MANUFACTURING

BCX

Leveraging Industry 4.0 to Create Smart Factories

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DIGITALISATION IN MANUFACTURING

Digitalisation is defined as the pervasive incorporation of digital technologies into a system and it is having a major impact across all business verticals as increasing numbers of digital solutions are implemented in business processes.

The core of Digitalisation is the mass adoption of connected digital devices and applications across all aspects of private, public and commercial life.

At the business level, Digitalisation looks not only at the increasing adoption of digital technology within business processes, but how these digital processes can be integrated and optimised in order to leverage greater business potential and interact more seamlessly with the new, digitally savvy consumer.

The manufacturing sector for example, has been successfully employing ICT innovations for many years now. According to Germany's National Academy of Science and Engineering and its recommendations for implementing the strategic initiative Industrie 4.0 in the German manufacturing industry for example, approximately 90% of all industrial manufacturing processes are already supported by ICT[1].

Digitalisation is, however, having a major impact as it is being leveraged to improve productivity and optimise resource planning and control. By embracing increasingly digital processes and solutions, factories can gain a significant competitive advantage.

Within a lot of industrial environments, technology solutions are often process-specific. This means that they provide solutions at specific designated points in the industrial process.

The problem with these process-specific point solutions is that they do not give a clear view of the entire value chain as they can only report on one task or section. It is therefore difficult to implement a solution that covers an entire industrial facility, as capabilities remain fragmented.

In order to improve the performance and capability of these processes 'smart industrialisation' must be implemented. This takes the embedded technologies that each support a single, specific, process and combines them into an integrated network architecture.

Increased Digitalisation in manufacturing creates a unified infrastructure, enabling businesses to build more efficient business models. By having more controlled and streamlined processes in every aspect of the business it is possible to optimise production and therefore profit margins.

Competitive Drivers in Manufacturing:

- Efficiency
- Quality
- Cost
- Agility
- Reduction of defects
- Reduction of downtime

There are two major systems that can be integrated to enable smart industrialisation.[2]

1. Industrial Services

The industrial services architecture looks at optimising the service-delivery, production, or output of the business. This involves integrating and streamlining all the internal business processes.

It also includes enabling mobility and online collaboration systems for staff in order to improve productivity and flexibility in the workforce.

2. Integrated Business

The integrated business architecture focuses on enabling a culture within the business of continuous improvements and innovation.

This includes streamlining and centralising management and governance as well as integrated plans for incident response and management.

Smart industrialisation drives a process of integration and alignment that enables a unified infrastructure and associated processes. This industrialisation of digital solutions enables manufacturers to integrate and manage both horizontal and vertical value chains within a business.

Horizontal Integration vs Vertical Integration

Horizontal integration refers to the integration of various IT systems across the different manufacturing and business process planning that involve an exchange of information, energy, or information. This includes areas such as logistics, production and marketing. The goal of implementing horizontal integration is to deliver a complete end-to-end value chain.

Vertical integration, on the other hand, refers to the integration of various IT systems at different hierarchical levels within a company. This includes sensors, controls, production management and corporate planning. Vertical integration creates a complete, single view of all processes and enables a central dashboard that can be used to monitor and control every aspect of production.

This has the impact of increasing the digitisation and interconnection of products and services. It therefore allows the business to adopt new and disruptive business models that promote horizontal co-operation across value chains and encourage the integrated use of data and analytics.

The current trend of Digitalisation in manufacturing is sometimes referred to as the fourth industrial revolution or industry 4.0[3] and is characterised by the increasing digitisation and interconnection of various business processes.

[1] Recommendations for implementing the strategic initiative INDUSTRIE 4.0 – Acatech - 2013
[2] Smart Industrialisation - Cisco - 2010
[3] Opportunities and Challenges of the Industrial Internet - PWC and strategy - 2014

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INDUSTRY 4.0: THE FOURTH INDUSTRIAL REVOLUTION

The industrialisation of manufacturing first began with the introduction of the first mechanical manufacturing equipment at the end of the 18th century.

In this first industrial revolution, machines such as the mechanical loom revolutionised how goods where made[4]. Steam-powered engines meant that manufacturing was no longer solely reliant on human labour efforts for production for the first time in history.

The second industrial revolution began at the turn of the 20th century, as electricity was introduced into business on a large scale. This second revolution enabled massive gains in production output by combining electricity-powered mass production with a new assembly line and division of labour approach.

The third industrial revolution, which began in the early 1970s, was a result of the advent of computers. It employed electronics and IT to make major advances in automation and process control, creating increasingly efficient and productive factories. This revolution was also the pivotal point at which machines replaced not only increasing numbers of manual labourers, but also some of the 'brain-work' involved in managing a large manufacturing plant.

The fourth industrial revolution, or industry 4.0, is the term that has been given to the stage that manufacturing is entering now as embedded digital systems, which can draw on the power and scale of the internet and cloud services, and which are being built into the manufacturing process.

The point of an industrial revolution is, however, that even though it is underpinned by a certain technology, it is not the technology itself that brings about changes. It is how the technology is applied.

The increasing pace of technological innovation over the last few decades has created a radical transformation in every aspect of society, from how people live and work, to the mechanisms that run many industrial processes.

For the manufacturing sector, the effects of industry 4.0 can be seen in greater automation, data gathering and exchange, and value chain digitisation. Some of the business implementations that identify industry 4.0 include: interoperability, virtualisation, decentralisation, real-time capability, service orientation and modularity.[5]

By embracing industry 4.0 in manufacturing, it is possible to create solutions to global challenges, such as resource availability and energy efficiency, by creating more efficient, productive and 'smart' factories.

[4] Recommendations for implementing the strategic initiative INDUSTRIE 4.0 – Acatech - 2013
[5] Design Principles for Industry 4.0 Scenarios - Technische Universität Dortmund - 2015

Outcomes of Digitalisation in Manufacturing:

- stronger digital links between design and production;
- fully inter-connected machines, factories and supply chains;
- greater transparency in the manufacturing process;
- an increasing amount of data being gathered, analysed and acted upon across the entire product lifecycle; and
- big data analytics and increased network connectivity being leveraged for greater efficiency and productivity.

The Key Features of Industry 4.0

The journey towards industry 4.0 will be a process of evolution for many businesses as current technologies are adapted and upgraded to meet the requirements of increasingly digitalised processes. There are several key features that need to implemented in the manufacturing environment in order to successfully embrace the principles of industry 4.0[6].

Standardisation: this involves the networking and integration of all key stakeholders across the value chain. This is made possible through the establishment of a set of common standards.

Managing complex systems: as manufacturing systems become increasingly complex, appropriate planning and explanatory models enable the management of increasingly intricate systems.

Connectivity: the Digitalisation of manufacturing processes requires a comprehensive broadband infrastructure and a reliable communication network to ensure consistent and high-quality connectivity.

Safety and security: safety is a major concern in any manufacturing environment. Digitalised systems must have built-in safety controls to protect personnel and the environment. Moreover, there must be security measures in place to protect all digital data against misuse, loss and unauthorised access.

Staffing optimisation: introducing Digitalisation in a manufacturing environment can vastly alter the working environment and the role of employees. With major shifts in the required job and competence profiles, it will be necessary to introduce training strategies and reorganise staff deployment.

Regulatory framework: as digital processes in manufacturing become increasingly advanced and sophisticated, it will be necessary to update current legislation, particularly around corporate data, liability issues, handling of personal data and trade restrictions.

Return on investment: digital manufacturing systems will be more resource efficient than ever before. This efficiency must, however, be balanced against the cost of implementing a new system. Careful calculations around return on investment must be considered when looking at the resource and productivity efficiency that can be gained from industry 4.0.

[6] Recommendations for implementing the strategic initiative INDUSTRIE 4.0 – Acatech - 2013

03

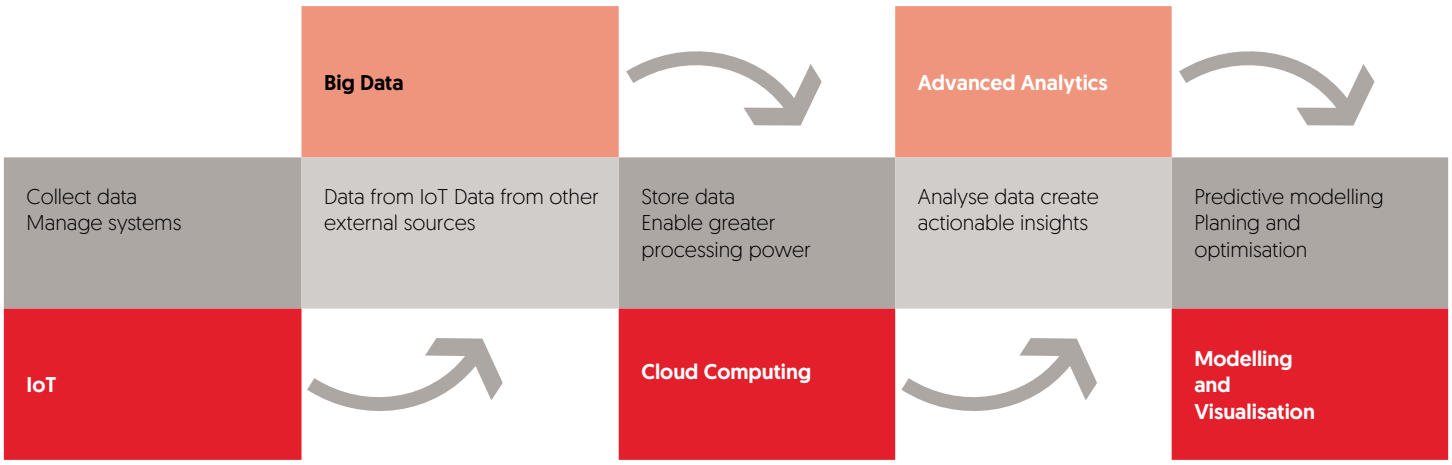
DIGITALISATION IN MANUFACTURING: SYSTEMS AND TECHNOLOGY

New digital technologies are making it possible to create networks that incorporate the entire manufacturing process, creating new smart factories.

Complete cyber-physical systems that combine smart machines, warehousing and production facilities have been developed, creating digital end-to-end IT based manufacturing processes. These incorporate the entire value chain, from inbound logistics to production, marketing, outbound logistics and after-sales service.

While technologies such as the Internet of Things (IoT), big data, cloud computing and advanced analytics are all digital trends in their own right, it is how they work together to enable the compete modelling and visualisation of processes in a smart system that enables manufacturers to leverage them and optimise the entire production eco-system.

Figure 1: Creating a Smart System



By using these tools to integrate industrial software and automation, it is possible to expand networks and create business-specific industrial services. Integrated ICT solutions allow information to flow more easily across internal processes as well as up and down the value chain to suppliers and consumers.

Digitalisation is causing increased transparency in the manufacturing industry as it enables increased integration and communication across the entire product value chain. For example, dynamic ordering processes allow for the constant monitoring and adjustment of material delivery.

By enabling smart connected systems that can monitor and track the availability of raw materials and streamline the inbound logistics of sourcing them, it is possible to optimise production output and minimise wastage. This creates a more agile manufacturing process that can respond proactively to supply problems before they impact production.

A comprehensive shared database can be created that extends across product design, production planning, sourcing of raw materials, engineering processes, and logistics and warehousing. This system should incorporate suppliers and consumers and create an end-to-end view of the entire value chain. Insights from this should feed back into the system to create smarter, more optimised, less wasteful processes in every aspect of the product eco-system.

By enabling these technologies to create an integrated digital value chain, manufacturers are creating a new type of data-driven business model, where big data analysis is a key driver of business strategy.

Simulating, testing and optimising processes can help ensure quality before full-scale production and roll-out, while gathering and analysing data on an ongoing basis make it possible to constantly monitor and refine processes. Feedback from both the production process and the end consumers can also be collected and analysed for further insights. End-to-end data integration enables predictive maintenance, helping plants to avoid unnecessary breakages and unscheduled downtime.

By taking a digitally integrated approach to manufacturing, it is possible to reduce costs, improve quality and unlock new products, markets and revenue streams.

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INDUSTRY 4.0 IN ACTION: SMART FACTORIES

One of the key features for industry 4.0 is the rise of so-called ‘smart factories’.

Smart factories embrace Digitalisation across the entire value chain, embedding digital processes, tracking and optimisation into every aspect of the manufacturing process.

In a smart factory, the people, machines and resources can all communicate with each other through an integrated networked system. Because of this, smart factories are able to manufacture goods more efficiently as they are better able to manage complexity and are less prone to disruption.

There are several key components that work together to make a fully integrated smart factory.

1. **Smart building:** all building infrastructure in a smart manufacturing environment should be connected and managed from a central location. Features such as air conditioning, lighting, security and access, and safety alarms and sensors can all be controlled by a central system.
2. **Smart product:** in a fully optimised manufacturing environment, it should be possible to track the product being produced through every stage of its production and distribution lifecycle.
3. **Smart grid:** in a manufacturing environment, it is important to track and optimise the usage of utilities such as water and electricity. Any wastage in this area can have major cost and environmental implications.
4. **Smart mobility:** workers should be equipped with mobile devices that enable them to track and analyse systems and processes, in real-time, from the factory floor.
5. **Smart logistics:** accurate stock and raw material tracking ensures that production is optimised and products are distributed efficiently.

These features allow production to be configured in new ways that optimise flexibility and resource usage and reduce wastages and inefficiencies. They also allow for a centralised management and control function, providing a dashboard view of the entire value chain.

Features of a Smart Factory

There are a number of disruptive trends that are being utilised to enable Digitalisation in the manufacturing sector and to create smarter factories. Some of the key features that differentiate a smart factory from earlier predecessors are:

The latest ICT offerings: technologies such as big data, the Internet of Things (IoT), and cloud services can be used to reduce costs around the gathering and storage of data and create a centralised database where all the gathered information is stored.

Data and analytics: all available data is gathered and analysed on all processes and systems. A combination of descriptive. and prescriptive analytics is then utilised to show not only current production levels, but also areas for improvement. Through advanced analytics it is possible to vastly improve the accessibility and readability of data, creating actionable insights that can make a major difference to factory management and optimisation.

Machine learning: the Digitalisation and automation of knowledge networks have led to breakthrough advances in artificial intelligence and machine learning. By taking all the data that is being gathered and stored, and applying advanced analytics and improved algorithms, smart machines can use feedback loops to optimise their own performance.

Scheduling and controlling: all processes can be scheduled and rescheduled through simple digital programs. The system can also adapt to sudden changes and allow for autonomous planning and rule changes.

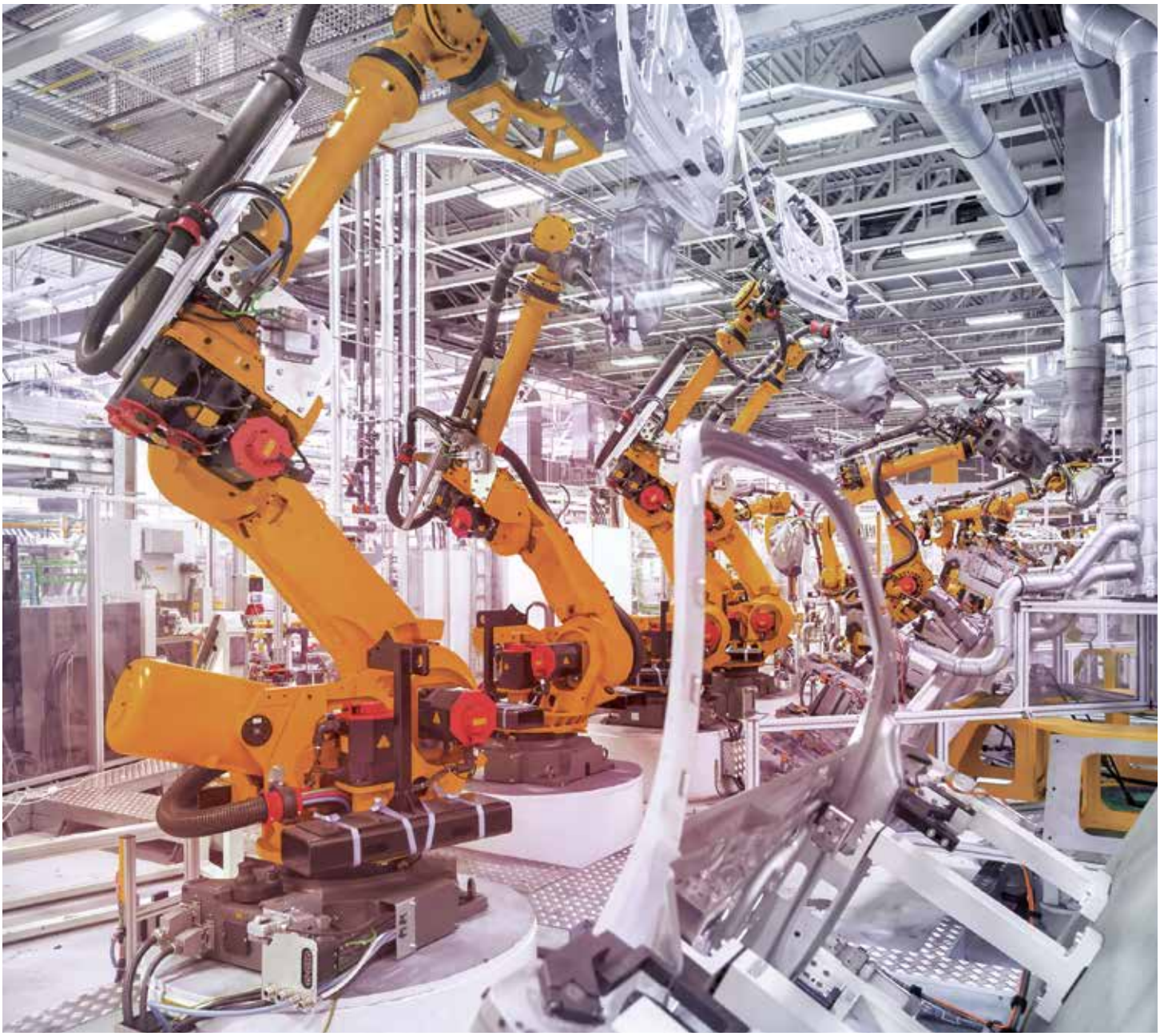
Failure prediction: monitors and sensors can detect signs of failure in an otherwise stable plant and track environmental changes or other influencing factors. They also allow for the monitoring of the status of a project or process.

Structural health monitoring: by using sensors and trackers to monitor the structural health of the various components in an industrial system, it is possible to reduce diagnostic costs and improve the efficiencies of repairs.

Simulation and virtualisation: digital factories make use of simulation and modelling technologies to run 'what-if' scenarios and evaluate both the system and the schedule robustness. This enables the assessment of key performance indicators and the evaluation of autonomous planning rules.

Human/machine interaction: the ubiquity of mobile devices has led to a major shift in how people interact with technology. People expect information to be presented to them in simple and intuitive ways. There has therefore been a growth in touch interfaces and next generation user interfaces that can display complex information using a smart dashboard to make the information actionable and easy to understand.

Convergence of the digital and the physical: advanced robotics and human robot collaboration are enabling a more adaptive approach to manufacturing. For example, processes such as 3D printing allow manufacturers to increase the range of materials used and introduce greater precision and quality into the process.



05

OPPORTUNITIES FOR INDUSTRY 4.0: BENEFITS OF SMART MANUFACTURING

By implementing the latest technologies into the manufacturing process, it is possible to disrupt the entire value chain.

This can create major opportunities for manufacturers who want to optimise output and efficiencies. Some of the opportunities presented by Digitalisation in manufacturing include:

Increased Customer Centricity

Digitalised processes make it easier to quantify and meet individual customer requirements. Customer-specific criteria can be built directly into the design, ordering, building and shipping of the product. It is also increasingly possible to have lower batch numbers or produce one-off items without losing process efficiency or incurring additional costs and wastage.

Increased Flexibility

Smart networks and centralised control systems enable the dynamic configuration of processes to suit current needs around output, product configuration and quality.

Data-enabled Decision Making

Smart factories create end-to-end transparency of the manufacturing process and enable data gathering and analysis from all points in the value chain. This allows for optimised decision making through advanced data insights and analysis.

Improved Resource Planning and Usage

One of the key goals of manufacturing is to create the highest number of products from a given volume of resources and materials. Smart systems enable the optimisation of resource usage on an ongoing basis, enabling the greatest possible production output.

New Business Models

Digitalisation is creating disruption and innovation in all industries. This is also true of the manufacturing industry, where new models of value creation are being unlocked through the deployment of smart algorithms and big data analysis.

06

CHALLENGES FOR INDUSTRY 4.0: CONSIDERATIONS AROUND SMART INDUSTRIALISATION

There are several challenges that manufacturers need to consider when implementing a smart industrialisation system.

Some of these include:

The Location of Sensors

Deciding on the optimal placement and arrangement of sensors in order to get data that is accurate and representative of the process can be very important. Sensors also need to be in an accessible place so that they can be maintained and replaced as necessary, as the replacement cycle on the sensors will often be much shorter than the mechanisms they are monitoring.

Data Aggregation

One of the main challenges when implementing smart industrialisation across a number of processes and systems is collecting all the data in an aggregated way. By aggregating the data, it is more easily collected, stored, compared, analysed and visualised. In order to be effective, sensor data must also be easily available and monitored at a high speed and frequency.

Business Case and ROI

While smart industrialisation has the potential to greatly transform a business, it is difficult to formulate a plan for the most optimal configuration. Careful analysis of the cost versus the expected returns is needed before implementing a new digital system.

Data Protection and Cybersecurity

A major concern for most businesses, including those in the manufacturing sector, is one of data security. As the use of systems such as cloud storage increases, these companies need to know that their information is secure and that proprietary information will not be exposed in any way.

As the entire manufacturing eco-system becomes more integrated, the exponential increase in connected devices means that information security becomes more important than ever before. As there are more points that data can pass through, so there are more points of vulnerability that potential hackers could exploit. Security measures will therefore need constant upgrading to keep ahead of potential threats.

Need for Qualified Employees

As the technological systems and processes governing the running of industrial environments become increasingly complex, there is an ever-greater need for skilled employees to manage and monitor the various systems.

Vendor Management

It is important to have a vendor who can implement a complete end-to-end solution across all systems and processes. This will give the business a single unified view of the data that can be more easily gathered and analysed.

It is also important to have the right mix of local and international vendors. While an international vendor may have the scope to supply high-level solutions to large manufacturing plants, local vendors are essential to understand and implement basic ICT services at a local level. This can be essential when it comes to optimising connectivity up-time and ensuring fast and efficient technical support.

07

ENABLING DIGITALISATION: BCX

BCX provides Africa's only end-to-end digital solution and has the power to take care of all your current and future digital needs.

BCX not only provides the necessary tools for digital transformation, but understands the importance of transforming in order to stay relevant for a new generation of customers.

BCX helps its customers build a foundation, based on strong technology offerings that will enable them to successfully develop a future business strategy designed to optimise business processes.

As one of the largest ICT services providers in Africa, we have a clear focus on serving the enterprise, public sector and SMB market segments, both in South Africa and across Africa.

Our passion is to seamlessly connect every business to a digital future. Our solutions are offered end to end — ensuring that your business benefits from every economy of scale and superior service quality.

08

THE BCX KEY DIFFERENTIATORS

BCX is one of the largest ICT services providers on the African continent with a clear focus to serve the enterprise, public sector and Medium market segments across the continent.

Our passion is to seamlessly connect every business with its digital future. All the solutions are offered end-to-end, ensuring that your business benefits from economy of scale and superior service quality.

Unmatched Data Centre and Network Infrastructure	Telkom's footprint includes 3 Tier 4 data centres, 147 000 kms of fibre and over 2700 mobile sites integrated throughout South Africa.
Unrivalled ICT Solutions Set	Proven ICT capabilities, with market leadership positions on both IT and telecommunication services.
Industry-Vertical Leadership	Market leader in retail, mining & manufacturing, banking & financial services (Gartner). Also key solutions provider for the public sector.
Leader in Service Excellence	Leading IT service management with an ITIL maturity rating of 4.25 – The highest on the African continent (Pink Elephant: 2014)
Unparalleled Geographical Reach	Extensive geographical reach with trained IT field engineers in multiple locations across Africa.
Strategic Vendor Relationships	Strong relationships with key technology vendors to ensure best technology solutions.

09

GLOSSARY OF ACRONYMS

3G
Third-generation wireless telephone technology

AI
Artificial Intelligence

IT
Information Technology

ICT
Information and Communications Technology/ies

IoT
Internet of Things

ITIL
Information Technology Infrastructure Library

LTE
Long-Term Evolution

ABOUT BCX

BCX is one of Africa's leading premier ICT solutions and service provider with the technology, capability and skills to deliver end-to-end digital solutions for large and medium enterprises in the public and private sectors. BCX leads with an unrivalled ICT solutions embedded on the foundation of unmatched Data Centre and Network Infrastructure and include world class solutions in ICT consulting and digital readiness assessments; a complete range of managed solutions that include both LAN and WAN; unified communications and connectivity solutions. In addition, cloud computing technologies underpinned by best in class security solutions and a host of value added services that include enterprise mobility services and analytics software with a specialised competency in the IOT (Internet of Things) and big data solutions.

BCX is a leader in Service excellence and boasts the largest pool of ICT skills in Africa, unparalleled geographic reach and points of network presence across the continent. Our strategic vendor relationships with leading multinationals enable BCX to deliver best in class solutions across industry verticals with skills and expertise seamlessly deliver integrated services to our customers. BCX is committed to providing ICT solutions that reduce the cost of doing business, increase overall business productivity and empower businesses to use technology as a competitive advantage.

Migrate your business into the digital future – contact thoughtleader@bcx.co.za

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