
SIEMENS
Ingenuity for life
Siemens Digital Industries South Africa
Dawn of Digitalization and its impact in Africa
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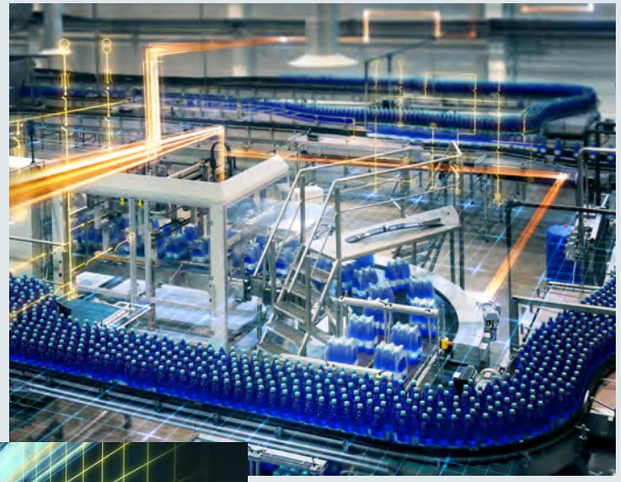

Foreword

Digitalization is changing the way the world operates –impacting different spheres of human existence from houses to personal devices and ranging to complex manufacturing and industrial processes. Digitalization has been witnessing a rapid adoption and is completely transforming the way businesses operate while defining new rules of competitive excellence.

The adoption of digital technologies, the speed of innovation as well as the range of digital offerings are expected to remain varied across industries, markets and geographies. The extent and impact of digital technologies is also expected to vary, favouring businesses and industries that seek relevance and increasing contribution in international markets in addition to existing domestic markets.

While advanced analytics and digitalization are witnessing growing adoption across certain industry sectors, such as the automotive sector, there is a real opportunity for adoption of these across sectors such as mining and food & beverage which are significant contributors to major African economies.

It is against this backdrop that Siemens has collaborated with an external service provider to conduct an assessment of Digitalization and its impact on Africa. The report outlines the current state of key industries across the continent and identifies challenges and opportunities.

Manufacturing, while the most mature sector in its transformation and adoption of digital technologies in Africa, remains a marginal player, struggling to make a bigger impact on country GDPs. Failing to pro-actively select and position Africa within the global manufacturing industry, the risk remains of continuing a path of non-industrialization.

In the mining industry we are witnessing subdued investment, rising cost pressures and increasing labour issues, a combination of mechanisation, efficient extraction of resources and better use of data can make it easier for mine operators to cut costs and create a leaner and more efficient mining operation. As such, the successful incorporation of technology will be possible through collaborative efforts of technology providers, industry, research institutes and organisations that work for uplifting the mining industry.

In the water industry, expenditure in water infrastructure has been low when compared to the global average. Inadequate investment in infrastructure coupled with poor water utility management has resulted in a greater need for development of the water sector. However, countries have started taking cognizance of the necessity for improvement in water utility management. Digital and automation solutions are critical to tackle cost pressures and enhance asset performance while addressing issues pertaining to water resource availability and relatively high levels of non-revenue water.

For the first time in history we have an incredible opportunity to use smart technology to transform entire economies at an unprecedented rate. Africa needs to get efficient strategies in place now in order to succeed. The findings from the study are just a starting point. We hope we can begin a dialogue and provide a frame to some of the unique opportunities that exist.

Ralf Leinen
Senior Vice President: Digital Industries
Southern and Eastern Africa

Siemens supports digital transformation with a range of services from consulting through to implementation.

We support our customers on the path to digitalization – from consulting on strategies for industrial digitalization through to supporting in the implementation and optimization of digital solutions.

Consulting is based on a thorough evaluation of the digital readiness of the company, which is carried out by digitalization experts together with the customer.

Together we determine the existing level of digitalization at the relevant company and from there we develop a tailored digitalization strategy for the customer together with a roadmap.

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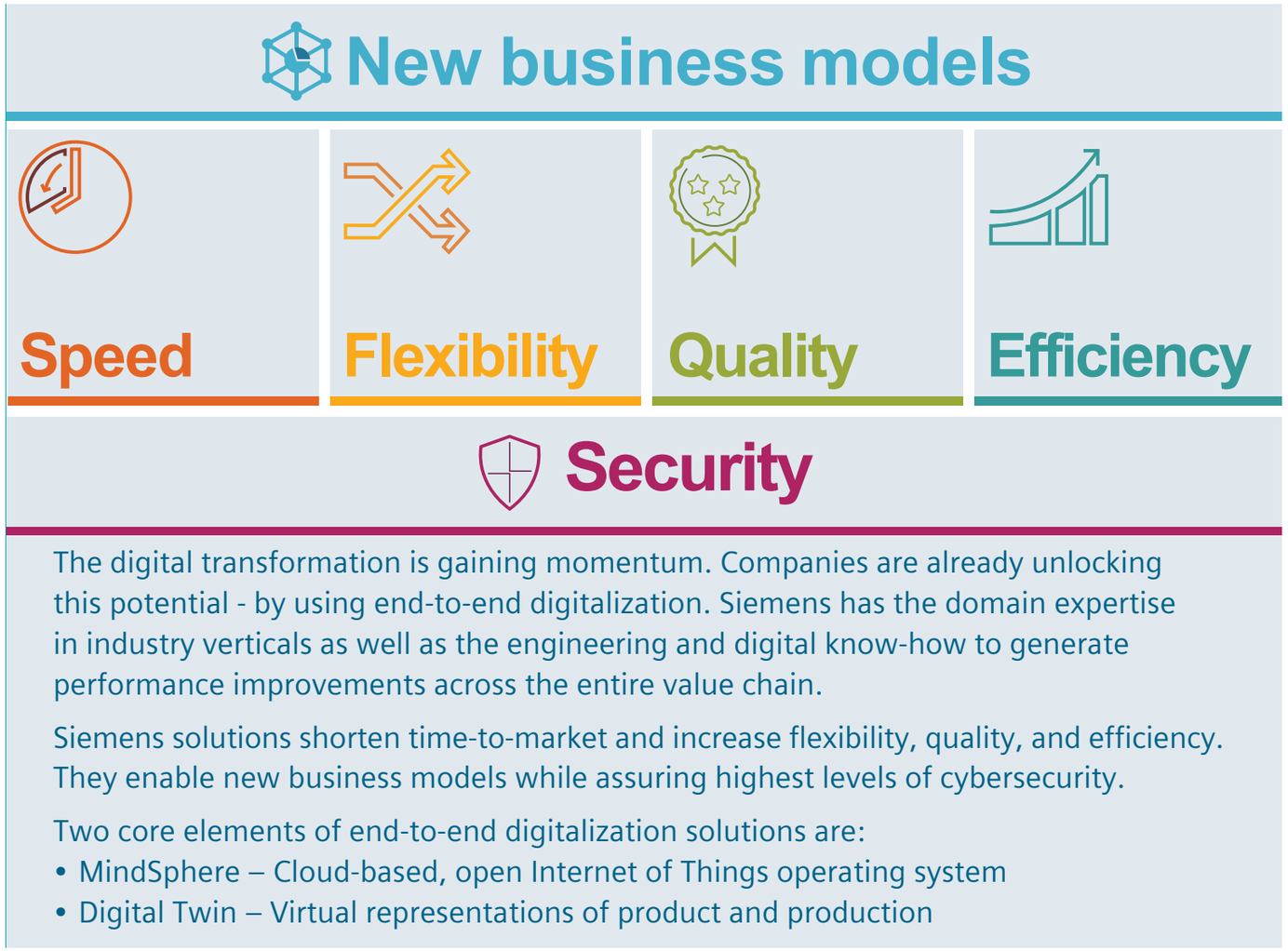
How do I derive business value?



The digital transformation is gaining momentum. Companies are already unlocking this potential - by using end-to-end digitalization. Siemens has the domain expertise in industry verticals as well as the engineering and digital know-how to generate performance improvements across the entire value chain.

Siemens solutions shorten time-to-market and increase flexibility, quality, and efficiency. They enable new business models while assuring highest levels of cybersecurity.

Two core elements of end-to-end digitalization solutions are:

- MindSphere – Cloud-based, open Internet of Things operating system
- Digital Twin – Virtual representations of product and production

Continue

MindSphere: Connecting devices and applications via the cloud

MindSphere is Siemens' cloud-based, open Internet of Things operating system, connecting real objects to the digital world. By applying advanced analytics, MindSphere enables you to harness value from the wealth of data. MindSphere enables the development of powerful industry applications (MindApps) and digital services to drive business innovation. Its open 'Platform as a Service' capabilities enable a rich partner ecosystem for applications and services. To protect your company's assets and intellectual property, MindSphere adheres to the strictest cybersecurity standards.

Festo – Condition monitoring services

Consumption transparency is the starting point for predictive maintenance. For Festo, the German control and automation company, Siemens provides MindSphere solutions which gather real-time data right from the plant. Energy savings of up to 30% compared to existing plants of similar functionality can be realized.

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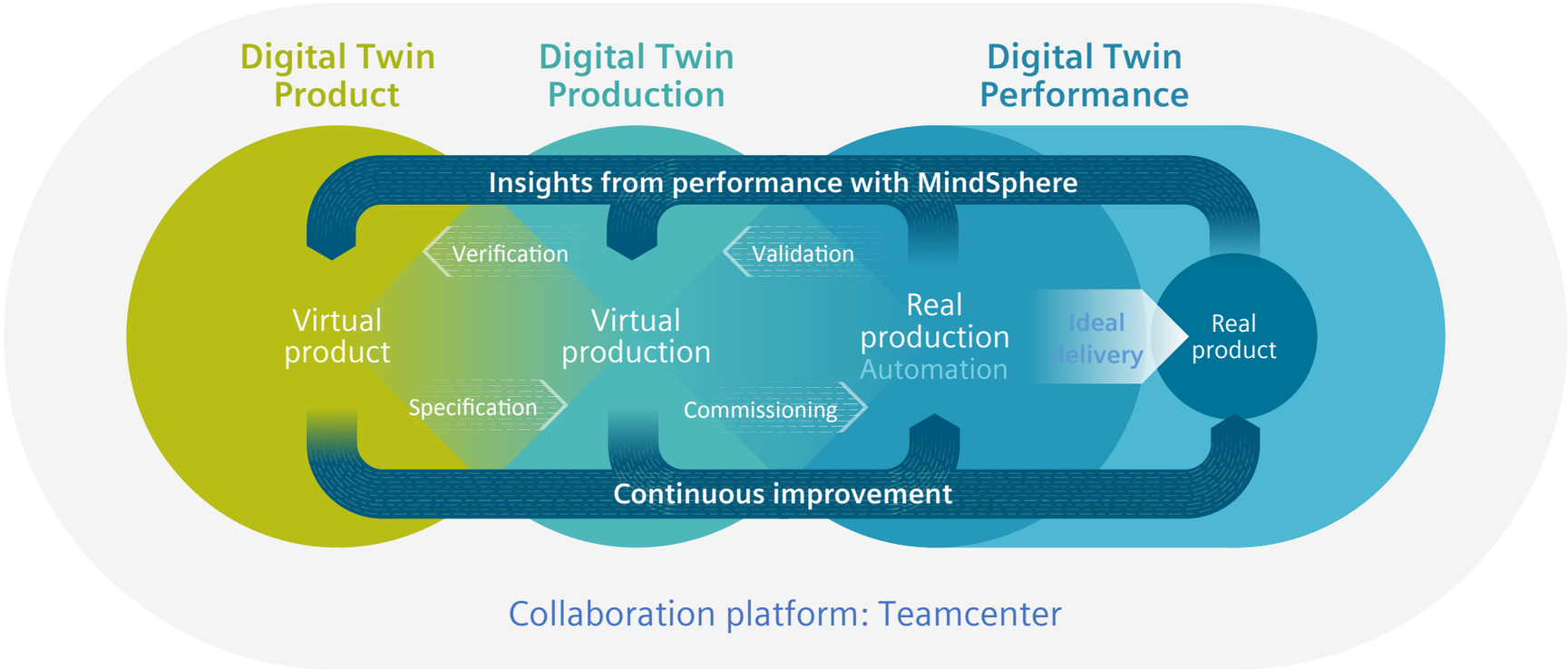
Digital Twin: Feedback insights to continuously improve product and production in the real world



Maserati – Boosting Product Design and Development

Digitalization starts with the design of a product. Maserati uses the CAD software NX for the Digital Twin to virtually create, simulate, and test their cars, significantly reducing the number of prototypes needed. In combination with the collaboration platform Teamcenter, the Maserati engineers manage their project collaboratively across various locations. The result: shortened time-to-market from 30 months to 16 months.

Continue

Siemens serves industrial verticals in a dedicated manner

- Aerospace & Defence
- Automotive
- Battery Manufacturing
- Chemicals & Petrochemicals
- Cranes
- Data Centers
- Distributors
- Fiber Industry
- Food & Beverage
- Glass
- Machinery & Plant Construction
- Marine & Shipbuilding
- Minerals – Mining & Cement
- Municipalities & DSOs
- Oil & Gas
- Panel Building
- Pharmaceuticals
- Ports
- Power Utilities
- Smart Cities
- Solar
- Transportation & Logistics
- Tyre Industry
- Water

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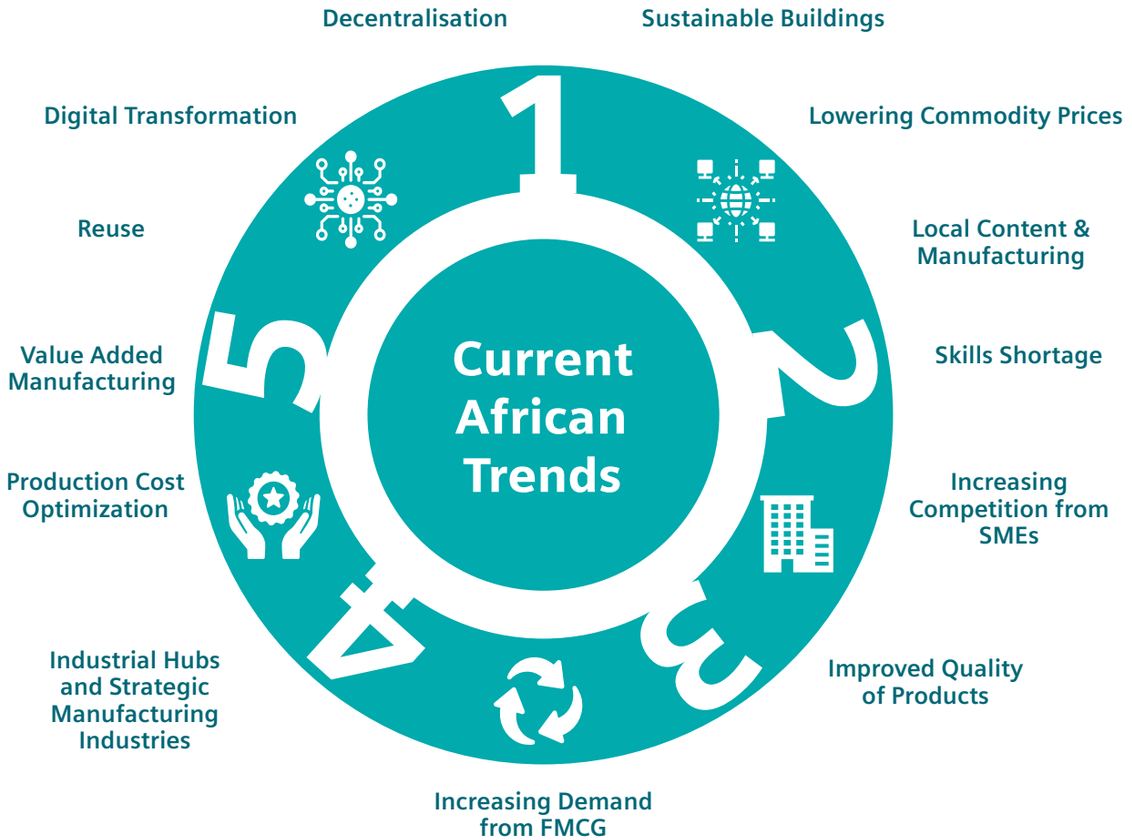
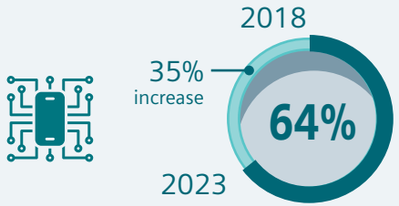
Africa: An emerging growth destination with a need for digital evolution



South African overview and trends

Overall Digitalization – Current Adoption level and Expected Scenario



Prominent Sub – Sectors, South Africa, 2018

- Mining, Metals & Cement
- Automobile Manufacturing
- Food & Beverage

Key Sector Challenges, South Africa, 2018

- Electricity supply insecurities and rising tariffs
- Under utilised capacity, lower productivity and declining global competitiveness
- Price sensitivity of the market leading to lower adoption of advanced automation and digitalization
- Skill shortages

Source: Frost & Silivan

Continue

Level of automation and digitalization adoption is expected to increase across South Africa

End User Segments / Country	Rest of Africa	South Africa
Minerals: Metals, Mining, & Cement		
Oil & Gas		
Food & Beverage		
Water and Waste Water		
Power Generation		
Automotive		
Petrochemicals		
Heavy Machinery		
Motion Control & packaging		
Others (Cement, Textiles, Pulp and Paper, Glass)		

Level of Product presence and market size: Rev (EUR Mn) | > 60 | 31-60 | 11 -30 | 1-10 | Negligible

Key messages per industry
Minerals Autonomous Mining Technologies & Efficiency Improvement
Oil & Gas Future Investment in Infrastructure
Food & Beverage Openness to Digitization makes South Africa a key market
Water & Wastewater Investments to improve management of water utilities
Power Generation Increasing need to reduce transmission & distribution losses
Automotive Greater appetite for digitalisation and Industry 4.0 platforms with gradual investments governed by demand
Heavy Machinery Mechanisation and automation entails reskilling of the workforce
Motion Control & Packaging Growing demand for packaged food and beverages

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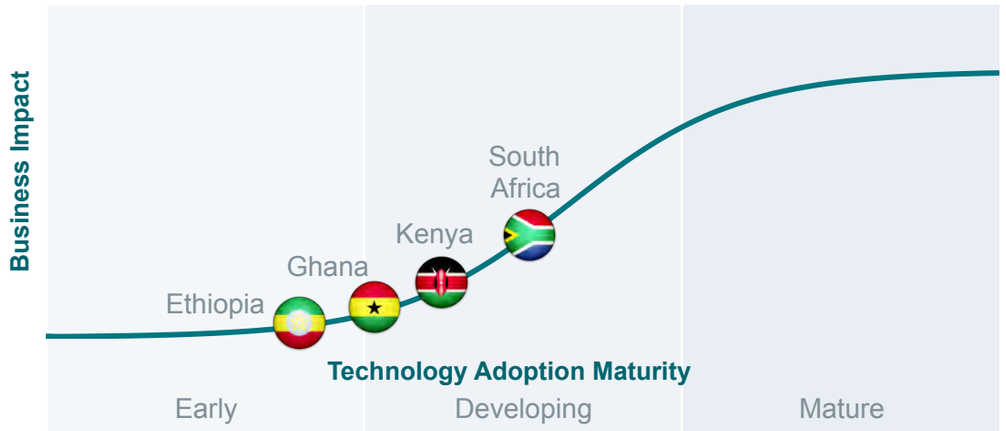
Source: Frost & Silivan

Digital transformation expected to be aimed at improving selective process and OPEX reduction

Digital Transformation Journey



Technology Trends

- Asset Performance management
- Shift from product centric approach to solution centric approach
- Plant Lifecycle Services
- Remote monitoring of assets and better visualisation

NA – Not Applicable

Summary table	Technology Adoption Stages - End-user Segments		
Country	Early	Developing	Mature
Ethiopia			NA
Ghana			NA
Kenya			NA
South Africa	NA		NA

Source: Frost & Sullivan analysis

Continue

Source: Frost & Silivan

Why Digital for Industrial? Volatility and cost pressures drives acute focus on implementing digital

Headwinds		Digital Implications
	**Capital Efficiency** *Plan, build and operate economically*	**Managing capital projects operations and process plant operations lifecycle.**
	**Resource Efficiency** *Skills sortage*	**Knowledge retention and transfer, Managed services, Field workforce automation and productivity.**
	**Asset Efficiency** *Optimize connected assets*	**Shorter turnaround/longer run links, Schedule-based maintenance → Data-driven maintenance.**

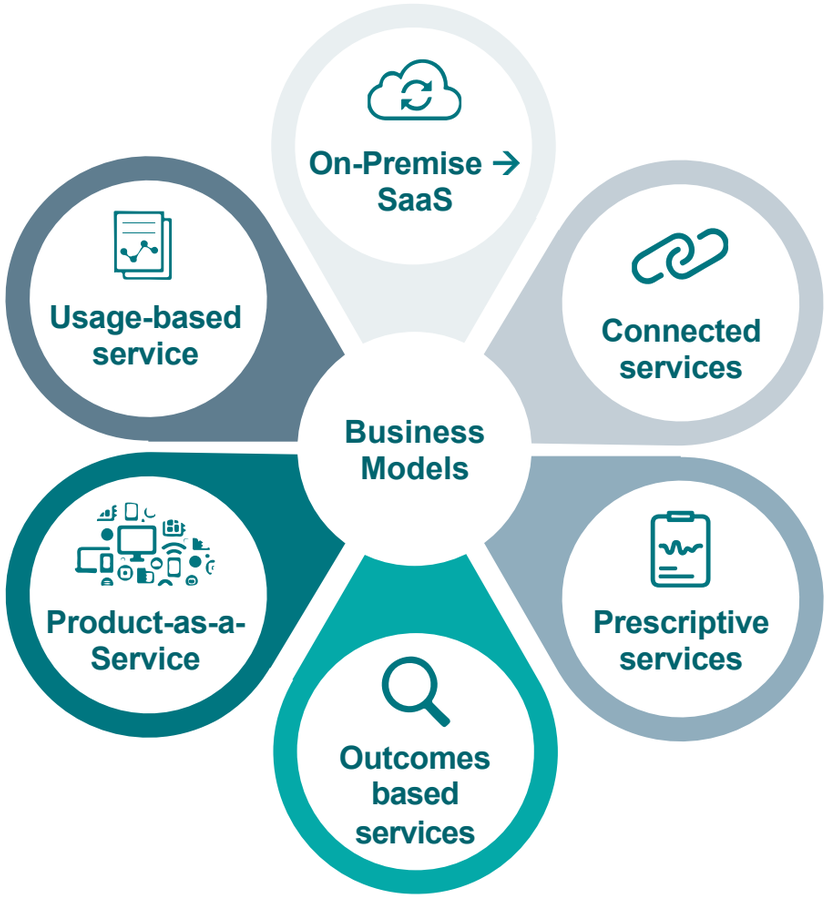
Continue

Source: Frost & Silivan

2019 and beyond: Shifts from industrial automation business. Mindset shifts are inevitable as customers and peers pace ahead

Digital Enablers

- Connected products
- Embedded services
- Focus on business outcomes
- Enhanced value addition
- Omni-channel distribution



Source: Frost & Silivan

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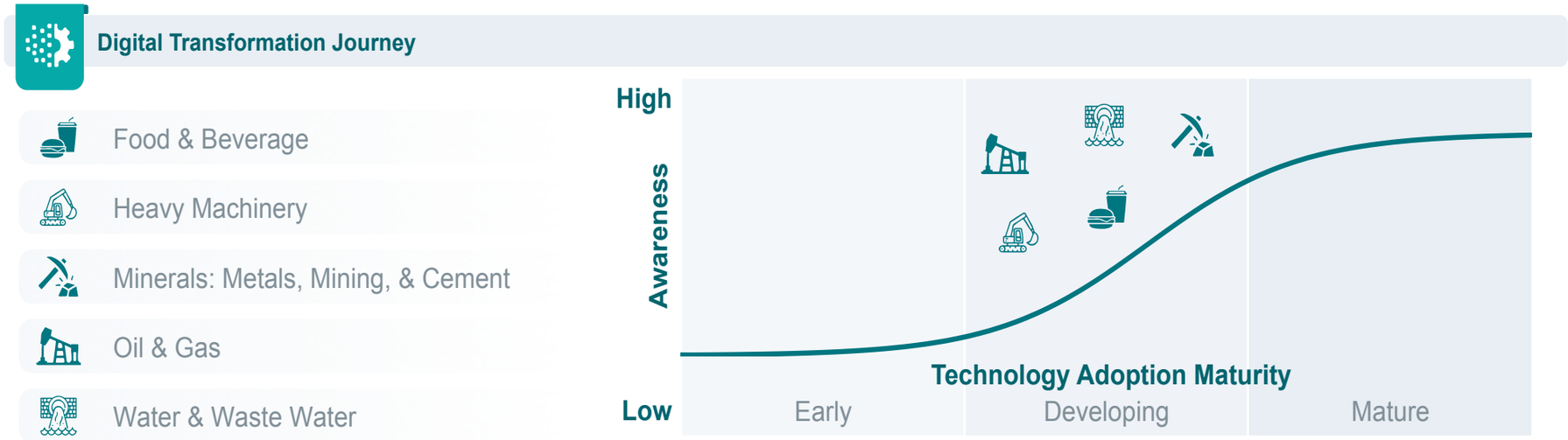
South Africa is the strongest positioned of the African countries on its digital journey, however it lags behind in 4IR and IIoT adoption levels



SA Stage of Digital Readiness	Industry	Digitalisation awareness	Tech Trends
Activate (the lowest stage of digital readiness) **Accelerate** (countries in the middle stage) **Amplify** (those in the highest stage of digital readiness)		High	Predictive Maintenance
		Medium low	Smart Mining
		High	Retrofit/Energy Management
		High	Pipeline Optimisation/Digital Oil Field
		Medium	Monitoring and Control

Source: Frost & Silivan

Food & Beverage

Enable flexible manufacturing and increase operational efficiency

250 Kcal Per capita Consumption for Sub Saharan Africa in 2030

Urban population in Africa is expected to grow to **56% in 2050**

South Africa - **Global Food Security Index Ranking, 45th place**

Raw and processed food contributing **8% of total South Africa exports**

Continue

Source: Frost & Sullivan

Both the Food and Beverage sectors are still developing in Africa. The understanding of automation and how it can assist in process optimisation exists but the adoption rate is slow

Lowering commodity prices

Commodities such as coffee, sugar and tea have historically driven economies such as Kenya and Ethiopia. However, the price crash in 2015/16 hampered the agricultural sector's growth in Africa.

Policy facilitating growth of local manufacturing

High import duties, free trade agreements and rebates in the form of tax incentives are increasingly being adopted to drive local manufacturing growth.

Increased competition from SMEs

Globally and in Africa, the industry has been dominated by large multinational players. Examples of local SMEs include microbreweries in the beverage industry, which has caused an increase in competition and a slight increase in price sensitivity due to these microbreweries catering to more niche products.

Increasing demand for FMCG

The urban population in Africa is expected to grow to 56% in 2050, from 35% in 2010. This rapid urbanisation combined with preference shifts towards formal retail will drive demand for FMCG products.

Skills shortages

Lack of skills at a local level in the industry have often resulted in a reluctance to adopt new technologies, due to operation, servicing and maintenance concerns.

Source: Frost & Sullivan, World Bank**, IMF, SARS, UN Projections*

Continue

South Africa is the strongest positioned of the African countries on its digital journey, with the Food & Beverage sector showing higher propensity for advanced automation & digitalization

Digital Transformation & Industry 4.0

Businesses in South Africa have been investing steaadily to prepare for the impact of the fourth industrial revolution.

Value Added Manufacturing

Shifting focus from export of raw materials and mineral resources towards development of supply chains and industry that add value to these base commodities and raw materials.
However this shift will be slow.

Give and take between automation and job creation

Unemployment has historically plagued African countries, and remains a key challenge. This has led to an abundance of low cost unskilled labour, thus slowing down the adoption of advanced automation in Africa.

Production Cost Optimisation

Manufacturing industries are increasing focus on resource and cost optimisation to improve production margins and competitiveness in the global markets.
While the current trend is towards utilisation of existing capabilities, investment in new facilities is expected to be gradual.

Increasing consumer spend

Africa's share in global consumer spend by region is expected to grow from 5% in 2012 to 7% in 2022, with spend on Food & Beverage products expected to be one of the key driving sub-segments of this increased expenditure. While there is an appetite for automation in Africa, market price sensitivity, low skills and a slow shift towards local value added manufacturing has led to a slow uptake of advanced automation technologies.

Continue

Source: Frost & Sullivan

Automation and digitalization are ideal to tackle cost pressures and traceability limitations

High Product Standards for Food Safety

The F&B Industry is characterised by stringent standards that manufacturers are required to adhere to, automation can increase ease of conformation to these standards.

Need for Product Traceability

Product record management and traceability are vital challenges for the industry. Increased digitalization provides a means of remedying this challenge.

Volatile Market Demands

A key marker of the industry: extremely volatile and shifting consumer demands. Keeping up with these demand trends will be heavily reliant on ability to adapt, which can be aided through adoption of IIoT.

Variegated Regulations

Food regulations vary heavily from region to region: a key pain point for manufacturers to keep track of. Monitoring of conformity in complex organisations can be aided through adoption of IIoT.

Slow Product Innovation Cycles

Timely creation and movement of products across the supply chain with respect to aligning products to dynamic customer demands.

Supply Chain Complexities

Both traceability and labelling result in supply chain complexity. Stringent processes need to be followed regarding labelling and serialisation of products, while tracking products through the supply chain remains a critical issue.

Continue

Source: Frost & Sullivan

Tracking and monitoring of products within the Food & Beverage industry presents great potential for the implantation of digital solutions

Appetite for Technology Adoption 2018

Sector	South Africa	Kenya	Ethiopia	Ghana
Food	Developing	Early	Early	Early
Beverage	Mature	Developing	Early	Developing

Early Developing Mature

The beverage sector in South Africa is mature in comparison to the rest of Africa, due to the presence of multinationals such as Coca-Cola and In-Bev, who utilize South Africa as an export hub into the rest of Africa.

South Africa and Kenya are expected to be at the forefront in adopting digital platforms for manufacturing. Adoption in South Africa will however happen at a much faster rate than in Kenya.

The Food Sector in Kenya, Ghana and Ethiopia are still in a nascent stage, with a strong focus placed on agriculture and cultivating raw products. There is still little focus on agro-processing in these countries, however these sectors are growing

"With the transformation of the industry through industry 4.0, IOT offerings and Digitalization, we are seeing changes in demands from end users, with similar adaption to meet these demands from suppliers. Furthermore, increased digitisation is something I expect to see much more of in Africa."

– A Leading OEM

"With increasing knowledge on the benefits of automation and digitisation in Africa we're seeing a shift from like-for-like replacement to replacement with the best possible product which also meets technical specifications. Industry margins are low, hence high efficiency is becoming increasingly important."

– An Automation Solution Provider

"In my experience this has not always been the case, but with more and more pressure to innovate in the industry I feel we will see greater enthusiasm to adopt IIoT solutions."

– A Beverage Plant Head

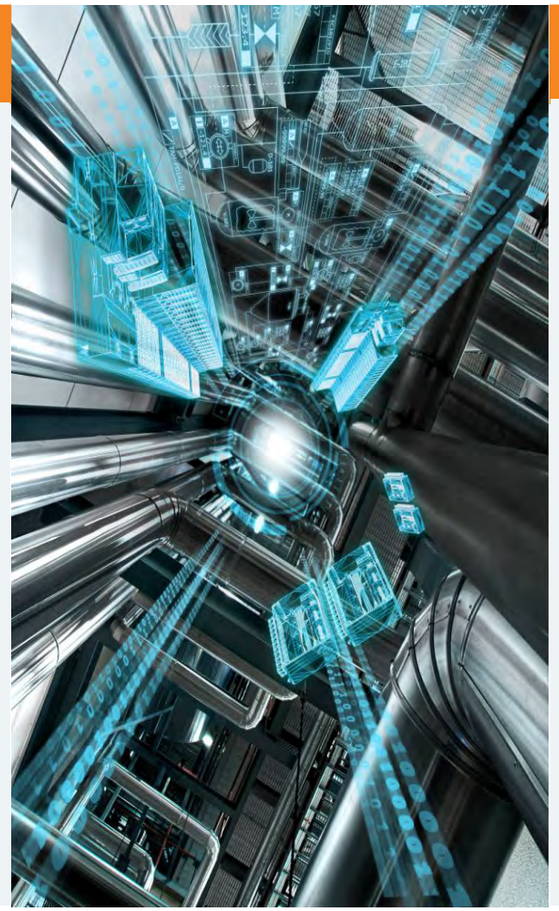
Continue

Source: Frost & Sullivan

Addressing Industry Requirements.
Siemens Solution: SIMATIC PCS 7 with BRAUMAT craft brewing libraries

Features

- Designed for the beer industry.
- Monitoring of brew quality enabled through automatically stored production data and analysis tools.
- Integration of BRAUMAT libraries and SIMATIC PCS 7 process control system can optimally run any size brewery.
- Active Interface.
- Reporting and trending capabilities.
- SIMATIC HMI operator interface



Benefits

- Increased production with no further staffing requirements.
- Improved quality, repeatability and consistency. This is done by automating labour-intensive tasks which have historically been done manually.
- Automation of temperature control to optimise cooling efficiency.
- Reduced energy use related to heating and cooling.
- Production scheduler helps you easily manage your Production Order List and CIP orders.
- Integrated, user-friendly system for monitoring, control, and planning is designed explicitly for the craft brewer.
- Allows operators to focus on ensuring quality, not on juggling all of the tasks required to get the job done.

Continue

Source: Siemens / Frost & Sullivan

Using Siemens technology Gruppo Campari created a unified repository for all product specifications and increased efficiency of manufacturing

Until 2012, Gruppo Campari's approach to management of product specification remained unstructured

Challenge

- With Gruppo Campari's rapid expansion (more than 20 acquisitions in the spirit industry globally in the past 20 years), there was a constant requirement to integrate new products, plants, and assets into its operation management systems.
- A need to standardise and streamline data acquisition while offering an accelerated response to product information requests from consumers and/or regulators.
- Previously this was done using Microsoft software such as Word documents or Excel spread sheets, with no standard workflow or authoring.
- In 2012 as a result of the complex growth of the organisation, it launched an extensive digitisation process.

Solutions

- Gruppo Campari adopted Siemens SIMATIC IT Interspec from Siemens PLM Software, which is a configurable solution for product specification management in process industries.
- This allows the company to develop, configure and manage all production specifications (raw materials, intermediate and finished products as well as packaging materials).
- This stores all specifications in a single, controlled data repository.

Benefits

- SIMATIC IT Interspec was selected for its flexibility and operation independence.
- According to Campari Global QHSE Content Manager, Marco Rocca:

"We can configure the systems independently, add properties, create new frames, and edit contents – virtually everything can be configured with no customisation.

"Alternative solutions were more rigid and required a system engineer to do that. With SIMATIC IT Interspec, it was enough to attend a short training course to be virtually independent. The tool has been around for a few decades, so it's proven, tested and stable."

Continue

Source: Siemens / Frost & Sullivan

Food & Beverage

Product Design → Production Planning → Production Engineering → Production → Services

Improve the plant efficiency for beer Industry - SIMATIC PCS 7 with BRAUMAT craft brewing libraries

Designed for the beer industry. Monitoring of brew quality enabled through automatically stored production data and analysis tools. Advantages include increased production with no further staffing requirements. Improved quality, repeatability and consistency. This is done by automating labour-intensive tasks which have historically been done manually.

Increase the manufacturing efficiency of liquor giant - SIMATIC IT Interspec

It is a key component of the R&D Suite but can also be implemented as a stand-alone system for global specification management in process industries. This allows the company to develop, configure and manage all production specifications (raw materials, intermediate and finished products as well as packaging materials).This stores all specifications in a single, controlled data repository.

Automates and intelligently control bottling lines - Leading soft drinks manufacturer

One of the largest carbonated soft drink bottling plants in South Africa is using Siemens PLC's at each filling line. Siemens technology supported ~79% of total local production of 4.2bn litres in 2016.

Unified Repository for Product Specifications - Leading Italian liquor giant

Company adopted Siemens SIMATIC IT Interspec from Siemens PLM Software, which is a configurable solution for product specification management in process industries. Using Siemens technology, Italian Liquor Giant created a unified repository for all product specifications and increased efficiency of manufacturing.

Source: Siemens / Frost & Sullivan

Minerals & Mining

New technologies and digital platforms critical to improve productivity and production margins

South Africa: **Input cost inflation of 6%** for mining sector during 2018

South Africa: **R356 billion GDP contribution** in 2018

Siemens has supported **~33% of SA mining contribution** to GDP

Exorbitant operational costs continue to dent investor confidence

Continue

Source: Frost & Sullivan

Overview: Initiatives being sought and undertaken in the mining sector

Zambia

- The Zambia Development Agency Act provides incentives to firms investing substantial amounts in the mining sector in the country. The Act specifies that the threshold amount should be US$ 500,000 or above in order to qualify for fiscal and non-fiscal incentives.

Zimbabwe and Namibia

- Last year Zimbabwe scrapped its indigenisation requirements and slashed the 51% indigenous shareholding quota for all minerals; this initially excluded diamonds and platinum. The move was well appreciated by investors.
- A similar measure was implemented in Namibia. The country relaxed the requirement for mining entities to have a minimum indigenous shareholding of 5% held by previously disadvantageous groups.

South Africa

- The Mandela Mining Precinct's role is to identify barriers and develop a vision for long term development and transformation of the mining industry. The project also emphasises on improving mining efficiencies and introducing most modern mining technologies.
- Introduction of Mineral beneficiation (Platinum Group Mineral) for fuel cell industry development.
- The Amended Mining Charter outlines the expectations of rights holders to invest in South African mining industry.

Botswana

- In 2018, Botswana announced plans to introduce the country's new minerals policy. The policy aims to improve the investment climate in the minerals sector. Moreover, the country has completed the legislative amendments to the Mines and Minerals Act, Precious and Semi Precious Stones Act and Diamond Cutting Act to enhance the ease of doing business.

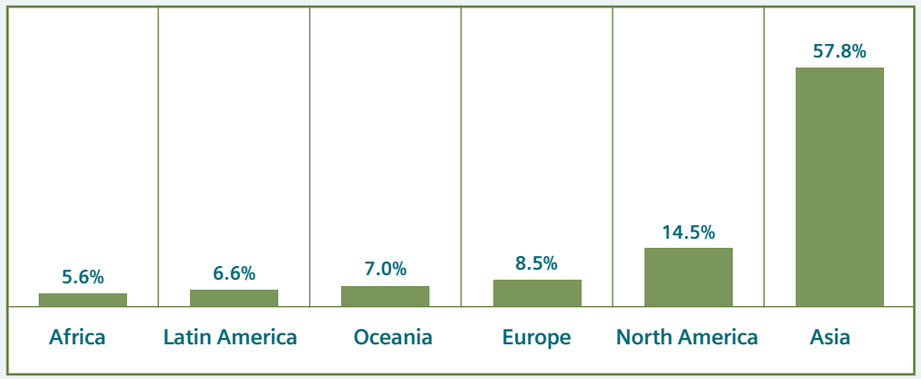
Source: Frost & Sullivan

Continue

Despite increasing labour issues and a drop in investment, South African mining industry, one of the largest in Africa, is focusing on improving growth

Total mining production by continent- 2017

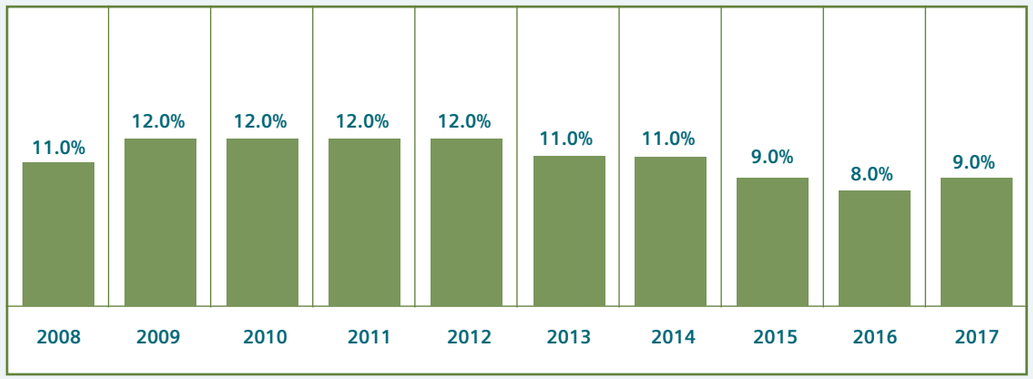
- Africa has excellent potential within its mining sector due to its enormous mineral endowment.
- Mining is one of the key industries for many African countries.
- South Africa's mining industry is one of the largest in Africa and the mining industry is the single largest contributor to the country's exports. In 2018, minerals accounted for 38% of all exports.
- However, mining's share to country's GDP has drastically dipped from 21% in 1980 to 8% in 2018 due to economic uncertainties, labour issues and other political instabilities.



Source: World Mineral Council

Mining contribution as % of total investment in South Africa

- Total mining investment in South Africa was more or less stable untill 2014. After 2014, the industry witnessed a drastic dip in investment, as mining struggled to regain investor trust.
- Lack of an environment conducive to making returns is one of the major reasons. The legal wrangling surrounding the mining charter, low prices forecast for strategic commodities, a contracting construction sector, stringent regulations and exorbitant operational costs may continue to dent investment in the sector in future.



Source: Mining Council SA

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Source: Frost & Sullivan

Digital Transformation challenges in enhancing labour skill sets, increasing efficiency of mines and changing the way the mining industry operates

Automation Adoption Maturity 2018

Manufacturing Sub-Sector	South Africa	Kenya	Ghana	Rest of Africa
Mining	Mature	Developing	Developing	Developing
Metals	Mature	Developing	Developing	Early
Cement	Mature	Mature	Mature	Mature

Early Developing Mature

Foreign investors are still wary of challenges facing mining projects in Africa

South Africa leads in the adoption of automation in mining sector

Automation leads to employee skills development and advanced on the job training.

Source: Frost & Sullivan

Continue

Outlook: The rise of intelligent mines is not a distant dream; Digitalization is slowly capturing the mining industry of Africa

Current (2019) Product Focused

Commoditisation, multiple suppliers, varying vendors and makes

- Sensors
- PLC, SCADA, DCS, HMI
- Control platforms and software

Short Term (2021 - 2022) Connected / Smart Mines

IT > OT

IT-OT convergence OT applications

Field Device > Sensors > IoT Gateway > Cloud Storage > Online diagnostics

- Cloud, XaaS
- Analytics
- Predictability/ Preventive Maintenance

Future (2023+) Mining-as-a-Service

Data > Insights > Outcome

Outcome-based Lifecycle Services

Outcome based > Predictive Analytics > AI/ML Blockchain

- AI/ML
- M2M, 5G
- AR & VR
- Blockchain/ Digital/ Integrated Supply Chain

Continue

Source: Frost & Sullivan

Siemens Mining Technologies implementation

Enhanced Productivity with reduced maintenance & service costs

SIMINE portfolio with complete electrical engineering, drive automation and service packages that increase productivity, improve drive system efficiency and reduce energy costs.

Optimizing Conveyor Belt Systems

Use of digital simulation tools to reveal the dynamic behavior of the whole system which allows improvements to be made in system operation while also minimizing idle times.

Optimized Processes and Operation

SIMATIC PCS7 with its open, flexible and scalable architecture forms the basis of the Minerals Automation Standard that aims at improvements in competitiveness, through optimized productivity, plant availability and efficiency.

Exploration & Excavation → **Transport & Material Handling** → **Processing & Beneficiation** → **Refining & Agglomeration**

Condition Monitoring Systems

SIPLUS CMS for the early detection of damage to machine and plants which aids in decision making for maintenance staff, operators and management.

Continue

Source: Siemens / Frost & Sullivan

Siemens Mining Technologies implementation

Equipment Availability and Efficiency

At the Sentinel Copper Mine in Zambia Siemens has implemented a SIMINE Gearless mill drive with SIMATIC PCS7 mill automation that has resulted in an operational efficiency of 95.3% in addition to lower operating costs, minimized downtimes and improved reliability.

Exploration & Excavation → **Transport & Material Handling** → **Processing & Beneficiation** → **Refining & Agglomeration**

Automation for Underground Mining

At the Freeport McMoran Grasberg copper and gold mine in Indonesia, SIMATIC PCS7 was installed for the DCS that controls eleven production trains and five service locomotives. The automation system allows to minimize production loss in the transition from open-pit to underground mining

Asset Health Analytic

Siemens' Asset Health Analytics creates a foundation that allows equipment like conveyors, ball mills and crushers to supply additional data. Analysis of this data provides information that allows for fact based maintenance decisions in real time while also planning maintenance and service measures.

Source: Siemens / Frost & Sullivan

Water & Wastewater

Partnerships between technology enablers and cross-functional participants are bringing in smart capabilities to water cycle management

Water Expenditure by Africa (1.3% of total infrastructure investment) **is extremely low**

South Africa: **Invested ~R12 bn in the technology** upgrade and construction of three treatment plants

Last 4 years Siemens flow meters measured the flow of **~3.7 million megalitres of water**

Continue

Source: Frost & Sullivan

Poor water utility management and inadequate water infrastructure investment results in greater need for water sector development

Digital Transformation

Smart and advanced technologies like leak detection and metering are being used to improve billing and efficiency.

Improved Quality

Preference is shifting away from cheaper products towards higher quality core products in the case of large water infrastructure projects, especially in the building services and industrial sectors.

Decentralisation

There is growth in the market for 'plug and play' treatment models owing to the development of industrial zones, gated communities and business parks. Under-sink treatment systems are growing in popularity retail will drive demand for FMCG products.

Sustainable Buildings

Buildings are constructed to be water efficient, reducing the amount of fresh water use, through wastewater reuse. This is driven by the increasing awareness of water scarcity.

Reuse

Deployment of technological solutions is becoming common-place in the industrial and residential segments. Policy enforcement regarding effluent discharge is becoming more stringent across the continent. There is reducing dependence on the public sector to provide water and wastewater services. Industrial and residential sectors are opting to install their own small-scale water treatment and, in the case of industrial sector, wastewater treatment facilities. This has opened the door to increased private sector participation.

Continue

Source: Frost & Sullivan, World Bank, WASREB, IMF, IWA, UN Projections*

Water sector overview: South Africa

Municipal Water Sector Challenges, South Africa, 2018

Climate variability has led to rising levels of water scarcity across the country creating a severe deficit in water availability. This has indirectly impacted the levels of municipal revenue generation from water sales.

There are a number of options being explored to increase water resources in the country, including wastewater treatment and desalination. The main barrier is the initial capital investment required.

South Africa loses approximately 1.58 billion kilolitres of water a year as non-revenue water. The water loss reportedly costs the country around R7.2bn a year.

Industrial Water Sector Challenges, South Africa, 2018

Water restrictions, fines and rising water tariffs resulting from low water availability in parts of the country have impacted water intensive industrial sectors.

Poor feed water quality is impacting industrial players as they need to invest in water treatment technologies to ensure feed water meets quality standards. This is especially the case in the food and beverage sector.

Acid mine drainage is one of the most significant water-related environmental challenges facing the mining industry caused by old abandoned mines and increasing illegal mining activities. This water is very difficult to treat.

Water Sector Initiatives, South Africa, 2018

Municipal

Pressure management, pipe replacement and demand-side management through digital capped water meters were the top 3 initiatives taken to rapidly reduce water consumption in the Western Cape in 2018.

More than 200 users were connected to be supplied with treated effluent for irrigation and various industrial applications not requiring potable water.

Industrial

Large industrial players have made changes or investments in their business to ensure reduction in their reliance on municipal water supply and ultimately use less water.

Government has invested ~R12 bn in the technology upgrade and construction of three treatment plants specifically designed to treat polluted water from old underground gold mines across Gauteng and mitigate further problems of acid mine drainage.

Continue

Source: Frost & Sullivan

Digital awareness is significant but the actual investment is expected to be challenge specific and value driven

Appetite for Technology Adoption 2018

Sector	South Africa	Kenya	Ethiopia	Ghana
Water	Mature	Developing	Early	Developing
Wastewater	Mature	Developing	Early	Developing

Early Developing Mature

The water and wastewater sector in South Africa is mature in comparison to the rest of Africa, due to strong technical skills, and commercial and financial management of water resources.

There has been chronic underinvestment in water and wastewater infrastructure across Africa. Currently, there is an estimated USD 12 billion investment gap. All 3 countries face cheap labour as a road block to the adoption of advanced technologies.

In Ghana and Kenya there is increasing focus and adoption of ever more advanced technologies in the water and wastewater sector. Ethiopia is using slightly less advanced technologies to overcome their challenges.

"One of the biggest barriers to the development of the water and wastewater sector across Africa is the low investment this sector receives. However, its importance is being recognised and investment is picking up, but very slowly."

– A leading Solution Provider

"Water and wastewater in the F&B market is a real driver in most African countries at the moment. Government is getting stricter about water discharged from industries and the enforcement of existing effluent policies is picking up."

- An EPC

"There is increasing uptake of the small-scale plug and play/containerised water treatment modules for business parks and housing developments and underserved, rural areas. The benefit of these is that less skilled labour is needed."

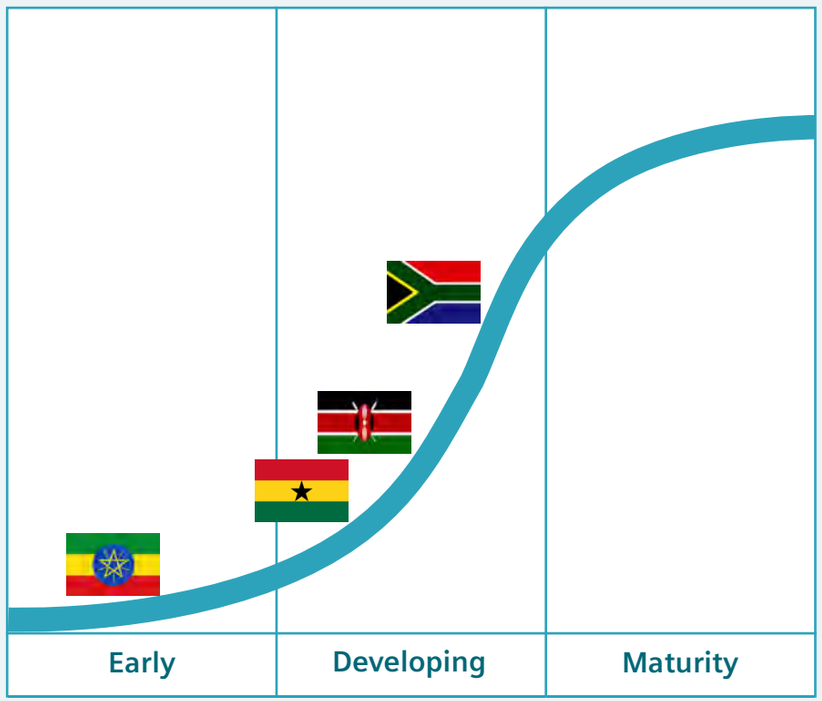
– A leading OEM

Continue

Source: Frost & Sullivan

Technology adoption maturity: Wastewater sector

Digital Transformational Journey



Current and Future State of Key Automation Product Adoption

Technology	Current State	Future State
Mobile and decentralised treatment systems	Industrial Water Treatment	Enhanced Adoption
Web-based technologies and Cloud Computing	Better data acquisition and real-time control and management	Enhanced Adoption
IIoT and AI for fully automated treatment systems	Integration of industrial treatment with central facility	Water Treatment as a service

Continue

Source: Frost & Sullivan

Automation is an ideal solution to tackle cost pressures and enhance asset performance leading to efficient CAPEX and reduced OPEX

Key Imperatives	Automation Implications
Capital Efficiency Plan, build and operate economically	Managing capital projects operations and process plant operations lifecycle.
Resource Efficiency Skills shortage	Knowledge retention and transfer, Managed services, Field workforce automation and productivity.
Asset Efficiency Optimise Connected assets	Shorter turnarounds/ longer run links, Schedule-based maintenance – Data-driven maintenance

Continue

Source: Frost & Sullivan

Expected transformation in the African water sector

Current (2019) Product Focused

Commoditisation, multiple suppliers, varying vendors and makes

- Sensors
- Analytical instruments
- Control platforms and software

Short Term (2021 - 2022) Smart Water Grids

IT > **OT**

IT-OT convergence
OT applications

- Cloud
- Machine learning
- Predictability

Future (2023+) Water Treatment-as-a-Service

Data > **Insights** > **Outcome**

Outcome-based
Lifecycle Services

- AI / ML
- XaaS

Continue

Source: Frost & Sullivan

Poor water utility management and inadequate water infrastructure investment results in greater need for water sector development

Challenges

Weak policy implementation due to poor coordination

- SSA countries have various policies in place to prevent the release of untreated wastewater from industrial processes. The inherent fragmentation at different government levels responsible for water and wastewater management results in limited enforcement of these policies. As a result, industries are not penalised for releasing untreated wastewater.
- Governments are becoming stricter with policy enforcement and the impact should decrease over the next 5 years.

Limited availability of funding

- Although the need for investment in water and wastewater infrastructure is being increasingly recognised, the availability of funding is a persisting issue.
- Water is not a high revenue commodity and non-payment is fairly common, resulting in decreased municipal funds for water projects.
- This is further compounded by the reliance on multi-lateral and bi-lateral organisations for funding of water related projects.

Limited expertise and necessary skills in the water and wastewater sectors

- There are limited individuals with the necessary expertise and skills to implement and manage technologically advanced water and wastewater solutions. This results in low demand for non-legacy products and is further compounded by the lack of available in-country training.
- Adding to this, the low cost of labour, compared to the high cost of advanced instrumentation, is a major restraint.

Industry Specific Challenges

Sector	Approach to water and wastewater	Challenges
Mining	• Water plays an integral role in the mineral processing stage of the mining operation. • Mine drainage and process water are the main types of water produced in the mining operation.	• High environmental impact from effluent water. • Poor wastewater quality that requires rigorous treatment methods. • Remote locations far from water treatment plants.
Food & Beverage	• The food & beverage industry requires an enormous amount of clean water. • The industry is focused on maximising wastewater reclamation in order to reduce the amount of fresh water needed.	• Regulations around effluent and reclaimed water standards are becoming more stringent, resulting in the need for rigorous treatment methods and increasing demand for zero-liquid-discharge solutions
Oil & Gas	• Oil & Gas production requires large volumes of water.	• Stringent environmental regulations result in rigorous treatment methods for water effluent. • Remote locations far from water treatment plants.

Continue

Source: Frost & Sullivan

Outlook: The African water / wastewater sector is expected to witness a gradual transformation with cost and skill implications of technology adoption emerging as key challenges for the sector

Siemens Flow Solutions:

Siemens has provided South Africa with simple, flexible flow solutions for more than 30 years. Some of these solutions are; standard electromagnetic flow meters with modular pulsed Direct Current (DC) technology, high-performance pulsed Alternating Current (AC) electromagnetic flow meters, external powered flow meters and battery-operated water meters with 3G information transmission.

In South Africa:

Siemens flow meters combine world-class performance with a low cost of ownership, tailored for the toughest water applications. Siemens assists the Water Boards in efficiently measuring water usage which improves productivity and ultimately the financial health of the Water Boards.

Siemens Future Focus:

Promote greater awareness, among customers and end-users, of the other uses of Siemens flow meters such as; water leakage detection, pipeline water management and irrigation flow measurement.

Siemens Smart Metering Solutions – Addressing Industry Requirements

- Siemens Smart Metering helps in Water Balancing
- Key Features: Designed for Water Industry Application
  One battery driven water meter DN 25 – 600 (1" - 24"),
  10 years battery operation & AC + battery backup

High Precision Flow meters usage across Water Boards

Siemens' high-precision volume measurement flow meters are used by various Water Boards across South Africa, such as Rand Water, East Rand Water Care Company (ERWAT), Lepelle Northern Water, Umgeni Water, Johannesburg Water.

Source: Frost & Sullivan

Manufacturing & Infrastructure

Digitalization and Industry 4.0 ideal for optimizing production costs and enhancing global competitiveness

- Focus on manufacturing to boost **economic prospects** and **create employment**
- South Africa: **Local content** in automobile production to be increased from **39% to 60% by 2035**
- Siemens technology has supported **~57% of SA local car production** in 2018
- **US$ 459 million annual investment** by South African businesses to prepare for impact of 4th Industrial Revolution

Continue

Source: Frost & Sullivan

Mega Trends: Impacting the manufacturing sector in Africa

- Increasing population and rising percentage of urbanisation across African economies will have a significant impact on demand for manufactured goods and the need for creating employment opportunities across manufacturing segments.
- Growing GDP per capita is expected to boost local demand for manufactured goods and while also providing the opportunity to create an export driven manufacturing setup. Local demand alone is however not expected to justify investment in the sector.
- FDI influx in Ethiopia and Ghana has witnessed a positive development owing to government initiatives and policies that are being implemented with regards to improvement in the manufacturing sector, infrastructure etc. Private investment in manufacturing is expected to increase with these initiatives.

Stagnating growth in countries like South Africa impacting disposable income levels, hampering sectors like the automotive industry where new investment in production expansion is constrained.

- Growing imports especially from Chinese and other Asian countries. This has a direct impact on foreign exchange and employment opportunities created in the manufacturing sector. There is a need for reversal of the trend and necessity to increase exports & value add from Africa.
- Reducing local demand and highly competitive global prices are challenging for local African industries. Higher operational costs of production in most African countries when compared to global standards.
- African countries are rich in mineral resources which are exported without much value addition and as such have a lower market value. The finished goods are however imported at a much higher price. Countries are losing out on valuable foreign exchange. Hence, the focus is to develop industries and supply chains that can add value to these raw materials and contribute in a greater way to the local economy.

Continue

Source: Frost & Sullivan

South Africa: Manufacturing sector overview

Prominent Manufacturing Sub – Sectors, South Africa, 2018

01 **Mining, Metals & Cement**
02 **Food & Beverage**
03 **Automobile Manufacturing**

Manufacturing Sector Challenges, South Africa, 2018

Issues pertaining to stability of electricity supply and rising costs of electricity/energy has eroded manufacturing margins that South African industries enjoyed in the past

Under utilised capacity, lower productivity levels and labour unrest have negatively impacted margins and net operating surplus levels

Development of local supply chains and content are not exactly aligned with the requirements of the country's manufacturing industry. This would also entail technology modifications that suit local operating environments and skills available.

Availability of proper infrastructure is a key impediment to the manufacturing sector in the country. Logistics and inefficient modes of transportation not only add to final product cost but also incur additional time in reaching the final destination.

Manufacturing Sector Initiatives, South Africa, 2018

Increasing automobile production to 1% of the total global production from the current 0.68%. Local content utilisation also to be increased from 39% to 60% by 2035.	Investment of USD 459 million annually by South Africa businesses up until 2021 to prepare for the impact of the fourth industrial revolution.
Manufacturing Competitive Enhancement Programme (MCEP) to improve competitiveness of existing manufacturing facilities.	Mineral beneficiation (PGM) for fuel cell industry development. Growing market share of domestic mining equipment manufacturers. Mandela Mining Precinct focusing on mining efficiencies, mining 4.0, modernisation etc.

Continue

Source: Frost & Sullivan

Automation, Digitalization and Industry 4.0. The ideal platforms for addressing concerns of the African manufacturing sector for achieving optimal production costs and enhancing competitiveness in the global/ export markets. However, implementation has its challenges

Key Imperatives	Automation Implications
Operational Efficiency Plan, manage and operate economically	Managing supply chains, resource utilisation and production processes efficiently; minimizing delays and production related losses.
Business Sustainability Growth amidst challenging business environment	Leapfrog technology adoption to enhance quality and competitiveness in global export markets.
Asset Performance and Management Connected assets	Data analytics, predictive maintenance and reduced production down times.

Source: Frost & Sullivan

Continue

Outlook: The African manufacturing sector is expected to witness a gradual transformation with cost and skill implications of technology adoption emerging as key challenges for the sector

Siemens Digital Twin:
The digital twin in the automotive industry is the precise virtual model of a vehicle or a production plant. It displays their development throughout the entire lifecycle and allows operators to predict behaviour, optimizing performance, and implement insights from previous design and production experiences. Siemens offers the digital twin of product, production and performance that helps reduce the number of prototypes, predict performance of production and products through a combination of domain expertise and optimized tools.

In South Africa:
Siemens technology automates, drives and intelligently controls assembly lines, paint shops and body shops. Siemens also plays in integral role in the manufacturing process of the upstream automotive segment with industrial control technology playing a role in the automotive component and the tyre manufacturing industry.

Siemens Future Focus:
Siemens is committed to working together with its customers to ensure that their production facilities run at optimal efficiency. Siemens digitalization solutions make it easier for manufacturing entities to adapt quickly to new market situations and evolving technology while ensuring greater flexibility in meeting customer specific requirements.

Siemens Digital Twin – Electric City Car

Uniti, Sweden used Siemens engineering to develop their electric city car. Employment of the digital twin optimized development of the new car, allowing simulation and optimization of design in a complete virtual environment. Simcenter and Tecnomatix platforms ensured efficient production planning.

Comprehensive Product Portfolio

Siemens offers a comprehensive portfolio of products, solutions, systems and services that optimizes the entire product and production lifecycle of Automotive companies – from efficient product design to flexible production and maintenance of the plant and supporting some of the largest automotive manufacturers in South Africa.

Continue

Source: Siemens / Frost & Sullivan

An understanding of the impact of digitalization & advanced manufacturing on processes exists. Steps are being taken by governments and industry associations for their adoption to increase competitiveness in local and global markets

Appetite for Technology Adoption / Digital Transformation 2018

Manufacturing Sub-Sector	South Africa	Kenya	Ethiopia	Ghana
Automobile Manufacturing & Assembly	Mature	Developing	Early	Developing
Food & Beverage	Developing	Developing	Developing	Early
Mining, Metals & Cement	Developing	Early	Early	Developing
Pharmaceutical	Developing	Early	Early	Early
Leather, Textile & Light Manufacturing	Early	Early	Early	Early

Early Developing Mature

Contribution of the manufacturing sector has been declining across key economies like SA and Kenya.

South Africa and Kenya are expected to be at the forefront in adopting digital platforms for manufacturing.

ROI is a key metric for determining investment in digital platforms across manufacturing sector.

"The automobile sector has a greater appetite for Digitalization and Industry 4.0 platforms. However, new investments in the sector will be gradual and governed by market demand. This will invariably impact the demand for advanced automation and digital solutions in the short to medium term."

-NAAMSA

"Manufacturing conglomerates have a preference for global OEMs which hampers participation of local players. Increased local OEM participation would increase demand and procurement of automation & digital products and solutions from regional partners and solution providers."

- Local Automotive Assembly Line Developer

"Technology and vendor preference for local OEMs is defined by product cost, service network, technical expertise & capabilities, availability of product/ stock
and past experience of the OEM with the brand."

- Global Mining Equipment OEM

Source: Frost & Sullivan

Conclusion

In line with global peers and the business transformation, mindset shift is key to success

Growth Focus

Challenge - specific solution focus

- Partner with solution providers who can be your business transformation enablers
- Transform from focus on capital (CAPEX) and operational (OPEX) expenditure to total expenditure (TOTEX)

Smarter Operations

- Utilise technology to drive down operational costs and shift to lifecycle/ outcome based service mode
- Demand proof of value (POV) based pilot projects
- Transform from plant centricity to business centricity – think of business objectives while adopting technology

Align with Government Initiatives on Technology Adoption & Localization

- Consider automation and digitalization as an enabler of skilled force development and workforce augmentation rather than skills replacement

Continue

Conclusion

We hope you enjoyed reading through the findings and look forward to sharing further insights related to specific countries and industries.

In the meantime, please reach out to us to start your digital transformation journey.

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