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GREEN AUTOMOBILE TECHNOLOGY COMPETENCIES IN NIGERIA AND THE FOURTH INDUSTRIAL REVOLUTION

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Abstract
The advent of the Fourth Industrial Revolution (4IR) has brought about positive changes in every aspect of life as well as potential dangers for the nations or societies that fail to embrace the revolution. This study reviewed articles that analysed the potential benefits of the 4IR to Green Automobile and subsequent competencies requirements of the 4IR with respect to the Nigerian Automobile industry. Consequently, a systematic review through an inductive content analysis of empirical evidences from literature was conducted based on the contents and benefits of 4IR; green automobile and competencies required in the 4IR; Nigerian automobile industry and competencies required of the 4IR and the Future of Green Automobile and 4IR in Nigeria. The review showed that there is lack of support on the part of government on issues of green automobile. Inadequate power supply, educational system and non-functional automobile industries have also been identified as constraints to green automobile adoption in Nigeria. Competencies summarly put as: Information Technology Skills, Communication Skills, Thinking Skills, Creativity and Innovative Skills, Problem-solving Skills, amongst others were found to be highly recommended in other parts of the as requisite for any 4IR operation. Finally, the researcher therefore concludes and recommends that, the Nigerian government should reconsider its position to support green transportation; the power sector should be overhauled to power electric vehicle together with the education sector so as to develop the competencies needed for the 4IR.

Keywords*:* Fourth Industrial Revolution 4IR, Green Automobile and Green Automobile Competencies.

INTRODUCTION
The Fourth Industrial Revolution (4IR) emerged as a diverse and fascinating revolution with noticeable differences from the other revolutions. With its distinct features from the previous revolutions whereby, professionals needed just skills upgrade to fit in the subsequent era, the 4IR entails nothing short of the humankind transformation. The 4IR has brought about changes on lifestyle, work life and interpersonal relation with a great scope, scale and complexity. We now struggle for a full grasp of the breath and speed of the 4IR with its unlimited possibilities where mobile devices with immense processing power, knowledge access and storage capacity connect billions of people. Also breath-taking is the diverse confluence of emerging technological breakthroughs with various fields like Robotics, Artificial Intelligence (AI), quantum computing, Internet of Things (IoT), 3D printing, autonomous vehicles, nanotechnology, materials science, biotechnology, preservation of energy and so on. One major feature of the 4IR is sustainable technologies (Green Technologies), which allows for intelligent use of renewable natural energy for sustainable production and consumption. The automobile industry which is the most popular means of transportation is not left out, as it is creating wave with the emergence of hybrid, electric and intelligent cars hence, the call for competencies in the production, application, maintenance and repair of such technologies.

The Fourth Industrial Revolution
The fourth industrial revolution, unlike the previous revolutions, is not only limited to smart and connected machines and systems but it also covers a large range of scope which are; gene sequencing, nanotechnology, renewable energy and quantum computing. The main features that makes the fourth industrial revolution fundamentally different from previous revolution is

its combination of these technologies and their interaction across the physical, digital and biological domains [1].

Emerging technologies and broad-based innovations in the 4IR tends to be spreading rapidly across the world compared to17% of the world population (almost 1.3 billion people) especially in developing countries who are yet to have access to some basic characteristics of the second industrial revolution and the third industrial revolution such as electricity and internet. The hallmark of the first industrial revolution took almost 120 years to spread outside of Europe [2]. By contrast, the internet permeated across the globe in less than a decade with consumers benefitting the most. The array of new products and services made by the fourth industrial revolution has made positive increment in the efficiency of our personal lives as consumers at virtually no cost. Ordering a cab, finding a flight, buying a product, making a payment, listening to music or watching a film – any of these tasks can now be done remotely. Other products and services such as internet, the smart phone and numerous apps are making our lives easier, and more productive as consumers. Thanks to the technology brought by the fourth industrial revolution. Tablet, an electronic device which are used for communication, browsing and reading, have the same processing capacity of 5,000 desktop computers produced 30 years ago, whereas storing information now cost a minimal amount (1GB storage costs approximately $0.03 a year, compared to more than $10,000 20 years ago).

In terms of urbanization, cities have always been known for its diversification in innovation and economic activity, this is witnessed in modern cities like Dubai, London, New York, Seoul, Shanghai, and Singapore. That notwithstanding, emerging cities like Bogota (Columbia), Lagos (Nigeria), Mumbai (India) need to buckle up to catch up with the trend for a sustainable future.

According to [3], the world's emerging cities, if they intelligently make use of the rapid attention- seeking technological change of the 4IR, have the potential to deliver a sustainable future for all. Today's emerging economies attract more urban citizens than ever before. It is predicted that, cities in Asia and Africa are likely to take in 90% of the world's 2.5 billion new urbanites by 2050. However, the challenges created by the fourth industrial revolution cannot be silenced. It seems to be mostly on the supply side, that is, in the supply of labor for industries and for production. Over the past few years, a large percentage of the advanced countries and also some fast-growing economies such as China have witnessed a sharp drop in the share of labor as a percentage of GDP. Half of this drop is due to the fall in the relative price of investment in goods, driven by the progress of innovation which compels companies to substitute labor for capital [4]. The results of this constraint include; alarming levels of poverty, disease, inequality, air pollution and environmental damage. Negative environmental impacts also hit productivity and the economy, with these constraints being acutely felt in China, India and increasingly urban Africa. In essence therefore, a systematic study is needed to explore the 4IR green automobile and competencies required for Nigerian automobile industries.

METHODOLOGY

The research employed a systematic literature review to get the appropriate information to guide the study. Using the title, the study sought to analyze the benefits brought about by the 4IR and the competency requirement of the 4IR in respect to green automobile for Nigerian automobile industry. Databases such as Science Direct, Research gate and articles from other reputable database considered. Following the keywords used which are: Fourth Industrial Revolution (4IR); Green Automobile; Green Automobile Competencies, and other criteria such as:

a. Restricting the articles to the ones between 2012 and 2019.
b. Limiting the search to only the use of title of the study.

The search for literature yielded the following results as found in the table.

Table 1: Results of Relevant Articles using keywords versus the database

Database	Fourth Industrial Revolution (4IR)	Green Automobile	Green Automobile Competencies	Total
Science Direct	78	45	12	135
Research gate	62	49	14	125
Other Sources	29	12	04	45
Total	169	106	30	305

Articles that appear in more than one database were filtered. Also publications that are not directly related to 4IR and automobile were screened out. Further screening covering only the works done so far about Green automobile in Nigeria summed the tally of articles to 32. 28 articles were finally considered for the review which was analyzed by inductive analysis.

GREEN AUTOMOBILE AND THE FOURTH INDUSTRIAL REVOLUTION

Going by the above explained benefits of 4IR technologies, advancement in 4IR technology can in addition assist to check traffic congestion, autonomous vehicles (cars, buses and trucks) can be deployed for shared transport and logistics services, especially the ones with low or zero carbon emission. The can serve to reduce energy use, emissions and the number of vehicles on the road, advance materials for low-carbon and clean fuel, hence, environmental sustainability [5].

To this effect, [6] supports Kushwaha & Sharma (2016) who affirmed that leading automobile manufacturers such as Honda, Toyota, GM, Ford, Daimler-Chrysler, Suzuki, Hyundai, Tata, etc, in countries like America, Europe, China, Japan and India are adopting strategies like improvement in firm performance and green initiatives such as green innovation, eco-production, green supply chain management, etc and have also made investment in research and development to build on and implement such strategy. Green product innovation is positively associated with the performance of the firm as people give much attention to environmental issues. They often tend to make comparison of the cost and environmental benefits before they consider purchasing an eco-product.

Toyota has made a significant effort to promote green image by changing their engines into hybrid combustion electric. Other manufacturers like Ford, Honda, Nissan, and Volkswagen are also engaged in producing their vehicles in the form that comply with eco-friendliness. In fact, the recent trends in Indian automobile is that, most of the firms have directed their attention to the production of eco-friendly cars due to its advantage and the satisfaction the customers are deriving from its use in terms of cost, clean fuel efficiency and environmental safety.

Other world class automobile manufacturers have banked on green supply chain management (GSCM) [6]. GSCM emphasizes on life cycle costing, asset efficiency, service innovation, waste reduction and recycling. The focus of some automobile industry is on green marketing. Taken from the environmental context, green marketing is, "the determined attempts by organizations and industries to produce, promote, package, and reclaim products in a manner that is sensitive or responsive to ecological concerns. The demand for green automobile is also rising, this tends to motivate auto manufacturers to produce, package, promote, retail and reclaim their products in a sustainable manner. They are contributing to protecting the environment and on the other hand working in accordance with regulations.

In terms of green automobile production in Nigeria, although not much has been done in terms of manufacture of green automobile but frantic efforts are being made to embrace this trending technology. For instance, the first Nigerian made electric car was launched on the 7th of September, 2019 by the University of Nigeria, Nsukka. The electric vehicle was produced with 80 per cent local materials and the car could be charged in any electric socket and could cover a distance of 30 kilometres, when fully charged [7].

In preparation for massive influx of electric vehicles into Africa, a Nigeria-based solar electricity and total renewable energy solutions manufacturer, PSC industries limited, Lagos have arranged to introduce EV chargers for electric vehicles in Nigeria, Ghana, Niger and Benin Republic. The Company's Chief Executive officer made this declaration as he speaks concerning the importance of the trend in green automobile in a motor show in Paris. "We are all aware of electric vehicles, the world over, are beginning to stop the use of diesel powered engines due to climate change considerations and serious noise and environmental pollution" [8].

In another development, Sirieco, a Slovak company plans to set up a plant in Nigeria, to assemble electric cars and manufacture the new-generation incandescent bulbs, the company's Chief Executive Officer (CEO) Groidis Peter announced during a recent visit to the West African nation. The plant will be located at Calabar in Cross River State, southeast Nigeria, Groidis Peter said. According to the CEO of Sirieco, the company wants to establish a strong working relationship with the Cross-River State government that will lead to the creation of a centre that will be second to none in Africa [9].

Relatedly, Nigus Enfinity, an indigenous automaker, have targeted 2020 to set up an electric vehicle assembly plant in Nigeria, in partnership with a Chinese firm, Build your Dreams. This was the remark made by the company chairman noting that, other countries across the globe such as India (2030), and the United Kingdom (2040) have set out to stop the use of petrol powered vehicles. He advised that Nigeria and Africa need to emulate this to be able to go along with automotive revolution, or risk becoming a dumping ground for banned vehicles from other countries [10]. The above statistics gives the analysis of works done on green automobile in other parts of the world and so far in Nigeria.

GREEN AUTOMOBILE COMPETENCIES

Green competencies according to [11] are the technical skills, knowledge, values and attitudes needed in the workforce to develop and support sustainable social, economic and environmental outcomes in business, industry and the community. Green competencies are classified into: Generic competence and specific competence. Generic or key green competencies/skills are required in almost all occupations in order to understand and appreciate the issues and demands involving greening economies and the environment. Specific Green competencies or task-oriented competencies are the technical skills, knowledge and attitudes required for a particular career or occupation, for example; Automobile mechanic, bricklaying, software designer etc. In general, green competencies are regarded as skills for sustainability which are related to the technical skills, knowledge, values, and attitudes needed in the workforce to support and promote sustainable development. These green skills facilitate the preparation of the future workforce to understand issues of green growth (including environmental, social, and economic), interpret environmental legislation, increase energy and resource efficiency, and enable the processes involved in greening the economy [12, 13].

[14], classified Green Competencies (GC) for industries into four, namely:

- **Natural Green Competencies (NGC)-** a person's innate characteristics gotten by observing things and mentorship.
- **Acquired GCs** - the knowledge and skills acquired through experiences about a particular subject.
- **Effective GCs**- the combination of natural and acquired GCs of people.
- **Green performance**- the product emanating from the combination of natural, acquired and adapting competencies.

Several generic green skills or competencies have been proposed by [12] [13] as vital for promoting green growth. These include;

- Coordination and management skills.
- Entrepreneurial skills.
- Innovation skills.
- Analytical thinking skills.
- Information technology literacy and numeracy skills.

A general study conducted on skills needed for 21st century engineering by [15], came up with four dimensional model of engineering competencies. Model II highlighted the following basic for 21st century engineers- These are: Problem Solving and decision making Skills, Lifelong learning skills, Analytical Thinking, System Thinking, Critical Thinking, Creative Thinking & Innovation Skills and Design. The 4IR attaches much importance to thinking skills especially creativity for economic progression. Other competencies required in the 4IR apart from the ones listed above include; time management and interpersonal skills. A summary of the green competencies for 4IR has the following as basic green competencies for 4IR automobile industries:

Information Technology skills (IT): Information technology skills are the abilities, knowledge and skills related to the use, administration, development, design, architecture and management of technology. The technology used in vehicle-to-vehicle communication in giving out information about conditions of road, incidences, patterns of traffic flow and other important information leading to enhanced the safety and comfort of vehicle user need experts in Information technology (IT). [16] stated that, IT practitioners are going to become gems with companies searching for employees with competencies not only for innovation in technology but also to maintain existing infrastructure. The technology of autonomous driving will also require an IT, software and mechanical specialist (skills) to manage this discipline. Other areas where IT skills are much needed include sales and retail, marketing, data analyst, App designing and data transmission.

Communication Skills: Communication skills are the abilities needed for the act of giving and receiving an information. Good communication is a paramount skill that must be possessed to succeed in any discipline, organization or industry, most notably in engineering and technology. Workers in the digital age must know how to effectively convey messages via any medium. Communication in the green industry does not only connotes spoken and non-spoken communication but it also entails technological skills for energy preservation and protection of environment [17]. Automotive job market for the 4IR have placed a high demand on employees who are fluent and proficient in communication, making use of the precise words for use on any social or digital media platforms and also service advisor in the 4IR auto-industry should be a more customer-friendly person, approachable and with a good ability to communicate with clients. They need to understand and give information to technicians, for smoothing out of processes, time management and professionalism [16].

Creativity and Innovative Skills: Having seen the importance of innovation and creativity to engineering and general development. [18] defined these concepts as the use of imagination or developing new ideas and approaches to create something new. Developing new learning especially in engineering is tagged as a means of encouraging creativity, original thinking and entrepreneurship [19] or creating knowledge by bringing vision into facts in a work [21].

Problem- solving and decision making skills: United States Department of Labour affirmed that problem-solving and decision making skills is the ability to identify, evaluate and implement solutions to problems according to its magnitude and complexity. Problems acts as a support to learners and its helps them to gain knowledge and skills from the initial training and knowledge learnt in school, and for subsequent utilization of such instruction in a different scenario. It makes also for one to think logically, but tactically examine the issue or tasked and proffer a solution. It therefore means that critical thinking is an essential part of problem-solving because it requires the effective utilization of data, knowledge and initiative to solve a problem or carry out a task. [20] maintains that problem-solving has been established as one of the key engineering and technology competency.

The automotive world is undergoing a constant change and as a result, automotive manufacturers are beginning to work together an umbrella of competencies that will be required for the new technology. The emergence of new technologies will also usher in new types of jobs. Hi-tech skills on an obvious ground will sell well in most of the industries, although it is generally believed that robots will accelerate job losses, but due to the focus on some competencies, some old skills will still be needed but, ultimately, information technology will dominate.

On the whole, great recognition will be given to products and manufacturing processes that will help to achieve environmental

protection and promotion. Using key features of green competencies in auto industries such as process competency, product competency, environmental performance abilities and firm performance. These efforts can help firms promote productivity and enhance corporate reputation, develop new markets, and achieve first-mover advantages [21].

GREEN AUTOMOBILE AND 4IR IN NIGERIA
The 4IR, as noted by [22] has presented enough constraints for labour force particularly to engineers and other professionals that are allied to technology. The 2nd and 3rd revolutions complement skilled workers with technology, the 4IR will substitute under skilled or low skilled workers with higher skills [23]. Automation of routine jobs in manufacturing and production firms will as well bring challenges to engineers in Nigeria and other developing countries where low-skills are still in fashion. Developing countries are likely to lose about 66 percent of its estimated available jobs [24]. The point to note with emphasis is that developed countries may decline sharing the idea about the processes of manufacture and assembling with developing countries. Consequently, nations like Nigeria may lose some of the potential benefits in their economic advancement resulting to migration of workers to industrial jobs.

To bring this analysis to a close, the future development of green automobile in available industries as well as competency development in the Nigerian institutions where potential employees are trained cannot be tagged as doom and gloom. Considering the recent developments in the Nigerian automobile industry, there is hope for the development of the industry as well as the corresponding competencies to tow the part of 4IR. This however, cannot be attained without the acceptance and support from the Federal Government of Nigeria. For instance, the Nigerian Senate recently decline the approval on the Bill to stop the use of fossil fuelled automobile by 2035 and embrace electric cars. The sponsor of the Bill withdrew it in compliance to the position of the lawmakers [25]. Another impeding factor that is likely to affect the smooth implementation of green car technology in Nigeria is the epileptic power supply as most of the electric cars that solely depend on plug-in charging cannot survive in our present system. This condition will only allow for the use of self-charging hybrid cars and the clean diesel technologies [21, 26].

According to [27], the development of green mobility which is driven by the 4IR allows us to transit to electric power in many different contexts, starting with transport. But as it is now, Nigeria's level of preparedness for the 4IR is nothing to write home about. This is as observed by [22] that "The fourth industrial revolution is a trend which is handled by Nigerians and Africans as a whole with laxity, it could leave a serious consequence in the country and Africa in general". Observation are that, in order to be certain about Nigeria's preparedness for the jobs of the future which are coming with the 4th Industrial Revolution, "we need to make sure that the educational system is completely transformed." [28].

CONCLUSION AND RECOMMENDATIONS
This study analyzed the position of Nigeria with respect to green automobile competences and the 4IR. The analysis revealed that, the future of green and smart automobile technology which is driven by the 4IR is uncertain despite the present efforts by some stakeholders. Considering the lawmakers' position, power supply system, education system as well as Nigeria's response to the 4IR, the country is at the peril of the dangers associated with the revolution. These can only be averted if the Nigerian government reconsiders its position on the act to the introduction of green transportation. The power sector which is necessary for powering electric vehicle must be overhauled together with the education sector to develop the needed competencies.

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