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Industry 4.0: Issues of Globalisation and Digitalisation of Work Force

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ABSTACT
Globalization is the process of the shrinking of the world, the shortening of distances, and the closeness of things. It allows the increased interaction of any person on one part of the world to someone found on the other side of the world, in order to benefit thereby turning the world to a global village. Industry 4.0 will create digital networks and ecosystems that in many cases will span the globe, but still retain distinct regional footprints. Both developed and developing markets stand to gain dramatically. As the fourth industrial revolution binds companies and countries ever more tightly together - through worldwide supply chains and data networks - it will increasingly promote globalisation. Many industrial leaders operate worldwide facilities, so successful Industry 4.0 implementation is not limited to specific countries or regions. This study examined the impact of industry 4.0 on the manufacturing industries, its effect on training and re-training of labour force in the developing nations of the world. The study recommends that Nigeria and other developing nations of the world should seek appropriate measures to adopt industry 4.0 in order to meet the fourth industrial revolution.
Keywords: Industry 4.0, Globalisation, Digitalisation, Work force.

INTRODUCTION

The term globalization comes from English, as base of the word “globalization” which refers to the emerging of an international network, belonging to an economical and social system. One of the earliest uses of the term "globalization", as known, was in 1930 in a publication entitled Towards New Education - to designate an overview of the human experience in education.

A near-term "giant corporations" was used in 1897 by Charles Russell Tazel to describe the big national trusts and other large enterprises of the time. Since 1960 both terms began to be used interchangeably by economists and researchers in social sciences and were used until about mid 1980.

Since the invention of the concept, globalization has inspired numerous interpretations, definitions and has had a history going back in time to the great commercial and imperialist movements throughout Asia and the Indian Ocean since the fifteenth century.

Vladislav Inosemtsev defines globalization as one of the most popular social studies of today, but is at the same time an empty term. It was first mentioned in literature in the mid 1940s, but up until the mid 1980s it was mentioned only occasionally.

After the Cold War the term began to be used to describe the world becoming more interdependent in its economical and informational dimension. Because of the complexity of the concept, research projects, articles and debates have remained mostly focused on one aspect of globalization.

Roland Robertson, a professor of sociology at the University of Aberden, was the first person who defined globalization as "the understanding of the world and the increased perception of the world as a whole."

Martin Albrow and Elizabeth King, sociologists, defined globalization as "all those processes by which the peoples of the world are incorporated into a single world society".

In his paper "The Consequences of Modernity", Anthony Giddens uses the following definition: "globalization can be defined as the intensification of social relations throughout the world, linking distant localities in such a way that local happenings are formed as a result of events that occur many miles away and vice versa".

In his paper "Global Transformations" David Held studies the definition of globalization and says, "although in a simplistic sense globalization refers to a rapid global interconnection, deep and on large scale, such definition requires now a more complex research".

Globalization can be linked to the local, the national and the regional. On the one hand, a connection is made between social and economic relationships and networks, organized on a local and / or national, on the other hand, it connects social and economic relationships and networks crystallized on wider scale the regional and global interactions.

Globalization can refer to those spatial-temporal processes of change, which constitutes the fundament of the transformation of human concerns in an organization, linking together and expanding human activity across regions and continents. Without referring to the expansion in space of the connections, there can be no clear and coherent formulation of the term globalization.

In 2000 the International Monetary Fund has identified four basic aspects of globalization: trade and transactions, capital movements and investment, migration and movement of people and the spreading of knowledge.

Globalization typically refers to the process by which different economies and societies become more closely integrated and concurrent. With increasing worldwide globalization, there has been much research into its consequences (Nilson, 2010). Covering a wide range of distinct political, economic, and cultural trends, the term globalization‖ has quickly become one of the most fashionable buzzwords of contemporary political and academic debate. In popular discourse, globalization often functions as little more than a synonym for one or more of the following phenomena: the pursuit of classical liberal (or free market) policies in the world economy (economic liberalization), the growing dominance of western (or even American) forms of political, economic, and cultural life (westernization or Americanization), the proliferation of new information technologies (the Internet Revolution), as well as the notion that humanity stands at the threshold of realizing one single unified community in which major sources of social conflict have vanished (global integration; Globalization, 2010). Globalization is not a new phenomenon, with global ecological changes, an ever more integrated global economy, and other global trends, political activity increasingly takes place at the global level (Globalization, 2005)

INDUSTRY 4.0

The term Industry 4.0 is a result on the history of the industrial revolutions, which so far is perceived in three stages. At the end of the 18th century, the introduction of hydropower and steam power brought on the change from an agricultural to an industrial society. The use of mechanical energy allowed production to be accelerated significantly compared to tasks formerly performed manually (e. g. mechanical weaving looms). The simultaneous increasing prevalence of steamboats and railway trains made transport and logistics considerably easier. Wage labour was born. The prevailing energy resource was coal. The second Industrial Revolution is chronologically attached to the beginning of the 20th century and ushered in the new era of industrialisation. The electrification of production by introducing electric power, crude oil replaced coal as the leading energy source resulting in an expansion of mass production (assembly line work). Fordist mass production with taylorist production processes triggered an increase in productivity which also facilitated a social middle class and the beginning of a welfare government. The third Industrial Revolution is chronologically attached to the 1970s and is also referred to as the digital revolution. The increased use of computers ushered in the change from an industrial to an information society. The introduction of electronics and information technologies allowed for further automation of production. A great extent of the control and coordination of machines, processes and the global integration of suppliers are performed with the help of computers. Microelectronics, new materials and

bioengineering introduced new production methods, applications and the development of new products and services.

The fourth stage of the Industrial Revolution can be perceived as a continuation or rigorous implementation of the ideas and technologies from the third Industrial Revolution. In addition to fundamentally rethinking the functionality of production facilities, it will also lead to changes in the work environment.

Industry 4.0 stands for the fourth industrial revolution. Other related terms include the 'Industrial Internet' or the 'Digital Factory', although neither takes as complete a view. While Industry 3.0 focused on the automation of single machines and processes, Industry 4.0 focuses on the end-to-end digitisation of all physical assets and integration into digital ecosystems with value chain partners. Generating, analysing and communicating data seamlessly underpins the gains promised by Industry 4.0, which networks a wide range of new technologies to create value. While the term Industry 4.0 is becoming increasingly familiar, we use it in a specific way in this study. In our view, Industry 4.0 is driven by:

1) Digitisation and integration of vertical and horizontal value chains:

Industry 4.0 digitises and integrates processes vertically across the entire organisation, from product development and purchasing, through manufacturing, logistics and service. All data about operations processes, process efficiency and quality management, as well as operations

planning are available real-time, supported by augmented reality and optimised in an integrated network.

Horizontal integration stretches beyond the internal operations from suppliers to customers and all key value chain partners. It includes technologies from track and trace devices to real-time integrated planning with execution

2) Digitisation of product and service offerings:

Digitisation of products includes the expansion of existing products, e.g. by adding smart sensors or communication devices that can be used with data analytics tools, as well as the creation of new digitised products which focus on completely integrated solutions.

By integrating new methods of data collection and analysis, companies are able to generate data on product use and refine products to meet the increasing needs of end-customers

3) Digital business models and customer access:

Leading industrial companies also expand their offering by providing disruptive digital solutions such as complete, data-driven services and integrated platform solutions.

Disruptive digital business models are often focused on generating additional digital revenues and optimising customer interaction and access. Digital products and services frequently look to serve customers with complete solutions in a distinct digital ecosystem.

Changes in the economy and society, which can already be observed today, will accelerate the trend towards Industry 4.0: So far, the powerful, export-oriented sectors of machine building, automotive and chemicals industry have been able to sustain their position internationally, mainly due to high product quality. Globalisation improves the comparability of services and increases competitive pressure. Companies must constantly defend their competitive advantage. Hence, product and process innovations are vital, particularly because the value chains continue to be more detailed and more complex. Not only must national limits be overcome but the interaction of a variety of different, in part highly specialised suppliers must also be coordinated.

Aspects of industrial production processes already highly developed today becomes more and more relevant for sectors such as commercial companies and the shipping industry or agriculture due to the urbanisation and the continued (worldwide) population growth. On one hand, more and more foods must be produced with limited space and more efficiently, and on the other hand, urbanisation poses new challenges for trade and transportation in terms of prompt and continuous provision of products and services. Furthermore, the demand for customised products will increase with the individualisation of society. Ultimately, the shortage of re-sources will also have to result in optimising production process.

All in all, in the future, continuous innovative activities must be aligned with an increasing complexity and dynamic in the value chains, which must result in rethinking the entire production control system across all economic sectors. This rethinking is defined using the keyword "Industry 4.0".

Issues of Digitalization of Manufacturing Processes:

Disruptive changes to business models will have a profound impact on the employment landscape over the coming years. Many of the major drivers of transformation currently affecting global industries are expected to have a significant impact on jobs, ranging from significant job creation to job displacement, and from heightened labour productivity to widening skills gaps. In many industries and countries, the most in-demand occupations or specialties did not exist ten or even five years ago, and the pace of change is set to accelerate. By one popular estimate, 65% of children entering primary school today will ultimately end up working in completely new job types that don't yet exist. In such a rapidly evolving employment landscape, the ability to anticipate and prepare for future skills requirements, job content and the aggregate effect on employment is increasingly critical for businesses, governments and individuals in order to fully seize the opportunities presented by these trends and to mitigate undesirable outcomes.

Past waves of technological advancement and demographic change have led to increased prosperity, productivity and job creation. This does not mean, however, that these transitions were free of risk or difficulty. Anticipating and preparing for the current transition is therefore critical.

According to many industry observers, we are today on the cusp of a Fourth Industrial Revolution. Developments in previously disjointed fields such as artificial intelligence and machine learning, robotics, nanotechnology, 3D printing and genetics and biotechnology are all building on and amplifying one another. Smart systems homes, factories, farms, grids or entire cities will help tackle problems ranging from supply chain management to climate change. Concurrent to this technological revolution are a set of broader socio-economic, geopolitical and demographic developments, each interacting in multiple directions and intensifying each another.

While these impending changes hold great promise for future prosperity and job creation, many of them also pose major challenges requiring proactive adaptation by corporations, governments, societies and individuals. As whole industries adjust and new ones are born, many occupations will undergo a fundamental transformation. Together, technological, socio-economic, geopolitical and demographic developments and the interactions between them will generate new categories of jobs and occupations while partly or wholly displacing others. They will change the skill sets required in both old and new occupations in most industries and transform how and where people work, leading to new management and regulatory challenges.

Given the rapid pace of change, business model disruptions are resulting in a near-simultaneous impact on employment and need for new skill sets, requiring an urgent and concerted effort for adjustment.

So far, the debate on these transformations has been sharply polarized between those who foresee limitless new opportunities and those that foresee a massive dislocation of jobs. In fact, the reality is likely to be highly specific to the industry, region and occupation in question and the ability of various stakeholders to successfully manage change. A major goal of this study is to unpack the relative impact of key drivers of change and provide specific information on the relative magnitude of these expected changes by industry and geography, and the expected time horizon for their impact to be felt on job functions, employment levels and skills.

Issues of Training and Retraining of Labour Force in the Developing Countries of the World:

The term training has been defined in various ways by different authors. Training refers to improving competencies needed today or very soon (Jackson & Schuler, 2003). Training is the act of increasing the knowledge and skills of an employee for performing the job assigned to him. It is a short term process. The term training refers to the acquisition of knowledge, skills and competencies as a result of vocational or practical skills and knowledge that relates to specific useful competencies (Wikipedia, 2017).

Training is any attempt to improve current or future employee's ability to perform through learning. The purpose of training is to achieve a change in behaviour of those trained. Training is also a learning process that involves the acquisition of knowledge, sharpening of skills, concepts, rules or changing of attitudes and behaviour to enhance the performance of employees. It is activity leading to skilled behaviour.

According to Nwachukwu (1992), training is an organizational effort aimed at helping an employee to acquire basic skills required for the sufficient execution of the functions for which he was hired. Training generates expertise or skill needed to perform a particular job or series of jobs. Also, Obikoya (1996) is of the opinion that training is a systematic process of altering the behaviour, knowledge and motivation of employees in a direction to increase the effectiveness and organizational goal achievement.

In Nigeria training involves a wide range of professional activities for workers which contribute to their enhancement of work. It can be visualized as the acquisition of techniques, skills, knowledge and experiences which enables the individual to make effective contribution to the combined efforts of a team in a productive process. On the other hand, re-training of workers involves the renewal or updating of worker's skills, knowledge, attitude, work habits and competencies to enable them perform their assigned responsibilities creditably (Imhabekhai, 2000). Re-training is a function of observed training needs and the amount of changes which have taken place in the techniques of production.

Stressing the importance of re-training to employees, Imhabekhai (2000) maintains that it is expensive to expect a man to pick up the thread as he goes along. Thus, at different levels in various ways, training for management succession is being fulfilled and grudgingly accepted to be vital for the well-being of an enterprise in Nigeria.

Training is a means to an end in itself, the end being the prosperity of the enterprise. Re-training of workers is very vital to the productivity of any organization considering the technological changes taking place in the world of work. This means workers must be trained to acquire the necessary skills and knowledge to be able to meet with these changes and perform their assigned roles in the organization towards the achievement of organizational goals.

Reforms in Science, Technology, Engineering and Mathematics (STEM) Education in the Developing Countries

Science, Technology, Engineering and Mathematics (STEM) education often is sometimes referred to as a meta-discipline, the creation of a discipline based on the integration of other disciplinary knowledge into a new whole. This interdisciplinary bridging among discrete disciplines is now treated as an entity, known as STEM (Morrison, 2006). STEM education enables students to view the world holistically, rather than in bits and pieces.

STEM education removes the traditional barriers erected between the four disciplines, by integrating them into one cohesive teaching and learning paradigm. This explains why Morrison and others have referred to STEM as being an interdisciplinary approach. It is also the reason that Tsupros (2009) refers to STEM education as an interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons with a view to ensuring that students apply science, technology, engineering, and mathematics in contexts that make connections among school, community, work and the global enterprise maximally harnessed to enable the development of STEM literacy and with it the ability to compete in the new economy. It is therefore important that Nigeria adopts the concept of STEM education particularly in this age of globalization.

Globalization and STEM Education

Jacques Halle (1998) defined globalization as a combination of free trade in goods and services combined with free capital movements. It means that a nation's investment, production, and innovation are not limited by national borders. This globalisation became possible only recently because of the technological infrastructure provided by telecommunications, information systems, microelectronics machinery and computer-based transportation. The idea of globalization is relatively new and most of the technologies that have fuelled it have been around for less than three decades.

Two main bases of globalization are information and innovation, which are in turn highly knowledge intensive (Carnoy, 1999). Inter nationalized and fast growing information industries produce knowledge goods and services. Today's massive movements of capital depend on information, communication, and knowledge in global markets. Knowledge is highly transmissible; hence it lends itself easily to globalization. In this regard, since knowledge is fundamental to globalization, then globalization should

also have a profound impact on the transmission of knowledge. Some, however, have argued that this has not occurred, casting doubt on the capacity of globalization to permeate local culture-influenced knowledge production and transmission. They opined that education appears to have changed a little in most countries at the classroom level while teaching methods and national curricula remain largely intact and globalization seems to have little or no effect on educational delivery.

However, Carnoy holds a strong view that globalization is having a profound effect on education at many different levels and will have even greater effect on it in the nearest future as nations, regions and localities fully comprehend the fundamental role of educational institutions. This role is not limited to transmitting skills needed in the global economy but also in reintegrating individuals into new communities built around information and knowledge.

The principal role of education has been the development of a whole individual. The minimum level of education that was necessary to achieve this goal in the agrarian society was basic or primary and in the industrial age, secondary. In the present borderless information dominated society, education needs to be able to respond to additional demands of a rapidly globalizing world by raising awareness of environment, peace, cultural and social diversity, increased competitiveness and the concept of global village. Such education is to a knowledge or international society what secondary education was to industrial economy.

Education prepares the individual to connect, and live in harmony with the environment around him. Globalization has changed the size, nature and quality of that environment. The challenge of STEM education therefore is to reform, create and develop a system that prepares the individual to work in a borderless economy and live in a global society. In other words, STEM education needs to produce global citizens.

STEM Education and Technology Transfer in Nigeria

One of the ways of reforming STEM education in Nigeria as suggested by Okongwu (2006) is through Technology Transfer. Technology transfer is the tendency of technology acquisition from one nation to another simply for the purpose of national development. Transfer of technology is a very complex process involving a myriad of cultural, socio-economic, environmental, intellectual, infrastructural, political and other related factors.

In Nigeria, efforts towards technology transfer has suffered some constraints due to the widening innovation gap between Nigeria and the developed countries as well as the nation's poor culture of innovation, the rapid changes in innovation and the shortening life span of innovation cycles. A critical review of 1956 – 1981 era shows that there was a massive importation of capital goods and establishment of very critical industries. In this regard, even though technology inflow was appreciable, the internalization of technology was not.

The state of Nigeria's technological development so far seems to look like that of the movement of an individual staggering about in the manner of a Brownian motion or more correctly a sleepwalker on a platform that is moving rapidly in the opposite direction, such that the net motion of the sleepwalker is really backwards. One of the key issues that has not been given adequate attention as far as technology transfer in Nigeria is concerned is how to construct a RECEPTOR which captures the transferred technology and ensures that it is fully internalized to enable it blossom and grow to create similar new technologies on its own within a given time frame shun of external support. It is only on this premise that we can confidently say that technology is said to be transferred.

The importance of a deliberate RECEPTOR programme cannot be over-emphasized because without it, technology transfer will be a chance thing. Data shows that Nigerian's National Research and Development (R&D) intensity under the Science and Technology Ministry is about 0.06% compared to South Africa (0.7.%), China (1.40%) and India (1.2%). In this case, there is the need to beef up the R&D expenditure to yield a national R&D intensity of at least 1.0% within the next six years i.e. by 2014 and to exceed 2% by 2018 (Okongwu, 2008).

Based on the above statistics, it appears that there is technology transfer problem in Nigeria. This demands that transfer of technology must effectively start by improving the quality of teaching and

learning of STEM subjects at all levels of the educational system. It requires a culture that encourages spirit of enquiry, freedom of thought, sound academic/work ethics, discipline, high regard for truth and integrity, reward for hard work/accomplishment, public spiritedness, justice and the like which will generate a technology-promoting culture. In a society where the above exist, innovation will sprout and abound, technology will develop and blossom, entrepreneurialism will flourish and thus rapid development.

For an effective technology transfer through STEM education in Nigeria, the following must be put in place:

a) Upgrading technological governance
b) Enthroning a culture of innovation
c) Strengthening intellectual property system;
d) Developing human capital with strong entrepreneurial base
e) Establishing strong technology support structures
f) Creating technology transfer receptor programs
g) Increasing R&D intensity
h) Infusing a technological culture and a new mindset.

Industry 4.0 and Issues of Training and Retraining of Workforce in Developing Countries

Training and retraining the workforce will be the "number one challenge" in the fourth industrial revolution, or Industry 4.0 as it is dubbed in the developing countries of the world. Simple tasks will be taken over by robots as factories and supply chains become ever more digitized; humans will need to oversee these tasks, and must be multidiscipline and able to adapt to changing roles.

The Price Waterhouse Coopers (PwC) 2016 Global Industry 4.0 Survey agrees: "The biggest challenge for industrial leaders isn't technology – it's the people." Meanwhile the World Economic Forum (WEF) thinks that three years from now, more than a third of skills (35 percent) considered important in today's workforce will have changed. "By 2020, the fourth industrial revolution will have brought us advanced robotics and autonomous transport, artificial intelligence and machine learning, advanced materials, biotechnology and genomics," it forecasts.

Clearly this will transform both the way we live and the way we work. All experts agree that routine jobs will disappear first – both in industry but also in the service sector. "Creativity will become one of the top three skills workers will need," the WEF predicts. Complex problem-solving and critical thinking are the other two; exactly what computer algorithms and robots so far can't do as well as humans. But humans will still be needed to supervise the robots for the time being; at least complete automation is not realistic.

Management consultancy BCG foresees completely new job profiles such as a "robot coordinator" who oversees robots on the shop floor and "responds to malfunctions or error signals." One of the most important new roles for humans will be the "industrial data scientist" – specialists who will extract and prepare data, conduct advanced analysis and apply their findings to improve products or production.

Some experts believe university degrees will be far less important in future, with personal skills becoming more critical. We need radically different thinking and platforms to focus on capabilities instead of qualifications.

Problem solving, creativity and critical thinking will be the three top skills required by industry in 2020. Quality control will no longer be required, except perhaps in high-end luxury goods, as machines will increasingly take over most of the work and probably do it better than humans. Employees will need to shift their focus to the things machines so far can't do and one of them is "emotional intelligence" – the ability to read people's emotions and react accordingly.

This new skill set will be particularly challenging on the shop floor, according to the BCG report "Man and Machine in Industry 4.0" It says employees will have to be more open to change, possess greater flexibility to adapt to new roles and working environments, and become accustomed to continuous interdisciplinary learning.

Companies will have to drastically increase their in-house training. There will be a huge amount of retraining necessary in industry. Retraining will even become a lucrative business in its own right.

Given the scope of change, it is clear that retraining for the fourth industrial revolution should not be left solely to HR departments but is also a CEO issue. Nonetheless, there is a lot that individuals can do to upgrade their skill sets. For example, many experts now agree that creativity is not an innate talent but can be learned.

To analyze the quantitative effects on the industrial workforce, ten most influential use cases for these foundational technologies were analysed. It is important to emphasize that our analysis, which focused solely on Industry 4.0's incremental effects on job growth, does not forecast changes in overall employment for the period studied. The figures do not account for overall market growth or productivity gains, which vary significantly by industry.

We selected the ten use cases on the basis of their overall impact on the workforce and the degree to which new skills would be required to complete the related tasks. The following examples of each use case illustrate the possibilities for deployment and the implications for the workforce.

- *Big-Data-Driven Quality Control.* A semiconductor company uses algorithms to analyze real-time or historical quality-control data, identifying quality issues and their causes and pinpointing ways to minimize product failures and waste. The application of big data in manufacturing will reduce the number of workers specializing in quality control, while increasing the demand for industrial data scientists.
- *Robot-Assisted Production.* A plastics producer uses robots that are similar to humans with respect to their size and hands and that can be easily trained to take on new tasks. Safety sensors and cameras allow the robots to interact with their environment. Such advancements will significantly reduce the amount of manual labour in production operations, such as assembly and packaging, but create a new job called robot coordinator.
- *Self-Driving Logistics Vehicles.* A food and beverage manufacturer has deployed automated transportation systems that navigate intelligently and independently within its factory, thereby reducing the need for logistics personnel.
- *Production Line Simulation.* A consumer products manufacturer uses innovative software to simulate production lines prior to installation and applies the insights to optimize operations. Implementation of this technology will increase the demand for industrial engineers and simulation experts.
- *Smart Supply Network.* By using technology to monitor its entire supply network, an international consumer-goods company has enabled better supply decisions. This application of technology will reduce the number of jobs in operations planning, while creating demand for supply chain coordinators to handle deliveries in smaller lot sizes.
- *Predictive Maintenance.* A wind turbine manufacturer offers its customers real-time remote monitoring of equipment and 24-7 access to a diagnostic centre. Alarms are automatically generated if one of the vibration-monitoring sensors in a turbine indicates that an abnormality has occurred. Monitoring and sensor technologies will allow manufacturers to repair equipment before breakdowns occur and will foster a significant increase in jobs associated with system design, IT, and data science. These advancements will also create a new job like digitally assisted field-service engineers while reducing demand for traditional service technicians.
- *Machines as a Service.* A German compressor manufacturer sells compressed air as a service instead of selling the machinery itself. The company installs a compressor at a client's site and maintains and upgrades the equipment as required. In addition to fostering job growth in production and service, this business model requires manufacturers to expand their sales force.
- *Self-Organizing Production.* A producer of gears has designed its production lines to automatically coordinate and optimize the utilization of each asset. Although the use of this type of automation will reduce the demand for workers in production planning, it will increase the demand for specialists in data modelling and interpretation.
- *Additive Manufacturing of Complex Parts.* Techniques such as selective laser sintering and 3-D printing enable manufacturers to create complex parts in one step, eliminating the need for assembly and inventories of individual parts. New jobs in 3-D computer-aided design and 3-D modelling are being created in R&D and engineering, while jobs are being lost in parts assembly.

- *Augmented Work, Maintenance, and Service.* Workers at a German logistics company use augmented-reality glasses to see dispatch information and navigation instructions, including the exact location of an item on a shelf, and to automatically scan bar codes. The system is also designed to enable remote assistance with basic maintenance tasks and provide customer-specific packaging instructions. The use of augmented reality is significantly increasing process efficiency for service technicians, while requiring companies to build extensive new capabilities in R&D, IT, and digital assistance systems.

The Nigerian Industrial Revolution Plan

The Nigeria Industrial Revolution Plan (NIRP) developed by Goodluck Jonathan administration in 2012 is a five year plan to rapidly build up industrial capacity and improve competitiveness in Nigeria. The plan identified Industry groups where we have comparative advantage – Agro allied and Agro Processing; Metals and Solid Minerals Processing; Oil and Gas related Industries; and Construction, Light Manufacturing, and Services. The NIRP also addressed the numerous issues that have held back the Nigerian non-oil sector for years – it addressed the high cost of funding and lack of long term finance in Nigeria; it built up Industrial infrastructure and power for industry; provided industrial skills; linked innovation and industry; improved our investment climate; strengthened product standards; and promoted local patronage.

In the modern global economy, industrial development is not luck; it is a nation's choice. With continued globalization of the world's economy, the convergence of consumer tastes, and world-wide dispersal of industrial technology, the manufacturing sector has never been as competitive as it is today. Companies are no longer concerned about firms within their geographic jurisdiction, but with every competitor all over the world. Low international freight costs and unprecedented levels of information available over the internet have truly transformed the world into a single accessible market. In today's world, the fierce global competition has reduced the likelihood of spontaneous development of new Industry. Countries must therefore have a deliberate, precise, and intense approach to nurture and expand Industrial activities. This is even more paramount for a country like Nigeria, starting from a relatively low manufacturing base. Industries succeed when they are competitive. The philosophy of the 'Nigeria Industrial Revolution Plan' (NIRP) starts with the acknowledgement that Nigeria's industrialization must be driven by long run competitiveness. Industries thrive locally, when they can compete globally. Industry needs a competitive business environment to prosper, an environment where costs are low, regulation is streamlined, infrastructure is reliable, and government bureaucracy is minimized. The global competition is for capital, technology, credible sponsors, and skilled labour. These resources are finite and not in limitless quantity, as such Nigeria has decided to act in earnest, and build differentiating competitive advantages in areas where it already has some comparative advantage and strengths. African countries, in general, need to be competitive to increase their share of the global economy. Africa has less than 1 percent manufacturing Value-Added, and accounts for less than 3 percent of global trade. This is because of the continent's emphasis on producing only raw materials, essentially limiting economic activities to the bottom of the value chain pyramid. This is not how African countries will develop. As part of economic transformation across the continent, African nations should produce more of what they consume and add value to local commodities. This however is only possible through the development of a competitive real sector. A new paradigm is required on the African continent, to change the old policies of exporting raw materials and jobs, without building up capacity in areas of comparative advantage, driven by raw materials, markets, cheap labour, and other strengths.

Policy makers must also consider that in most circumstances investors always have the options to relocate. Investments have become less sticky than in prior decades. Even in China, despite large investments, manufacturing plants are beginning to move out to neighbouring countries like Vietnam and Thailand due to lower labour costs in those countries. The context for Nigeria therefore is not just to become competitive, but actually to remain competitive.

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 make 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 and Nigeria 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.

Way Forward

To prepare for the exponential speed and change of industry 4.0, Nigeria and other developing nation manufacturers need to:

1) Adjust their infrastructures and develop new ones, up skill their workforce and reorganise their businesses.

2) Have 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.

3) Attract the right digital talent/skills, training 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.

4) Nigeria and other developing nation 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.

5) There is need for government of developing nations to get involved by way of enacting laws and policies that will encourage entrepreneurs to embrace industry 4.0 through provision of enabling environment by way of low interest financing, tax holidays and provision of some required infrastructures.

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

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