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Effects of Big Data Management on Industrial Growth: A Case for the Organization of Economic Cooperation and Development Countries

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Abstract

Industrial growth is an essential condition for sustainable economic development. However, data management also plays an important role in ensuring effective planning and result-oriented decision-making in an organization. Although big data management is essential in this regard, its usage in most countries seems to be a new field. The aim of this study was to examine the effect of big data management on industrial growth in the Organization of Economic Cooperation and Development (OECD) countries. The study used expost-facto design approach and time-series or secondary data covering 2018 to 2020. A sample of 43 countries were used for the study. The Ordinary Least Square (OLS) regression technique was used as a technique for data analysis. The results from the descriptive analysis revealed that ICT access and usage had a higher mean value than internet access which signifies that ICT access and usage contributed more to industrial growth in OECD than internet access (INA). The findings from the analysis of the hypotheses also found that ICT access and usage and internet access have a significant effect on industrial growth in OECD countries. The study, therefore, concluded that big data management had positive effects on industrial growth in OECD countries and recommended that governments of OECD countries should invest more on internet access so as to promote efficiency in big data management and that they should also provide ICT infrastructure that are necessary for effective management of big data and industrial growth.

Keywords: *Big Data, ICT Access, and Usage, Internet Access, Industrial Growth.*

Introduction

The advent of globalization as brought to limelight the need for data management by organizations. Smart technology surfaced with many industrial advantages, yet it pulled along some challenges. A study [1] stated that the view that current digital business landscape requires companies to be able to provide employees, partners, and customers with secure access to critical enterprise systems and applications at any time, anywhere. While responding to this need, data management challenges are inevitable. [2] held the view that sensors spread around the world produce shocking amounts of machine data, but also highlighting the challenges of capturing and managing these massive amounts of data that are generated continuously in real-time and in multi-structured format. Therefore, considering the nature of big data today, the management of the data is observed to be held in proportions that were unimaginable in the past. According to [3], the term Big Data was coined by Roger Mougalas in 2005, but the application of big data and the quest to understand the available data is something that has been in existence as far back as 7,000 years where some earliest records of the application of data to analyze and control business activities are traceable to that period.

This implies that big data management has been in existence long ago, but its universal and formal usage is a recent development. [4] opined that currently, data is identified in numerous environments in volumes never seen before, increasing daily as a result of smart technology

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and increased in internet use. The scholar maintained that the world today is tech-savvy, where 90% of data is produced in just the past two years, and daily 2.5 quintillion bytes of data are produced by humans every day. The author also stated that 2.5 quintillion bytes of data are produced by humans every day and that it will increase to 463 exabytes each day by the same humans by 2025. [5] pointed out that all industries use big data because big data helps companies evolve and achieve success. This means that the role of big data management to industries cannot be over-emphasized, and hence, the increasing studies on the nature of the relationship between industrial big data management and productivity-related variables.

The benefits of big data management have been clearly explained in the extant literature, yet the consensus is that effective management of this data helps organizational planning and in decision making. In the light of this assumption, [6] stated that reflections on big data must be able to effectively meet business competitiveness and support decision-making, which should also be related to the information science and knowledge engineering, besides elements that integrate the application of information management and knowledge management to business. Thus, the advantage of big data management is that they enable the organization to align itself with the right manpower, specific technologies and techniques required for better control of processes and human resources with specific skills to meet needs that are related to big data management and organizational goals and objectives. However, industries are challenged with difficulties in managing big data. [7] shows that 95% of industries in different sectors have been wondering on how to manage the surge in big data, to enable them to capitalize on the abundance of big data for effective decision-making. Big Data offers a ton of benefits. It comes with its own set of issues, for it is a new set of complex technologies and still in the nascent stages of development and evolution [8]. The author identified some of the challenges to big data management to include; handling a large amount of data, real-time can be complex, data security, and shortage of skilled people.

Therefore, in view of the industrial changes occasioned by big industrial data, how to engage and optimize the new industrial big data management techniques are becoming tougher for the captains of industries. That is, the management processes, realization processes, and support process. Therefore, there is a need for industries to fully invest in industrial big data management in their industrial activities.[9] argued that insight-driven industries will continue to dried up those industries relying on traditional methods of data management. Thus, he predicted by 2021, insight-driven businesses are predicted to take $1.8 trillion annually from their less-informed peers. The author added that data-driven organizations and industries are 23 times more likely to acquire customers than their peers, signifying that there is no substitute to industrial big data management.

The global working group conducted a global survey on Big Data in official statistics approved by the Statistical Commission. The aim of the survey was to examine the practical experiences of national statistical offices with Big Data and to identify all of their concerns in order to recommend future steps for the implementation of Big Data in the modernization of statistical production. The survey was conducted from June to August 2015, containing questions on the management of Big Data, advocacy, communication, link to the sustainable development goals, access, privacy, confidentiality, skills, training, and concrete experience with the use of Big Data [10]. The findings revealed that about a half of the national statistical offices reported at least one Big Data-related project, mostly on price statistics (scanner data), transport and labour statistics (web-scraping data), tourism, and population (mobile phone data), and agriculture (satellite imagery data). Among the main reasons for using Big Data are: they can be collected faster

and are produced in a timelier fashion, and they reduce the respondents' burden due to the modernization of the statistical production process [11] evaluated the impact of information and communication technology (ICT) on the economic growth of selected developing countries in the Middle East and North Africa region and the Sub-Saharan Africa region using a panel Generalized Method of Moment (GMM) growth model over the period 2007 to 2016.

The results revealed that except fixed telephone, other information and communication technologies such as mobile phone, Internet usage, and broadband adoption are the main drivers of economic growth in MENA and SSA developing countries. This study underscored the need to manage big industrial data, which benefits are yet to be tapped in the light of new smart technology preferences emerging in both developed and developing economies.

Statement of the Problem

Globally, the growth of industrial big data generation a data that is generated but not analyzed (dark data) among industries is so alarming such that there seem to be increasing rates of industrial decline instead of industrial development considering the fact that more data means more decision variable for effective decision making. Industrial big data management is now an essential reality before all industries considering big data roles in industrial decisions for industrial development and competitive advantages. The presence of smart technology heralded the generation of big cheap data for industries, suggesting timely and efficient decision variables that guarantee success for industries. As such, big industrial management remains crucial in facilitating industrial development through industrial big data management.

However, despite the undeniable presence of big industrial data, industries have not given the needed attention to industrial big data management resulting in the continuous growth of dark industrial data and industrial mortality while big industrial data keeps increasing. Rai (2020) [12], lately, the term big data has been under the limelight, but not many people know what big data is. The current situation regarding big data management ushers in diverse studies involving technological issues, big data management issues, and data analysis.

The motivation for this study, however, is that extant studies of big data link it to either business intelligence or to other consolidated information technology approaches. In this case, most of these studies only propose two approaches; that is, one that strongly addresses the technological and technical issues so as to institutionalize and maintain an infrastructure that considers big data, and another that seeks to meet the business goals. Contrary to these views, big data management in this study will in addition to examining its role management based exclusively on information technology will also consider the involvement of human resources at all levels, including organizational processes for managing big data. But, to what extent to access to information communication technology (ICT) and internet services as measures on big data management affected industrial growth? Hence, this study seeks to point out the role of industrial big data management on industrial development among Organization for Economic Cooperation and Development (OECD) member countries and partners and also to highlight some reasons for persistent difficulties and necessary infrastructure needed in big data management among industries.

Research Objectives

The study was guided by the following research objectives in line with the aim of the research:

i. To assess the effect of ICT access and usage on industrial growth in OECD countries.
ii. To determine the effect of internet access on industrial growth in OECD countries.

Research Hypotheses

The following hypotheses were tested at 0.05 level of significance:

HO_1: ICT access and usage has no significant effects on industrial growth in OECD countries

HO_2: Internet access has no significant effects on industrial growth in OECD countries

Literature Review

The concept of big industrial data refers to a structure, semi-structure, and unstructured industrial data that are diverse, voluminous, and speedily generated. Those traditional methods of data management cannot handle it. The expression, or the full-term big data, presents diverse definitions observed in the recent scientific literature.[13] stated that big data refers to datasets whose size is beyond the ability of a typical database software tools to capture, store, managed, and analyze. Big data is data that goes beyond the traditional limits of data along three dimensions: volume, variety, velocity. Similarly, [14] defined big data as data generated in high volume, high variety, and high velocity that require new technologies of processing to enable better decision making, knowledge discovery, and process optimization. The study [15] identified some considerations that will give the best results for big data management that include: security or data policies definition, system integration to build a solid big data environment, skilled staff or organizational change and talents; the best use of the information gathered from your data and data access, and cost and infrastructure. Another Study [16] asserted that 99.5% of collected data never gets used or analyzed, resulting to much potential wasted.

In view of the fact that most industrial big data generated is not used, giving rise to lake of unused data known as dark data or unknown data. A study [17] noted that most of the data collected by businesses simply goes unused. This dark data usually comprises more than half the data collected by companies. Research [18] defined dark data as all the unknown and untapped data across a company, generated by systems, devices, and interactions. The scholar stated further that dark data may be the biggest untapped resource in business today for it includes the "data exhaust" generated as a byproduct of our online lives, is all the unknown and untapped data across your organization generated by systems, devices, and interactions. This data at times may be soloed off somewhere, formatted, or metadata that is inconsistent. On the other hand, it may be no one can figure out what to do with it or literally, you do not know it exists. Johnson [19] opined dark data, however, emerges from the user-centric point of view, when the users are the engineers, dark data will refer to unstructured data that does not get analyzed, and it is the data stored through various network processes on servers and in data lakes that end up sitting around to satisfy the industry's statute of limitations or is kept because data storage can be so cheap.

An organization's ability to effectively manage big data depends on a lot of factors. Consequently, [20] identified to the barriers that organizations faced in managing big data management to include, amongst others; technological and cultural barriers. The technological barriers range from the costly infrastructures required for big data acquisition, storage, and analysis to the shortage of qualified data scientists and analysts, while cultural barriers: Organizational culture is a set of values, beliefs, and attitudes shared by the members of an organization as cultural barriers to big data strategy implementation, the challenges related to developing a data-driven culture have to do with given consideration of values, beliefs, and attitudes shared by the members of an organization. Bulao reported that that 1.7MB of data is created every second by every person during 2020, in the last two years alone, an astonishing 90% of the world's data has been created [4]. Besides**,** 2.5 quintillion bytes of data are produced by humans every day**;** 463 exabytes of data will be generated each day by humans as of 2025. The scholar further asserted

that 95 million photos and videos are shared every day on Instagram, by the end of 2020, 44 zettabytes will make up the entire digital universe, and that every day, 306.4 billion emails are sent, and 500 million Tweets are made.

The structure of big data differs from other data. [12] stated that that big data takes any of the following types: big structured data is one of the types big data that can be processed stored, and retrieved in a fixed format. Structured big data refers to highly organized information that can be readily and seamlessly stored and accessed from a database by simple search engine algorithms; unstructured big data refers to the data that is devoid of any specific form or structure whatsoever. This makes it very difficult and time-consuming to process and analyze unstructured data; semi-structured data relates to the data containing both structured and unstructured data types. It refers to the data that, although it has not been classified under a particular database, yet contains vital information or tags that segregate individual elements within the data. Regardless of the type of big data that is considered, [21] reported that different industries used big data for specific purposes, such as:

Banking

Retail banks use big data extensively to understand how their customers use their accounts and to help identify security risks besides understanding the markets and making smart trading decisions.

Agriculture

Data analytics are now crucial for agriculture, and they are poised to grow only more important as predicting the weather and squeezing maximum productivity out of the land become essential for feeding a growing world population.

Real Estate and Property Management

Real estate firms are leveraging Big Data for better property analysis, better trend analysis, and better understanding of their customers and markets. Similarly, property management companies are utilizing Big Data collected from their building systems to optimize performance, surface areas of concern, and streamline maintenance processes.

Telco

The telco industry is using Big Data to improve in several key areas, including customer experience, network monitoring, and management, fraud reduction, churn prediction, and dynamic pricing. With Big Data, telco no longer simply ‘dials it in’ when it comes to impactful analytics.

Healthcare

Data has long been crucial for doctors seeking to figure out, based on analysis of a large number of data points collected from many patients, which blood pressure range is normal or how much sugar you should consume each day. Now, the healthcare industry is using data analytics to answer bigger, more complex questions.

Be that as it may, the benefits of big data management cut across different sectors and industries, partly because they help in decision making regarding resources allocation and policy implementation. Thus, to realize business objectives, managing big data becomes essential to provide relevant results from the huge amount of data. Hence, [16] argued that 43% of organizations are changing their structures to take advantage of the big data market. This implies that big data management has an influence on the size and structure of an organization or company. This brings to bear the question of big data management dimensions that will produce results. There are different views about classifying or dimensions of the big data management system, [22] opined that as part of an information system and as the principal component of this type of system, data are collected, qualified, stored, and processed by information systems to deliver results that satisfy its users. The author further considered information systems in three dimensions: people

which have to do with the role of humans in big data management, Technology processes that focus on the role of technology in big data management, and organization process which has to do with the organization frame that supports big data management. There are many challenges bedeviling big data management by companies and organizations.

The challenges to big data management refer to organizational problems of managing huge volumes of data to aid effective decision-making processes in an organization. For [23], big data challenges are numerous. Thus, big data projects have become a normal part of doing business, even though it doesn't mean that big data is easy. [24] reported that these challenges as insufficient understanding and acceptance of big data, the confusing variety of big data technologies**,** paying loads of money, the complexity of managing data quality, dangerous big data security holes, the tricky process of converting big data into valuable insights, and troubles of upscaling. According to [25], no organization can function without data these days. With huge amounts of data being generated every second from business transactions, sales figures, customer logs, and stakeholders, data is the fuel that drives companies. The deduction from these views is that big data management reflects several aspects, both in the technological field and in how to manage teams (technical or users); big data management is also strongly related to the processes involved that consider aspects related to collection, storage, and retrieval of data by using technical and user knowledge. Hence, it can be argued that the human, technological dimensions and related processes for big data management should be organized in way that they would be able to provide more favorable conditions for industrial development.

Methodology

This study employed *expost-facto* design approach based on the fact that secondary (time series) data were used. Based on this, the research had no opportunity of manipulating the variables under investigation. The data were source from big data management statistics for the 43 countries that are members of the Organization of Economic Cooperation and Development (OECD) and other 7 countries that are referred to as strategic partners in big data management for the period of 2018 to 2020 considering the non-availability of up-to-date data for the years before 2018.

Model Specification

This study used big data management as the independent variable, while industrial development in these countries was considered the dependent variable. Thus, ICT access and usage (ICTAU) and internet access (INA) were used as proxies of big data management while the sum total of industrial productivity and tourism services were also used as proxies of industrial growth (ING) respectively. The functional form of the relationship between big data management and industrial growth, therefore, is expressed as follows:

$$IND = f(ICTA, INA) \quad (1)$$

The model is therefore specified mathematically in their log form as follows:

$$\ln ING = \alpha_0 + \beta_1 \ln ICTA + \beta_2 INA + \varepsilon_t \quad (2)$$

Model Estimation Technique

The study used the Ordinary Least Square (OLS) multiple regression techniques for the estimation of the data collected from secondary sources. The essence was to examine the linear relationship that exists between big data management and industrial growth in OECD countries. The estimated form of the model specified in equation 2 above takes the form:

$$\ln ING = \alpha_0 + \beta_1 \ln ICTA + \beta_2 INA \quad (3)$$

In addition to estimating the OLS model, the model was also diagnosed using the tolerance value, the VIF, multicollinearity, Durbin Watson (DW) for serial correlation test, normality test, t-statistics, and F-statistics were also used to test the significance of the estimated parameters and the overall model significance at 0.05 level of

significance. Furthermore, the goodness-of-fit of the model was determined using the adjusted R square coefficient. The statistical computation of the coefficients was carried out using the Statistical Package for Social Sciences (SPSS) version 25 because it has the capacity of accommodating data covering a small sample size, while the views, which is a more robust software application, does not.

Results

The findings in Table 1 revealed that industrial growth had a mean coefficient of 118.23, and a standard deviation of 59.98, while ICTA had a mean of 65.36 and a standard deviation of 31.09. Furthermore, the results showed a mean value of 52.87 and a standard deviation of 36.9, respectively, for INA. This implies that ICT access contributed more to industrial growth in OECD than internet access (INA). The findings also revealed that the deviation of the individual countries' ICTA contributions to industrial growth was statistically smaller than that of their internet access (INA).

Table 1. Results of Descriptive Analysis

Variables	N	Mean	Standard Deviation
ING	36	118.2250	59.98149
ICTA	36	65.3553	31.08884
INA	36	52.8703	36.98297

The fitted form of the model is therefore shown as follows:

$$ING = 0.211 + 0.518ICTA + 0.617INA \quad (4)$$

The findings from the analysis revealed an estimated coefficient of 0.528 and 0.617 for ICT access and internet access, respectively. The results show that ICTA and INA have a positive relationship with industrial growth. More so, the F-statistic had $p<0.05$, which implies that the overall model is statistically significant at 0.05 level, and hence, it can be used for statistical decisions. The correlation of regression R for the combined effects of ICTA and INA revealed a coefficient of 0. 894.This suggests that a positive relationship exists between the variables of big data management and industrial growth in the Study area. The coefficient of the adjusted R square computed as 0.842 means that the model is a good fit because ICTA and INA explained about 84.2% of the changes in industrial growth in Nigeria.

Table 2. Result of OLS Regression Analysis

Variable	Coefficient	t	p-value	Tolerance Value	VIF
Constant	0.211	0.422	0.696	-	-
ICTA	0.518	41022	0.000	0.698	1.43
INA	0.617	48799	0.000	0.698	1.43
R	0.894				
Adjusted R Square	0.842				

F-Statistic =4486708919, p=0.000, Durbin Watson (DW) = 2.649

The results of the correlation matrix in Table 3 revealed that all the variables (ING, ICTA, and INA) had a correlation value that is less than 0.8, which is used as the benchmark for multicollinearity. Based on this, the study concluded that there was no multi correlineairy or covariance between the explanatory variables of big data management.

Table 3. Correlation Matrix for Multicollinearity

Variable	ING	ICTA	INA
ING	1	.657	.701
ICTA	.657	1	549
INA	.701	.549	1

The histogram and the normal curve in figure 1 revealed that the data used for the study were normally distributed around their mean value of zero (0) and constant variance. This is captured by the belt-shaped nature of the normal distribution curve.

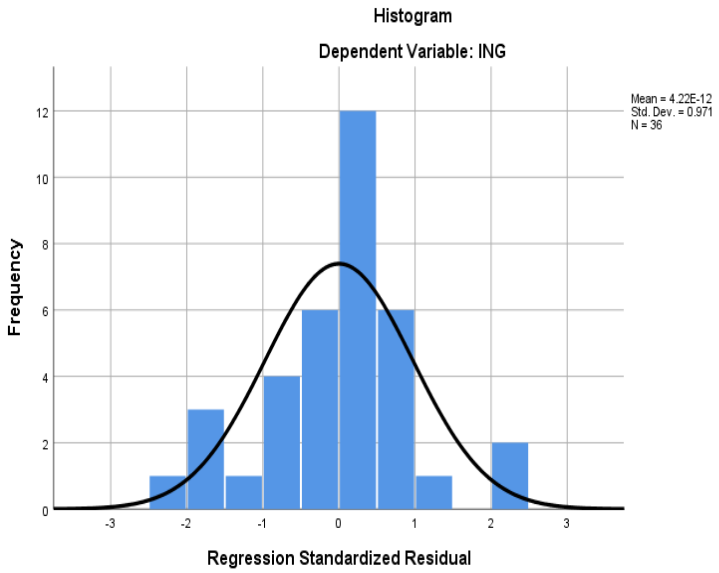

Figure 1. Histogram and the Normal Distribution Curve for the Normality Test

Discussion of Findings

The aim of this study was to examine the effect of big data management on industrial growth in OECD countries. The results of the estimated model in revealed a slope coefficient of 0.518 for ICTA and 0.617 for INA, respectively. The results indicated that a unit increase in ICT access which is an indicator of big data management by industries, will leads to a 51.8% increase in industrial growth. It was also found that a unit increase in internal access (INA) which is also another index for measuring big data management will leads to a 71.7% increase in industrial growth in OECD countries. Similarly, the coefficients of the t-statistic revealed that ICTA had a probability value (p-value) that is less than 0.05($p<0.05$). [26] stated that the most advanced firms around the world have not slowed their rate of productivity growth; the aggregate productivity slowdown masks a widening performance gap between more and less productive firms, especially in the ICT services sectors. This implies that the null hypothesis was rejected. The study concluded that ICTA has significant positive effects on industrial growth in OECD countries. However, the diffusion of digital technologies across OECD countries is far from complete, even amongst the most advanced economies.

While most firms now have access to high-speed broadband networks, more advanced, productivity-enhancing digital tools and applications, such as enterprise resource planning systems or big data analytics, have diffused to far fewer firms in OECD countries [27]. While, digital transformation, as with other technological changes, is not just about the diffusion of technology but also about the

complementary investments that firms need to make in skills, organizational changes, process innovation, new systems, and new business models [28]. Brynjolfsson, Rock, and Syverson (2017) [29] asserted that these investments involve much trial and error and take time. Productivity growth may be low and can even turn negative during this process of adjustment and experimentation.

Furthermore, the findings from the t-statistic of internet access (INA) were also less than 0.05($p<0.05$). Hence, the null hypothesis was rejected, and the study concluded that internet access (INA) had a significant positive effect on industrial development in OECD countries. This is in conformity with the study of [11] who found in their study on the impact of information and communication technology (ICT) on the economic growth of selected developing countries that information and communication technologies such as mobile phone, Internet usage, and broadband adoption are the main drivers of economic growth in MENA and SSA developing countries.

Hence, [27] pointed out that Policies should promote successful diffusion to unleash the potential of ICTs and digital tools for firms to increase productivity. Approaches to boost diffusion should take into account not only the individual firm but also networks of suppliers, users, and customers. This agreed with the view of [5] that all industries use big data because big data helps companies evolve and achieve success.

The implication of these results is that to enhance industrial growth, big data management by organizations should focus on ICT access and usage and internet access. But, [30] argued that there are large differences among countries, industries, and firms in the state of digital transformation and thus in how digital transformation affects productivity, and that recent OECD analysis shows that some sectors are less advanced than others in terms of the pace of digital transformation.

Conclusion

The review of literature on big data management in extant literature showed that industrial big data management has attracted the attention of many researchers because of the relevance of data in planning and decision-making by organizations. The results from the descriptive analysis revealed that ICT access and usage had a higher mean value than internet access which signifies that ICT access and usage contributed more to industrial growth in OECD than internet access (INA). The findings from the analysis of the hypotheses also found that ICT access and usage and internet access have a significant effect on industrial growth in OECD countries. The study, therefore, concluded that big data management had positive effects on industrial growth in OECD countries.

Recommendations

Based on the results of the findings and the conclusion made, the following recommendations have been made amongst others:

i. There is a need for Organization of Economic Cooperation and Development (OECD) countries to take decisive steps toward implementing effective management of big data so as to promote industrial growth.
ii. The government of OECD countries should invest more in internet access so as to promote efficiency in big data management and industrial growth.
iii. The government of OECD countries should provide ICT infrastructure that are necessary for effective management of big data and industrial growth.

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Conflict of Interest

The writer has no conflict of interest.

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