



FOURTH INDUSTRIAL REVOLUTION: PROSPECTS AND CHALLENGES FOR AFRICA

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Abstract

Industrial Revolution is the process of change from an agrarian and handicraft economy to one dominated by industry and machine manufacturing. Industrial revolution has evolved through different eras starting with first industrial revolution era from 1760 to 1840 characterized by the development of machines, steam engines and weaving looms. The objectives of the paper are to further create awareness of the fourth industrial revolution are to identify prospects inherent in the fourth industrial revolution for Africa and to identify challenges of the fourth industrial revolution for Africa and Africans. The findings from the study revealed that, the major beneficiaries have been consumers able to afford and access the digital world; technology has made possible new products and services that increase the efficiency and pleasure of our personal lives. Ordering a cab, booking a flight, buying a product, making a payment, listening to music, watching a film, or playing a game remotely. The challenges of 4IR to Africa are enormous as the very nature of manufacturing is changing irrevocably as technologies such as automation (robotics), the industrial internet of things and big data analytics are enabling the fourth industrial revolution. These technologies are causing the loss of low-skilled routine jobs, of which Africa has the highest share. It is estimated that up to 66% of all jobs in developing countries are at risk. The 4IR is furthermore leading to a re-shoring of manufacturing back to advanced economies meaning that African countries may need to rethink their current approach, which is based largely on attracting foreign direct investment into manufacturing activities that require low-cost labour, such as assembly plant. Robots increasingly doing much of the work in factories. It is further recommended that, If Africa and particularly Nigeria is able to see the big picture by studying the weakness, threat and opportunities so created by 4IR then we could stand a chance of being one of the world Powers in the fifth industrial revolution as countries that initiated and joined the Industrial Revolution Acts early became world powers.

Keywords: Industrial Revolution, Prospects, Challenges, Africa

Introduction

The industrial revolution according to Hom, *et.al* (2010) was the transition to new manufacturing processes in the period from about 1760 to 1840. This transition included going from hand production methods to machines, new chemical manufacturing and iron ore production. The increasing use of steam power, development of machine tools and factory system were dominant

factors of industrial revolution but textiles were the most dominant industry of the Industrial Revolution in terms of employment, production output and capital invested. The textile industry was also the first to use modern production methods.

The Industrial Revolution began in Great Britain and many of the technological innovations were of British origin. By the mid-18th century Britain was

the world's leading commercial nation controlling a global trading empire with colonies in North America, Africa and India through the activities of the East India Company. The development of trade and the rise of business were mainly due to the Industrial Revolution. (Gupta, 2016)

The Industrial Revolution marks a major turning point in history; almost every aspect of daily life was influenced in some way. In particular, average income and population began to exhibit unprecedented sustained growth. Some economists say that the major impact of the Industrial Revolution was that the standard of living for the general population began to increase consistently for the first time in history, although others have said that it did not begin to meaningfully improve until the late 19th and 20th centuries (Feinstein, 1998)

The Gross Domestic Product per capital according to Lucas (2003) was broadly stable before the Industrial Revolution and the emergence of the modern capitalist economy while the Industrial Revolution began an era of per-capita economic growth in capitalist economies. Economic historians are in agreement that the onset of the Industrial Revolution is the most important event in the history of humanity since the domestication of animals and plants.

There were also many new developments in non-industrial spheres, including the following: (1) Agricultural improvements that made possible the provision of food for a larger non-agricultural population;

(2) Economic changes that resulted in a wider distribution of wealth, the decline of land as a source of wealth in the face of rising industrial production, and increased international trade; (3) Political changes reflecting the shift in economic power, as well as new State policies corresponding to the needs of an industrialized society;

(4) Sweeping social changes, including the growth of cities, the development of working-class movements, and the emergence of new patterns of authority;

(5) Cultural transformations of a broad order. Workers acquired new and distinctive skills, and their relation to their tasks shifted; instead of being craftsmen working with hand tools as they became machine operators, subject to factory discipline. Finally, there was a psychological change: confidence in the ability to use resources and to master nature was heightened. (Encyclopedia Britannica; www.britannica.com.)

Literature Review

Industrial Revolution, as contained in encyclopedia Britannica is the process of change from an

agrarian and handicraft economy to one dominated by industry and machine manufacturing. This process began in Britain in the 18th century and from there spread to other parts of the world. Although used earlier by French writers, the term *Industrial Revolution* was first popularized by the English economic historian Arnold Toynbee to describe Britain's economic development from 1760 to 1840. Since Toynbee's time the term has been more broadly applied. The main features involved in the Industrial Revolution were technological, socioeconomic, and cultural. The technological changes included the following:

(1) The use of new basic materials, chiefly iron and steel;

(2) The use of new energy sources, including both fuels and motive power, such as coal, steam engine, electricity, petroleum and the internal combustion engine

(3) The invention of new machines, such as the spinning jenny and the power loom that permitted increased production with a smaller expenditure of human energy,

(4) A new organization of work known as the factory system which entailed increased division of labour and specialization of function,

(5) Important developments in transportation and communication including the steam locomotive, steamship, automobile, airplane, telegraph and radio and

(6) The increasing application of science and technology to industry. These technological changes made possible a tremendously increased use of natural resources and the mass production of manufactured goods.

The main cause of the first industrial revolution was richness accumulated by Britain from its large empire of colonies and losing the America colony in 1783 which was considered a setback. Britain was able to maintain firm control over trade from India while British people were getting wealthier hence, they need to spend their wealth on new things thus, demand for all kind of goods shot-up considerably.

The first industrial revolution period according to Lucas (2003) took place approximately from 1760 to 1840 and saw to the rapid industrial development through machines, steam engines and weaving looms. The first industrial revolution was largely centered on Britain and parts of the Northeastern United States.

The second industrial revolution era which last between 1870 to 1914 also known as the technological revolution was a phase of rapid industrialization characterized with mass production, assembly line and electric energy. The second industrial revolution was a great leap

forward for society as it fast track steel production from iron casting, fossil energy/petroleum discovery and hydro-electricity which led to the introduction of public automobile and airplanes. The second industrial revolution laid the foundation for globalization and created a rough draft of today's world. (Gustavo 2016).

The third industrial revolution according to Rifkin (2012) emerged by 1969 and was characterized by main frame computer (ICT), electronic (internet), green electricity and 3-D printing. The third industrial revolution era led to fundamental economic change that occurs when new communication technologies converge with new energy regimes mainly renewable electricity and linking economy globally.

The Fourth Industrial revolution

The fourth industrial revolution according to Klaus (2016) is building on the Third, the digital revolution that has been occurring since the middle of the last century approximately (2005). It is characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres. There are three reasons why today's transformations represent not merely a prolongation of the third industrial revolution but rather the arrival of a fourth and distinct one: velocity, scope, and systems impact. The speed of current breakthroughs has no historical precedent. When compared with previous industrial revolutions, the fourth is evolving at an exponential rather than a linear pace. It is disrupting almost every industry in every country. The breadth and depth of these changes herald the transformation of entire systems of production, management, and governance. The fourth industrial revolution is mainly characterized by artificial intelligence, self-driving cars, drones for virtual assistance, robotics, iCloud computing, digital fabrication, additive manufacturing, materials engineering, and synthetic biology pioneering a symbiosis between microorganisms, our bodies, products we consume and even the buildings we inhabit (Klaus 2016).

Prospects of 4IR

In general term, the prospect of industrial development is hinged on the development of science and technology which has resulted in the growth and spread of heavy industries. Human progress now-a-days is measured in terms of industrial potentialities and prosperity.

The prospects of the fourth industrial revolution and development are many such as; The growth of industries has resulted in large scale production of goods which are available to the consumer at much cheaper rates; There is saving of time and labour; Industrial development has resulted in a

considerable rise in the standard of living of the people; A number of substitutes and alternatives in consumer goods are available and the customer get wide variety of choices; There are means to control and check the colossal wastage of human energy that can be utilized for some other uses; Industrial development creates new job opportunities, leading to the removal of poverty to a great extent and has also resulted in the development of new modes of transport making quick export and import possible. The world has become a small place called global village.

The Fourth Industrial Revolution according to Schwab as cited by Okoro (2017). It has the potential to raise global income levels and improve the quality of life for populations around the world. To date, those who have gained the most from it have been consumers able to afford and access the digital world; technology has made possible new products and services that increase the efficiency and pleasure of our personal lives. Ordering a cab, booking a flight, buying a product, making a payment, listening to music, watching a film, or playing a game—any of these can now be done remotely.

In the future, technological innovation will also lead to a supply-side miracle, with long-term gains in efficiency and productivity. Transportation and communication costs will drop, logistics and global supply chains will become more effective, and the cost of trade will diminish, all of which will open new markets and drive economic growth.

Prospects of 4IR are many but in more specific terms:

- i. Chris (2012) predicts that the fourth industrial revolution is likely to reduce barriers between inventors and markets due to new technologies such as 3D printing for prototyping. Chris (2012) further predicts tissue engineers use rapid prototyping techniques to produce 3D porous scaffolds. The 3D printing technique fabricates scaffolds with a novel micro- and macro-architecture and these in turn help shape the new tissue as it regenerates. New technologies, like this 3D printing, allow entrepreneurs with new ideas to establish small companies with lower start-up costs. The entrepreneur can bring the product to reality with 3D printing without the traditional time constraints often encountered with traditional prototyping methods. The typical barriers to entry are removed from the marketing equations.
- ii. Increasing trends in artificial intelligence point to significant economic disruptions

in the coming years. Artificial systems that rationally solve complex problems pose a threat to many kinds of employment, but also offers new avenues to economic growth. A report by McKinsey & Company found that half of all existing work activities would be automated by currently existing technologies, thereby enabling companies to save billions of dollars and to create new types of jobs. Driverless cars may modestly replace tax and Uber drivers, but autonomous trucks may radically transform shipping with far fewer jobs for truck drivers. (Manyika et al. 2017)

- iii. Innovative technologies will integrate different scientific and technical disciplines. Key forces will come together in a fusion of technologies that is blurring the lines between physical, digital, and biological spheres. This fusion of technologies goes beyond mere combination. Fusion is more than complementary technology, because it creates new markets and new growth opportunities for each participant in the innovation. It blends incremental improvements from several often previously separated fields to create a product (Schwab 2015).
- iv. Robotics can and will change our lives in the near future. Technically robots are automated motorized tools. They cook food, play our music, record our shows, and even run our cars according to Schwab as contained in Okoro (2017). Meanwhile, we just do not see it because robots do not have a face to whom we can talk or a butt we can kick. Consequently, robots have the potential to improve the quality of our lives at home, work, and many other places. Customized robots will create new jobs, improve the quality of existing jobs, and give people more time to focus on what they want to do (Okoro 2017)
- v. The Internet of things (IoT) is the Internetworking of physical devices. Typically, the IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine (M2M) communications and covers a variety of protocols, domains, and applications. (Holler, et al. 2014). The interconnection of these embedded devices is expected to usher in automation in nearly all fields, while also enabling advanced applications like a smart grid, and expanding to areas such as smart cities. The revolution of the

connected life came about thanks to the advance of the Internet. In 1969, the first data was transmitted over the Internet and linked two main frame computers. Now, the Internet is connecting personal computers and mobile devices. By 2010, the number of computers on the Internet had surpassed the number of people on the earth. (Gershenfeld and Vasseur 2014)

Challenges of the 4IR

The challenges of Industrial development are enormous which include; the gradual disappearance of many natural resources, the pollution of land, water and air; the increase in vehicular traffic, the incessant working of machines in factories have brought in noise-pollution, dust and emissions; the general dirty and unhealthy conditions in and around the industrial sites have affected human health and happiness. Diseases that are unheard of before, are spreading far and wide; there has been instances of child labour in factories; the gradual displacement of manpower in industries with robots is ultimately leading to unemployment; industrial conflicts as a result of poor management of production factories lead to strike and then lockouts cause hardship and unrest and the society suffers the consequences and large scale heavy industries lead to a sharp fall in the number of cottage industries and their gradual disappearance. Regional and local artisans and workers of various trades and professions suffer a great deal. The economists Erik Brynjolfsson and Andrew McAfee have pointed out, that the fourth industrial revolution could yield greater inequality, particularly in its potential to disrupt labor markets. As automation substitutes for labor across the entire economy, the net displacement of workers by machines might exacerbate the gap between returns to capital and returns to labor. On the other hand, it is also possible that the displacement of workers by technology will, in aggregate, result in a net increase in safe and rewarding jobs. We cannot foresee at this point which scenario is likely to emerge, and history suggests that the outcome is likely to be some combination of the two. However, I am convinced of one thing—that in the future, talent, more than capital, will represent the critical factor of production. This will give rise to a job market increasingly segregated into low-skill/low-pay and high-skill/high-pay segments, which in turn will lead to an increase in social tensions.

In addition to being a key economic concern, inequality represents the greatest societal concern associated with the Fourth Industrial Revolution. The largest beneficiaries of innovation tend to be the providers of intellectual and physical capital—the innovators, shareholders, and investors—which

explains the rising gap in wealth between those dependent on capital versus labor. Technology is therefore one of the main reasons why incomes have stagnated, or even decreased, for a majority of the population in high-income countries; the demand for highly skilled workers has increased while the demand for workers with less education and lower skills has decreased. The result is a job market with a strong demand at the high and low ends, but a hollowing out of the middle. This helps explain why so many workers are disillusioned and fearful that their own real incomes and those of their children will continue to stagnate. It also helps explain why middle classes around the world are increasingly experiencing a pervasive sense of dissatisfaction and unfairness. A winner-takes-all economy that offers only limited access to the middle class is a recipe for democratic malaise and dereliction.

Discontent can also be fueled by the pervasiveness of digital technologies and the dynamics of information sharing typified by social media. More than 30 percent of the global population now uses social media platforms to connect, learn, and share information. In an ideal world, these interactions would provide an opportunity for cross-cultural understanding and cohesion. However, they can also create and propagate unrealistic expectations as to what constitutes success for an individual or a group, as well as offer opportunities for extreme ideas and ideologies to spread.

Schwab (2015). We stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before. We do not yet know just how it will unfold, but one thing is clear: the response to it must be integrated and comprehensive; involving all stakeholders of the global polity, from the public and private sectors to academic and civil society. This gives us some idea of the challenges surrounding the fourth industrial revolution. The enormity of the challenges and the breadth required of the response are reinforced accordingly (Peters. 2017).

The evolution of global industries in the fourth industrial revolution is both exciting and scary. Life will change with the 3D printing, the IoT, and the fusion of technologies. The fourth industrial revolution can raise income levels by allowing entrepreneurs to run with their new ideas. It will improve the quality of life for many people around the world (Jee 2017). Consumers are likely to gain the most from the fourth industrial revolution. Technological innovation will also lead to a supply-side miracle, with long-term gains in

efficiency and productivity. Transportation and communication costs will drop, logistics and global supply chains will become more effective, and the cost of trade will diminish, all of which will open new markets and drive economic growth (Schwab 2015).

While there are many benefits of the fourth industrial revolution, there are several key challenges that lie ahead. At the same time, the revolution could yield greater inequality, particularly in its potential to disrupt labor markets. As automation substitutes for labor across the entire economy, the net displacement of workers by machines might exacerbate the gap between returns to capital and returns to labor. The scarcest and most valuable resource in an era driven by digital technologies will be neither ordinary labor nor ordinary capital; rather it will be those people who can create new ideas and innovations. In the future, talent, more than capital, will represent the critical factor of production. People with ideas, not workers or investors, will be the scarcest resource. (Brynjolfsson, McAfee, and Spence 2014). In 2017 Bloomberg Global Business Forum, Apple CEO Tim Cook commented; If I were a country leader, my goal would be to monopolize the world's talent (Leswing 2017). The quest for talent will give rise to a job market that may become increasingly segregated. Low skilled and low wage jobs will be replaced by computers and digitization. The higher paid jobs requiring more skills are less likely to be replaced. This increased dichotomization can lead to an increase in social tensions. (Wolf 2015)

In addition to the threat of massive job displacement under the ongoing fourth industrial revolution, there are a variety of challenges, such as cybersecurity, hacking, risk assessment, and others (Lambert 2017). A higher level of alert is raised up when our lives become extensively connected to various devices, from our cell phones, cars, and light switches to our home security cameras, and smart speakers. One of the biggest trends in 2018 Consumer Electronics Show is that everything is connected and there is no going back. (Goode 2018)

Having everything attached to everything else in the IoT is going to monumentally increase the vulnerabilities present in any given network. Connections and burden of connectivity, systems are going to have to be more secure. The fourth industrial revolution calls for greater cybersecurity. Companies will need to map their networks, assessing the risk and critical factors relating to security. Such an assessment should examine accessibility to systems, such as possible threats from internal sources, from disgruntled employees to internal human error, and external sources

including hackers and cyber terrorists. Furthermore, companies must assess risk and determine if these risks will be accepted, reduced, shared via insurance or other vehicles, or rejected. Risks can be from both intentional and unintentional sources. If your house lights turn on via your computer, but you have lost the wireless connection to your house, you may be living in the dark. Unintentional sources of risk can include errors promulgated by company employees or nature itself such as storms causing disruptions in connectivity. Individuals too should assess their risks, just as companies will. It may come that the Internet will have more information about individuals than the family, friends, and colleagues of the individuals. Certainly, the ability of data to be processed and the speed in which it can be done surpasses the ability and speed of individuals. It is necessary to examine the value of processes and assets, from machinery to intellectual property, ensuring that there is insurance, security measures and that any vulnerability is sufficiently identified.

When we consider the changing nature of security threats from employees connecting personal devices to company networks to brute force attacks from hackers the situation is further complicated. The sophistication in risk identification and neutralization has to change with it. While data can be lost or stolen by employees, either inadvertently or intentionally, the biggest attacks in recent years have been external malicious attacks, collectively or commonly referred to as hacking. These could be hacking to move money around, such as when Russian hackers stole \$10 million from Citibank customer accounts, Internet terrorism, such as the \$2 million damages caused to WeaKnees.com over a six week botnet attack, Internet pump-and-dump fraud where hackers take advantage of manipulating stock prices, or software piracy which is estimated to cost over \$50 billion a year. (Romney and Steinbart 2017)

The fourth industrial revolution is more than just technology-driven change. Rather, it is powered with disruptive innovation to positively impact our core industries and sectors, such as education, health and business. In education, with the previous industrial revolutions, the focus of education changed. During the first industrial revolution, education was focused on standard modes of learning, such as the McGuffey reader. As we move toward mass production in the second industrial revolution and standardized testing. Education is service oriented and with the move into the third industrial revolution we come to see students under a customer learning model. Now in the fourth industrial revolution, technologies really blur the lines between physical, digital and biological spheres. Disruptive innovation makes its

way into higher education in which it redefines the conventional ways universities deliver their content to students. New modes of curriculum and teaching arise, and the focus changes from modes of teach to modes of learning. Alternative curriculums are being constantly developed. Disruptive innovation also reshapes how businesses operate. Thinking has really moved outside of the box. New markets are created and new products are defined. Netflix is competing with traditional television. Taxis must compete against Uber and Lyft. These offered similar product offered to customers in new ways. You could watch your shows from your home or get a ride somewhere. With the Airbnb alternative overnight accommodations are competing against traditional hotels and motels. (Jules 2017).

Last, in an era featuring Artificial Intelligence, automation, robots, and genetic engineering, we have new ethical concerns emerging. Lots of debates have arisen in genetic engineering about the use of tools and research technologies. On one hand, preventing genetic disease by genetic engineering is desirable. On the other hand, what guidelines, or regulation, or ethical boundaries we should establish in order to prevent the over manipulation of genetics for desirable traits, Is there such a thing as over manipulation, Infused with artificial intelligence and machine learning ability, robots have become smarter and more autonomous, but they still lack an essential feature such as the capacity of moral reasoning. This limits their ability to make good or ethical decisions in complex situations. Furthermore, the most critical question is whose moral standards robots should inherit. Moral values differ greatly from individual to individual, across countries, religions, and ideological boundaries. Uncertainty over which moral framework to adopt underlies the difficulty and limitations to ascribing moral values to artificial systems (Al-Rodhan 2015).

4IR and Africa in perspectives

Naude (2017) asserts that approximately 170 million Africans will enter the continent's labour market within 20 years (between 2010 and 2020). African policymakers consider industrialization the way to create employment opportunities for these new labour market entrants. With new technological changes and the rise of robotization, how can industrialization ensure inclusive growth? Where will the 170 million African labour market entrants find jobs? Agriculture is already characterized by surplus labour and low-income growth, and mechanization on farms may further limit job creation in future. Likewise in the mining sector, most new technologies are job-replacing. Even in spite of high commodity prices, the number of jobs in mining has declined in many of Africa's largest mineral exporters.

In Africa most future job opportunities will be in service sectors, including in household enterprises. While this will be welcome in terms of shifting labour out of farming and keeping unemployment from rising, it means that African economies will suffer from productivity-reducing structural change. Productivity growth is slower in the service sectors than in other sectors, because service sectors require less-skilled labour and benefiting less from technology. If wages depend on labour productivity, then the wages of lower-skilled, poorer workers will grow slower than those of more skilled workers. Productivity-reducing structural change will thus imply less inclusive growth in Africa. (Naude 2017)

African policymakers have in recent years put renewed emphasis on the promotion of industrialization this is to minimize the reduction of productivity and provide jobs for the millions of job seekers. Despite many efforts, according to Naude, Africa has so far failed to industrialize as in 2013; manufacturing contributed only 9.9 percent on average to African countries' GDP, less than any other region of the world. There is even evidence of premature de-industrialization. Current attempts to promote industrialization in Africa need to take into account the reasons for the continent's failure to industrialize. Another major problem according to Naude (2017) is that the very nature of manufacturing is changing irrevocably as technologies such as automation (robotics), the industrial internet of things and big data analytics are enabling the fourth industrial revolution. These technologies are causing the loss of low-skilled routine jobs, of which Africa has a disproportionate share. He further said, It is estimated that up to 66% of all jobs in developing countries are at risk. The 4IR is furthermore leading to a re-shoring of manufacturing back to advanced economies meaning that African countries may need to rethink their current approach, which is based largely on attracting foreign direct investment into manufacturing activities that require low-cost labour, such as assembly plant. Robots increasingly doing much of the work in factories, the question African policymakers have to ask themselves is how important is low-cost labour when you don't actually need labour?

Reducing the demand for low-skilled routine labour, the 4IR however, does not only threaten inclusive growth and equality in Africa, but also offers opportunities for new forms of manufacturing that would trigger a period of valuable growth. These new forms of manufacturing include more competitive small-scale manufacturing through additive manufacturing, mass customization, cheaper automation and cheaper input costs. Cheap robots-

in-a-box that makes it possible for small business owners to quickly set up their own highly automated factory, dramatically reducing the costs and increasing the flexibility of manufacturing". These 'new forms of manufacturing' also include new business models of bringing goods and services to the consumer such as products-as-services, the sharing (collaborative) economy, and digital services and exports. These are markets that are currently underdeveloped in Africa but are likely to have substantial potential given Africa's geography, demography and on-going urbanization. (Brynjolfsson and McAfee 2015)

Naude (2017) acknowledge trends such as urbanization and climate change will create problems and opportunities that new technologies, together with clever entrepreneurs, can address. In the process, they can also deliver growth that is more inclusive as Africa's rural populations will be the main beneficiaries of the use of drone technology to protect crops and livestock and deliver medical supplies. Rwanda is building the world's first drone port to be used in deliveries of medical supplies and other goods in a country with a very rugged, mountainous terrain; Recently Liberia piloted the first Ebola-fighting robots that disinfects rooms and kills the Ebola virus in a hospital in Monrovia. The upshot is that the new business models associated with the 4IR will have positive spill-over effects, such as better alignment of the needs of African consumers with producers, greater accessibility to goods and services, better use of natural resources and less waste.

The Fourth Industrial Revolution according to Alozie (2017) is already upon us in Africa Disrupting Technologies like IoT, Data analytics, Cloud technology, Artificial Intelligence, Augmented/Virtual Reality, Blockchain, Genome, Humanoid robots, Nano-medicine, Telecom Innovations, 3D printing to mention a few, are already altering the way people live their lives and run their businesses. He further asserted that the 4th Industrial Revolution is completely focused around connecting the Physical, Biological and Digital. The merging of the Digital with real life as lots of billions of devices, organisations and things are connected in digital networks. Computers are exponentially getting more powerful and will take away millions of jobs. Computer chips are mostly built in 2-Dimension but in this 4IR the chips are built in 3-Dimension because of the enormous power it possess.

Crude Oil is no longer where the money is, Data has become the new Oil, and it could be a National, Organizational or personal asset which could create enormous wealth while, Nations that are able to wield its powers 4IR can become great. Blockchain

technology will redefine how business and financial transactions will be conducted. As soon as the younger generation who prefer cashless transactions step into financial independent status, Blockchain powered solutions will become more popular. Many things on earth will require to connect to the internet hence with a unique Personal Identification Number (PIN password). Many corporations will start owning their base stations as the price will significantly drop as Telecommunications became democratised. The case could be likened the kind of transformations that happened from the Big Old computers operated by dozens of people to achieve a very small function called ENIAC to new computers of today which can be run by almost nobody and achieve limitless functions. 3D-printing is already disrupting the supply chain, Courier and Freight service industry, it is also revolutionizing manufacturing, where manufacturers are limited only by their imaginations and not by the physical properties of materials. The level of importation and exportation is greatly reduced as most products can be 3D printed locally. Human organs can now be printed using cultivated stem cells, nano-materials and metallic constructs are going to re-invent the construction and engineering sectors, etc. Even medicines will be printable, there's already a printer that can print the basic compounds for a lot of medicines. The amount of materials used in 3D-printing is expanding rapidly. We can use micro-organisms to produce all kinds of materials from plastics to oil. Using hazardous substances, like the gas methane for instance, as an input, to get a useful product out of it is also within reach. People can now print food using nutritiously edible supplements. (Alozie 2017)

The Way Forward

Sequel to 4IR, companies will reduce staff strength as artificial intelligence are already becoming receptionists handling services like picking up calls, scheduling physical meetings and carrying out few business operations that can be abstracted on a computer. As more institutions and organisations become connected, the speed of the world's operations could be synonymous to the speed of Galactic miles per hour. These to a large extent will affect African countries negatively in view of our dependence on numerical labour force and weak advancement in science, technology and innovation. In spite of our enormous resources and possibilities in Africa we have to get involved significantly or else Africa will be relegated to the background with wasted efforts of trying to re-inventing the wheel.

It is projected according to Alozie (2017) that 4IR will significantly impact Africa within the next few

years arising from the need to seamlessly connect and transact business with foreign organisations already leveraging Disruptive Technologies. This will usher in the Business unusual era. The fourth Industrial revolution is here and Africa has an opportunity to boost its economy by doing the right things at the right time as relates to 4IR.

History shows us that Countries like Britain, USA etc which initiated or joined Industrial Revolutions early, became world powers, so there is a strong need for African Countries particularly Nigeria to step forward to lead the way in the fourth Industrial revolution by;

- i. Creating awareness and understanding of the 4IR and Digital Economy
- ii. Update and Re-formulation of Industrial policies and regulatory framework to Leverage 4IR.
- iii. Capacity Building on Disruptive Technologies; Industrial Internet-of-Things, Blockchain, Artificial Intelligence, M2M, Drones, Big data management etc.
- iv. Ensuring Smart Connectivity to enable IoT networks and Smart-cities.
- v. Increase technical support and funding of research, innovation and development
- vi. Promotion of Local Content for domestication of indigenous Technologies and innovations

All Industrial revolution eras leads to economic advancement and also creates new weakness and threat which also present new opportunities. Africa and indeed Nigeria need to take pro-active steps in the 4IR to prepare, reposition and leads other Africa countries and Nigeria in to the Fifth Industrial Revolution. If Africa and particularly Nigeria is able to see the big picture by studying the weakness, threat and opportunities so created by 4IR then we could stand a chance of being one of the world Powers in the fifth industrial revolution as countries that initiated and joined the Industrial Revolution Acts early became world powers.

Conclusion and Recommendations

We stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before. We do not yet know just how it will unfold, but one thing is clear: the response to it must be integrated and comprehensive, involving all stakeholders of the global polity, from the public and private sectors to academia and civil society. There are three reasons why today's transformations represent not merely a prolongation of the Third

Industrial Revolution but rather the arrival of a Fourth and distinct one: velocity, scope, and systems impact. The speed of current breakthroughs has no historical precedent. When compared with previous industrial revolutions, the Fourth is evolving at an exponential rather than a linear pace. Moreover, it is disrupting almost every industry in every country. And the breadth and depth of these changes herald the transformation of entire systems of production, management, and governance.

The possibilities of billions of people connected by mobile devices, with unprecedented processing power, storage capacity, and access to knowledge, are unlimited. And these possibilities will be multiplied by emerging technology breakthroughs in fields such as artificial intelligence, robotics, the Internet of Things, autonomous vehicles, 3-D printing, nanotechnology, biotechnology, materials science, energy storage, and quantum computing. Already, artificial intelligence is all around us, from self-driving cars and drones to virtual assistants and software that translate or invest. Impressive progress has been made in artificial intelligence in recent years, driven by exponential increases in computing power and by the availability of vast amounts of data, from

software used to discover new drugs to algorithms used to predict our cultural interests. Digital fabrication technologies, meanwhile, are interacting with the biological world on a daily basis. Engineers, designers, and architects are combining computational design, additive manufacturing, materials engineering, and synthetic biology to pioneer a symbiosis between microorganisms, our bodies, the products we consume, and even the buildings we inhabit.

Achieving inclusive growth in Africa is to pursue industrialization strategies that can harness the opportunities and minimize the threats of the 4IR. Such strategies need to have entrepreneurship and education at their core, focusing strongly on science, technology, engineering, innovation and advance process scientific management these are skills predicted to be increasingly in demand in the 4IR. The hoped-for increased investment by individuals and governments in education and in new businesses is risky, particularly so in Africa with its vulnerability to conflict, natural disasters and often difficult business environment. Therefore, the expansion of social security, which is still under-provided in Africa, should be the bedrock of policies aiming at inclusive growth through industrialization.

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