract investor interest, the shocks underscore the vulnerability of smart manufacturing initiatives built around preferential trade access.[69]

62 "From Seoul to Addis Ababa: Shaping Ethiopia's Digital Future", World Bank, October 2023

63 For more information, see Data Center Map's profile of Addis Ababa.

64 "Ethio Telecom Launches Cloud-Based Enterprise Solutions to Drive Digital Transformation", Telecom Review Africa, February 2025

65 "Ethiopia Launches 'Zoorya' Digital Platform with Ethio telecom, Dashen Bank & ETTA", Telecom Review Africa, July 2025

66 "Ethiopia loses 11,500 jobs, 18 foreign companies following AGOA suspension", AGOA.info, February 2025

67 "Hawassa Industrial Park Launches New Call Center to Support Workers", AllAfrica, August 2022

68 For more information, see On the Path to Industrialization, World Bank, 2022

69 "Hawassa Industrial Park generates $32mln in 3 months", Fana Media Corporation, January 2023

4. Realising the potential of smart manufacturing in Africa



4.1 Key considerations for accelerating smart manufacturing in Africa

Smart manufacturing is crucial to Africa's economic development and social prosperity, offering both immediate and long-term benefits by significantly increasing the continent's manufacturing output and enhancing its competitiveness in the global economy. The advancement of the manufacturing sector can lead to growth in related sectors including logistics, energy and services. It can create new jobs at various skill levels for the continent's young and rapidly growing workforce. Additionally, the future growth of the manufacturing sector, driven by the adoption of digital technologies, will play a key role in economic diversification. This is especially important in resource-reliant economies, enabling inclusive growth by supporting SMEs and rural development through raw materials value addition, and improving trade balances and foreign exchange earnings through increased export of manufactured goods.

The significance and inevitability of smart manufacturing in Africa are increasingly recognised by stakeholders in the manufacturing sector, in view of global trends. However, the scale of the challenges facing the realisation of smart manufacturing in African nations is substantial, given the critical issues that must be addressed by ecosystem stakeholders. Some of these are highlighted below.

Figure 12: Areas of attention to accelerate smart manufacturing in Africa

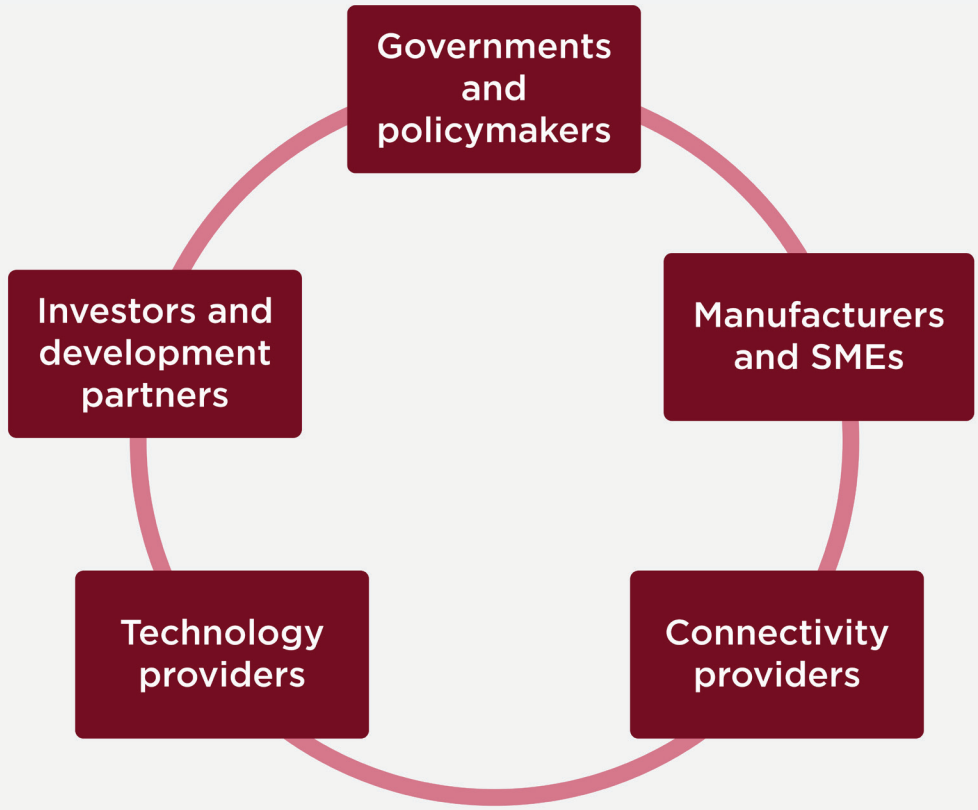
Source: GSMA Intelligence

Policy and regulatory environment	The need for national digital and industrial strategies that stimulate investment and innovation in advanced digital technologies and connectivity networks, as well as policy harmonisation (in-country and across borders).
Digital infrastructure	The availability of foundational connectivity networks, such as 5G and fibre, and physical hardware and software-based technologies, including data centres, edge computing and IIoT, which enable smart manufacturing practices.
Funding	The investment required for smart manufacturing adoption, especially by small and medium-sized companies with limited access to affordable finance.
Skilled workforce	A workforce with the required levels of skills to develop, operate and maintain smart manufacturing technologies, such as automation, data analytics and robotics. Alignment of technical and vocational education training with smart manufacturing needs.
Value chain maturity	Linkages and cooperation between different players in the smart manufacturing value chain, including manufacturers, connectivity and cloud providers, device vendors, startups, academia and R&D institutions, systems integrators and application developers.

Cybersecurity and data governance	Protection from cyber threats in view of the larger attack surface and emergence of new vulnerabilities from the deployment of IIoT sensors, implementation of AI workloads in the cloud, and the generation of new datasets by digital systems.
Environmental and social impact	Alignment with global sustainability goals around manufacturing processes, including reducing raw materials and energy waste, and addressing concerns around job displacement and the potential to exacerbate other inequalities.
Supply chain infrastructure	Roads, rail, ports and other logistics infrastructure and services providers required to transport raw materials from their sources to factories, and finished products from factories to markets in an efficient manner.
Regional and global market access	Access to international markets is essential for growth and commercial viability of production output. This involves considerations around tariff and non-tariff barriers to trade in regional and global markets.
Affordable and reliable energy	Access to affordable and reliable energy sources is crucial, considering the energy requirements of smart manufacturing processes, from sensors and robots in factories to 5G networks and cloud infrastructure to store, process and analyse data.

Addressing these considerations requires the coordinated efforts of multiple stakeholders (Figure 13), with each group playing distinct and complementary roles in building the infrastructure, capabilities, and ecosystem needed for the development and implementation of smart manufacturing processes.

Figure 13: Key considerations for accelerating smart manufacturing in Africa
Source: GSMA Intelligence



4.2 Call to action: strategic recommendations for stakeholders

Governments and policymakers

National governments and regional/continental bodies that formulate and implement policies and regulations impacting smart manufacturing

Integrate Industry 4.0 objectives into national industrial strategies. Embedding clear digital transformation goals and metrics into national development plans, sectoral masterplans and export strategies will ensure smart manufacturing becomes a core lever for improving productivity and global competitiveness across strategic sectors of the economy. Making Industry 4.0 a centrepiece of industrial policy helps to prioritise investment, public-private sector coordination and long-term planning, aligned with global manufacturing trends.

- **Drive regulatory reform to foster innovation and digital integration.** Many industrial policies across the continent predate the digital era and now inhibit the adoption of smart technologies. Governments must reform licensing frameworks, streamline approval processes and establish enabling regulations for industrial connectivity. At the regional level, they should leverage the AfCFTA to harmonise standards and support regional value chains for smart manufacturing inputs, and work collaboratively with other governments and regional bodies to tackle persistent tariff and non-tariff barriers to inter-regional trade, such as customs duties and red tape. This is an important step to integrate African markets into global value chains.
- **Implement targeted financial incentives for small and medium-sized manufacturers to encourage adoption of smart manufacturing processes.** Financial incentives, such as tax exemptions and digital adoption grants, can help offset upfront costs for transitioning to smart manufacturing. There is also an opportunity to develop de-risking financial instruments, such as blended finance and subsidised loans, and implement targeted digital adoption schemes, especially within SEZs and industrial corridors, to stimulate clustered adoption and enable smaller firms to benefit from economies of scale.
- **Facilitate inter-ministerial collaboration to align on policy formulation and implementation, considering the cross-cutting nature of smart manufacturing.** This is essential to avoid duplication and a fragmented approach while streamlining efforts and taking advantage of synergies in the implementation of Industry 4.0 initiatives. Key ministries, departments and agencies that need to work together for the advancement of smart manufacturing include Trade and Commerce, ICT, Education, Labour and Energy.

- **Establish clear data protection frameworks, cybersecurity protocols and intellectual property protection to build trust in smart manufacturing technologies.** Governments across Africa need to adopt and implement robust frameworks for data ownership, sharing and cybersecurity, in line with the African Union's Malabo Convention. These include industrial data protection laws, operational technology cybersecurity standards, and national cyber-resilience strategies for manufacturing systems. This is essential to protect industrial systems, build investor trust and safeguard sensitive production data in increasingly digitalised manufacturing ecosystems.
- **Implement enabling regulations for investment in advanced connectivity infrastructure, especially around SEZs and other manufacturing locations.** Enabling policies and regulations around digital connectivity networks are crucial to attract much-needed investment in the deployment of capital-intensive infrastructure, such as 5G and fibre networks. This involves ensuring that the right spectrum is made available and on the right terms for the rollout of advanced mobile networks; implementing technology-neutral licensing to provide flexibility in the deployment of connectivity networks; and avoiding spectrum set-asides for private mobile network deployment.
- **Support local research institutions and startups, given the important role they play in developing affordable, context-specific solutions that address the challenges of local manufacturers.** Locally relevant applications are essential for the adoption of smart manufacturing technologies. Local innovators are best placed to develop these, considering their familiarity with the environment around them and the actual problems that require smart solutions. Governments also have an opportunity to partner with global technology providers to facilitate technology transfer and support the local production of affordable devices and solutions, and encourage reverse engineering and the use of open-source tools to accelerate the localisation of global solutions.
- **Facilitate investments in renewable energy and off-grid solutions to improve access to affordable and reliable energy.** Smart manufacturing relies on stable, continuous energy access – something many African manufacturers cannot guarantee through the national grid alone. Governments can invest and encourage private sector investment in renewable energy infrastructure, such as solar or wind microgrids, to power industrial zones and smart factories. Governments can also offer incentives for manufacturers and technology providers to adopt energy-efficient IoT devices and renewable energy solutions, and support emerging models for off-grid solutions, such as the anchor-business-community (ABC) model, where mobile towers share renewable energy with nearby factories and other public and private facilities.[70]

70 Rural renewal: telcos and sustainable energy in Africa, GSMA Intelligence, 2024

Manufacturers

Companies of various sizes across different industries adding value to products at different stages of the manufacturing cycle

- **Develop digital transformation roadmaps with a strategy to adopt smart manufacturing practices that address operational challenges**. This involves evaluating current operational processes to identify key pain points and developing plans to integrate the right solutions and at the right pace to address key challenges. A roadmap provides clarity for internal and external stakeholders, ensuring a seamless transition to digitally enabled manufacturing processes.
- **Build a strong digital foundation with entry-level solutions before transitioning to more advanced solutions.** An important first step for many manufacturers in Africa, particularly small and medium-sized companies, is to enable internet connectivity and digitalise basic operational activities, such as inventory management. This could be followed by affordable, modular technologies, such as IoT, and (over time) more sophisticated solutions, prioritising technologies that address immediate challenges, such as energy-efficient systems or predictive maintenance.
- **Design and implement smart manufacturing technologies in new factories from the outset.** Manufacturers with legacy factory equipment must confront the cost and complexity that may be involved in retrofitting that equipment with sensors, industrial cameras and other hardware to enable automation. These and other smart manufacturing technologies should be integrated into the design of new factories from the outset to avoid costly and time-consuming retrofitting of factory equipment in the future.
- **Leverage multistakeholder partnerships to share learnings and best practices in the implementation of smart manufacturing technologies.** Manufacturers can work with governments and other stakeholders to share resources and knowledge, including digital infrastructure sharing with other manufacturers to ease the initial cost of smart manufacturing adoption. Proactive engagement with other stakeholders is vital to co-design scalable and affordable solutions that address unique challenges. Partnerships with academic institutions can also help in accessing talent and piloting new technologies.
- **Facilitate clear and effective internal communication regarding the transition to smart manufacturing to ensure staff engagement and support.** Recognising that some employees may have concerns about how smart manufacturing could affect their roles, it is important to involve staff in the smart manufacturing roadmap to promote readiness for adoption of these advanced technologies.

Connectivity providers

Mobile operators and other companies whose connectivity networks enable smart manufacturing technologies

- **Focus network deployment on industrial hubs to capitalise on opportunities in smart manufacturing.** Mobile operators are leading the rollout of next-generation infrastructure, including 5G and fibre, across Africa. While consumer markets remain a priority, there is significant potential to expand into the enterprise sector, particularly within manufacturing, as digital transformation accelerates in the region. Operators serve as foundational providers of the connectivity that is essential for smart manufacturing technologies.
- **Add services beyond connectivity to enhance value propositions for manufacturers.** Connectivity remains at the core of operators' services. Beyond connectivity, however, they can consider layering additional services and applications that demonstrate value to manufacturers, leveraging key assets – such as data centres and technical expertise – to enhance value capture in the smart manufacturing ecosystem. This can take the form of in-house development or partnerships with specialists in other layers of the value chain to acquire new capabilities that enhance their smart manufacturing offering.
- **Leverage private 5G networks for applications requiring superior performance pending 5G SA deployment.** Most 5G networks in Africa are currently based on non-standalone (NSA) architecture, primarily providing essential connectivity functions such as wide-area coverage, capacity and reliability. While 5G SA networks, which utilise end-to-end 5G equipment, offer advanced features such as network slicing and support enterprise digital transformation, widespread deployment across Africa remains a long-term prospect. In the meantime, operators can deploy private 5G networks to deliver tailored connectivity solutions with improved performance.
- **Implement a hybrid strategy to leverage 4G connectivity in areas where 5G is not yet accessible.** The deployment of 5G remains in its early stages across most African countries, with coverage currently below 20%. 4G networks offer broader availability, reaching more than 70% of the population in many markets. There are likely to be manufacturing sites located outside the range of 5G service. Adopting a hybrid approach enables operators to develop smart manufacturing solutions that utilise 4G, capitalising on its extensive reach. Proven success with 4G-based implementations can help drive demand among enterprises for future upgrades to private 5G networks.

Technology providers

Firms that provide devices and sensors, software and analytics tools, and integration services for smart manufacturing implementation

- **Customise solutions to local needs and constraints to ensure relevance for local manufacturers.** Localising smart manufacturing solutions is an essential step to boost adoption. In practice, this means creating flexible solutions that are adaptable to the specific operational requirements and challenges faced by manufacturers in Africa. It could include developing low-cost IoT devices or AI tools suitable for low-bandwidth conditions, or creating mobile-first dashboards compatible with widely used smartphones. Such solutions could find relevance in areas with only 4G connectivity or environments where high energy costs necessitate low-power solutions.
- **Develop modularised solutions to ease adoption barriers, including cost, for small and medium-sized manufacturers.** Technology providers should ensure that smart manufacturing solutions are accessible to small, independent factories – not just large multinationals. Modular options such as plug & play systems that integrate with current production lines can help lower initial costs and reduce implementation complexity for manufacturers by eliminating the need for extensive retrofitting of existing equipment. These solutions should factor in the operating conditions faced by local manufacturers, including mobile-centric connectivity, particularly 4G, and high energy costs. Technology providers could also focus on cloud-based software-as-a-service (SaaS) solutions to reduce the need for expensive on-premises infrastructure.
- **Create value-added services and flexible financing models.** Technology providers can offer integrated service offerings that include hardware, software, analytics and training within adaptable contracts – such as software-as-a-service or pay-per-use arrangements – to lower initial cost barriers and offer continued support. Providers could also participate in co-development partnerships with local research institutions to facilitate iterative solution testing in practical environments and establish technologies validated by local standards.
- **Incorporate sustainability and circular economy principles to help local manufacturers comply with international standards.** Unsustainable production processes may serve as non-tariff barriers, limiting access for African manufacturers to global markets. Aligning production processes with global sustainability standards can attract investment and enhance the competitiveness of African manufacturers within environmentally conscious global markets. While smart manufacturing technologies present opportunities to address these issues, it is imperative for technology providers to integrate sustainable production practices, such as waste minimisation and the use of renewable energy, from the outset.



Investors and development partners

Local and international organisations with the financial capability to fund investments in smart manufacturing ecosystems

- **Provide low-cost funding for early-stage innovation.** In Africa's emerging smart manufacturing sector, grants and affordable capital are essential to develop relevant solutions and encourage adoption, particularly among small and medium-sized manufacturers. As digitalisation gains traction, the continent's startup and tech ecosystem will be vital in creating new solutions, but sufficient funding remains critical.
- **Recognise the social impact dimension of smart manufacturing.** Social impact is an important consideration for many investors and international development partners. Although manufacturing has not traditionally been a primary destination for social capital, the adoption of smart manufacturing practices can enhance production efficiency and global competitiveness. This, in turn, contributes to poverty reduction and job creation.

4.3 Key areas for stakeholder collaboration

Beyond individual initiatives and actions by stakeholders to promote smart manufacturing adoption in Africa, collaboration is necessary to leverage synergies and minimise redundant efforts. Areas of collaboration include the following:

- **Address the awareness gap, particularly among small and medium-sized manufacturers.** A considerable lack of awareness regarding the benefits of smart manufacturing exists among key stakeholders in the ecosystem, especially within smaller manufacturing enterprises. Bridging this gap is essential to foster acceptance, dispel misconceptions and accelerate the adoption of digital solutions. Achieving this objective requires coordinated efforts from governments, connectivity providers, investors and technology companies through targeted outreach initiatives and by facilitating interactions between manufacturers and other ecosystem participants. In addition to highlighting the advantages of smart manufacturing, these engagements should incorporate comprehensive training on cybersecurity best practices to help mitigate vulnerabilities as digital adoption advances.
- **Reskill and upskill the workforce.** Digitalisation and automation can result in job displacements in certain cases. This is a consideration for stakeholders, including governments in Africa and factory workers who may be affected. To address this, reskilling and upskilling of current factory workers and the wider workforce may be necessary to provide new skills and capabilities relevant to the digital era. Approaches could involve integrating training on technologies such as AI and data analytics into Industry 4.0 plans, funding initiatives to reduce skills gaps, including Industry 4.0 technologies in educational and vocational curricula, and encouraging digital literacy throughout society.
- **Develop smart manufacturing strategies and applications collaboratively.** Developing and implementing smart manufacturing practices typically requires the involvement of multiple stakeholders. For instance, governments, private sector entities, manufacturers and investors often need to work together throughout various stages of the smart manufacturing agenda, including national strategy formulation and co-investment in infrastructure and testbeds that allow manufacturers to explore practical scenarios. This collaboration can help distribute costs and address technical challenges associated with advancing smart manufacturing processes.
- **Promote the development of a smart manufacturing ecosystem**. A key objective of collaboration is to establish an environment that facilitates effective connections among different stakeholders, enabling them to address shared challenges and uncover new opportunities. This is especially critical within the African context, where such partnerships between prospective ecosystem participants are often underdeveloped, which could impede progress in smart manufacturing technology adoption and result in inefficient use of resources.

An opportunity awaits for Africa to compete and thrive

Africa is on the cusp of a new era of industrialisation, propelled by the integration of digital and physical systems in manufacturing processes. This presents an opportunity to transform manufacturing from a legacy-driven sector to a dynamic, technology-enabled catalyst for inclusive growth. The adoption of smart manufacturing practices can deliver significant advances in productivity, sustainability and competitiveness across the continent. However, realising these benefits extends beyond technological implementation; it requires visionary leadership, cross-sectoral collaboration and strategic action throughout the ecosystem.

Manufacturers must champion this transformation internally by recognising that smart production processes are now essential to maintain competitiveness in the global economy. Achieving success entails deploying advanced technologies, building digital capabilities within the workforce and nurturing a culture of continual innovation. Governments play a critical role in enabling this shift by embedding Industry 4.0 principles into national industrial strategies, harmonising digital and manufacturing policies under a cohesive framework, and modernising regulatory environments to accommodate emerging technologies. Strategic incentives such as concessional financing, tax relief and public-private pilot projects can help lower barriers to adoption, particularly for small and medium-sized manufacturers. Additionally, regional trade, leveraging the AfCFTA, is pivotal to expanding market access and improving competitiveness.

Connectivity and technology providers can form the basis of smart solutions, by investing in digital infrastructure and delivering tailored, interoperable solutions that align with manufacturers' operational realities, whether through advanced networks within SEZs or cloud-based solutions for mobile-centric independent factories. The most effective solutions will result from co-creation with end users, ensuring responsiveness to local conditions as well as scalability and cost-effectiveness. Investors and development partners are instrumental in generating early momentum. By channelling resources towards innovation hubs, SME digitalisation initiatives and workforce development programmes, they can mitigate first-mover risks and speed up the rate at which the ecosystem matures. Acknowledging the social implications of smart manufacturing is vital to mobilising the necessary funding in this domain.

Collaboration among all stakeholders remains fundamental. Progress will depend on robust public-private partnerships, adherence to open standards and a collective focus on localisation, inclusivity and sustainable growth. Ultimately, smart manufacturing represents more than technological advancement; it signifies a comprehensive transformation in how Africa produces, competes and thrives in the 21st century.

Appendix

Smart Manufacturing Readiness Index

The Smart Manufacturing Readiness Index is an analytical tool designed to evaluate a country's preparedness to adopt and scale smart manufacturing. It offers a composite assessment based on both the strength of a country's manufacturing sector and the maturity of its digital infrastructure – two critical pillars that underpin Industry 4.0 transformation.

The index is structured around two dimensions:

- Technology Readiness (40%), which captures the digital backbone required for industrial digitalisation. This includes 4G/5G coverage, international bandwidth usage per capita, the density of manufacturing IoT connections, and the presence of data centres.
- Smart Manufacturing Capability (60%), which reflects a country's industrial base and enabling environment. This is assessed through the manufacturing sector's contribution to GDP, the presence of supportive policies (as tracked by the Global Trade Alert), electricity reliability and access (captured by a composite index) and broader ICT infrastructure and adoption.

Data sources used for the index include GSMA Intelligence, World Bank and the African Development Bank.

Table A1: **Smart Manufacturing Readiness Index composition**

Source: GSMA Intelligence

Dimension	Indicator	Weight indicator	Weight dimension
Digital infrastructure	Coverage of 4G/5G	25%	40%
	Log of international bandwidth usage per capita	25%	
	Manufacturing IoT connections per capita	25%	
	Number of data centres	25%	
Smart manufacturing	Manufacturing share of GDP	33%	60%
	Manufacturing policies from GTA	17%	
	Electricity composite Index	8%	
	ICT composite Index	42%	

Table A2 presents the scores for all African countries. Each score reflects a composite measure of both digital infrastructure and manufacturing capacity, enabling a side-by-side comparison of their readiness to adopt and scale smart manufacturing technologies.

The index highlights frontrunners and identifies countries with strong potential but existing gaps, offering a strategic lens for prioritising investment, policy reform and ecosystem development.

Table A2: **Smart Manufacturing Readiness Index country scores**

Code	Country	Index	Technology	Smart manufacturing
ZAF	**South Africa**	70.9	78.4	65.9
TUN	**Tunisia**	58.7	48.4	65.6
MAR	**Morocco**	57.2	63.6	53.0
EGY	**Egypt**	56.4	40.8	66.8
MUS	**Mauritius**	52.9	50.2	54.7
SYC	**Seychelles**	50.7	41.6	56.7
BWA	**Botswana**	49.3	54.9	45.6
DZA	**Algeria**	45.5	38.7	50.0
NGA	**Nigeria**	45.1	36.9	50.5
KEN	**Kenya**	44.9	49.2	42.1
GHA	**Ghana**	41.1	39.2	42.3
LBY	**Libya**	40.7	35.4	44.3
NAM	**Namibia**	39.1	33.2	43.1
DJI	**Djibouti**	36.4	36.7	36.1
GAB	**Gabon**	35.1	30.2	38.4
LSO	**Lesotho**	34.0	26.0	39.3
ZMB	**Zambia**	32.3	34.0	31.2
UGA	**Uganda**	32.2	40.5	26.6
SOM	**Somalia**	31.8	41.7	25.2
CMR	**Cameroon**	31.0	31.0	31.0
BFA	**Burkina Faso**	29.8	11.3	42.2
SWZ	**Eswatini**	29.7	32.7	27.7
CPV	**Cabo Verde**	29.4	31.8	27.9
SEN	**Senegal**	28.7	20.3	34.2
MLI	**Mali**	28.4	27.7	28.9

Code	Country	Index	Technology	Smart manufacturing
COM	**Comoros**	28.4	29.8	27.4
TGO	**Togo**	27.4	31.7	24.5
TZA	**Tanzania**	27.3	31.5	24.6
SDN	**Sudan**	27.1	20.8	31.3
STP	**São Tomé and Príncipe**	27.0	26.7	27.2
MOZ	**Mozambique**	26.6	28.4	25.5
BEN	**Benin**	26.5	34.6	21.1
COG	**Congo**	26.3	29.6	24.1
AGO	**Angola**	25.2	25.1	25.2
RWA	**Rwanda**	25.1	32.0	20.6
GNB	**Guinea-Bissau**	24.9	23.3	25.9
CIV	**Côte d'Ivoire**	24.7	36.3	17.0
SLE	**Sierra Leone**	24.3	24.4	24.2
MDG	**Madagascar**	24.0	30.3	19.7
TCD	**Chad**	23.4	17.3	27.4
MWI	**Malawi**	22.6	27.7	19.2
GIN	**Guinea**	21.7	14.2	26.6
ETH	**Ethiopia**	21.2	19.7	22.2
LBR	**Liberia**	19.2	12.9	23.3
GNQ	**Equatorial Guinea**	18.6	11.9	23.0
ZWE	**Zimbabwe**	18.2	28.2	11.5
BDI	**Burundi**	17.9	14.8	20.0
COD	**Congo, Democratic Republic**	16.9	12.0	20.2
GMB	**Gambia**	16.9	12.6	19.8
NER	**Niger**	13.1	7.1	17.1
MRT	**Mauritania**	11.5	13.5	10.2
CAF	**Central African Republic**	11.1	0.8	18.0
ERI	**Eritrea**	10.4	0.9	16.8
REU	**Réunion**	10.3	0.9	16.6
MYT	**Mayotte**	10.2	0.6	16.6
SSD	**South Sudan**	4.4	9.6	0.9

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