Deloitte.

Industry 4.0
Is Africa ready for digital transformation?

Contents

About the study

This study sets out opportunities for the South African manufacturing industry and its companies in achieving a successful digital transformation towards 'industry 4.0' and the various challenges associated with it.

Between October 2015 and January 2016, more than 15 personal interviews were conducted with representatives of the CSIR-Meraka Institute, Department of Science and Technology, IDC (International Data Corporation) and Manufacturing Circle and with executives from Bigen Africa, Ford, Hulamin, Nampak, Nissan, Toyota South Africa and other manufacturing companies.

Statements made by representatives and executives that did not wish to be named or to have statements attributed to them have been anonymised.

Introduction

Dear reader

Around the world, the traditional manufacturing industry is in the throes of a digital transformation that is accelerated by the exponential growth of smart technologies. Companies and industrial processes need to adapt to this rapid change and exponential growth if they are not to be left behind by developments in their sector and by their competitors. In today's globalised world, this applies to traditional industrial economies such as Germany and the US, as well as to emerging economies in Asia, Africa and South America.

These new trends are global and universal and cannot be ignored by manufacturing companies. Everybody is affected and will need to adjust to remain competitive. The current digital transformation is not to be compared simply with a greater level of production automation, a process that has been driven by developments in electronics and information technology since the 1970s. The widespread adoption of information and communications technology by the manufacturing industry around the world is now paving the way for completely new disruptive approaches to development, production and the entire supply chain.

Experts use the term 'industry 4.0' to refer to a 'fourth industrial revolution' that will produce, with the help of smart technologies, smart machines and factories, smart products and services and new interaction models among other things, that go beyond simply automating production. The merging of the real and virtual worlds and the networking within an 'internet of things, services, data and people' will transform the future of manufacturing completely and will make it much more competitive for manufacturers that operate across global and local markets.

Currently there are various efforts underway in South Africa which focus on improving the rather subdued local manufacturing industry. It is however equally important to focus on the future of manufacturing.

Our **Africa industry 4.0** report provides a unique local perspective on industry 4.0 and covers the following themes:

- Current and future impact of industry 4.0 on Africa/South Africa and South African manufacturing companies
- Current and future usage of smart manufacturing technologies (i.e. advanced analytics, cloud computing, advanced sensors and robotics as well as additive manufacturing/3D printing)
- Current and future status of technology-enabled interaction models (i.e. mass customisation, crowdsourcing, collaborative consumption and gamification)
- Challenges and risks that manufacturers face in the new industry 4.0 environment (e.g. infrastructure, talent etc.)
- Solutions to maximise the opportunities of industry 4.0

We would like to thank the representatives of official agencies and the management of the companies that took part in our interviews for their views and comments. Their input has enabled us to assess the opportunities and challenges that the digital transformation towards industry 4.0 represents for South African businesses.

We hope you enjoy reading the study and look forward to your feedback.

Karthi Pillay

Africa Manufacturing Industry Leader
Deloitte South Africa

Executive Summary

Increased global competitiveness

Industry 4.0 will make global manufacturing much more competitive in the future. Traditional industrial economies such as Germany and the US expect the fourth industrial revolution to create many competitive advantages and reverse the trend to relocate manufacturing processes to low-cost countries and create new high-tech opportunities at home. Hence, we are seeing strong government funding for industry 4.0 and advanced manufacturing initiatives. China's shift in recent years from a manufacturing-intensive 'made in China' economy to an innovation driven 'designed in China' economy illustrates that emerging countries can also become early adopters of the industry 4.0 trend and increase their global competitiveness.

Leapfrog potential for Africa/South Africa

Compared to the rest of the world, the current adoption and impact of industry 4.0 on the African continent remains low. However, it is a topic that is increasingly being acknowledged and discussed by industry leaders and policy makers, mainly because of the impact smart technologies can make at a socio-economic level. The biggest challenges in Africa/South Africa remain connectivity and accessibility. Further progress in this space will drive broader adoption of industry 4.0 applications by businesses and consumers. More private and public investments and incentives are needed. Africa/South Africa has an advantage over the developed markets because it is not weighed down by infrastructure legacy issues and may have little difficulty in embracing change. Great potential exists for manufacturing companies to directly adopt specific industry 4.0 applications, develop unique local high-tech products and services and even leapfrog global competitors in the future.

Smart technology adoption at foundation stage

The adoption level of smart technologies that accelerate industry 4.0 remains at a foundation stage in the South African manufacturing industry overall, with some sector differences. A stronger usage of advanced analytics exists within the automation and automotive sectors, compared to others. However, the real opportunities of advanced analytics are generally not yet explored by manufacturers. The adoption of cloud solutions is currently more driven by consumers than businesses, with cyber-crime fears and privacy issues cited as main concerns by the latter. Advanced sensor technologies are, with some exceptions (e.g. automotive industry), still at a foundation stage. However, there is a lot of interest among manufacturers to better leverage the potential for monitoring, controlling, tracking etc. Usage of robotics is mostly at an automated stage and not yet at a smart or advanced stage. There is no widespread adoption of 3D printing yet within the South African manufacturing industry, although awareness of the significance and the potential of this exponential technology is high.

Great potential for new interaction models

The increasing trend towards highly individualised and customer-specific solutions is an important topic for South African manufacturers, but mainly as a special service at a higher price and not necessarily as part of the main business. Some flexible manufacturing is taking place, but mass customisation is not yet seen as feasible. There is no strong collaboration with customers through open innovation or crowdsourcing, with IP rights issues and industrial espionage being mentioned as main concerns. The collaborative consumption trend as part of the increasing sharing economy remains a relatively young phenomenon in South Africa. New trends in owning, sharing, trading, renting etc. of manufactured goods and services are slowly being picked up. Gamified applications for marketing purposes, customer retention or employee motivation are also not widely used by South African manufacturers.

Infrastructure opportunities and challenges

To get ready for the exponential speed of change that industry 4.0 will introduce, any old and disparate IT systems of South African manufacturers will need upgrading or replacing. This creates an opportunity to introduce brand new, industry 4.0-ready IT infrastructure. However, cost implications are a key factor in deciding on harmonising and upgrading existing IT infrastructure systems or replacing them. In addition, electricity constraints are seen as an obstacle for the digital transformation towards industry 4.0. Nevertheless, some South African manufacturers see it as an opportunity to embrace renewable energy and become completely self-sufficient. Overall, new investments in infrastructure and new technology are required for greater development and adoption of industry 4.0 applications.

Talent opportunities and challenges

Many South African manufacturers will face major talent challenges when organising their businesses for the digital transformation towards industry 4.0. Different IT skill sets, better skills blend and realignment of skills are necessary. A major challenge for South Africa is also the fact that there is not only a local, but also a global talent shortage for industry 4.0 professionals. An extensive need exists to (re-)train the existing workforce and/or upskill labour to understand and operate new and smart technologies. This is an opportunity for industry and government involvement in the training and development of the digital workforce of the future. However, the mind-sets of many manufacturing companies and government representatives are not yet fully geared towards the inevitable shift to industry 4.0.

What is industry 4.0?

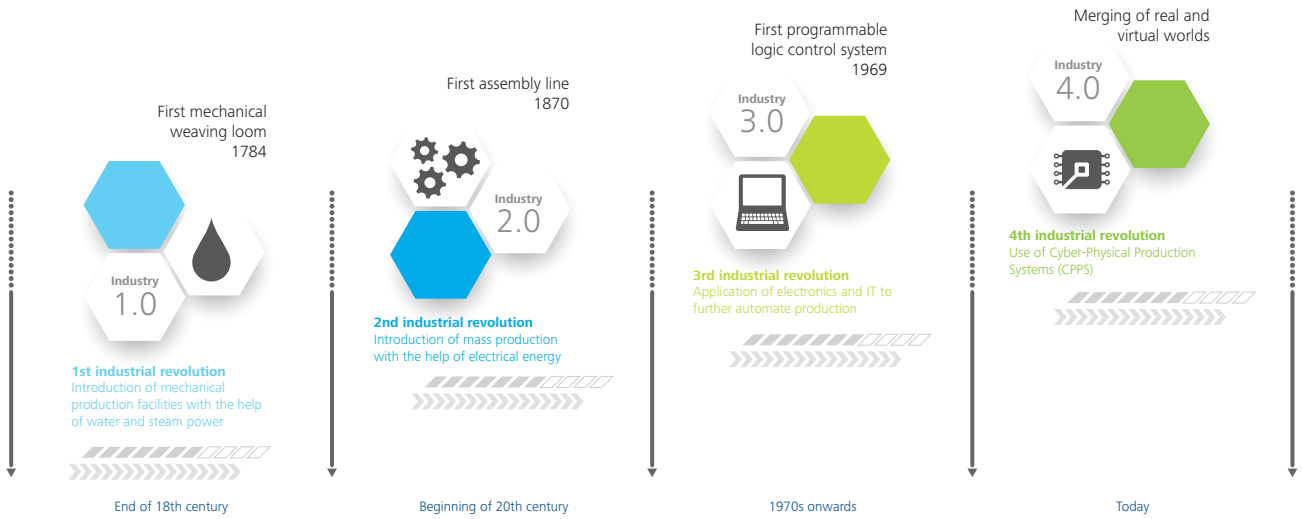
Definition and environment

The term 'industry 4.0' refers to the next developmental stage in the organisation of the entire value chain process in the manufacturing industry. It is also known as the 'fourth industrial revolution'.

The concept of industry 4.0 was first introduced by the German government as a high-tech strategy to promote the computerisation of its manufacturing industry. It is now widely used across Europe and has also been picked up in Asia, especially in China. In the US and the English-speaking world, the terms 'internet of things' (IoT), the 'industrial internet' or the 'internet of everything' are often used as equivalents.

What all these terms and concepts have in common is the recognition that traditional manufacturing and production methods are going through a digital transformation process. For some time now, industrial processes have increasingly embraced modern information technology (IT), but the most recent trends go beyond simply the automation of production that has, since the early 1970s, been driven by developments in electronics and IT (see chart 1).

Chart 1. Evolution of industry 4.0[1]



The widespread adoption by the manufacturing industry of information and communication technology (ICT) is increasingly blurring the boundaries between the real world and the virtual world, and is creating new production systems, namely cyber-physical production systems (CPPSs).

CPPSs are online networks of social machines that are organised in a similar way to social networks. Simply put, they link IT with mechanical and electronic components that then communicate with each other via a network. Radio frequency identification (RFID) technology, which has been in use since 1999, was a very early form of this technology.

Smart machines continually share information about current stock levels, problems, errors or faults, and changes in orders or demand. Processes and deadlines are coordinated with the aim of boosting efficiency and optimising throughput times, capacity utilisation and quality in development, production, purchasing, sales and marketing.

CPPSs not only network machines with each other, they also create a smart network of machines, properties, ICT systems, smart products and individuals across the entire value chain and the full product life cycle. Sensors and control elements enable machines to be linked to plants, fleets, networks and human beings. Full traceability in any part of the value chain and live product data and customer feedback will make it possible to assure and improve overall product and service quality.

Smart factories and their CPPSs are at the heart of industry 4.0, interfacing with other smart infrastructures, such as those of smart mobility, the smart grid, smart logistics and smart homes and buildings (see chart 2). Links to both business and social networks – the business web and the social web – also play an increasingly important role in the digital transformation of manufacturing to industry 4.0.

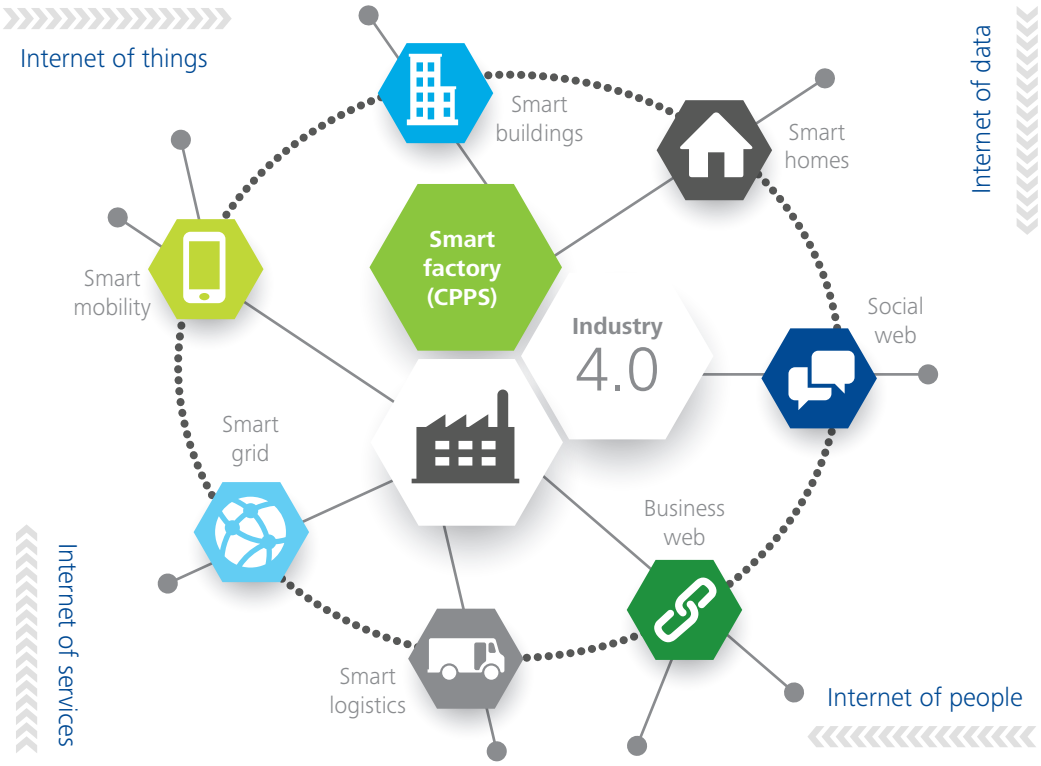
"Lots of companies are often not aware of how some of their data is already connected to potential new market opportunities. For those who are aware, the question is: How do we transform the information contained in data into actionable insights?"

Dalton Lunga Ph.D
Data Scientist and Machine Learning Researcher, CSIR-Meraka Institute

"IoT has the potential to not only transform industries, but societies as a whole. The creation of smart cities with free Wi-Fi and fast connectivity will enable governments across Africa to deliver better services to their people."

George Kalebaila
Senior Research Manager Telecoms & Digital Media, IDC (International Data Corporation) South Africa

Chart 2. Environment of industry 4.0[2]



All these new networks and interfaces offered by industry 4.0 within an 'internet of things, services, data and people' mean that manufacturing is set to undergo enormous changes in future. This trend is still in its infancy in some manufacturing companies, industrial sectors and geographies, but in others, the transformation to industry 4.0 is already well underway.

Traditional industrial economies such as Germany and the US expect this fourth industrial revolution to bring many advantages, ranging from enhanced global competitiveness to the reversal of the trend to relocate production to low-cost countries and opening of more domestic production locations in Europe and North America. Strong government funding for industry 4.0 and advanced manufacturing initiatives are already taking place.

Emerging economies can become early adopters of industry 4.0, acquire capabilities to develop advanced manufacturing systems and leapfrog their global competitors with unique locally-developed high-tech products and services. China's shift in recent years from a manufacturing-intensive 'made in China' economy to an innovation driven 'designed in China' economy clearly illustrates that opportunity.

"A lot of incentives would be required, before widespread adoption of industry 4.0 applications amongst South African manufacturers will happen."

Coenraad Bezuidenhout
Former Director, Manufacturing Circle

"South Africa as a whole is still at a formative stage when it comes to the adoption of IoT applications. There is a foundation, but widespread adoption is lacking."

George Kalebaila
Senior Research Manager Telecoms & Digital Media, IDC (International Data Corporation) South Africa

Smart technologies and trends

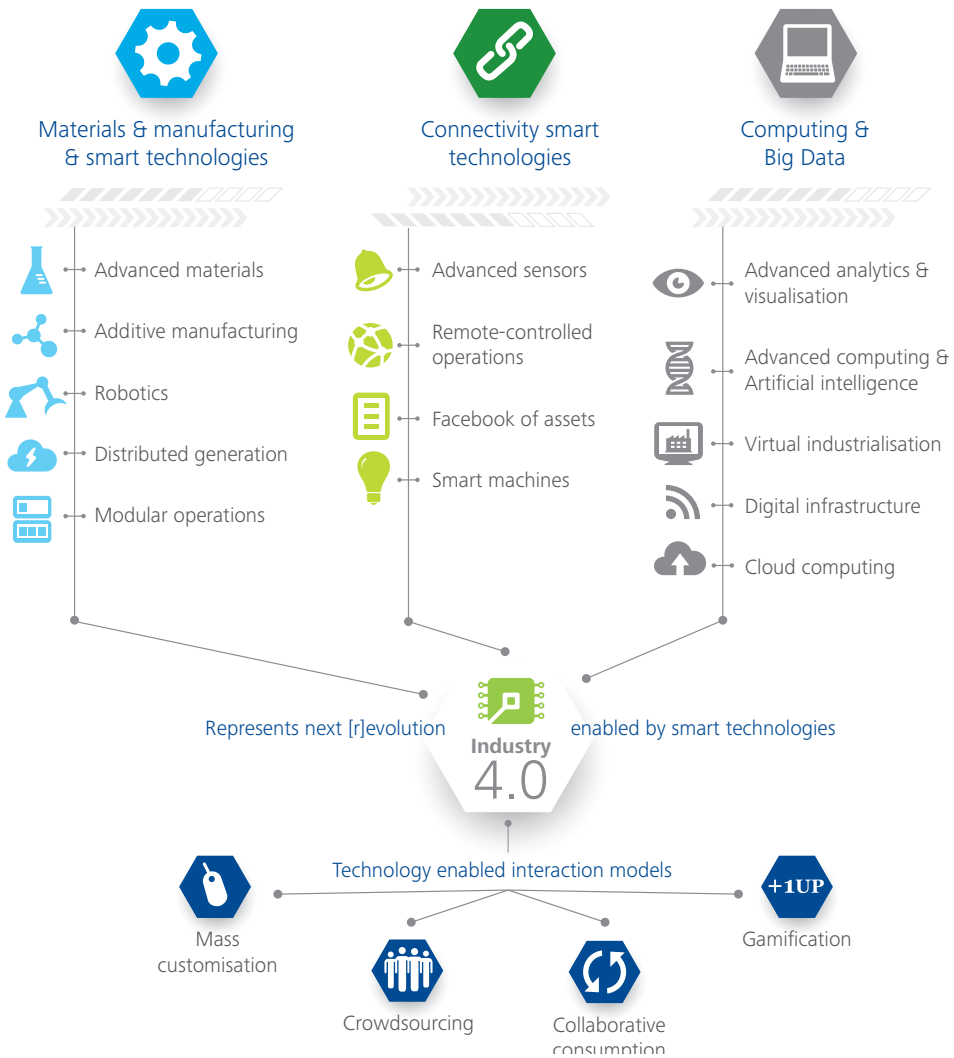
Different smart technologies are helping to speed up the digital transformation of manufacturing and enable a decisive move towards industry 4.0 (see chart 3).

The most crucial smart technologies for this digital transformation are in the field of advanced materials and manufacturing processes, which extensively leverage connectivity and use advanced computing and big data capabilities. In addition, these smart technologies will facilitate new cooperation and interaction models with suppliers, business partners and customers (e.g. crowdsourcing, gamification, mass customisation and collaborative consumption).

"80-90% of companies are yet to experience the advantage of artificial intelligence, machine learning and advanced analytics and how it can benefit their businesses and help to develop new products and services."

Dalton Lunga Ph.D
Data Scientist and Machine Learning Researcher, CSIR-Meraka Institute

Chart 3. Smart technologies and trends[3]



The smart factories of the future will organise themselves and enable production that is collaborative, customer-specific and individualised. This requires data to be extensively integrated. Smart sensor technology is needed to help with monitoring and autonomous organisation.

However, besides autonomous and smarter organisation of production management, smarter maintenance management will be possible. Resources and products can be networked, and materials and parts can be located anywhere and at any time. All processing stages in the production process can be logged, with discrepancies registered automatically. Amendments to orders, fluctuations in quality or machinery breakdowns can be dealt with more rapidly. Smart technologies enable wear and tear on materials to be monitored more effectively or pre-empted. All in all, waste is reduced.

In addition, a new generation of local and global value chain networks will be created with the help of smart technologies. These new value-creation networks are real-time optimised networks that enable integrated transparency, offer a high level of flexibility to respond more rapidly to problems and faults, and facilitate better local and global optimisation.

Smart networking from inbound logistics through warehousing, production, marketing and sales to outbound logistics and downstream services will be possible. The history of any part or product can be logged and accessed at any time, ensuring constant traceability (a concept known as 'product memory'). This can create transparency and flexibility across entire process chains. Customer-specific adaptations can be made not only in the production but also in the development, ordering, planning, composition and distribution of products. This can enable factors such as quality, time, risk, price and environmental sustainability to be handled dynamically, in real time and at all stages of the value chain.

Industry 4.0 already requires automation solutions to be highly cognitive and highly autonomous. Artificial intelligence, advanced robotics and sensor technology have the potential to increase autonomy further still and to speed up the mentioned collaboration, individualisation and flexibilisation. Artificial intelligence not only helps to plan driverless vehicle routes in factories and warehouses more flexibly, save time and cost in supply chain management, increase reliability in production and analyse big data, but can also help to find new construction and design solutions and enhance the cooperation between humans and machines across the whole value chain up to the point of services.

The strong global market outlook in the coming years for smart machines, smart sensors and industrial robotics emphasises the significant potential for industry 4.0 and IoT applications in the manufacturing industry (see chart 4).

"Web-based collaboration platforms that allow input on an ongoing basis are highly beneficial. These smart and mobile technologies can simplify site surveying while being offline or online. Changes to construction plans can be made onsite and offsite and can be easily shared."

Deon Fabel
CIO, Bigen Africa

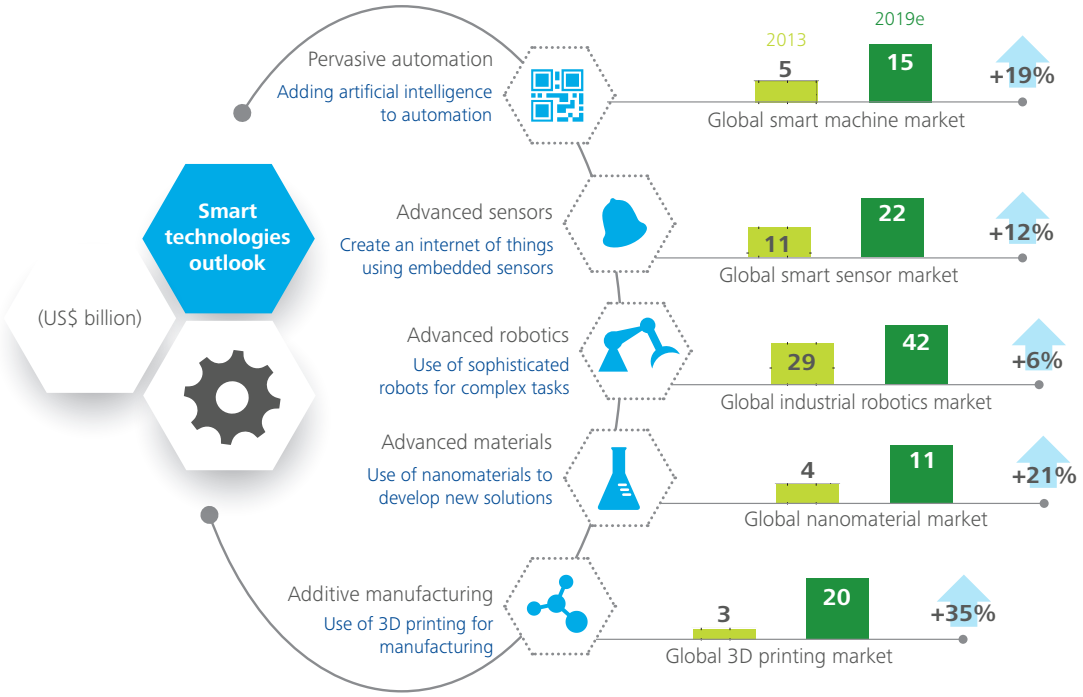
"There is a definite potential for South African manufacturing to benefit from smart logistics and smart supply chain solutions, which focus strongly on smarter, leaner and more efficient systems and processes that help to reduce complexity and waste."

Nigel Ward
Senior Vice President,
Toyota South Africa

"Mobile technology has brought many advantages to remote maintenance processes. It is now possible for our engineers to do quick maintenance from home in a very efficient way."

Richard Jacob
CEO, Hulamin

Chart 4. Smart technologies market outlook[4]



An even stronger global market growth, albeit from a lower base, is also expected for nanomaterials and additive manufacturing (3D printing).

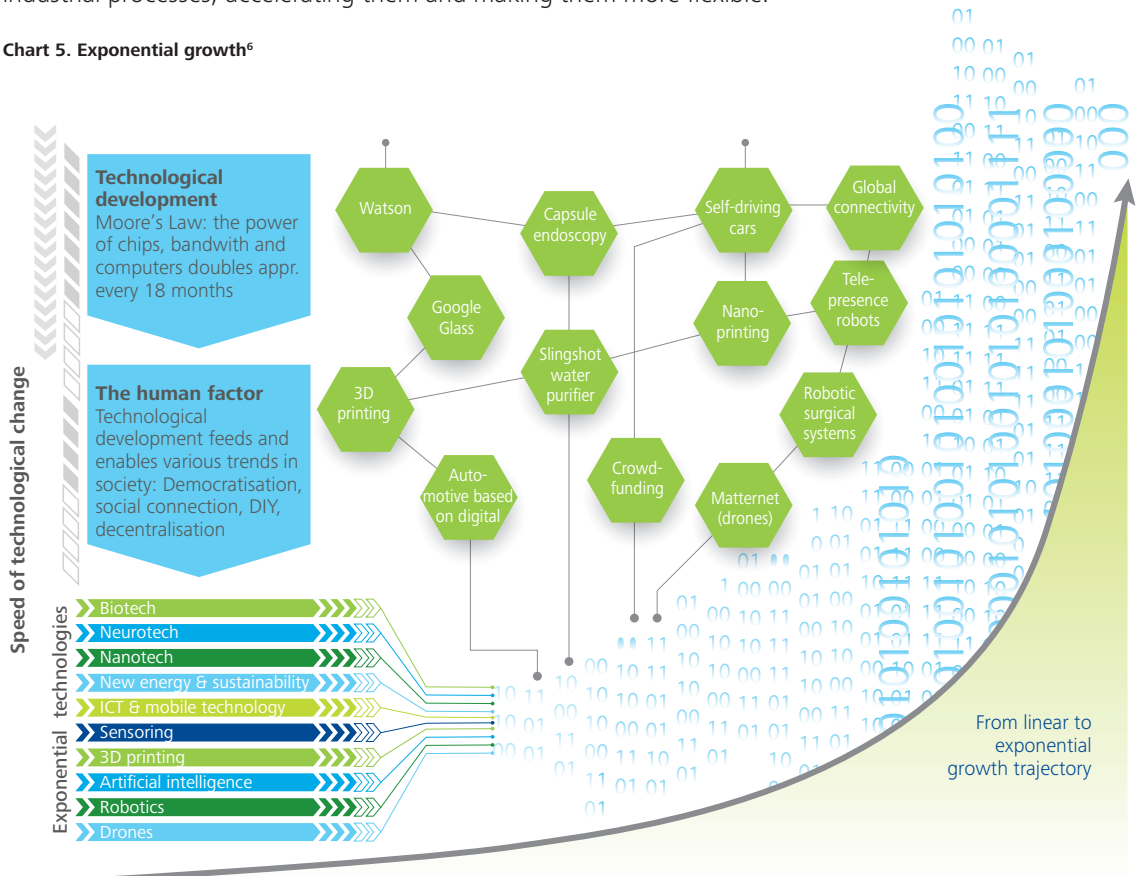
Nanosensors and functional nanomaterials can be used in an industry 4.0 environment in production control functions to make quality management more efficient or allow the production of next generation robots that work 'hand in hand' and safely with humans. Additive manufacturing (3D printing) is an example of a smart technology that will accelerate industry 4.0 and make it more flexible. 3D printing can enable new production solutions (e.g. functionality, higher complexity without additional cost), new supply chain solutions (e.g. inventory reduction, faster delivery times), or a combination of both that can lead to disruptive new business models (e.g. disintermediation of supply chain members, customer integration).

Exponential growth as an accelerator

One important aspect of smart technologies is that the majority of them are growing exponentially and will further accelerate the digital transformation of traditional manufacturing towards industry 4.0 (see chart 5).

Research has shown that Moore's law – which states that the capacity of microchips, bandwidth and computers doubles every 18 months, representing exponential growth – also applies to other technological developments[5]. Additive manufacturing, sensor technology, robotics, artificial intelligence, nanotechnology or drones are just a few examples of exponentially growing smart technologies that are radically changing industrial processes, accelerating them and making them more flexible.

Chart 5. Exponential growth[6]



Many of these smart technologies are not new and were, in fact, 'invented' some 20 to 30 years ago. However, the recent massive boost in computing power (Moore's law) and the reduction in cost, along with miniaturisation, now make them suitable for industrial use.

New technologies can be overrated and can cause concern, because of the slow development curve in absolute terms at the beginning. When the exponential development takes off, the influence of such technologies is often underestimated and disruptive market changes are missed. Several of these smart technologies will be leaving their linear growth paths in the coming years and we are expecting exponential growth. This exponential growth will fundamentally shape and accelerate industry 4.0.

How does Africa/South Africa stack up?

Current impact of industry 4.0

The majority of our interviewees believe that industry 4.0 will have a strong impact in the coming years on Africa/South Africa in general and especially the South African manufacturing industry. The current adoption and impact of industry 4.0 in Africa/South Africa is still relatively low, compared to the rest of the world.

Emerging economies have more constraints than the developed world when it comes to new technology adoption. However, it is a topic that is increasingly being acknowledged and discussed by industry leaders and policy makers. The biggest challenges on the African continent remain connectivity and accessibility, and progress in these will drive broader adoption of industry 4.0 or IoT applications by businesses and consumers.

Strong wireless connectivity investments serve as a good basis for further technology development, but more private and public investments and incentives are needed. A broader industry 4.0 adoption is hindered by a general reluctance to invest in new knowledge and technologies within government and industry. In addition, the current economic environment is also forcing South African manufacturers to save costs first and spend less on innovation. Some global industry 4.0 or IoT applications are leveraged by global manufacturers operating in South Africa. Not many local applications have been developed yet. More innovation still needs to happen first, before widespread adoption will occur.

However, Africa has an advantage over developed markets because it is not weighed down by infrastructure legacy issues and may have little difficulty in embracing change. Great leapfrog potential to directly adopt or develop specific industry 4.0 or IoT applications exists. Numerous possibilities to use connected networks across various industries for competitive advantages can be created. There is also a huge potential for collaboration between government, industries and research institutions. However, more education and information about the topic of advanced manufacturing and its benefits for policy makers as well as industry leaders are needed.

Overall, industry 4.0 offers great opportunities for South African manufacturers to lead the way and create completely new business models. A move of value propositions from products to more services and usage of smart technology could also make a real impact on a socio-economic level. It is key for manufacturers to plug into a networked economy and develop completely new offerings that enable faster, simpler service to customers. The world-leading mobile money services in African banking are a prime example that could serve as a successful blueprint for manufacturing companies. The best known example of an innovative mobile money service that allows people without a bank account to transfer funds is M-Pesa, launched in Kenya in 2007. Money deposits, withdrawals, bill payments or microcredit provisions have become as easy with M-Pesa as sending a text message. A lot of today's successful mobile money offerings across the world are very similar to or result from M-Pesa.

"A lot of South African manufacturers are focused on immediate issues, like labour and electricity. There is a general lack of focus on building for the future and investing in education and training as well as R&D and innovation."

Coenraad Bezuidenhout
Former Director, Manufacturing Circle

"There are a few good examples where South Africa is already successful with its own IoT applications. In the telematics sector for instance, South African providers have developed some very innovative vehicle tracking and fleet management solutions that are very competitive globally."

George Kalebaila
Senior Research Manager Telecoms & Digital Media, IDC (International Data Corporation) South Africa

"There are some pockets of innovation and cutting edge technology happening in South Africa today. However, South African manufacturers are generally users of existing technology, rather than developers of new ones."

Richard Jacob
CEO, Hulamin

Usage of smart technologies and new interaction models

According to our interviewees, the majority of the mentioned smart technologies – i.e. advanced analytics, cloud computing, advanced sensors and robotics as well as additive manufacturing (3D printing) – are slowly being adopted by South African manufacturers. Nevertheless, they are seen as very promising for the future of manufacturing.

Current usage of smart technologies in the South African manufacturing industry (Findings from interviews)		
Advanced analytics	• Strongest adoption of advanced analytics within automation and automotive sectors; other sectors like process industry are still catching up • Many manufacturers do not know what kind of data they have, how much it is already connected and what insights and benefits they could derive from it • Majority of manufacturers have a 'reactive approach' when it comes to data usage and analysis and not a 'predictive approach' • There are huge opportunities in advanced analytics that are not fully explored yet by South African manufacturers (e.g. to support decision-making, for condition monitoring or predictive maintenance)	*"There are significant opportunities when it comes to analytics and the smarter use of data. The foundation is often there, but the challenge remains to create greater value from data and gain the right insights."* André de Ruyter CEO, Nampak
Cloud computing	• Adoption of cloud solutions has increased in recent years with the implementation of better mobile infrastructure/connectivity in South Africa • Currently, there is a stronger adoption happening by consumers than by businesses/industry • However, this is bound to change in the coming years, with higher business adoption expected • Fear of cyber-crime and privacy concerns are cited as the main concerns hindering cloud adoption	*"First the cost of cloud computing needs to come down and the availability needs to go up, before industries that deal with a lot of data-hungry files will use such services more extensively."* Deon Fabel CIO, Bigen Africa
Advanced sensors	• With a few exceptions, advanced sensor technology like machine to machine (M2M) communication is mostly at a foundation stage in South African manufacturing • Higher traction can be found in the automotive industry and some non-manufacturing sectors (e.g. retail, logistics/freight) • However, there is a lot of interest amongst South African manufacturers to better leverage the potential of sensor technology in their manufacturing processes (e.g. monitoring, controlling, tracking etc.)	*"Simulation modelling that includes real time feedback can help to significantly reduce cost and disruption in production."* Richard Jacob CEO, Hulamin

Current usage of smart technologies in the South African manufacturing industry (Findings from interviews) (continued)

Advanced robotics	• Adoption of advanced robotics remains low across different South African manufacturing sectors • Usage of robotics is mostly at an automated stage and not yet at a smart or advanced stage • Stronger adoption of advanced automation/robotics technology can be found only in a few industries, e.g. automotive • Cost factors are a prohibitive adoption factor for many South African manufacturers
Additive manufacturing (3D printing)	• No widespread adoption of 3D printing yet within the South African manufacturing industry • Manufacturers are aware of the significance and the potential of this exponential technology • Examples of actual usage are mostly in rapid prototyping, testing of design options or understanding engineering problems better • No examples of usage of 3D printing for low-level or mass production due to cost reasons • Affordability remains an issue in developing markets, compared to developed economies • Once the cost of printers and material comes down further, more investments by manufacturers and greater usage are expected

"We are currently experiencing an increased interest in cloud computing in South Africa. This comes at the right time for manufacturing companies to drive IoT agendas, where high scalability is required."

George Kalebaila
Senior Research Manager Telecoms & Digital Media, IDC (International Data Corporation) South Africa

South African manufacturers are also slow in their adoption of technology-enabled interaction models within an industry 4.0 environment. However, developments in new forms of cooperation and interaction with suppliers, business partners and customers – like mass customisation, crowdsourcing, collaborative consumption or gamification – are seriously followed by some of our interviewees.

Current usage of technology-enabled interaction models in the South African manufacturing industry (Findings from interviews)	
Mass customisation	• The general trend towards highly individualised and customer specific solutions is seen as an important topic by South African manufacturers, albeit with some sector differences • However, most manufacturing companies see customisation as a special service at a higher price and not necessarily as part of the main business • Some flexible manufacturing is taking place, but mass customisation, like the mass production of highly customised products and services, is not yet seen as feasible by many manufacturers
Crowdsourcing	• A stronger collaboration with customers through 'crowdsourcing', e.g. getting input from a crowd of people for the development/production process, is not a real topic yet within South African manufacturing • Customer integration and contribution towards ideas and development of products and services remains generally low and is seen by traditional manufacturing companies as something that creates more (rather than less) complexity and costs • Concerns around IP rights and industrial espionage dominate the discussions around open innovation and crowdsourcing
Collaborative consumption	• The collaborative consumption trend as part of the increasing sharing economy remains a relatively young phenomenon within the South African manufacturing industry • New trends in owning, sharing, trading, renting etc. of manufactured goods and services are only slowly being picked up by traditional manufacturers • The automotive industry has been at the forefront of this new trend, with extensive partnering with new car sharing companies or launching their own car sharing businesses
Gamification	• Gamification, e.g. the inclusion of game design elements and principles into the employee, supplier or customer experience, is also not a significant topic in South African manufacturing yet • Globally on the rise, not many South African manufacturers use already gamified applications for their marketing purposes and customer retention or as a motivational tool for their employees

"In traditional manufacturing, customisation produces complexity that slows down production. It would be highly desirable, if new technology could reduce such complexity."

André de Ruyter
CEO, Nampak

"Cyber security needs to be ramped up along with the increased extraction of value from data and introduction of industry 4.0 applications."

Dalton Lunga Ph.D
Data Scientist and Machine Learning Researcher, CSIR-Meraka Institute

New technology offers great opportunities to improve supply chain connectivity. Better communication with suppliers and customers also helps to reduce cost and increases efficiency."

Richard Jacob
CEO, Hulamin

Infrastructure and talent opportunities and challenges

The majority of our interviewees see the main opportunities and challenges that South African manufacturers are facing while getting themselves ready for the digital transformation towards industry 4.0 as being related to the infrastructure and the people/ talent dimension.

Infrastructure opportunities and challenges in South African manufacturing (Findings from interviews)	
IT infrastructure	• Many old and disparate IT systems are in places that need upgrading to be able to handle the speed of change in a new industry 4.0 environment • Old IT systems are not ready to network and communicate with each other • Complexity amongst many South African manufacturers is very high, with different systems in place in different business areas, such as research and development, procurement and purchasing, production, warehousing and logistics, marketing, sales and services • However, this is also an opportunity to introduce brand new industry 4.0-ready infrastructure • Cost is a key factor in deciding on harmonising and upgrading existing IT infrastructure or replacing them with entirely new systems
Cyber-risks	• Fear of cyber-risks and privacy concerns in light of the digital transformation towards industry 4.0 are very high • However, the majority of South African manufacturers think that the risks will be manageable through tailored risk management and appropriate security strategies • Investments are needed so that the developments in cyber security can keep pace with the ever-changing nature of cyber threats
Electricity infrastructure	• Electricity constraints, e.g. load shedding as well as a lack of stable electricity supply, are big challenges for South African manufacturers and are seen as an obstacle for the digital transformation towards industry 4.0 • Trend to embrace renewable energy, become completely self-sufficient and get production off the grid • Great opportunity to leapfrog with industry 4.0 applications (e.g. smart metering etc.)

"The lack of infrastructure is a key risk for the success of the industrial internet in South Africa. That needs to be overcome first."

Coenraad Bezuidenhout
Former Director, Manufacturing Circle

"One challenge of digital transformation and increased open collaboration facilitated by advanced IT solutions, is the heightened cyber-risk and potential issues with IP rights."

Nigel Ward
Senior Vice President,
Toyota South Africa

"Electricity constraints also actively encourage us to embrace renewable energy and implement smart technologies from industry 4.0. Smart metering and solar panels are only one example that can make factories more self-sufficient and less grid-dependent."

Deon Fabel
CIO, Bigen Africa

Talent opportunities and challenges in South African manufacturing (Findings from interviews)	
IT skills	• More collaboration in the field of IT skills between the manufacturing industry and the university/educational sector is required • Often it is not really a lack of skills, but a misalignment of skills • Generally, a lot more software/digital skills are needed to support the move towards industry 4.0 • Lots of entry level IT skills are available in South Africa; however, the right skills blend is crucial (e.g. a combination of IT skills, business experience and storytelling capabilities for analytics) • A major challenge for South Africa is also the fact that the IoT talent shortage exists not only locally, but also globally • Global manufacturing companies operating in South Africa are more attractive for the local talent than South African manufacturers; SMEs are finding it harder to keep the good talent
Training needs	• Extensive need to (re-)train existing work force/upskill labour to understand and operate new and smart technologies • Significant opportunity for industry and government involvement to develop the digital workforce of the future
Mindset	• Mindsets of many manufacturing companies are not fully geared towards industry 4.0 solutions, even though the trend is acknowledged • Companies have to deal with the surprisingly high number of technology-averse people within the workforce • Different degree of technology-readiness across the different workforce generations (X, Y and soon Z)

"Getting the right talent and retaining it is fundamental for South African manufacturers to remain competitive. This will become even more important in the future, as traditional manufacturing moves towards digitalisation and industry 4.0."

Pedro Adams
Former Quality Director, Ford Motor Company of Southern Africa

"To improve the quality of labour through the use of technology, one needs to first upskill the labour force so they can understand and operate the technology."

André de Ruyter
CEO, Nampak

"The mind-set of leadership and employees plays a key role when it comes to the adoption of digital technology in the work place. Generation Y are generally at the forefront of such new trends, while Generation X need more time or convincing to adapt."

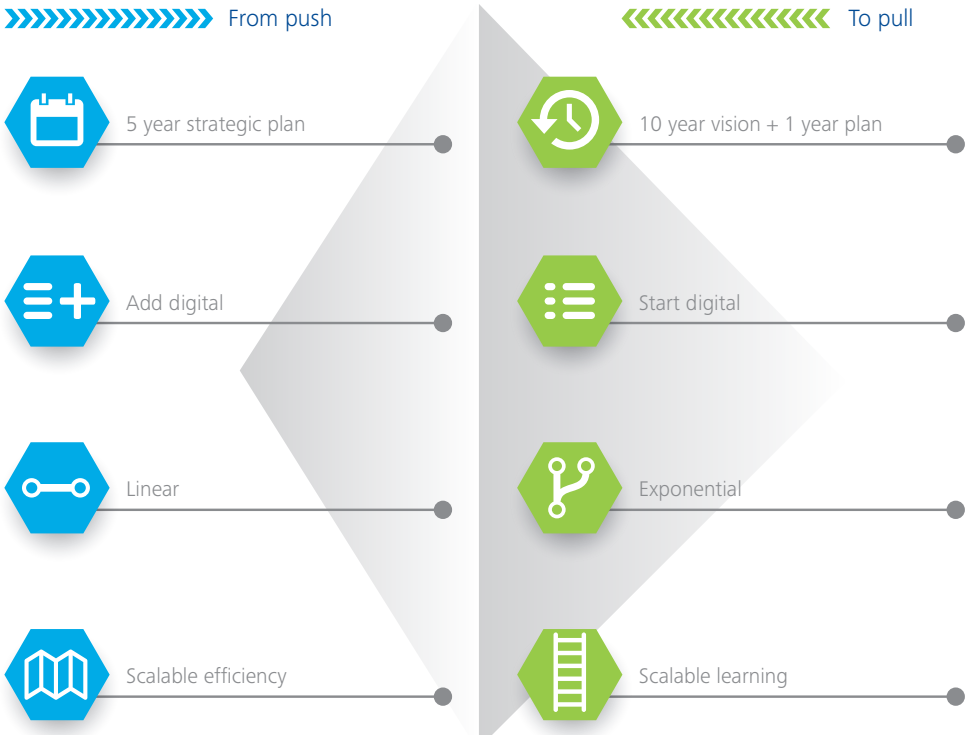
Nigel Ward
Senior Vice President,
Toyota South Africa

How can you prepare your business for industry 4.0?

To navigate a world that is changing exponentially, you as a manufacturing company will be increasingly challenged to shift from a 'push' to a 'pull' approach (see chart 6)[7].

To develop the full potential and truly maximise the opportunities of the digital transformation towards industry 4.0, companies will be required to switch from the 'push into the market' of better products for their customers to an individualised understanding of customers' needs and specialised, industry-specific solutions ('pull from the customer').

Chart 6. From push to pull[8]



The world has traditionally been organised around labour, with many assets and knowledge pools focused on efficiency. Superior engineering allowed higher prices, and planning and driving change was needed.

To benefit from exponential growth and the digital transformation towards industry 4.0, successful manufacturing companies of the future will require a long-term vision, need to organise around digital power, tap into external pools of knowledge, combine assets, gain better knowledge about markets, industries and customer preferences and focus on scalable learning.

If you want to remain successful and competitive in the age of the fourth industrial revolution you will need to get yourself ready for the exponential speed of change, organise your business for 'pull' and scale the edges of your business for new innovative business models.

Get ready for exponential speed of change

As a manufacturing company, you will need to prepare yourself for the depth and speed of how traditional manufacturing processes will be completely changed and transformed in the fourth industrial revolution. If you do not, you may be left behind by developments in your sector and by your competitors.

You will need to ensure that you are aware of these industry-changing processes and trends and need to spread this understanding within your organisation. Urgency is required, because competition will increase rapidly with many new entrants challenging traditional players. Somewhere in a garage nearby or far away the next breakthrough innovation is currently being developed by your future competitor that will disrupt your industry.

It will be increasingly important for you to have a long-term vision about your future environment, rather than just short-term strategic plans. This should include keeping abreast of the latest trends and technologies that will impact the industry as a whole in the coming years, as well as being on the lookout for the next big idea and developing disruptive innovation that will change the rules of the current business[9].

To be successful in the future, you will need to explore these current trends and new technologies and create space for development and growth of new business areas on the edge of your existing business activity that could, in time, become central to your actual business.

Organise your business for pull

The move from a push-world to a world with pull-based business models will also require some organisational change from your company[10].

To organise your business for pull, re-invent yourself and profit from the exponential growth and digital transformation towards industry 4.0, you need to confront and change the core of your business. This will cause anxiety within your organisation. The antibodies in the core (e.g. people who have difficulty with change) can be powerful and will try to crush any attempt at transformation.

It is therefore important that you tap into the passion of your employees. It will be essential that you invest in the right talent that already exists in your organisation and that has the right attitude and will embrace the digital transformation towards industry 4.0. You will need to identify talented people who are passionate, unafraid of change and willing to explore new possibilities. In many cases, there is not enough talent within the organisation, so you will need to recruit new people with the right skills.

Additionally, the workplace itself will need to be redesigned. To unlock the potential and passion of your employees in the digital transformation towards industry 4.0, new policies, practices and actions are required. This could mean that you need to encourage employees to work cross-functionally and more collaboratively with suppliers or customers, or on projects they are interested in but outside their responsibilities. Your new workplace design should also include the creation of spaces for creativity.

Overall, this redesign should facilitate continuous experimentation and innovation of new, scalable business models, not just the traditional area of product innovation.

Innovation has traditionally focused predominantly on product offerings, but its major potential lies in the areas of company structures, processes, networks and profit models, together with customer-facing functions, such as new services and distribution channels, new uses for a strong brand and distinctive customer engagement. Industry 4.0 will make it easier for your company to innovate beyond products and build breakthroughs[11].

Scale the edges of your business

Once you have prepared your company for the exponential speed of the digital transformation towards industry 4.0 and organised your business for pull-based business models as well as unlocked the passion in your workforce, you will be ready for the next step: Scaling from the edge[12].

It is not easy to introduce the successful innovation and creation of new business models in your entire organisation. A solely top-down approach will create resistance in your organisation, while introducing pockets of innovation within the traditional business areas will provoke a reaction from less engaged employees. Placing innovation entirely outside of an organisation also has its drawbacks, because there will not be any connection with the rest of the company nor with the benefits that the organisation already possesses.

To be successful, you need to innovate and create new business models not within your core business or outside of your organisation, but on the edge of your current business. The first step is to develop an inspiring vision on exponential technologies and the new possibilities of industry 4.0 at the edge of your business and to consider which of these are relevant for your company and your customers.

Your next step will be starting up a small initiative based on this inspiring vision and a scalable learning mindset. Continuous experimentation and failing forward ('failing quickly in order to learn fast') will be key. The intent should not be to pull this initiative back into the core. The core can crush even well-articulated edge initiatives. Rather than pulling the edge back into the core the alternative is 'scaling from the edge'. This means that if you can find an edge that has the potential to scale extremely rapidly, you can pull more and more of the core out to the edge, to the point where the new edge becomes the core of the business over time. New stakeholders and new innovators – e.g. other companies – will want to join you, as well as the explorers within your organisation.

The digital transformation towards industry 4.0 will help your company to come to grips with radical new approaches to business rather than merely making incremental improvements to established business models.

What will you need to do?

IT integration

Industry 4.0/IoT will change everything. A new digital world is emerging and we are entering another era in Enterprise IT that focuses on business models and digital business innovation. Business leaders need to use IT effectively in order to stay ahead of the game. IT leaders need to bring new solutions for businesses to innovate and stay relevant. Smart organisations need to focus on their strategic alignment and IT governance to drive IT integration and become more efficient and competitive for the explosion of information.

Digital business is about 'people, business and things' working in sync in order to transform manufacturing operations in the coming years to 'autonomous manufacturing'. With integration between different devices and solutions, the loop will be closed and smart factories will evolve. IT integration involves end to end business with key focus areas on Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Supply Chain Management (SCM), collaboration and digital transformations supported by best of breed and innovative technologies. **Standardisation is key as it makes a business more efficient and assists in achieving speed and customer service, with a move to dynamic integrated systems.**

Case study

Overall project
The client's solution drivers for this project included a solution that would provide fully integrated/interfaced online Applications systems, covering accounting, finance, administration, HR, apprenticeships, artisans, skills, ETQA, SCM, learnerships and project modules, including collaboration suites and CRM. The client chose a solution that would provide a cost effective option with a shared services hosted environment as well as a dedicated team of experienced specialists, who could service and support the systems with any legislative necessities and enhancements required to align with business processes.

Approach
The project was planned in a phased approach, bringing in the new integrated solutions with the ERP Microsoft AX and MIS platforms, with blueprint and specifications sessions, user acceptance testing and data migration completed as a web-based solution available to all their stakeholders' countrywide. The solution formed part of a fully outsourced solution, including an ERP solution, Applications systems, SharePoint and Website and other outsourced services.

The service offered caters for the non-core functions of the client and is underpinned by ITIL and COBIT principles frameworks, audit and legislative compliance alignment as well as readiness and support for corporate and IT governance and King III alignment.

Value delivered/results
The new technology and enhanced IT integration systems have given the client best-of-breed systems to support their business processes as well as key management reporting functionality and support for audit readiness and IT governance.

Cloud-based applications

"Change is constant and 'technology' can be referred to as the most recurring change in today's world."[13] Cloud computing is a technology for delivering information or services in which resources are retrieved from the internet through web-based tools and applications, rather than a direct connection to a server. Simply put, all the computer hardware and software sitting on local machines, or somewhere inside a company's network, is provided as a service by another company over the internet usually in a completely seamless manner. In a number of ways, the cloud computing infrastructure is revolutionising all fundamental areas of IT – from security and investment in infrastructure to application development.

Most IT departments spend an excessive part of their time on frustrating implementation, maintenance and upgrade projects – without adding value to the company's bottom line. **IT teams in major global organisations and small businesses are turning to cloud computing technology in order to minimise time wasted on lower-value activities allowing IT to focus on high impact strategic activities.** The adoption of cloud technology allows for fast implementation and no major upfront costs. It also requires no maintenance and solutions can be provided to anyone, anywhere and at any time on demand.

Case study

Overall project
A pharmaceutical company's five year vision was to embrace cloud computing and replace the current delivery model with a multi-sourced multi-layer cloud eco-system. The organisation's objective for cloud was to dramatically increase IT responsiveness by being agile and instantly scalable, by ensuring reduced cost and driving more value from IT investments and by enabling workload flexibility and mobility between providers as the cloud market develops and matures.

Approach
The first step of the vision was migrating a large proportion of workload to Infrastructure as a Service (IaaS). As IaaS technologies developed, the company used multiple suppliers and broker services between them. By 2015, once cloud technologies and standards matured, the company sourced services from multiple cloud vendors, brokering and coordinating the cloud eco-system.

Value delivered/results
Deloitte is currently supporting the company with defining the new cloud service and preparing for the migration of 6 000 servers and 1 200 applications. Through the experience gained with the company and multiple other cloud engagements, Deloitte has identified a number of key learnings for successfully migrating to the cloud.

Operational efficiency

Industry 4.0 offers new opportunities to drive operational efficiency, by providing immediate access to data. **The effective analysis, assessment and application of data collected from machines and sensors enable rapid decision-making to improve operational safety, work processes, servicing and maintenance.** Data itself is difficult to interpret and through the application of focused analytics and statistics it can be mined and analysed to inform specific hypotheses or create new ones about performance. Data is turned into usable information in the form of graphics and dashboards. These can be easily interpreted and acted upon to make fact-based decisions about processes, equipment and even human performance.

Transparency and real time information have the ability to make development and production processes more efficient. They also offer cost reductions that benefit the operations through better management and control of working capital and provide customers with improved services and better product quality. Maintenance work can be carried out in a needs-oriented, pro-active manner (e.g. only a short while before a risk develops), through understanding certain trends observed in equipment. This creates long-term competitive advantages in reliability, sustainability, predictability and cost. More price competitive products/services are possible and even innovative solutions that allow customers to track performance of goods in a broader supply chain.

Case study

Overall project

A leading South African steel producer experienced failure on blowing fans inside a bell shaped container where steel coils are placed for 'normalising' (normalising is a term for a specific heat treatment where the steel is heated to a specific temperature and allowed to be air cooled). Failures were experienced on the fans inside the bell container that housed the coil which was to be cooled after being heated. On failure, the bell needed to be lifted and the coil removed to access the fan. This was a demanding task due to the environment being unsafe and challenging to access. Often the motor failure caused subsequent damage of the fan housing and other components that resulted in repairs taking longer than expected. These delays also impacted the heat treatment process. The coil was affected being removed from the normalised environment and, depending on repair duration, it often needed to be heated again to restart the treatment process, resulting in production delays.

Approach

During the project, a mechanism was installed on the fans that measured the vibrations from the motor. This allowed a live data feed on motor performance. The data was measured for a set period and all information on maintenance and motor failures recorded. The data was analysed using various regression and correlation techniques, the hypothesis drawn was that the vibration and noise on the motor increased when it approached failure point. A prediction model was developed to accurately predict failure by evaluating the degree of vibration experienced on the motor. This model was programmed into the motor-control system. Problematic motors were flagged and prevented from starting up if the model predicted that they would fail during the treatment process.

Case study (continued)

Value delivered/results

This intervention reduced unplanned maintenance on the motors by approximately 80%. It reduced maintenance and repair time by 55%, as additional repair work on damage that previously resulted from failed motors decreased, and planned maintenance could be done more effectively. This affected the correct parts being held and available, when maintenance is required. Overall downtime in production was reduced. The simple use of sensors to provide feedback on motor vibration predicted failures for the client. The analysis of data and development of a prediction model helped to improve productivity, reduce downtime, plan more effectively, reduce rework and save on operational costs. Such use of data and measures provide valuable information about almost any production operation and once this is known, it can be acted upon to improve performance.

IT security management

The extensive networking already cited and the high levels of data sharing involved in industry 4.0 will greatly increase the demands made on data security. The connected technologies envisaged to be used by the manufacturing industry will still be made up of software and hardware – each with its own unique vulnerabilities and weaknesses. If not adequately protected, these devices can be identified from remote locations and targeted – often without the knowledge of the custodian.

Companies urgently need a tailored risk-management system and a security strategy geared to cyber security and aimed at improving operational security and protection from attack right across the value chain. In this respect, the manufacturing industry currently lags a long way behind the financial services sector, but has the opportunity to learn from it.

New products, data, intellectual property and so on will have to be protected against unauthorised use and/or abuse. But the focus should not just be on the potential of data loss. The possibility of devices being manipulated to fail should always be kept in mind, as downtime means an immediate loss in productivity and revenue.

Case study

Overall project
In 2015 Deloitte successfully proposed and is currently implementing a cyber-fusion concept for a large financial services company. The establishment of a Cyber Intelligence Centre (CIC) is a big move away from the monolithic security operations centre approach, to a security operation model that includes all aspects of security. In a CIC there will be continuous monitoring of cyber incidents, continuous vulnerability management and threat intelligence services, all interlinked to take into account new technologies and business practises.

Approach
The client benefit from subscribing to CIC services is essentially derived from the common difficulties experienced in today's security environment. Security is complex, expensive and suffers from a shortage of skills. The CIC managed security services attempts to make continuous security services affordable and easy to use, as well as providing the skill set required by today's challenges.

Included in the CIC monitoring scope, is Operational Technologies (OT). OT cannot be seen as purely an engineering responsibility anymore and thanks to the expertise in the CIC, OT monitoring and security can also be included in daily surveillance and incident response. The reason OT is now being included in security operations is because it has also become a target. Where IT is the business enabler, OT is the revenue generator. If OT grinds to a halt, revenue is immediately lost.

Value delivered/results
In the end, the CIC will enable the client to focus on its business while the security monitoring and improvement are placed in the hands of the security team from Deloitte. Information security or IT security management cannot be an ad hoc or infrequent activity. It also cannot just stay stuck in a legacy approach to security management. For one, the advent of Industry 4.0/IoT, mobile computing and cloud computing, have essentially forced the remodelling of security thinking. The traditional network boundaries and perimeter security principals have been radically altered, thanks to industry 4.0 and other connected paradigms.

Disruptive innovations

Business and society are being dramatically influenced by exponential technologies, and manufacturing is no different. The rise of additive, customised and real time manufacturing offers the potential to deliver on evolving customer expectations by delivering small volumes of customised product at competitive prices. It is not difficult to conceive of a fully automated factory that can create hundreds of different products in a real time multiproduct assembly based on online orders delivered to homes within hours by self-driving vehicles. Similarly it may be possible to produce ultra-low-cost products to serve the bottom of the pyramid by completely eradicating the supply chain and aggregating regional demand for scale.

Although these ideas may seem radical, in a few years they could be table stakes. **The only thing that is certain is that the rate of change will continue to accelerate and if manufacturing companies do not have a dedicated focus on exponential technologies they face the danger that they will fall behind and become obsolete.**

Case study

Overall project
A large financial services company was struggling under the weight of new capital constraints and increasing bureaucracy. At the same time radical new funding mechanisms began emerging from outside the banking sector, namely in the form of crowdfunding where the likes of Lending Club became a billion dollar business without the traditional constraints. Despite seeing this as an attractive opportunity, the client did not know how to pursue such a strategy given its legacy structures and inherent organisational resistance.

Approach
Deloitte evaluated the client and the market, and advised on and secured a potential M&A target who was operating a fledgling crowdfunding platform. This was structured as a minority interest to maintain the flexibility and dynamism of the start-up.

Value delivered/results
From this case we can learn that large companies need to be able to tap into new exponential revenue streams but must be aware of their limitations and configure accordingly.

The learning organisation

Industry 4.0 means getting to grips with radical new approaches to business rather than merely making incremental improvements to established business models. These new approaches can either be seen as the best or worst of times for organisations. We have more than enough incremental evidence that talks to the positive implications technology has brought to business, but on the other hand many organisations struggle with the rapid change. Regrettably the increasing pace of progress has also led to unprecedented levels of disruption and uncertainty.

If organisations are going to respond to these radical new approaches of business in a succinct way, due consideration needs to be given to a 'shift' in how learning takes place. Traditional ways of learning are disrupted not only by the changing demands in how workers work, but also by how their environments are changing at the same time and as a result, access to learning in a different way has come to the forefront. This new way of learning for today's modern learner is referred to as a 'continuous learning' culture. Continuous learning is defined as "structuring resources, expectations, and learning culture in such a way as to encourage employees to learn continuously throughout their tenure with the organisation."[14]

A move away from a traditional classroom/e-Learning 'push' approach needs to enter into more of a 'pull' learning environment. Employers need to establish a culture of 'demand learning', where employees have the ability to access learning in an unconventional way. An organisational competency of 'problem solving' needs to be inbred into the learning culture and any learning initiative that is derived. So as Human Resources transforms itself to meet the demands of the modern worker and learner, it is critical to redefine and re-imagine these roles to cater for the changes industry 4.0 brings to the manufacturing sector.

Case study

Overall project
A large food and beverages company recently announced its goal to redesign the learning organisation, identify new content needs and establish a culture of learning across the organisation. The company engaged Deloitte to assess and recommend opportunities to enhance the learning operating model, curriculum offerings, and processes.

Approach
Through extensive engagement by means of interviews and workshops, Deloitte began by reviewing background learning information, examining leading practices and working and collecting data on learning-focused headcount at the client. Based on this, a learning operation model, governance structure and funding approach were recommended, with clear action items for the near-term as well as a more long-term comprehensive roadmap for transforming the learning organisation.

Value delivered/results
Through our work with the client, Deloitte was able to provide clear, actionable steps and structures (including roles, responsibilities and processes) required to take their learning environment to the next level, with a sound operating model aligned to leadership vision and learning differentiators, and a curriculum structure with impactful courses and opportunities of future curriculum enhancements.

Conclusion

The fourth industrial revolution is transcending the traditional manufacturing industry and the penetration of industry 4.0 concepts in companies' manufacturing processes is growing rapidly. The use of smart technologies and the fast flow of information makes it possible to manufacture entirely new things in entirely new ways and revolutionise research and development, supply chains, production and business models. To be at the forefront of this exponential change will be the key differentiator and competitive advantage for successful manufacturing companies.

Traditional industrial economies such as Germany and the US already embrace industry 4.0 as the leading strategy for future manufacturing success. China is following in the same footsteps, with a strong emphasis on an innovation-driven future economy. Even though the current impact of industry 4.0 on the African continent remains comparatively low, some emerging economies such as South Africa could still become early adopters and leapfrog their global competitors with unique, locally developed high-tech products and services. Emerging markets often have an advantage over the developed ones, because they are not weighed down by infrastructure legacy issues and they have no difficulty in embracing change.

To prepare for the exponential speed and change of industry 4.0, South African manufacturers need to adjust their infrastructures and develop new ones, upskill their workforce and reorganise their businesses. Having an integrated IT system in place that can handle the increased speed of change, higher flow of data and new networking and communication needs, while leveraging new applications such as cloud computing for example, will become indispensable in an industry 4.0 environment. Attracting the right digital talent/skills and (re-)training and developing the existing workforce to understand and operate the new and smart technologies (e.g. advanced analytics, sensors and robotics, 3D printing) will be equally important. Last but not least, South African manufacturers need to develop the right industry 4.0 vision and mindset within their organisations, embrace a new collaborative culture with suppliers, business partners and customers, innovate beyond product levels and create opportunities for new disruptive business models on the edges of their businesses.

Industry 4.0 offers huge opportunities for South African manufacturers to re-invent themselves and become more successful and competitive in local as well as global markets.

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Acknowledgements

We wish to thank the following Deloitte professionals for their insights and contributions to this report:

Dr Mariana Carroll	Manager: Technology
Ursula Fear	Director: Human Capital
Edwin Kediutwile	Senior Manager: Business Process Solutions
Johan Oelofse	Associate Director: Strategy and Innovation
Gareth Rees	Senior Manager: Monitor Deloitte
Evert Smith	Senior Manager: Risk Advisory Cyber, Risk and Resilience