

Impacts of the Fourth Industrial Revolution on Transportation in the Developing Nations

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Abstract

Despite the level of industrial shifts, the roles of transportation cannot be substituted, transportation is an important factor in the transformation of any nation's economy, as a result of this; effort has been made in order to ensure effective and efficient transportation. The essence of transport revolves around the following which cannot be farfetched or beyond: economic purposes, spatial interaction and social integration. Transportation is the movement of people and goods from one place to another. Industrial revolution is a rapid change in the economy that is marked by the general introduction of powered-driven machinery or by an important change in the prevailing types and methods in the use of such machines. It can also be seen as a sudden fundamental change in the industrial organization: the overthrow or renunciation of the first, second, and third industrial change is substituted by fourth industrial change or shift. The Fourth Industrial Revolution is the sustainability of innovation, automation and sophisticated processes which are at the root of industrial success strategies. Although, there are possibilities of threats in the fourth industrial revolution, but the impacts of threats can be reduced. The era will likely prove to be a source of huge opportunities for developed countries; developing countries will also benefit much from technology transfer. For the take of developing countries, the fourth industrial revolution will improve their standards on building efficient and reliable transport modes as well as investing more on technology transfer which will aid the local manufacturing sector and agriculture.

Keywords: Transportation, Industrial revolution and Fourth industrial revolution.

1.0 Introduction

Despite the level of industrial shifts, the roles of transportation cannot be substituted. The essence of transport revolves around the following which cannot be farfetched or beyond: economic purposes, spatial interaction and social integration. According to Merriam-Webster Dictionary, industrial is a word that can be used instead of industry; it is a company that engages manufacturing, production or services. Industry is a distinct group with various departments or branches integrated with systematic labor which can be inform of art and craft, business, or manufacture with the sole aim of productive profit making. Merriam-Webster Dictionary defines revolution as a period made by the regular succession of a measure of time or by a succession of similar events such as industrialization.

This paper is aimed at examining the analysis of the fourth industrial revolution and how it will play out in the developing nations with emphasis on transport industry. The objectives are;

1. To overview the history of industrial revolution;
2. To establish the link between the fourth industrial revolution and the previous industrial revolution;
3. To examine the impacts of the fourth industrial revolution on transportation sector in the developing country and;
4. To identify possible risks associated with the fourth industrial revolution and proffer solutions.

2. Conceptual and Theoretical Framework

2.1 Transportation

According to Oxford English Dictionary, transport was derived from two Latin words 'trans' which mean 'across' and 'portare' which mean 'carry'. Transportation is the movement of people and goods from one location to another (Microsoft Encarta, 2009). According to Merriam Webster Dictionary, transportation is an act, process, or instance of transporting or being transported. The same dictionary also defines it as a means of conveyance or travel from one place to another or a public conveyance of passengers or goods especially as a commercial enterprise. Longman Dictionary of Contemporary English (2003) defines transportation as a process or business of taking goods from one place to another or a system for carrying passengers or goods from one place to another.

Transportation refers to the process of conveying or moving of goods and people from place to place (Anyanwu et al 1997). According to Good and Jebbin (2015) transportation is a system for carrying passengers, raw materials and goods from one place to another both internally and internationally, often through power driven machines. It is commonly said to refer to movement of people and goods from one place to another (Okefor, 1998). Transportation service is the port of physical distribution activity which is concerned with the actual movement of goods to their various consumers (Good and Jebbin, 2015).

2.2 Industrial revolution

Merriam-Webster Dictionary defines industrial revolution as a rapid change in the economy that is marked by the general introduction of power-driven machinery or by an important change in the prevailing types and methods of use of such machines. It can also be seen as a sudden fundamental change in the industrial organization: the overthrow or renunciation of the first, second, and third industrial change substituted by fourth industrial change of shift.

Industries play crucial roles in the development of any nation, they also serve as a key driver of development. The growth and development of any business starting from small scale business to multinational business is highly embedded in innovation which came as a result of Information and Communication Technology (ICT). The rate of innovation in developed countries is very high that is why they contribute more into exports and transfer technology to developing countries. Developed countries produce and liberate technological devices into the environment of developing countries and the developing countries absorb whatever technology that is given to them. Industry could be considered as the social and economic engine of a nation. When there is enough industry, manufacturing jobs is inevitable and transportation will become more efficient. If developing countries place industrialization on her first priority list and prevent importation of goods that can be locally produced through policy and also prevent more technical experts in developed countries from rendering services in the developing countries but rather few technical experts sent to train personnel in the developing countries, they also will be able to stand and match developed countries.

According to Roland Berger Strategy Consultants (2014), in the early 1990s, the world's manufacturing value added stood at EUR 3,451 billion in 1991. Over 60% of that could be attributed to six major industrial nations: the USA, Japan, Germany, Italy, the UK and France. At that time, emerging countries only produced 21% of the manufacturing value added. The number of manufacturing jobs in China and Brazil increased by 39% and 23% respectively, whereas in Germany this figure decreased by 8%, in France by 20% and in the UK by 29%. All of the traditional industrialized countries experienced a decline in manufacturing employment due to three main factors.

1. The major productivity gains achieved in mature economies over the last few decades;
2. The loss of market share to newly emerging competitors;
3. The outsourcing of activities such as logistics, facility management, maintenance and different types of professional services to the service industry. This outsourcing often resulted in the relocation of the activity. With this outsourcing trend now coming to a close, increased productivity and international competition are the main drivers of the decrease in industrial employment.

2.3 Fourth industrial revolution

The Fourth Industrial Revolution is the sustainability of innovation, automation and sophisticated processes which are at the root of industrial success strategies. Innovation will be applied to rebuilding structures of old-fashioned manufacturing industries, imitation of the business models of successful countries by other developing countries. According to Deloitte 2015, fourth industrial revolution is a further developmental stage in the organization and management of an entire value chain process involved in manufacturing industry.

Some researchers believe that fourth industrial revolution will be centered across the main developed countries which are US, Japan, Germany, Italy, UK and France. Others believed that some other developed and developing countries will partake in the revolution. Such developing countries must have attained the boundary of crossing from being developing to being developed. Hence, the fourth industrial revolution will not be centered across the six powerful countries in the world.

2.4 Historical overview of industrial revolution

For over 40 decades now, industrial processes have embraced modern information technology which results into full innovation, digitization, automation, nanotechnology, and so on. It was fully embraced in the beginning of 21st century which seems to be the changes associated with embracing innovation in the field of digital technology and the rapid transform of electrical into electronics in all aspects of society and economy.

Before the fourth industrial revolution, western civilization has already witnessed three industrial revolutions, which could also be described as disruptive leaps in industrial processes resulting in significantly higher productivity.

1. The First Industrial Revolution: At the end of 18th century (1784), the first industrial revolution came into existence through the introduction of mechanical production facilities with the help of water and steam power (hydropower). The increasing use of steam power led to the development of steam engine propelled machinery;
2. The Second Industrial Revolution: At the beginning of 20th century (1870), the second industrial revolution came into existence through the introduction of mass production (assembly lines) with the help of electrical energy;

3. The Third Industrial Revolution: This came into existence at the end of 20th century (1970) through the application of electronics and information technology to further automate production. It is the era of automated and sophisticated technology lunching and testing or partial automation phase. In this phase, there is more of human labor and less of automation;
4. The Fourth Industrial Revolution is gradually approaching on the basis of full automation and digitizations which will results into more of automated devices in operation and less of human, but the human will be working in a highly complex and sophisticated technological environment and with the major work of programming through communication. Fourth industrial revolution is the era of linking the innovated existing first industrial revolution devices with the innovated existing second industrial revolution devices and innovated third revolution devices. The linking will be done with effective communication through programming.

Below is the diagrammatic representation of the above explanation:

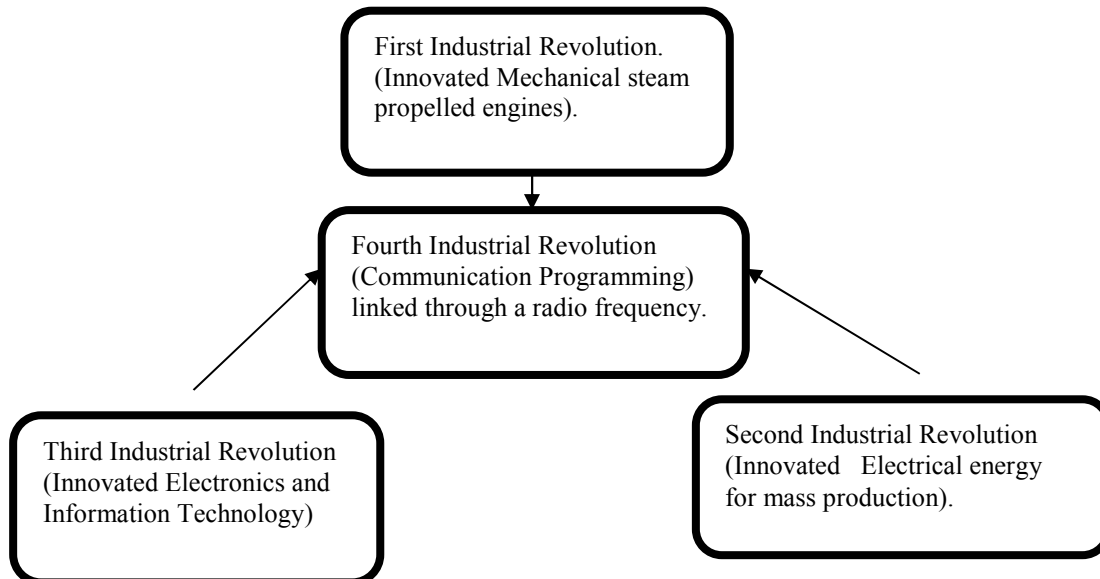


Figure 1: Fourth Industrial Revolution Linking the First, Second and Third Industrial Revolution

Source: Authors' work

Therefore, mechanical, electrical and communication devices will be linked together through a network of radio frequency. In the fourth industrial revolution, businesses and social networks will be linked together such that people will be internet oriented, smart and programmatic. The word “smart” and “linking” are the common words that will be considered in this paper for the fourth industrial revolution, this will enhance global competitiveness and individual country be it developing or developed will have more economic advantage over the most manufacturing product and raw materials.

Using the two major factors to compare between the third industrial revolution and the fourth industrial revolution, these two factors are:

1. Technological factor and
2. Human factor

In the third industrial revolution, there is more of human factor and less of technology factor but in the fourth industrial revolution, reverse is the case such that there will be more of technological factor and less of human factor. This simply means that technology will replace some hard labor played by human and human will still play the technical roles hence, the existence of human in the industry cannot be totally wiped out or ignored. Among the examples of technological development lunched and tested during the third industrial revolution are 3D Printing, Sensor Technology, Artificial Intelligence, Robotics, and Nanotechnology. All these technologies have been tested and perfected in the third industrial revolution and they will all be fully in operation in the fourth industrial revolution.

Fourth industrial revolution will enhance the following:

1. Despite the fact that the third industrial revolution enhanced effectiveness, the fourth industrial revolution will enhance efficiency;
2. It will enhance integrated networking and transparency;
3. More job opportunities will be realized with high level of flexibilities;
4. Global optimization and cost savings and
5. Industrial solution to challenges.

Nevertheless, some areas will experience fast and disruptive changes, some will change slowly and steadily, and

others will be forgotten or go into extinction. In the Fourth Industrial Revolution, the physical objects are being seamlessly integrated into the information network.

3.0 Discussions

3.1 Impacts of fourth industrial revolution on transportation sector in the developing nations

Nigeria is considered to be among the developing nations and Africa's most populous, this made the nation to be more of human oriented and less of technology. It should be clearly stated that Nigeria has witnessed rapid technological shift within the last one decade which happened to fall under the period of third industrial revolution. Majority of the technological shift came into existence through technology transfer from the developed countries.

This part of the paper is focusing on the impact of the fourth industrial revolution on transportation in the developing nations. Transportation is an important factor in the transformation of any nation's economy, as a result of this; effort has been made in order to ensure effective and efficient transportation. According to a lecture delivered by Prof. Olukayode, Oyesiku on 10th February, 2013 in the Institute of Transport Administration of Nigeria (IOTA) "an efficient transport system covering rail, waterways, air and road, is a catalyst for economic growth and development" also, "a well developed transport system would among other things positively affect the socio-economic life of the citizenry".

Transport demand and travel tend to increase sharply with the growing size of a city and town especially when the city center of major activity areas increases in terms of commercialization and industrialization. An example of such is an urban center. For a nation to be classified as a developed, developing or underdeveloped nation, the level of transport infrastructure is one of the major factor movers that will be considered.

Transport industry is a system that ensures successful movement of passengers, cargoes and mails from one point to another point through various modes such as air, water, road, rail, pipeline, and cable. The industry is not a homogenous body of its own but it is made up of different interacting sub-system working interrelated to ensure the performance of its objectives. Each mode has its various sub-systems or components.

The sub-systems are;

1. The vehicle which is the motor for road, aircraft for air, ship for water, pipe or tube for pipeline and each has different sizes and classes;
2. The way which is natural or artificial;
3. The terminal (bus-stop, airport, seaport, depot) and
4. The motive power which is the propelling that moves the entire vehicle e.g. the engine, propeller, tires and others.

3.2 Features of technological system in transport

Among several features of transport technological systems in the fourth industrial revolution are:

1. Way patrol, monitoring and docking by robot.
2. Sensor technology on the way, terminal and vehicle for security, tracking and control.
3. Reliable vehicle recognition independent of its position and orientation.
4. Parallax-free display informing drivers of a particular vehicle.
5. Passive video sensor system.
6. Sensor installation independent of the lead-in line, even possible in lateral position.
7. Easy integration into front of the terminal or in pole mounting.
8. Utilization of display also for information to the ground staff.
9. Video monitoring of ground areas also usable for monitoring and recording.

The term 'Information Technology' means computers, ancillary equipment, software and firmware (hardware) and similar procedures, services (including support services) and related resources. It also includes any equipment or interconnected system or subsystem of equipment, which is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission or reception of data or information. Information technology refers to computer mediated work where a task is accomplished through the medium of the information system rather than through direct physical contact with the task (Zuboff, 1985). Two basic opposing views exist with regard to the impact of information technology on individuals. First, some argue that the computerized workplace is inhumane and workers' jobs are robbed of enriching elements (Attewell & Rule, 1984).

According to Zuboff, IT tools fall into two types:

1. Automated and
2. Informed.

An automated technology seeks to deskill the processes that make up the work. With this type of technology, greater control and continuity over the work process can be achieved through substituting technology for human

labor (Zuboff, 1988). An informed technology, on the other hand, is designed to upgrade or enrich the work processes. Through removing the most boring, repetitious, dangerous and mindless tasks from the work, human labor is left to perform the creative, challenging, intellectual and satisfying aspects of the work.

According to Robert Solow (2013), technological change generally increases productivity, it is a tenet held in economics since the 19th century, although it disrupts the careers of individuals and the particular firms, it produces opportunities for the creation of new unrelated jobs. Technological change has an effect on productivity and structural unemployment and has been subjected to different and contradicting views in particular with respect to the role that full computerized automation can have on jobs.

Economists based their belief on two assumptions;

1. That machine is used as tools to increase workers production and most workers will be able to operate those machines and
2. That the increase in computerized automation can destroy works in a disruptive way in which most workers will have the capabilities of carrying out new jobs.

The fear of automation is rather like a fear of collision with an enormous rock. But it is not a harmless fear. It do harm in two ways;

1. It provides a convenient excuse for those who are unwilling to face up to the unemployment problem which already in existence and which have little to do with technology and
2. It diverts attention from two or more interesting questions that do arise from the progress of automation, and need to be thought about.

It should be pointed out that transport terminals are subjected to constant modification. Transport system must be able to adapt to various modifications. It is essential for software maintenance to be carried out throughout the life of the system by experts experienced in the field of transport technology. The major concern should be on the transport personnel, there are too matured people in transport industry to be changed and they should not be prompted to work directly on highly technical features. So, the idea of giving them software interface, training and exposure of how to handle those technological devices will fail immediately. The way out is to employ young graduates, train and retrain them in order to bridge the gap.

Another important concern is the procurement of those devices through government allocation of fund. Government representatives should be transparent and prudent enough to procure the sophisticated and ever changing technological devices.

Furthermore, the level of technical knowledge of related personnel in the technological system is questionable; the fear of many Nigerians towards full automation is widening the digital divide; it is time to bridge the digital gap. Transport personnel in countries which are not yet absorbing automation style should begin thinking about it now. Training is the first step, which will reduce fear when implementation begins.

3.3 Opportunities and risks

The digital transformation to industry in the fourth industrial revolution brings in both new opportunities and risks. Among the opportunities are;

1. Provision of collision avoidance of vehicle from static objects.
2. Reduction of unskilled transport employees.
3. Flexibility of customer integration and the quality and efficiency of service will be boosted.
4. Reduction in operational costs of transport operators.
5. Resources will be efficiently allocated, be it man, material, money and machinery.
6. Reduction in the level of damage caused by risks.
7. Higher productivity and safety will be maximized.
8. Data analysis and records will be free from errors, free from damages and losing and will also be sustained for future researches.

Despite the capabilities and opportunities in the fourth industrial revolution, there will be certain inefficiencies because of the mechanical and electrical device.

3.4 Risks and possible solution

Risk can be defined as the effect of uncertainty on objectives whether positive or negative. Its management is followed by coordinated economical application of resources to minimize, monitor, and control the probability and impact of unfortunate events (Hubbard, 2009). Among the risks are;

1. Industry data may be attacked by hackers, cyber attacks, and viruses which will lead to data lost, data manipulation and data theft. This is referred to as data insecurity.
Way Forward: This can be managed by ensuring appropriate data security strategy and backing up every sensitive and important data.
2. Infrastructure supporting the present state of information technology may not be readily available to support digital transformation.

Way Forward: There is need for proper conduct of research on the current state of the technological system. This is needed to be done so as to be aware and procure new technological devices to the industry or rather upgrade the existing systems.

3. In the area of networking, there might be challenged in various business segments such as research and development, procurement and purchasing, facility management, production, warehousing, and logistics, market sales and services.

Way Forward: The companies must harmonize and network their existing information technology infrastructure system integrated such that each area will not be negatively affected.

Installation is needed for efficient communication and a feedback plan be conducted.

4. Research conducted towards the acceptance of full automation, reveals that human showed several attitudes towards full automation. Some have the idea that they will lose their jobs while others assume that the coming of the Lord is at hand and that is an end time symbol. According to Taiwo (1998), attitudes are inclinations and feelings, prejudices or bias, preconceived notions, ideas, fears and convictions about any specific topic.

Way Forward: Indeed it is quite obvious that robots will replace human workers in the industry that is why they must be afraid of losing their jobs. Some human workers do not have the capacity to learn and embrace changes of information technology, it should also be noted that where we have many aged ones, they might be too old to adapt to the flexibility of changes in information technology and might even lack innovative concepts. In the fourth industrial revolution, robots will not only replace humans, robots and humans will work hand-in-hand, so interlinking and using smart sensory human-machine interfaces. The use of robots is widening to include various functions: agriculture, manufacturing or production, logistics, distribution in office. These can be controlled remotely. For instance, if a problem occurs in the farm, the worker will receive a message on his mobile device which is connected to a web camera, so he can see the problems and give instructions to the support teams for that functional area. The support teams are group of robots.

The question arising in the course of writing this paper is that during air transportation of commercial passenger flight, will it be advisable to entrust passengers live for a robot as pilot? I suggest that robots should be used as pilot for military purposes whereby the robots will replace military pilots and the militant will sit in the comfort of his camp and give instructions to the pilot through interconnected digital devices. Also, in the case of commercial flight, a human pilot can be a co-pilot that will assist the robot or even instruct the robot during flight operation. This is not applicable to air transportation only, but also applicable to other modes of transportation.

5.0 Conclusion

The digital aspect has become mission-critical for many products and services. Therefore, industry needs a competitive environment that fosters dynamic telecommunications and internet usage. Infrastructure providers can contribute in this field, not only by providing structures for power and telecommunications supply, but also by developing standards for data transfer and security procedures.

The fourth industrial revolution lies directly ahead, and will likely prove to be a source of huge opportunities for developed countries; developing countries will also benefit much from technology transfer and transportation. For the take of developing countries, the fourth industrial revolution will improve their standards on building efficient and reliable transport modes as well as investing more on technology transfer which will aid the local manufacturing sector and agriculture.

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