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Trends in the Industrial Revolutions through the Lens of Nigeria in the Shaping of a Humane World.

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Abstract

Industrial Revolutions have changed the face of human endeavours for over two centuries and a half. Industrial revolutions have led to cataclysmic economic accelerations and growth alongside systemic shifts in global socio-cultural perceptions within the last two hundred years. While the amount of literature and studies devoted to studying the Industrial Revolution's dimensions, scopes, and challenges are burgeoning, more emphasis is needed on the nexus between the humanities and the emerging trends in the Industrial Revolution. As such, this study aims to fill the gap. This article utilises historical and phenomenological approaches to analyse the impact of industrial revolutions on the humanities. The focus is on the fourth industrial revolution (4IR) and its various positive and disruptive characteristics. The study aims to explore the emerging realities of 4IR and its effects on the field of humanities. The core presumptions concerning what it is to be human and the parameters of how people interact with the natural environment, especially in the context of Nigeria as a nation, were vigorously brought to the fore in the article.

Keywords: Education, Humane world, Trends, Industrial Revolutions, Nigeria

Introduction

One of America's renowned songwriters and musicians, Bob Dylan, originally known as Robert Allen Zimmerman, who received the 2016 Nobel Prize for Literature**,** has a chequered music career spanning over sixty years, including working with the Civil Rights Movement. Bob Dylan wrote and released a song 1963 titled "The Times They Are a-Changin'. The song responded to the dynamic changes in society, which was an attempt to create an anthem for change influenced mainly by Irish and Scottish ballads. Times they are Changin', to a large extent, has affected people's perspectives on society, transcending the ideological concerns of the time it was composed. Reviewers have noted how the universal lyrics contribute to the song's enduring message of change. However, Bob Dylan pointed out that times are no longer changing, but 'Times

have changed' in his music from the film *Wonder Boys*, "released as a single on May 1, 2000, that won both the Academy Award for Best Original Song and the Golden Globe Award for Best Original Song".[1] Kees de Graaf, a Dylan critic, defines "things have changed" concerning the biblical instruction Dylan experienced. At the same time, he was a Vineyard Fellowship student in the late 1970s. According to de Graaf, the song exudes a sensation that "the world may end at any moment.".[2] Despite Dylan's eschatological apprehension, the world is yet to end. Still, the forces of change are continuous as the world is ever-changing, courtesy of the changing faces of technological advancements from time immemorial and shortly after that.

Industrial Revolutions

The Four Industrial Revolutions have changed the face of human endeavours for over two centuries and a half. The phrase "industrial revolution" may be traced back to Arnold Toynbee's 1884 book Lectures on the Industrial Revolution.[3]According to Toynbee's definition of the Industrial Revolution, the development of power and mechanical production only became a revolution combined with a "political culture that was susceptible to change.".[4] Hobsbawm argues that "the Industrial Revolution is not merely an acceleration of economic growth, but an acceleration of growth because of, and through, economic and social transformation.".[5] In the context of this study, industrial revolutions are a series of technological, mechanical, and power developments that have occasioned cataclysmic economic accelerations and growth alongside systemic shifts in global sociocultural perceptions within the last two hundred years. Accordingly, the Industrial Revolution is categorised into four phases, critically examined in the subsequent paragraphs from a humane perspective.

The First Industrial Revolution, occasioned by the invention of the steam engine in 1780, heralded changes in socioeconomic structures and redefined the meaning of work and labour. The redefinition of work (labour) and the First Industrial Revolution redefined all facets of human development. The Industrial Revolution transformed societal values, relational dynamics, and social interactions as people worked and interacted. Rosen argues that steam power is the pivot that facilitated the nexus between the spokes of coal, iron, and cotton.[6] This era replaced manual labour with machines, which increased the

[1] B.A. Adedibu, "*Mission out of Africa: The Changing Faces of African Christianity*," 10th Inaugural Lecture (Redeemer's University Press, Ede, Nigeria, 2022), p. 1.
[2] Kees de Graaf, Bob Dylan's "The Times They Are A-Changin," an analysis, Web: https://www.keesdegraaf.com/media/Misc/1324thetimestheyareachanginananalysisweblogarticle.pdf Accessed May 25, 2023.
[3] A. Toynbee, Lectures on the Industrial Revolution, London: Rivingtons, 1884
[4]Gavin Weightman, *The Industrial Revolutionaries* (New York: Grove Press, 2007), p. 3
[5] Eric Hobsbawm, *Industry and Empire: The Birth of the Industrial Revolution* (New York: The New Press, 1968).
[6] W. Rosen, *The Most Powerful Idea in the World – A Story of Steam, Industry, and Invention*. (University of Chicago Press. 2010).

production rate of goods and services. Thus, industrialisation heralded a shift from the agricultural economy. It has led to massive human migration from rural areas to urban centres, where factories and industries offer new opportunities and challenges. Urbanisation also created social problems such as overcrowding, pollution, poverty, and crime.[7]

Partly to resolve this societal problem, an idea for an entirely novel sort of curriculum began to emerge, offering more diverse options for degrees and innovative general education courses that sought to broaden the breadth of learning by utilising an array of industry-led and machine-oriented methodologies. Economists have observed that when new technologies are brought into an economy, there is an extensive lag period before the technology is wholly assimilated to the point in which it provides demonstrable impacts on production. The difference between technical innovation and productivity increases is the productivity paradox. It is attributed to the time necessary to provide instruction and experiment using novel technologies to spread across the industry.[8] The New Model of Education, which emerged as a result of the First Industrial Revolution, is a framework that needs to be better organised and foster a profound sense of shared affiliation as well as positive fraternity amongst its participants.[9] Newton's law of motion accentuated the emergence of the first industrial revolution when he formulated his laws of motion.[10] This led to knowledge appropriation of movement and quantification, which largely influenced the design of steam engines that led to mechanisation, thereby eliminating the drudgery associated with human work. It has mechanised much of the work that humans traditionally did.

The Second Industrial Revolution began in the late 19th century and was associated with new industrial technologies utilising electricity, the internal combustion engine, and mass production. Faraday and Maxwell's laws catalysed the second industrial revolution, which utilised unified magnetic and electric motors, producing electricity and motors vital in various assembly lines.[11] This development accentuated more changes, forging a different economy.[12]

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[7] See Industrial Revolution and Technology (nationalgeographic.org) Accessed May 4, 2023

[8] Andrew Atkeson and Patrick Kehoe, "Modelling the Transition to a New Economy: Lessons from Two Technological Revolutions,"*American Economic Review* 97, no. 1 (2007), pp..64–88

[9]*Charles* William *Eliot* (1834-1926) was President of Harvard University from March 12, *1869,* to May 19, 1909. For further study, see Hugh, Hawkins, "Charles W. Eliot, University Reform, and Religious Faith in America, 1869-1909", *The Journal of American History*, Vol. 51, No. 2 (Sep. 1964), pp. 191-213

[10] Newton's law states that *the time rate of change of the momentum of a body is equal in both magnitude and direction to the force imposed on it*.

[11] Faraday's law of electromagnetic induction, also known as Faraday's law, is the fundamental law of electromagnetism, which helps us predict how a magnetic field would interact with an electric circuit to produce an electromotive force (EMF). This phenomenon is known as electromagnetic induction. However, Maxwell modified

Workers during the Second Industrial Revolution were obliged to perform their mechanical function in production with skill in a limited area rather than an end-to-end understanding of a product. Steel manufacturing ushered in the development of skyscrapers, trains, and electric vehicles, redefining what advancement and development meant. Society transformed yet another time, with material wealth taking on even greater significance as a way of life. With the spread of various sorts of institutions of higher learning, it expanded the increasing technological divisions[13]

The Third Industrial Revolution, or Electronics or Internet Revolution, was ascribed to digitisation and Internet-based inter-connectedness. In the 1980s and 1990s, it was a powerful force. The inflexible production line methods became unexpectedly adaptive, and technological advances in communication and information expanded across every sector, spanning agribusiness to the financial sector, management, and commerce.[14] Access to higher learning expanded as campus heterogeneity grew and research on globalisation was enhanced by internet technology.[15] Local state and personal networks enabled the internet for factory automation, numerically controlled (NC) machines, and Programmable Logic Controllers (PLC). Personal computers function on the factory floor as part of automation and tracking systems based on spreadsheets, bespoke database applications, and the initial wave of commercial manufacturing software, such as computer-aided manufacturing (CAM) and computer-integrated manufacturing (CIM). Lean, industrial methods, automation, and information technology significantly increase industrial productivity. Distributed information networks loosely connect manufacturing business software for procurement, inventory control, scheduling, operations management, and finance management. Towards the end of this revolution, internet-enabled e-commerce apps and data sharing with suppliers via email. The Third Industrial Revolution is also having a significant impact on the way people live. For example, the development of new technologies has enabled people to work from home, shop online, and stay connected with friends and family worldwide. It has also allowed people to acquire knowledge irrespective of where they might be. The early three Industrial Revolutions demonstrated tremendous upheavals in humanity, the economy, and education, which resulted in a profusion of innovative courses of study and novel and dysfunctional institutions of learning.

Faraday's law of induction. It describes the production of electric fields by a time-varying magnetic field. This law defines the work needed for moving a unit charge around a closed-loop structure as the magnetic field transforming around that loop.

[12]A., Atkeson, & P. Kehoe, "Modelling the transition to a new economy: Lessons from two technological revolutions". *Pp.* 64–88.

[13] D. A., Razak, & A. R. Moten, "The fourth industrial revolution: Shaping a humane world?" In E. J. Valeau, R. L. Raby, & U. Gaulee (eds), *Shaping a humane world through global higher education: Pre-challenges and post-opportunities during a pandemic*, (*Baltimore, US*, STAR Scholars, 2022) p.20

[14] D. A., Razak, & A. R. Moten, "The fourth industrial revolution: Shaping a humane world?" p. 21

[15] Ibid

The technological advancements of the twenty-first century have heralded a new narrative concerning the magnitude and impact of development. Technological advancement changes under the discourse referred to as the Fourth Industrial Revolution (4IR). 4IR, compared to prior Industrial Revolutions, is distinguished by numerous multiplying technologies that are exponentially capable of fast-scale growth. The concept of 4IR, to a large extent, has been popularised by Klaus Schwab.[16] The schematisation of the Four Industrial Revolutions, showing major hallmarks of each Industrial Revolution, is depicted below. The next section of this article focuses on the dialectics of the 4IR due to its ongoing impacts and likely futuristic trajectories that will redefine humanity beyond the previous three industrial revolutions across the globe.

2. Dialectics of the Fourth Industrial Revolution

The term Industrial Revolution was first used at the Hannover Industrial Fair in 2011 by scientists researching high-tech strategies for the German government to raise German manufacturing by appropriating new advanced technologies such as the Internet of Things.[17] This thesis demonstrates the current phase of rapid technological progress within a distinct socio-historical narrative and earlier industrialisation wave. Throughout the early stages of the Industrial Revolution, hydraulic and steam power led to mechanised industry, and the second utilised electric power and product assembly based on labour division. The third is automated using electronics and information technology. The multifaceted impact of the third industrial revolution is evident with the "expansion of access to higher education, which rose to even greater prominence with greatly increased diversity on campuses, and the globalisation of academic research accelerated by online technologies".[18] This ultimately led to increased opportunities for higher education globally in such countries as India, China, and the United States. For instance, in the United States, 4% of adults attended higher education in 1900, but as of 2000, 70% of the population had some form of opportunity for higher education.[19] The perspective mentioned above is further corroborated by Penprase, who notes that "proliferation of new educational institutions and new curricula after the first two Industrial Revolutions enabled the technical and managerial capacity to implement the massive expansion of the economy and manufacturing that arose in the 20th century".[20]

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[16] Klaus Schwab, *The Fourth Industrial Revolution* (Geneva: World Economic Forum, 2016).
[17] Chu-Chi Kuo, Joseph Z. Shyu, Kun Ding "Industrial revitalisation via industry 4.0 e A comparative policy analysis among China, Germany and the USA" in Global Transitions Vol. 1, (2019), p.3
[18] B.E. Penprase, "The Fourth Industrial Revolution and Higher Education". In: Gleason, N. (eds) *Higher Education in the Era of the Fourth Industrial Revolution*. (Palgrave Macmillan, Singapore,2018). pp.215-216
[19] Ibid, p.217
[20] Ibid

The enormous developments in society and education that accompanied the first two industrial revolutions extended for several years following the initial emergence of the contributing technologies of electricity and streams. Mazuir argues that the Third Industrial Revolution led educators into a world where information is instant and free, changing the emphasis towards hands-on methodologies that promote cooperation across various groups in a project-oriented and collaborative educational setting.[21] It is crucial to highlight the shifts in society and education brought about by both the industrial and technological revolutions, which are difficult to distinguish from other reasons, such as economic fluctuations and other gigantic geopolitical events of the time. The shift towards online education was one of the most significant consequences of the Third Industrial Revolution. Online open courses replaced conventional face-to-face tertiary education, providing higher education to thousands of hitherto underserved people worldwide. The online education revolution continues to unfold, but it is more likely in top-notch synchronous classroom settings utilising online technology to allow students to gain skills and knowledge asynchronously and rapidly.

Interestingly, Nigeria is still grappling with the dynamic shifts of the third industrial revolution concerning online courses; as of June 2020, only 12 universities have received licenses to run and operate both conventional and open and distance learning (ODL). However, Nigeria's statutory regulatory body for university education might have grasped the immense benefits of online courses yet cautious in the granting of license to Nigerian universities to offer open and distance learning. Still, more infrastructure facilities such as buildings, technological facilities, stable electricity and a host of other needs, in these universities might motivate proliferation of online courses in Nigerian universities to meeting the educational aspirations of millions of Nigerians who might be unable to attend the Federal, state and private owned universities.

A '4IR' is now on the horizon, defined[22] By a convergence of technologies erasing the distinctions between the physical, digital, and biological realms. In light of the pace with which technological advancements occur, the concurrent nature of drastic shifts within fields of study, and the alteration of entire systems, this shift is causing greater chaos than earlier industrial revolutions.[23]

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[21] Eris Mazur, "Farewell, Lecture?" Science 323, no. 5910 (2009): pp.50–51.
[22]]. Klaus Schwab, The *Fourth Industrial Revolution*, p.1
[23] Some scholars have argued that the 4th IR argues about continuing the techno-deterministic capitalist neo-liberal agenda. This inevitably entails that the emerging technologies envisaged in the 4th IR will be in the hands of private capitalists while they will contrite little or nothing in addressing the societal challenges of the society, thereby relegating such to an ancillary status. Managing new technologies is usually only done by a few business people and industry professionals. By their capacity to 'innovate', these innovators are posited as the most capable, which is often abused, leading to economic exploitation. A., Kravchenko, & I. Kyzymenko, "The Fourth Industrial Revolution: New Paradigm of Society Development or Post humanist Manifesto". *Philosophy & Cosmology*, 22, (2019), 120–128; J. Avis, "Socio-technical imaginary of the fourth industrial revolution and its implications for vocational education and training: A literature review". *Journal of*

However, underneath the 4IR's predictions of increased efficiency, economic growth, and consumer choices are the concealed assumptions and goals of those responsible for generating and disseminating this discourse. This has led to a diverse critical stance of scholars on the 4IR

The Fourth Industrial Revolution is an extensive and breathtaking reshaping, work, interaction and blurring of ethical lines hitherto perceived as sacrosanct. Hence, humanity has never witnessed such massive technological advancements, which are multifaceted and redefine human, social, economic, educational, and healthcare services across the globe.[24] 4IR deploys Smart sensors, Cyber-Physical Systems (CPS), the Internet of Things (IoT), the Internet of Services (IoS), big data analytics, virtual and augmented reality (AR), autonomous robots, the use of additive manufacturing (3D printing), and cloud-based computing are all utilised by the Fourth Industrial Revolution for optimisation. The impact of these technological breakthroughs on humanity is quite diverse and significant. For instance, A machine that can communicate, reason, learn, and solve problems is artificial intelligence (AI), a phrase first used by John McCarthy in 1955.[25] According to Baker and Smith, AI is a general word that refers to various technologies and methods (such as machine learning, NLP, data mining, and neural networks). Artificial Intelligence (AI) technologies, such as "Machine Learning (ML), are embedded in everyday communication services".[26] However, the history of AI is complex and characterised by positive and negative expectations, which led to a period of hype occasioned by disappointments and decline.

Vocational Education & Training, (2018). 1–27. https://doi.org/10.1080/13636820.2018.149890; C., Hughes, & A. Southern, "The world of work and the crisis of capitalism: Marx and the Fourth Industrial Revolution". *Journal of Classical Sociology,* 19(1), (2019). 59–71. https://doi.org/10.1177/1468795X18810577; M. A. Peters, Technological unemployment: Educating for the fourth industrial revolution. Educational Philosophy and Theory, 49(1), (2017), 1–6. https://doi.org/10.1080/00131857.2016.1177412; S. Pfeiffer, The "Vision of "Industrie 4.0" in the Making—A Case of Future Told, Tamed, and Traded". *NanoEthics,* 11(1), (2017). pp.107–121. https://doi.org/10.1007/s11569-016-0280-3

[24] Klaus Schwab, *The Fourth Industrial Revolution, S*upra note 1 at 1 A., Trauth-Goik, "Repudiating the Fourth Industrial Revolution Discourse: A New Episteme of Technological Progress". *World Futures*, Online First, (2020), pp.1-24. N. J. Nilsson, *Artificial Intelligence: A New Synthesis.* (San Francisco: Morgan Kaufmann Publishers, Inc, 1998).

[25] A., Trauth-Goik, "Repudiating the Fourth Industrial Revolution Discourse: A New Episteme of Technological Progress". *World Futures*, Online First, (2020), pp.1-24; N. J. Nilsson, *Artificial Intelligence: A New Synthesis.* (San Francisco: Morgan Kaufmann Publishers, Inc, 1998).

[26] T., Baker, & L. Smith, Education rebooted? Exploring the future of artificial intelligence in schools and colleges. Retrieved from Nesta Foundation website https://media.nesta.org.uk/documents/Future_of_AI_and_education_v5_WEB.pdf accessed 25, January, 2024

In the ever-dynamic contemporary industrial sector, 4IR technologies, referred to as the Internet of Things (IoT), have made it possible for nearly anything to be designed on a computer and then printed on 3D printers that create objects in countless materials or even biological tissues. This capability will allow humans to turn data into things and things into data. 3D printing materials could range from the standard thermoplastics in traditional 3D printers to large-scale construction materials for buildings, to clumps of atoms 10 nm across". The technology of 3D printing is utilised in the construction of anything from houses to companies to bridges. Dubai has begun preparations to build the world's first 3D-printed mosque. The choice of 3D technology for constructing the mosque is "because it is a new and innovative technology that can save time and resources compared to traditional building methods".[27]The 3D mosque construction is with concrete mix and, when completed, will accommodate 600 worshippers over 2,000 square metres over two floors.[28]

> *The 4IR combines digital, physical, and biological systems. It has brought significant changes to work, the economy, and society. Given the continued technological advancements, the 4IR is a meaningful discourse amongst global agencies and various governments, as indicated by multiple thinkers like Deloitte.[29] 4IR, according to the World Economic Forum at Davos, will require "accelerating workforce reskilling."[30] within business leadership, McKinsey and Company[31] and national initiatives like the Accelerating US Advanced Manufacturing[32] Moreover, many others have engaged the concept of 4IR in their deliberations.[33]*

[27]Nadia Leigh-Hewitson, "World's first 3D-printed mosque to be built in Dubai" Web: https://edition.cnn.com/style/article/3d-printed-mosque-dubai-spc-intl/index.html Accessed May 29, 2023

[28] Ali Mohammad Alhalyan Alsuwaidi, head of engineering at the Dubai Government's Islamic Affairs and Charitable Activities Department (IACAD), For further reading, see Nadia Leigh-Hewitson, "World's first 3D-printed mosque to be built in Dubai." Web: https://edition.cnn.com/style/article/3d-printed-mosque-dubai-spc-intl/index.html Accessed February, 21, 2023

[29] The Context of Digital Transformation Framework, McKinsey &Company Web: The Context for a Digital Transformation Framework, McKinsey & Company, YouTube Accessed 23 February, 2023

[30] President's Council of Advisors on Science and Technology, Report to the President on Ensuring American Leadership in Advanced Manufacturing, 2011, https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/pcast-advanced-manufacturing-june2011 .pdf (accessed 24 Feburuary, 2023).

[31]The context of Digital Transformation Framework, McKinsey &Company Web: The Context for a Digital Transformation Framework | McKinsey & Company, YouTube Accessed May 23 23, 2023

[32] President's Council of Advisors on Science and Technology, Report to the President on Ensuring American Leadership in Advanced Manufacturing, 2011

The projected potential of 4IR might lead to massive societal changes, which the World Economic Forum referred to as tipping points. For instance,

> A survey of 800 high-tech experts and executives determined a series of dates by which tipping points would be reached. Examples include implantable cell phones by 2025, 80% of people with a "digital presence" by 2023, 10% of reading glasses connected by 2023, 10% of people wearing internet-connected clothes by 2022, 90% of the world population with Access to the internet by 2024, 90% of the population using smartphones by 2023, 1 trillion sensors connected to the internet by 2022, over 50% of internet traffic directed to homes and appliances by 2024, driverless cars making 10% of all cars in the US by 2026, and many other outcomes such as AI members of the board of directors, Ai auditors and robotic pharmacists, the proliferation of bitcoin in the economy, 3D printed cars by 2022, transplants of 3D printed organs such as livers by 2024, and several others.[34]

1.Emerging Realities from 4IR

Various schools of thought argue that the 4IR has heralded an era of disruptive changes (Drath Horch and Deschamps Mesquita 2021, 44). A snapshot of novel and converging technologies that have evolved in the 4th IR highlights the various positive and disruptive features of the 4IR. The 4IR is a time of significant change and opportunity. It is essential to be aware of the emerging realities of this revolution due to the rapid technological changes transforming how we live, work, and communicate.

Multifaceted Impact of 4IR

The 4IR is converging technologies, including artificial intelligence (AI), robotics, 3D printing, the Internet of Things (IoT), and blockchain. Although 4IR is still in its early stages, it significantly impacts the world. For example, the Internet of Things (IoT), which describes the phenomenal growth in the

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https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/pcast-advanced-manufacturing-june2011 .pdf (Accessed 24 February, 2024).

[33] It has been observed that many countries have initiated and sustained corresponding industry revitalisation agendas. For instance, in Germany's Industry 4.0 policy, other countries have proposed similar approaches, such as the Advanced Manufacturing Partnership (AMP) by the USA, Industrial 4.1 by Japan, Strategy for Innovation in Manufacturing Industry 3.0 by the Republic of Korea, Made in China 2025 by China, and Productivity 4.0 by Taiwan. For further study, see Chu-Chi Kuo, Joseph Z. Shyu, and Kun Ding, "Industrial revitalisation via industry 4.0: A comparative policy analysis among China, Germany and the USA," in *Global Transitions* Vol. 1, (2019), pp. 3–14.

[34] B.E. Penprase, "The Fourth Industrial Revolution and Higher Education" pp. 215-216

number of physical objects with Internet connectivity, will increase by 2025. Data networks are expected to be available to every person on Earth at negligible cost.[35]Meanwhile, the uptake of 5G networks across the globe is forecast to dramatically increase the volume and variety of connected device types within society.[36] Regarding performance, 5G outstrips its predecessor, 4G, by several orders of magnitude, untethering applications traditionally dependent on cable connectivity, such as fibre optics or copper. This technological 'renaissance' is prophesied to envelop the world in high-speed, interconnected and wireless networks[37] thereby facilitating the continued breakdown of the 'online.[38]

Creation of synthetic creatures

The creation of synthetic creatures (life from DNA produced within computers and bio-printed) produced utilising robotic production lines, where nano materials give enormous advances in manufacturing effectiveness, is one example of a coming reality within the 4IR. The 4IR stretches the new industrial concept into a future in which many components of what we call industry—fixed and centralised manufacturing facilities, vast human resources inside significant corporations—will cease to exist.[39] The most widely recognised rapid technology is the increasing rise in computer processing power and decreasing costs for storage, which follows a geometric relationship referred to as Moore's Law.[40] Owing to the doubling of CPU power every 18–24 months, newer supercomputers can already achieve computing rates of 300 quadrillion FLOPS (floating operations per second) in the future.

Nexus between 4IR and bioeconomic opportunities

Over time, new technologies have the potential to enhance bioeconomics, which will fuel and define the future. Thus, it is poignant considering the climate change changes due to the loss of arable land, which requires additional food production of almost 50% by 2050, which will depend on scientific breakthroughs through the appropriation of 4IR technologies in food production.[41]The rise of biological refineries, which employ synthetically

[35] Drath Horch and Deschamps Mesquita, *British International Journal of Education And Social Sciences*, Vol. 8, No. 8 (2021), p.44
[36] J. Barker, "Silencing the Noise,"*Deloitte Insights Review*, Issue 24, January 2019, p. 6.
[37] J. Barker, "Silencing the Noise", p. 6
[38] Drath Horch and Deschamps Mesquita, p. 44
[39] B.E. Penprase "The Fourth Industrial Revolution and Higher Education," p.217
[40] Moore's law is the observation that the number of transistors in an integrated circuit (IC) of a fixed size doubles about every two years. Moore's law is an observation and projection of a historical trend. Rather than a law of physics, it is an empirical relationship linked to gains from experience in production. For instance 1993, the Intel Pentium processor had 3.1 million transistors. Two years later, the new version of the same processor had 5.5 million transistors. By 2003, the number of transistors had jumped to 55 million.
[41] B.E. Penprase "The Fourth Industrial Revolution and Higher Education", p.215

engineered microorganisms to produce a wide range of valuable chemicals and food components, might be a critical component of the 4IR environment. These biological refineries could use flexible food stocks such as cellulose, biomass, and simple sugars to mass produce massive fuels, pharmaceuticals, and food products in huge quantities, allowing for an anticipated decrease in petroleum and natural gas consumption in the coming decades.

Microorganisms might also help the environment by eliminating different environmental chemicals, such as harmful metals, from landfills.[42] For instance, Penprase notes that Start-up companies are inventing new species with standardised genetically engineered wetware, enabling the production of organic circuits and computers, as well as substances for construction built with biological components known as "bio-bricks."[43]

Biotechnology's contributions to the energy sector are not limited to the generation of biofuels, and microbe-mediated methane generation may be the most significant in the future. The oil industry leaves sixty to eighty per cent of the crude oil in the Earth's crust because it is technically and economically irrecoverable.[44] However, it is pertinent to note that the swift advancement of enhanced biofuel production techniques from easily accessible resources such as biomass and the comparatively low cost of installing biofuel production facilities compared to fossil fuels makes biofuel more attractive for implementation in economically disadvantaged economies.[45] Despite the lack of this development, Nigeria has yet to appreciate the positives of biofuel technology, even with the establishment of the Dangote Refinery. Nigeria's energy sector is mainly dependent on petroleum and fossil fuels for energy and electricity production, as "biomass, solar, and large hydropower have the highest energy potential in Nigeria, but current utilisation is still low. Less than 30% of each renewable energy source's potential is utilised.".[46] The 4IR may provide technological answers to environmental issues caused by the accumulation of CO2 and other greenhouse gases from the initial two industrial revolutions. Some scientists have projected that a temperature increase of more than ten degrees Celsius might leave the Earth uninhabitable, causing widespread agricultural losses and exposing substantial portions of the global

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[42] James Philp, "The economy: the challenge of the century for policymakers,"*New Biotechnology* 40, Part. A (2018), pp. 11–19. https://doi.org/10.1016/j.nbt.2017.04.004.
[43]B.E. Penprase "The Fourth Industrial Revolution and Higher Education, p.215
[44] Muggeridge A, Cockin A, Webb K, Frampton H, Collins I, Moulds T, Salino P., "Recovery rates, enhanced oil recovery, and technological limits.". *Philos Trans A Math Phys Eng Sci.* 2013 December 2;372(2006):20120320. doi: 10.1098/rsta.2012.0320. PMID: 24298076; PMCID: PMC3866386.
[45] Nigeria,Ebuwa Elisabeth Eweka, Enrique Lopez-Arroyo, Christian Oluwaremilekun Medupin, Abiola Oladipo and Luiza Cintra Ca"Renewable Energy Resources in Nigeria"*Scholarly Community Encyclopaedia* Web: https://encyclopedia.pub/entry/26194 Accessed May 29, 2023.
[46] Ibid

population to heat exhaustion and death. Temperature rises may lower agrarian output by up to 15% for each degree of warming.[47]

Knowledge Management for 4IR

The Fourth Industrial Revolution is also having a significant impact on the way we work. For example, AI is being used to automate tasks humans previously did and robots to replace factory workers. Businesses are increasingly seeking workers with AI, data analytics, and IoT skills. Nevertheless, there is a growing concern about job displacement, and it negatively affects employment and future work, leading to the need for upskilling and reskilling.[48] The workforce and workers face challenges because of the generational shift in technological capacity within 4IR, which corresponds to the development of the social process. A lack of competent workers comes with fewer workers and a shortage of personal knowledge. Despite having extensive process expertise and work experience, the existing workforce, primarily older people, must be able to use highly advanced technology such as ICT and data science.[49]

Furthermore, these new technologies have led to an enormous advantage; nevertheless, this depends on, among several other factors, the capacity of humans to adapt. Humans, as well as both the need and availability of talents and the evolving framework of work, are all affected by technological advances.[50] Nevertheless, this raises queries regarding how this innovation may affect human labour. Will the employment market endure significant alterations, particularly for current workers whose employment may be affected by industrial production shifts? What are the ethical repercussions of implementing Industry 4.0? What are the implications for employees, as well as how can knowledge administration (KM) methods assist firms in ensuring their staff are ready to tackle 4IR?

Job loss versus Job creation

Employment loss is particularly likely in gathering and analysing data tasks and jobs that depend extensively on physical labour carried out within a structured setting, such as production workers, construction and grounds cleaners, and administrative roles such as clerks. Ansari, Syafrudin & Fitriyani[51] Quoting a McKinsey Global Institute analysis, a 2017 McKinsey Global Institute study found a link between the probability of labour tasks transforming into

[47]For further details, see David Wallace-Wells, "The Uninhabitable Earth,"*New Yorker*, July 9, 2017, http://nymag.com/daily/intelligencer/2017/07/climate-change-earth-too-hot-for-humans.html.
[48] Ansari, M.; Almunawar, M.N.; Masri, M.; Hamdan, M., "Digital marketplace and FinTech to support agriculture sustainability.". *Energy Procedia* (2019), 156, pp. 234–238
[49]Ibid., p. 292.
[50] Ibid, pp.1-23.
[51]Ansari, Syafrudin & Fitriyani, "Digital marketplace and FinTech to support agriculture sustainability". p.292

automated tasks and the present level of education required for these professions. In his study, Kergroach anticipated that between 400 million and 800 million individuals might be affected by technologies and would need to seek employment opportunities by 2030.[52] 4IR is an industry-knowledge-driven workplace where manual labour has begun to phase out in favour of highly skilled labour.

Furthermore, because of the Internet of Things, novel job opportunities for hard-skill jobs that include data analytics or upkeep, designing circuits in AutoCAD, for instance, microprocessor programming, machine learning, and algorithm creation will become accessible. For example, "according to research conducted by Boston Consulting Group, Industry 4.0 will generate approximately 390,000 new jobs in Germany alone by 2025.".[53] Likewise, manual jobs are traditionally replaced by workers executing the same operations in an enhanced or virtual reality context.[54] As a result of the platform economy's emergence, there would be an increase in freelance jobs, such as chauffeuring vehicles for Uber "or carrying out microwork, such as taking on a project, breaking it down into tiny components, and distributing each component into some people to complete via crowdsourcing websites.".[55]

Most countries have changed The occupational structure, and job creation has moved significantly away from low-skill routine professions towards higher-skill occupations. It is imperative to posit that new technologies are not only beneficial to an organisation but also have their challenges. For instance:

> Many countries supervise technology in a highly positive or neutral manner. While some countries view the speed of automation and employment as neutral, others view the pace as more detrimental than beneficial. Moreover, this could be because some countries view new technologies as the engine of human economic growth. Some advanced economies may be concerned about the impact on competition if other countries adopt the latest technologies. Whether new technology creates more or fewer jobs depends on the country. Some emerging online jobs are search engine evaluator, social media manager, freelance

[52] S. Kergroach, Industry 4.0: New Challenges and Opportunities for the Labour Market. Foresight STI Gov. 2017, pp. 6–8
[53] M. Reaney, Inside Industry 4.0: "What is Driving the Fourth Industrial Revolution? Big Cloud Recruitment". Available online: http://www.bigcloud.io/inside-Industry-4-0-whats-driving-the-fourth-industrial-revolution (accessed on April 1, 2023).
[54] L. Patterson, "Is IoT Creating or Destroying More Jobs?" Available online: https://www.iotevolutionworld.com/smart-factories/articles/433239-iot-creating-destroying-more-jobs.htm (accessed on April 1, 2023).
[55]Ansari, Syafrudin & Fitriyani, "Digital marketplace and FinTech to support agriculture sustainability,p.292

> web designer, online recruiter, online tutor, and online influencer. [56]

Humans may not be necessary for production in the foreseeable future. Still, humans are an essential part of 4IR since human beings are change drivers in the technology industry through various innovations and creativity. It is more complex than machines taking over all routine and predictable tasks.

The Fourth Industrial Revolution through the Lens of Nigeria: Shaping a Humane World?

Technological advancements have changed virtually all facets of human engagement over the years. This development disrupts the inherent modalities of preceding production activities but has positive benefits that have changed the economic production process. Industrial revolutions have boosted commerce over the years. The comparative edge gained via specialisation and automation contributed to global development, resulting in trade across borders. However, the 4IR cannot be divorced from the previous industrial revolutions. Still, technological advancements are unprecedented in human history, catalysing virtually every facet of human enterprise globally. This section gives an overview of the fourth industrial revolution in Nigeria, with particular attention to the possible present and future disruptions and gaps in the nation and the humanities in general. Like other countries globally, Nigeria faces the challenges and opportunities of appropriating 4IR technologies in all facets of its existence. Nigeria, with an ever-increasing population of 220 million people characterised by a gradual economic meltdown, solely relies on a mono-economic product for export, which is crude oil; leadership ineptitude; poor fiscal discipline; and operating a magnificent democratic structure that has failed to take cognisance of the character of the nation as federalism. Although "there has been growing investment in tech start-ups and telecommunications, agriculture and manufacturing have been growing below potential.".[57] Moreover, the appropriation of 4IR technologies is incomparable to that of developed nations. Still, to a large extent, there is considerable potential for applications of these technologies in virtually all the sectors of the Nigerian economy, but this might cause disruptions like in other countries.[58]

Obijole, citing Lund, notes that 4IR technologies in Nigeria include:

> It will impact trade via blockchains, digital platforms, and IoT, among other drivers of these transformations.

[56] Ibid

[57] E. Obijole, "The Fourth Industrial Revolution: Economic Impact and Possible Disruptions"*Exploring Economics*, 2020, Web: https://www.exploring-economics.org/en/discover/nigeria-fourth-industrial-revolution/ Accessed May 16, 2023

[58] Ansari, Syafrudin & Fitriyani, "Digital marketplace and FinTech to support agriculture sustainability, pp.156, 234–238

> International trade has been faster using blockchains since they provide more flexibility in making payments than traditional letters of credit. These technologies could reduce shipping and customs processing times by 16–28%, boosting global trade by 6-11%.[59]

Furthermore, Obijole argues that modern economic theories affirm that technological developments provide the impetus for aggregate output growth, which translates to more employment opportunities. Obijole's assertion is based on Price Water Cooper's projection of 2017 on Nigeria's structural transformation and jobless growth, as he states that:

> Employment elasticity of the agricultural, manufacturing, and services sectors is 0.1%, 0.3%, and 0.5%, respectively. With businesses becoming more intense in their use of digital technologies, it is projected that there will be job growth, especially in information and communication technology (ICT). Thus, a 1% increase in services output will, on average, increase employment in that sector by 0.5%.[60]

Though its employment elasticity is less than proportionate, its impact could be considerable since services contribute most to employment in Nigeria.[61]

In terms of market, the impact of 4IR on Nigeria's labour market is a function of whether the technologies appropriated complement or replace labour, which will differ from the various sectors of the economy. According to studies, over 46% of occupational operations in Nigeria are open to mechanisation. Around 6% of businesses are also projected to have reservations regarding an inadequately competent workforce. This figure is anticipated to rise in the years to come as the basic skills necessary across occupations change.[62] Compared to advanced economies, Nigeria is evaluated to possess an average potential to adjust to these interruptions and an average exposure to these future developments. The situation will probably alter when these advances in technology find more uses. Thus, the Nigerian government is crucial in reducing potential job-market disruptions.

In a developing economy like Nigeria, the appropriation of 4IR is expected to increase due to the various opportunities for modern economic activities that defer localisation, particularly in using digital platforms for e-commerce. Digital platforms such as Amazon and Alibaba and freelancing sites like Upwork, which bring sellers and buyers together, are increasing in Nigeria, which will contribute to the nation's economic development. Similarly, the digitalisation of

[59] E. Obijole, "The Fourth Industrial Revolution: Economic Impact and Possible Disruptions,"*Exploring Economics*,
[60] Ibid
[61] Ibid
[62] Ibid

transport businesses, such as Taxify, Uber, and Bolt, is booming and increasing. The need for transportation is anticipated to rise because of Nigeria's growing populace, greater industrialisation, and more commercialisation through the 4IR. The cost of transportation will decrease as businesses grow to be more competitive and benefit from industry economies of scale. Through these digital platforms, the transformation in the commerce and transportation sectors is also producing work prospects for delivery drivers and independent contractors, as 4% of the output of the services industry in 2018 came from this significant subsector.[63]To address the issues of the country's growth, 4IR should be utilised. Nigeria, however, needed a national plan that focused on 4IR technology. [64]

From the preceding, it is apt to posit that the 4IR will contribute positively to the economy and manufacturing. It is imperative to look at how 4IR is shaping the humane world in Nigeria. 4IR is an integrated, adaptable, optimised, and customer-focused production method. It resulted in a comparable factory-like approach for mass-producing human resources for the industry, unlike the preceding three Industrial Revolutions. For instance, the Nigerian government needs a strategic plan for the 4IR, particularly in human resources development through university education, compared to the developed economies with the renowned Education 4.0. Education 4.0 aims to prepare graduates for a society driven by cyber-physical structures, which is just one of the apparent effects of 4IR. However, Nigerian university education is primarily regulated by the National Universities Commission. This is evident in the vision of NUC, which states:

1. To work with Nigerian universities to achieve full accreditation status for at least 80% of the academic programmes.
2. To initiate and promote proficiency in the use of ICT for service delivery within the Commission and the Nigerian University System
3. Upgrade and maintain physical facilities in the Nigerian University System to deliver quality university education.
4. To match university graduate output with national human resources needs.
5. To foster a partnership between the Nigerian University System and the private sector [65]

The emphasis on innovation, especially technological advancement, which is a component of primarily developing the intellect and skills required to produce new products and create opportunities for creativity or the innovative economy, has turned education into a factory for job creation. Thus, the vision statement of NUC for the Nigerian university system might be summed up in

[63] Ibid
[64] Ibid
[65]Vision https://www.nuc.edu.ng/ Accessed 25 2023

four critical defining parameters, notably workforce, mind, and machine, driven by the market.

Nigerian university education has been reduced purely to market requirements, as students receive training to be obedient employees. Additionally, the information and abilities imparted could be more frequently adequate and are instead described as preparatory training sessions that pave the way for memorisation and regurgitation when these students are examined. It is apt to concede that the above scenario does not represent the totality of the Nigerian university educational system but largely shaped the approaches of the third industrial revolution. Thus, I concur with Sheldon and Abidoye that "factory mass teaching methods of the third revolution era have failed to conquer enduring problems of inequity and unfairness.".[66] There is an urgent need for the NUC to ensure the actualisation of global practice following UNESCO's Pillars for the 21st century, notably "learning to know, learning to do, learning to live together, learning to be, and more recently, learning to become with a stronger sense of personal responsibility for the attainment of common goals.".[67] Learning to become requires reimagining the strategies for realigning knowledge and understanding in shaping the future of humanity and the planet.

A social constructivist perspective on each student's instruction and a social constructionist approach to establishing educational settings are connected by these five pillars, and they substantially impact how students learn and how teachers and staff support their learning. Based on a social constructivist view of learning, an individual's development of new information and abilities is significantly affected and encouraged by the social context in which the learning takes place. Instead of merely taking in knowledge from their teachers or texts, students who are actively involved with people and the world in which they are located can make sense of their experiences. The vital elements of a social constructivist viewpoint include self-responsibility, complex issues, cooperative research, open-ended educational exercises, conversation, and introspection, while individuals learn in various ways.

Furthermore, the Nigerian university system should be interested in "what the student discovers for themselves when their natural curiosity and creative impulse are aroused, which will not only be remembered but will be the basis for further exploration and inquiry and perhaps a significant intellectual contribution.".[68] The following educational philosophy informs how the courses are created, delivered, and supported for the students: a demonstration of enthusiasm towards learning; a focus on education that is based on applied research; the student's knowledge of using shared learning tools are shared,

[66] A. Seldon & O. Abidoye, The Fourth Education Revolution: Will Artificial Intelligence Liberate or Infantilize Humanity? (The University of Buckingham Press, 2018), p. 22.
[67] J. Delors, I. Al Mufti, I., Amagi, Carneiro, R., Chung, F., Geremek, B., Gorham,W., Kornhauser, A., Manley, M., Padrón Quero, M., Savane, M. A., Singh, K., Stavenhagen, R., Suhr, M. W., & Nanzhao, Z.. *Learning: The Treasure Within.* UNESCO. (UNESCO, 2014), p.93.
[68] A. Arnove, *The Essential Chomsky.* (New York City, The New Press, 2008), p.234

learning to be critically reflective activities and promotion of courteous, inviting, and equitable environments for learning.

Nigeria might need to take a cue from the Singaporean educational system, which initiates and sustains courses on digital literacy so that its people may take advantage of 4IR's benefits. The introduction of Core Curriculum Minimum Academic Standards (CCMAS) by the National Universities Commission seems plausible. Still, innovative courses that are significant drivers for the 4IR must also be introduced. Adopting several of Singapore's innovative measures would assist in counteracting the significant unemployment that the current quo is expected to cause in most nations.

Given the above assertions, there is an urgent paradigm shift concerning the tertiary education approach in the first three industrial revolutions, centring on man, mind, machine, and market, to embrace the peculiar challenges of the 4IR. The submission of Dzulkifli Abdul Razak and Abdul Rashid Moten[69] University education in the 4IR in shaping the humane world is a significant contribution that needs further exploration. The three perspectives are stated verbatim below:

1. Broaden Manpower for employment to humanity and sympathy, a feeling of pity and sorrow towards the misfortune, and to stand in solidarity with the vulnerable and the marginalised.
2. Complement mind and innovation with heart and empathy, which is the ability to understand, acknowledge, and experience the feelings of others. Participation and engagement in providing real-world support to those affected by translating knowledge into real solutions should be encouraged.
3. Combine machines driven by Hi-Tech with Hi-Touch, which, according to Daniel Pink, "we are entering the age animated by a new form of thinking. It is a new world where an aptitude for high concept and high touch is highly prized.".[70] He defined hi-interactions as "the ability to empathise with others, understand human beings' subtle yearnings and interactions and pursue beyond every day for a new purpose and meaning."[71]

Conclusion

The first three Industrial Revolutions demonstrated the significant changes in society, the economy, and education that led to a profusion of innovative curricula and brand-new, illegitimate educational institutions.The fourth

[69] Razak, D. A., & Moten, A. R., "The Fourth Industrial Revolution: Shaping a Humane World?" In E. J. Valeau, R. L. Raby, & U. Gaulee (eds.), *Shaping a humane world through global higher education: Pre-challenges and post-opportunities during a pandemic* (STAR Scholars, 2022), pp. 30–31
[70]Ibid
[71] Ibid

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industrial revolution (4IR) differs from earlier ones because it is characterised by a few exponential technologies that may scale up quickly. 4IR questions core presumptions concerning what it is to be human and the parameters of how people interact with the natural environment.This articles explores the intricacies and adds to the discussion on 4IR and its sociocultural ramifications. Investigating the relationship between the humanities and technology developments in the 4IR is both urgent and essential, especially for emerging nations like Nigeria.The rate of technological changes necessitates a timely reaction on the part of the educational community. This article offers insightful information about the advantages and difficulties of implementing Education 4.0 methods in Nigeria as well as signposting emerging comparative educational approaches to technological developments like the Singaporean model. These discoveries can serve as a strong basis for upcoming legislation and studies in Nigeria.