WILEY | Hindawi

Research Article

The Impact of Open Data Implementation on Entrepreneurship Ability in Sub-Saharan Africa

Tosin Ekundayo [iD],[1] **Amiya Bhaumik,**[1] **Justine Chinoperekweyi,**[2] **and Zafarullah Khan**[1]

[1]*Lincoln University College, Petaling Jaya, Malaysia*
[2]*Centre for Organization Leadership and Development, Zimbabwe*

Correspondence should be addressed to Tosin Ekundayo; oluwatosin.phd@lincoln.edu.my

This article conducts an experimental investigation on the impact of national open data implementation (ODI) on entrepreneurship ability in sub-Saharan Africa based on epistemological predispositions. With the commitment of 150 countries and organization to open data, this study is founded on the theory of planned behavior that behavioral intention can be induced by background variable categorized as personal, social, and informational. In a bid to validate the informational impact, this study is aimed at determining how much of entrepreneurship ability (EAB) is explained by open data implementation (ODI) in sub-Saharan Africa. This study analyzes secondary data from 22 sub-Saharan African countries, using regression analysis. Result shows that open data implementation has a negative nonsignificant impact on entrepreneurship ability in the continent. It is no surprise that Open Data Barometer (ODB), which is the official open data assessing body, posits that there is need for improved open data implementation in sub-Saharan Africa for economic development purposes. Therefore, this study recommends further research on open data implementation as a national data governance initiative to identify opportunities for entrepreneurial impact in sub-Saharan Africa similar to those observed in Europe and other parts of the world. The findings have implications for policymakers and stakeholders seeking leverage to improve entrepreneurship in sub-Saharan Africa through open data implementation.

1. Introduction

The debate surrounding whether entrepreneurs are "born" or "made" has long persisted in both professional and educational arenas. With the increasing recognition of entrepreneurship's impact on economic development, the argument warrants further examination. Entrepreneurs develop creative and innovative frameworks that offer solutions to challenges faced by a population segment [1]. They confront threats and opportunities in pursuit of financial rewards and economic contributions [2].

Some scholars argue that entrepreneurs are "born" because certain personal characteristics, such as attitudes and behaviors, are inherent [3]. Others posit that entrepreneurs "are made" due to environmental factors that shape new capabilities for entrepreneurial ventures [4]. Forbes [5] suggests that a combination of both inborn traits and acquired skills influences entrepreneurs' decisions regarding their entrepreneurial journey.

In sub-Saharan Africa and the rest of the world, entrepreneurship plays a crucial role in job creation and poverty alleviation. However, several factors play a role in shaping entrepreneur nuances in the region. This study poises to investigate one of such nuances—national open data implementation. On a national scale, open data implementation is output of the Open Data Barometer (ODB). ODB is a nongovernmental entity charged with the responsibility of tracking and evaluating global commitment to Open Data Charter (ODC) agreement signed by over 150 nations and organizations speared headed by the G7 nations [6]. The ODB tracking framework used a tri-subindex for their evaluation. They track and evaluate Open data readiness, Open

data implementation and Open data impact. While the open data readiness measures the preparedness of an entity or state to commit the principles of open data as per the ODC, open data implementation is the actual practice of the open data initiative based on the agreed upon principles and as such stands as the independent variable of this study, whereas open data impact is the use of the outcome as a result of open data implementation. The open data implementation posits that government must ensure open data implementation in an identified 15 sectors of the economy, if it is aimed at reaping the benefits of open data as its national data governance initiative [7, 8].

The existing literature has explored various aspects of open data and its potential effects on entrepreneurship, including theoretical frameworks, adoption predictors, benefits, challenges, and governance approaches [9–11]. The current study is aimed at building upon this literature by examining the impact of open data implementation on entrepreneurship ability in sub-Saharan Africa, using Ajzen's [12] theory of planned behavior as a guiding framework.

Open data implementation offers valuable resources for entrepreneurs, providing them with the information and insights needed to develop innovative solutions and foster economic growth [13]. However, further investigation is required to understand the specific implications of open data implementation-driven entrepreneurship in sub-Saharan Africa. By examining open data implementation in this context, stakeholder can investigate leveraging opportunity toward entrepreneurial and economic development as well as enabling policymakers and stakeholders to develop targeted interventions and initiatives [11].

Case studies, such as the Chicago open data project [14], have demonstrated the role of open data in fostering innovation and entrepreneurship. These findings offer valuable insights into strategies for promoting open data-driven entrepreneurship through effective governance approaches. Furthermore, studies investigating the broader context of digital technology and innovation ecosystems in sub-Saharan Africa [15] provide a foundation for understanding the role of technology in fostering entrepreneurial growth and innovation, which is relevant to the study of open data-driven entrepreneurship.

Entrepreneurs possess various abilities that enable them to deliver their creative ideas and innovation [16, 17]. These abilities can be influenced by factors such as life balance [18] and leadership [19]. The Global Entrepreneurship Development Institute (GEDI) defines entrepreneurial ability as the characteristics of entrepreneurs and their businesses [20, 21].

Open data implementation has been leveraged worldwide to drive innovation, improve transparency, and increase citizen participation in economic development activities [22]. The potential of open data to improve public service delivery, increase transparency, and drive innovation has been demonstrated through case studies, such as in Austria [23]. Despite its narrow scope, open data in the region is driven by a strong economic argument in line with the European Commission's ambitions. By building upon these existing studies, the current research is aimed at providing a comprehensive understanding of the impact of open data implementation on entrepreneurship ability in sub-Saharan Africa. The region presents a unique context, characterized by a growing entrepreneurial ecosystem and digital technology advancements and the potential for open data-driven entrepreneurship to contribute to inclusive economic growth.

Through the lens of the theory of planned behavior, this study will specifically explore the open data implementation and entrepreneurial ability nexus. By examining the relationship between open data implementation and entrepreneurial ability, the study will shed light on open data implementation and its impact on entrepreneurship ability development. This research will also contribute to the ongoing debate on whether entrepreneurs are born or made by investigating how open data implementation may shape entrepreneurial ability in sub-Saharan Africa. This exploration will provide insights into the role of environmental factors, such as access to open data, in fostering entrepreneurial skills and capabilities.

2. Background of the Problem

2.1. Open Data in Africa. The Open Data for Development Network (OD4D) report highlights the need to strengthen efforts on the provision and use of open data in Africa to achieve sustainable development goals (SDGs). The report references Tim Berners-Lee's five-star model of open data and posits that there has been appreciable effort in creating data portals that align with the requirements of the Open Data Charter (ODC). However, the report suggests that there is still a need for countries to make a giant stride toward data provision in open formats. OD4D cites Bello et al. [24] in its disposition that African countries' desire to open up to open data initiatives is motivated by the need for transparency and accountability. However, the OD4D report argues that open data will contribute to SDG objectives through sectors such as entrepreneurship.

2.2. Entrepreneurial Abilities in Africa. To develop entrepreneurial skills in Africa, Mmbengwa et al. [25] suggest that perseverance, personal motivation, creativity, and a positive attitude are key determinants that can enhance youth entrepreneurial success. Mamabolo et al. [26] identify human resource management, start-up, social and interpersonal capacity, leadership, financial management, personality, marketing, technical, and business management skills as the abilities required for entrepreneurial success in countries like South Africa.

2.3. Open Data, Entrepreneurship, and Economic Development. The use and deployment of open data, according to Ekundayo [27], provide an opportunity that could have otherwise been ignored. The findings conclude that the 12% of economic development measured in GDP is explained by open data. In a working paper, Ekundayo's [28] regression analysis of cross-sectional data based on epistemological assumptions indicates that open data implementation (ODI) impacts entrepreneurial attitude by 32% in Europe and Central Asia.

Therefore, there is a need to investigate variables that could potentially induce the development of the right entrepreneurial skills for the growth of the African continent, and the use of open data can be an effective tool to achieve this goal.

2.4. Statement of the Problem. The availability and use of open data are becoming increasingly important in achieving sustainable development goals (SDGs) globally. In Africa, there is a need to strengthen efforts on both the provision and the use of open data to achieve economic objectives in the implementation of the SDGs. However, the level of data provision in open formats in sub-Saharan Africa is still inadequate, despite some progress made in creating open data initiatives that align with the principles of Open Data Charter (ODC). This situation could hamper the development of the entrepreneurial sector, which is crucial for economic development in the continent. Although there are studies on the determinants of entrepreneurial success and the impact of open data, there is a gap in the literature on the role of open data implementation (ODI) in the development of entrepreneurial abilities in sub-Saharan Africa. Therefore, this study is aimed at investigating the impact of open data implementation on entrepreneurial abilities in sub-Saharan Africa, focusing on the development of entrepreneurial ability (EAB) with open data implementation (ODI) as the inducing element.

2.5. Significance of the Study. This study on the impact of open data implementation (ODI) on entrepreneurial ability (EAB) in sub-Saharan Africa is significant for several reasons. Firstly, the study addresses a critical gap in the literature regarding the role of open data in developing entrepreneurial abilities in sub-Saharan Africa. Investigating this topic is essential as the entrepreneurial sector is vital for the economic development of the continent. Secondly, the study's findings will provide insight into the determinants of entrepreneurship abilities in sub-Saharan Africa, which can be used to inform policies aimed at promoting entrepreneurship in the continent. Thirdly, the study's findings on the potential contribution of open data implementation to developing entrepreneurial abilities can provide policymakers and stakeholders with valuable information on the benefits of investing in open data initiatives.

Lastly, the study's findings can contribute to the broader debate on the role of open data in achieving sustainable development goals and economic goals, providing insights on the effectiveness of open data initiatives in promoting economic growth and development in sub-Saharan Africa.

2.6. Research Question. "What is the impact of open data implementation on entrepreneurial ability in sub-Saharan Africa?"

Based on the problem statement and the significance of the study, a research question that could guide this investigation is the following. What is the impact of open data implementation on entrepreneurial abilities and economic development in sub-Saharan Africa, with a focus on the development of entrepreneurship ability with open data implementation as the inducing element?

2.7. Assumptions, Limitations, and Delimitation. This study assumes that the deployment of secondary data, namely, open data implementation (ODI), captures the true open data implementation initiatives within each country, as depicted by its index. It is also assumed that the entrepreneurial ability index captures the ability of entrepreneurs within the respective country. This study is limited by its cross-sectional data collection and analysis compared to the alternative of a longitudinal time horizon. To delimit these limitations, this study proposes opportunities for future research, using a more recent dataset and variable indexing. As such, dynamics of the relationship between both sets of variables will be captured, updated, and optimized.

3. Literature Review

The rarity of literature on the intersection of open data implementation and entrepreneurial ability is a testament of little or no attention that is attributed to this sphere of entrepreneurial development. However, the search produces three papers that pose some relevance to sub-Saharan Africa. This is specifically important since this study experimentally investigates the nexus in a sub-Saharan African context.

Asongu and Nwachukwu [29] in a study, titled "Openness, ICT and Entrepreneurship in Sub-Saharan Africa," explore the relationship between openness, information and communication technology (ICT), and entrepreneurship in sub-Saharan Africa. The article argues that greater openness, particularly in terms of trade and financial flows, can facilitate the growth of ICT and entrepreneurship, which in turn can promote economic development. The authors draw on a wide range of studies to support their argument, providing a nuanced and well-supported analysis of the topic and providing practical recommendations for policymakers looking to promote entrepreneurship and economic development in sub-Saharan Africa. One of the recommendations by the authors is that policymakers should focus on promoting greater openness in trade and financial flows, as well as investing in ICT infrastructure and education. A key weakness of the article is that it is somewhat limited in scope. The article focuses specifically on sub-Saharan Africa, and while this may allow a detailed analysis of the region, it limits the generalisability of the findings to other contexts. The study did not address some of the potential challenges associated with greater openness, such as concerns about the impact of globalisation on local industries or the potential for greater economic inequality. Asongu and Nwachukwu [29] provide a useful analysis of the relationship between openness, ICT, and entrepreneurship in the context of sub-Saharan Africa.

Corrales-Garay et al. [30] in an article themed "Entrepreneurship Through Open Data: An Opportunity for Sustainable Development" discuss the potential of open data to spur entrepreneurship and sustainable development. The article cites increased transparency, innovation, and economic growth as key benefits of deploying open data initiatives. The article acknowledges the challenges that come with the use of open data, such as issues related to privacy

and security, and provides a comprehensive overview of the potential of open data in promoting entrepreneurship and sustainable development. In addition, the author provides a clear explanation of what open data is and why it matters, making it accessible to readers who may not be familiar with the concept. A key weakness of the study is that it is somewhat limited in scope due to its focuses on the potential of open data in promoting entrepreneurship and sustainable development. Additionally, the article could have provided more detailed examples of successful open data initiatives, as well as practical guidance for entrepreneurs and policymakers looking to leverage open data. Overall, Corrales-Garay et al. [30] proffer insight on the potential of open data to promote entrepreneurship and sustainable development. However, for an exhaustive analysis of the topic, more research may be needed to fully understand the benefits and limitations of open data as an entrepreneurship or economic leverage tool.

Park [31] in a study themed "How to Improve Government Openness for Sustainable Development: The Interaction of Four Factors in African Countries" explores the factors that contribute to government openness in African countries and how this openness can promote sustainable development. The article identifies four key factors that contribute to government openness as political institutions, civil society, the media, and international organizations. The study provides a detailed analysis of the interactions between these four factors and how they influence government transparency. According to the study, this could lead to improved governance, increased transparency and accountability, and enhanced citizen participation. A weakness of the study is that it does not provide a comprehensive analysis of the factors that hinder government openness in African countries. The analysis does not provide a detailed analysis of these issues or how they interact with the four factors identified in the article. It is also noted that the study analysis is limited in scope, as it focuses only on government openness in African countries. Although this focus allows for a detailed analysis of the specific context of African countries, it may limit the generalisability of the findings to other regions or contexts. Overall, Park [31] provides a useful analysis of the factors that contribute to government openness and its potential benefits for sustainable development.

Lindman et al. [32] in a study themed "Industrial Open Data: Case Studies of Early Open Data Entrepreneurs" aim to investigate the emerging open data value network structure based on empirical findings from 14 Finnish organizations. The authors aim to report the experiences of pioneer entrepreneurs of open data, who build their company offering on released open datasets. Specifically, they seek to answer two research questions: (1) what are the actors and their positions in the emerging value network and (2) which business and revenue models are utilized by the early open data entrepreneurs? The article describes an empirical investigation of open data entrepreneurship in Finland. The authors conducted a qualitative case study research, which involved interviewing 14 Finnish organizations that were early adopters of open data. The interviews were semistructured and focused on the actors and their positions in the

emerging value network, as well as the business and revenue models utilized by the early open data entrepreneurs. The authors analyzed the interview data using content analysis to identify themes and patterns related to their research questions. The study found that open data entrepreneurship is still in its infancy, but there is potential for creating novel services and sustainable value networks based on government-released datasets. The authors identified several actors in the emerging value network, including data publishers, service providers, and end users. They also identified various business and revenue models utilized by the early open data entrepreneurs, such as freemium models, subscription-based models, and advertising-based models. The study highlights the importance of addressing legal restrictions and privacy concerns associated with opening data. Overall, the findings suggest that open data entrepreneurship has the potential to create significant economic and social value if properly supported. However, the research is based on a small sample of Finnish organizations, which may not be representative of open data entrepreneurship in other national contexts.

3.1. Review Conclusion. Corrales-Garay et al. [30] specifically look at the potential of open data initiatives and provide a clear explanation of what open data is and why it matters and identify transparency, innovation, and economic growth as key benefits of deploying open data initiatives. Asongu and Nwachukwu [29] explore the relationship between openness, ICT, and entrepreneurship in sub-Saharan Africa and argue that greater openness, particularly in terms of trade and financial flows, can facilitate the growth of ICT and entrepreneurship, which in turn can promote economic development. Park [31] focuses on the factors that contribute to government openness in African countries and how this openness can promote sustainable development using factors like political institutions, civil society, the media, and international organizations in African countries. Lindman et al.'s [32] literature review contributes to this current study by providing empirical evidence of early open data entrepreneurship, offering insights into the emerging value network structure, and highlighting various business and revenue models used by open data entrepreneurs.

3.2. Hypothesis Development. While each article provides useful insights into the potential benefits of openness for data for entrepreneurship and sustainable development, none of this study indicates or measures how open data implementation induces the ability of entrepreneurs that can be leveraged for entrepreneurial and economic developments. As such, this study hypothesizes as follows:

H1. Open data implementation has a positive impact on entrepreneurial ability in sub-Saharan Africa

3.3. Theoretical and Conceptual Framework. The framework of this study is theoretically founded on the theory of planned behavior (TPB) by Ajzen [12]. This theory posits that behavioral intention is influenced by three factors: attitudes, subjective norms, and perceived behavioral control.
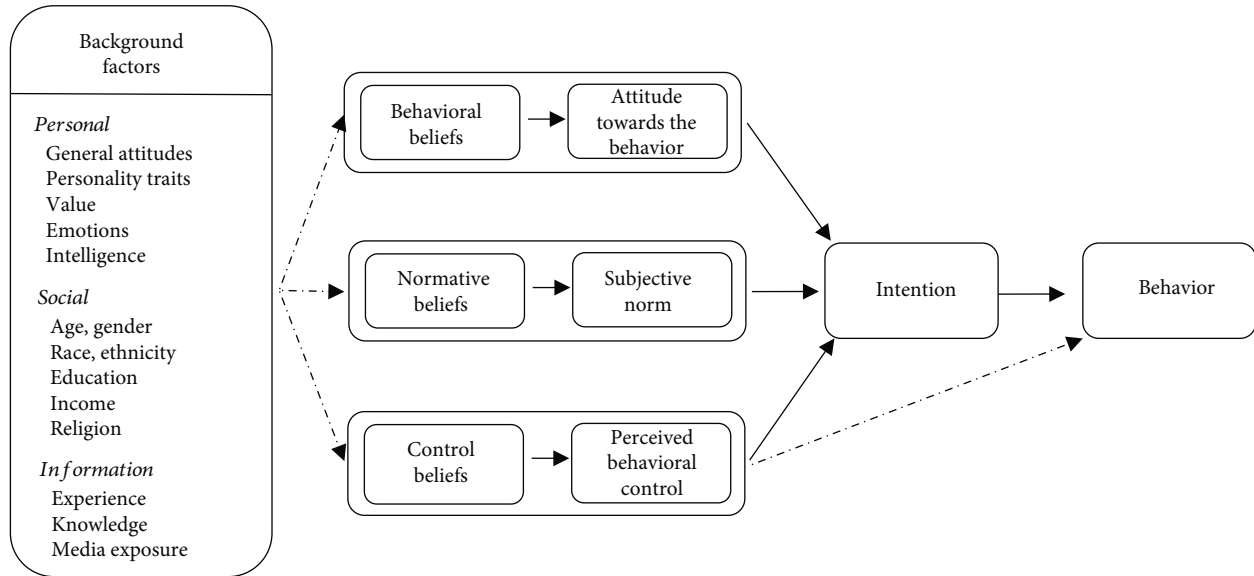
FIGURE 1: Theory of planned behavior. Source: Ajzen [12].

Attitudes refer to an individual's positive or negative evaluation of the behavior, subjective norms refer to the perceived social pressure to engage in the behavior, and *perceived behavioral control* refers to the individual's perception of their ability to perform the behavior. The theory also posits that each of this factor is induced by background factor categorized as either personal, social, or informational [12]. Overall, the theory behavioral intentions can be induced if the inducing variable can be induced. The theory is represented in Figure 1.

The theory of planned behavior (TPB) by Ajzen [12] is highly relevant to the study of the impact of open data implementation on entrepreneurship ability in sub-Saharan Africa. By examining the three main components of TPB—attitudes, subjective norms, and perceived behavioral control—researchers can gain insights into the factors influencing an individual's intention to engage in entrepreneurial activities within the context of open data implementation.

(i) Attitudes: in the context of this study, attitudes refer to an individual's positive or negative evaluation of using open data to support their entrepreneurial ventures. This component can help researchers understand whether the availability and accessibility of open data are perceived as valuable resources for entrepreneurs in sub-Saharan Africa. By investigating the nexus of open data implementation and entrepreneurial attitudes, the study can identify strategies to improve the overall perception and understanding of open data's role in fostering entrepreneurship

(ii) Subjective norms: the subjective norm component examines the perceived social pressure on individuals to engage in entrepreneurial activities using open data. By investigating the nexus of open data

implementation and entrepreneurial attitudes, the study can identify framework or model in the uptake of open data-driven entrepreneurship

(iii) Perceived behavioral control: this component of TPB assesses an individual's perception of their ability to perform entrepreneurial activities utilizing open data. By investigating the nexus of open data implementation and entrepreneurial attitudes, this study will help identify the framework that positively induce behavior of entrepreneurs.

While the theory emphasizes on the influence of personal, social, and informational background factors, this study specifically investigates the role of information as an inducing factor in understanding how open data implementation and entrepreneurial attitude correlate in sub-Saharan Africa.

Conceptually, this study argues that open data implementation plays a role in formulating/developing attitudes, subjective norms, and perceived behavioral control toward entrepreneurial intentions and behavior, especially in in their decision-making processes. This model simply posits that entrepreneurial ability can be induced and open data can be the leverage for such inducement. The study conceptual framework is indicated in Figure 2.

4. Methodology

4.1. Research Design. This study is aimed at determining the impact of "open data implementation" on entrepreneurship abilities in sub-Saharan Africa. This study proposed two phases in its investigation: (1) to determine if there is a relationship between both variables and (2) to measure the impact of open data implementation on entrepreneurial abilities in sub-Saharan Africa. Research design follows the research onion framework by Saunders et al. [33].
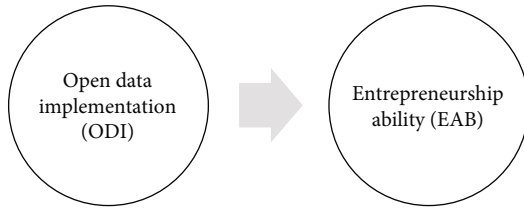
FIGURE 2: Conceptual framework for this study.

This study adopts the epistemological branch of research philosophy, which examines existing knowledge and its acquisition. The study explores the relationship between open data implementation as a data governance initiative and entrepreneurship ability in sub-Saharan Africa. Utilizing a positivist approach, the research acknowledges that scientific processes generate scientific knowledge, which is considered valid and reliable [34]. Consequently, this study employs a scientific process to investigate the impact of open data implementation on entrepreneurial ability, generating insights that are deemed accurate and credible [33]. This approach aligns with the study's objective, as opposed to merely describing the phenomenon within the philosophical branch of ontology.

This study approach is *deductive*. The deductive research approach involves starting with a specific theory, developing a hypothesis, and conducting an experiment to test it, through selected observations/datasets. In this study, it is hypothesized that the implementation of open data positively impacts entrepreneurship ability to start up in a sub-Saharan Africa, based on the theory of planned behavior. Hence, an experiment is modelled to validate the hypothesis using 2016 dataset.

This study *research strategy* is an experiment. Saunders et al. [33] posit that experiment helps to test casual effect of a phenomenon or establish of relationship between multiple variables. More specifically, this study experiments on the casual effect of open data implementation on entrepreneurial ability in the context of sub-Saharan Africa.

Applicable *research choice* is quantitative. A quantitative study is a study that requires the use of numerals. The use of numbers allows for the use of inferential statistical tools [33]. For inferential analysis, this study utilizes secondary numeral indexes on open data implementation (ODI) from the Open Data Barometer (ODB) and the entrepreneurship ability indexed by Global Entrepreneurship Index (GEI).

Research time horizon for the study is 2016—cross sectional. It covers a period of 12 months instead of an indefinite period (longitudinal). The period is suitable for the study due to the simultaneous availability of indexes for both variables. It is also a key criterion for the deployment of inferential statistical tools like regression and correlation which are critical to this study [35–37].

Research data collection encompasses data from 22 countries in sub-Saharan Africa. Datasets are sourced from the website because both organizations practice open data policies. This means that data can be downloaded for reuse for analysis purpose. It is important to state that the method of the data collected by both institutions was reviewed to

ensure scientific standard. Both ODB and GEI deploy the use of both primary and secondary data collection methods and analysis in their indexing, relative to respective indexing objectives. These indexes are used by countries all over the world by major credible international entities like the UN and the World Bank in pursuance of respective project aims.

4.2. Data Analysis: Model Construction. Developing a model to investigate the impact of open data implementation, as a national data governance initiative to boost entrepreneurship ability in Africa, is to be constructed in several stages.

Firstly, the independent variable (IV) of this study, open data, as a data governance initiative, is an index sourced from the Open Data Barometer (ODB) website. ODB is the official evaluator of the nation's commitment to the Open Data Charter (ODC) agreement. ODB evaluates global open data commitments in tri-subindex formats, namely, *open data readiness*, *open data implementation*, and *open data impact*. This study selects *open data implementation* since its objective is to determine and measure the impact on entrepreneurship ability in sub-Saharan Africa. The dependent variable (DV) is sourced from the Global Entrepreneurship Development Institute (GEDI) and Global Entrepreneurship Programme tagged Global Entrepreneurship Index (GEI) website. The GEI program also measures global entrepreneurship prowess in a tri-subindex format, namely, *entrepreneurial aspiration*, *entrepreneurial ability*, and *entrepreneurial attitude*. This study selects the entrepreneurship ability subindex, since it is aimed at assessing how open data implementation impacts entrepreneurship ability within a country. This period is selected because it is a period in which both variables are indexed.

Secondly, to create a matching dataset for sub-Saharan Africa that will be suitable for inferential analysis, this study identified only reciprocating index for both open data and entrepreneurship nuance in the sub-Saharan African region. Sub-Saharan African nations with no reciprocating index were eliminated to create a balance set of data series for possible correlation and regression analysis [35–38]. This process represents 22 sub-Saharan African countries suitable for the experimental study.

The variables with their matching abbreviations used for this study are as follows:

(i) Open data implementation (ODI)

(ii) Entrepreneurship ability (EAB)

More details on description of these variables are included in Table 1.

Thirdly, we precede with correlation analysis between ODI and EAB to establish a relationship, if any.

Fourthly, we conduct a regression analysis. This is to determine the cause-and-effect relationship that ODI has on EAB in 22 countries in sub-Saharan Africa. The study regression type is the ordinary least squares model.

To infer the relationship of national open data implementation and national entrepreneurship, the indexes must meet certain criteria [41].

TABLE 1: Description of these variables.

Indicator	Description	Unit measure
Sub-Saharan African *open data implementation* (ODI)	Measures the availability, accessibility, and use of open data in sub-Saharan Africa	From 1 to 100
Sub-Saharan African *entrepreneurship ability* (EAB)	Measures entrepreneurs' and businesses characteristics in sub-Saharan Africa	From 1 to 100

Source: GEI [39] and ODB [40]—key indicators.

TABLE 2: Open data implementation (ODI) index vs. entrepreneurship ability (EAB) index for year 2016.

Sub-Saharan African countries	Open data implementation (ODI) index	Entrepreneurship ability (EAB) index
Benin	13	17.6
Botswana	4	34.4
Burkina Faso	16	19.1
Cameroon	5	16.9
Côte d'Ivoire	7	19.3
Ethiopia	9	23.5
Ghana	11	22.4
Kenya	22	21.8
Malawi	16	14.1
Mali	3	19.3
Mexico	58	20.8
Mozambique	4	21
Namibia	8	27.9
Nigeria	7	68.3
Rwanda	27	23.4
Senegal	9	19.9
Sierra Leone	5	18
South Africa	28	37
Swaziland	0	24.6
Tanzania	17	17.5
Uganda	11	14.5
Zambia	5	25.1
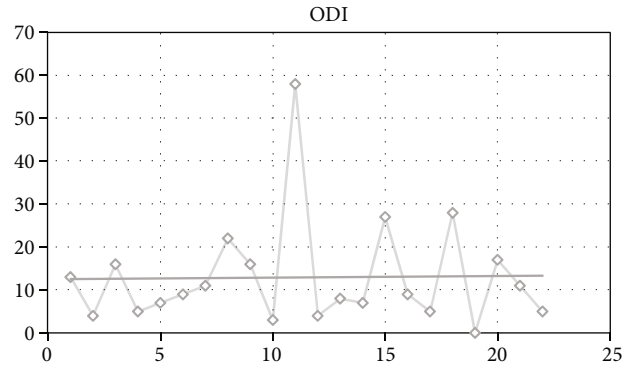
FIGURE 3: Scattered plot for ODI.
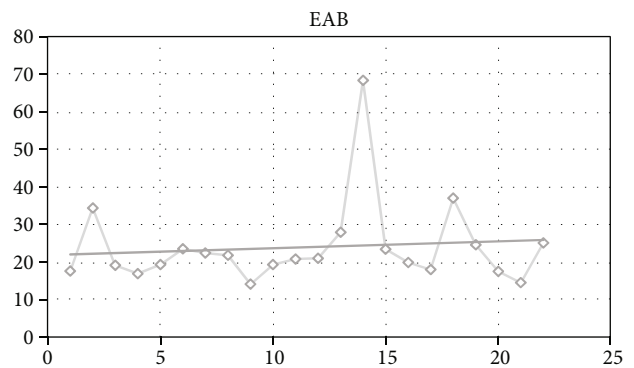
FIGURE 4: Scattered plot for EAB.

(i) Indication of independent variables (IV) as X and dependent variable (DV) as Y (see Table 2)

(ii) X and Y combination should show random pattern on a scattered plot (see Figures 3 and 4)

(iii) Skewness of the Y-value falls between 3 and +3, and kurtosis falls −10 and +10 (see Table 3)

(iv) The variable should be measured in continuous data type. They often carry decimal points, with the number stretching out as far as possible [37] (see Table 2)

(v) Variables should also correlate to be eligible for regression analysis [37] (see Table 4)

As such, the regression model is as follows:

$$Y = a + bX, \tag{1}$$

where Y is EAB representing the unknown intercept of any country (entrepreneurship ability), b are the coefficients for every independent variable obtained from the ODI index, X represents the level of ODI that guarantees a level of EAB, and a is the intercept.

Due to the size of dataset, Microsoft Excel is used for correlation and regression analysis. Alternative inferential analysis tool is SPSS and Python programming software. Regardless of analysis software, the outcome remains unchanged.

5. Results

Table 3 shows that descriptive statistic indicates a mean of 12.95 with a standard deviation of 12.58 for open data

TABLE 3: Descriptive statistics.

	Mean	Standard error	Median	Standard deviation	Sample variance	Kurtosis	Skewness	Minimum	Maximum
ODI	12.95	2.68	9	12.58	158.14	7.37	2.41	0	58
EAB	23.93	2.43	20.9	11.39	129.83	11.36	3.09	14.1	68.3

Source: author computations.

TABLE 4: Pearson's correlation.

	ODI	EAB
ODI	1	
EAB	-0.064994793	1

implementation (IV) and 23.92 with a standard deviation of 11.39 for entrepreneurship ability (DV). This indicates that the average implementation of open data for the 22 countries in Africa, selected from the ODB, is 13% in 2016, and the average entrepreneurial ability, selected from the GEI, for the same country is 24% in 2016. *Standard deviation* indicates by how much the members of a group differ from the mean value. It is at 12.58 for open data implementation and 11.39 for entrepreneurship ability.

Empirical study of data nature supports dataset linearity for Pearson's correlation coefficient with a 95% confidence level indicating that if we select 100 different samples, we have a 95% confidence of arriving at the same mean. *Standard error* is the accuracy of a sample mean at 2.68 for open data implementation and 2.43 for entrepreneurship ability. By implication, if several samples of this same population are extracted to calculate a mean, it will produce a mean comparable to the true population mean. A small standard error indicates that sample and its analysis provide a more precise estimate for the value of population. *Median* is the midpoint at 9 for open data implementation and 20.9 for entrepreneurship ability. *Kurtosis* is the sharpness of a frequency-distribution curve. When a distribution is too peak, the number is greater than +1. For these datasets, it is at 7.37 for open data implementation and 11.35 for entrepreneurship ability. *Skewness* is a dataset's measure of symmetry (if the number is greater than +1 or lower than −1, the dataset has a substantially skewed distribution). Skewed distribution is when the data point clusters toward one side of the scale than the other, thereby creating a curve that is not symmetrical—that means both right and left sides are shaped differently at 2.41 for open data implementation and 3.09 for entrepreneurship ability. *Minimum* lowest value is 0 for open data implementation and 14.1 for entrepreneurship attitude, and *maximum* highest value is 58 for open data implementation and 68.3 for entrepreneurship attitude, where the number of observations is 22 for both variables.

The graphic representation of the dataset to show the respective nature is as follows.

Becker et al. [42] and A. Hess and J. Hess [36] indicate that the correlational standard for the result is within the range of -1 to +1, with 0 indicating no correlational significance. +1 indicates a positive correlation, and -1 indicates a negative correlation. Positive correlation indicates that an increase in IV (in this case ODI) would see a reciprocating increase in DV (in this case EAB), and -1 is vice versa. Zero as the correlation output indicates no relationship of sort between both variables. For this study, Pearson's correlation output value $r = -0.06$ for ODI and EAB in sub-Saharan Africa. This indicates a negative weak (nonsignificance) relationship between ODI and EAB for 2016 datasets. By implication, an increase in open data implementation will produce a nonsignificant decrease in entrepreneurship ability in sub-Saharan Africa in 2016, whereas a degree open data implementation will cause a nonsignificant increase in entrepreneurship ability with sub-Saharan African countries.

Table 5 shows that the square value of R is 0.00 which indicates 0% of the dependent variable, and entrepreneurship ability is explained by the independent variables, open data implementation. However, the 0.06 correlation result is not to be ignored. The adjusted squared R value of -0.05 indicates that that model is not a good fit to determine entrepreneurial ability in sub-Saharan Africa [36]. Invariably, this indicates that 99.95% of the model is a function of other variables. The probability value of 0.77 indicates that the overall model is significant [37], and the Durbin Watson statistics (P value) of 1.19 indicates that the sourced data have no autocorrelation of any sort [35].

For the model, intercept is 24.7 and the beta coefficient value for ODI is -0.06 with an insignificant probability of 0.77. This indicates a negative impact of open data implementation on entrepreneurship ability in sub-Saharan Africa, *but it is subject to 77% chance*, which is insignificant. By implication, when the indexing score for ODI is decreasing, entrepreneurship ability increases and vice versa, but there is a greater than 0.05 (5%) chance as indicated by the P value that this impact is a function of only open data implementation. By extension, there are other factors that could contribute to such an outcome. However, finding supports the hypothesis of Ekundayo et al. [43] that the impact of open data on entrepreneurship is relative to region of the world. Therefore, to predict entrepreneurial ability, using open data implementation as leverage, in sub-Saharan Africa, the model is $Y = 24.7 + (−0.06) X$.

6. Discussion, Conclusion, and Recommendation

Investigating the impact of open data implementation as part of the data government initiative in sub-Saharan Africa is not a common practice. According to Ekundayo et al. [43], this is due to the low popularity of open data on the African continent; hence, the insufficiency in it impacts investigation on economic sectors or subelements like entrepreneurs' nuances. Entrepreneurship ability also suffers the same faith since entrepreneurship is mostly reviewed in its holistic form

TABLE 5: OLS regression output.

R squared	Adjusted R squared	F-statistics	Probability (F-statistics	Durbin Watson statistics (P value)
0.00	-0.05	0.08	0.77	1.19
Variable	β (beta)	Std. error	t-statistics	Probability
ODI	-0.06	0.20	-0.29	0.77

instead of the breakdown approach of Global Entrepreneurship Index, namely, entrepreneurship ability, entrepreneurship aspiration, and entrepreneurship attitude. Alas, the debate whether "entrepreneurs are made or born" has professionals/scholars on either end of the aisle. Nevertheless, this study poses a novel ideology. The objective is to assess and, if possible, measure the impact of open data implementation on the development of entrepreneurs' abilities in sub-Saharan Africa.

While *open data implementation* is the extent to which accessible, timely, and open data is published by each country government in key 15 economic sectors, *entrepreneurial ability* refers to the entrepreneurs' characteristics and those of their businesses. The findings of this study indicate that the open data implementation has an insignificant impact on the development of entrepreneurial ability in sub-Saharan Africa. Correlation relation is the measure of relationship. Regression relationship is the cause-and-effect status. These study correlation results indicate a very weak relationship between open data implementation and entrepreneurship ability; the regression analysis indicates insignificant impact on the sub-Saharan African entrepreneurship ability. However, the findings do not, by any means, indicate that open data implementation should be ignored. The very weak relationship and insignificant negative impact of open data implementation on entrepreneurial ability are a function of low correlation traced to low average open data index as indicated and reported by all recent report of the Open Data Barometer (ODB) [8, 44, 45]. This is also supported by the preliminary findings of a working paper by Ekundayo et al. [43]. Ekundayo et al. [43] posit that in Europe and Central Asia, open data implementation and entrepreneurship ability correlate by 42% and its impact by 32%. But the average open data implementation for Europe and Central Asia is 47.08% while the average for sub-Saharan Africa is menial of 12.95%.

The insignificant negative impact of open data implementation on entrepreneurial ability in sub-Saharan Africa can be attributed to various factors. These factors are highlighted in the following academic evidence:

(i) Canares and Shekhar [46] argue that the role of subnational governments in open data initiatives in developing countries, including sub-Saharan Africa, is crucial. They emphasize the importance of local context in implementing open data and suggest that inadequate attention to local needs and capacities may limit the impact of open data on entrepreneurial ability

(ii) Zuiderwijk et al. [11] identify factors influencing the adoption and use of open data technologies, such as perceived usefulness, perceived ease of use, and trust in the data. The lack of these factors in sub-Saharan Africa may hinder the adoption of open data-driven entrepreneurship

(iii) Ndemo and Weiss [15] explore the broader context of digital technology and innovation ecosystems in sub-Saharan Africa. They argue that underdeveloped innovation ecosystems in the region may contribute to the insignificant negative impact of open data implementation on entrepreneurial ability

(iv) Ekekwe Rivera-Santos et al. [47] examine the emergence of entrepreneurial economics in sub-Saharan Africa, highlighting the need for an enabling environment for entrepreneurship to thrive. The absence of such an environment could contribute to the observed insignificant negative impact of open data implementation

These findings reveal that several interconnected factors contribute to the insignificant negative impact of open data implementation on entrepreneurial ability in sub-Saharan Africa. Addressing these challenges would require a multifaceted approach, including strengthening the innovation ecosystems, providing adequate resources and capacities, and fostering an enabling environment for entrepreneurship to thrive.

Based on the findings of this study, which indicate an insignificant negative impact of open data implementation on entrepreneurial ability in sub-Saharan Africa, the following recommendations are suggested to enhance the effectiveness of open data initiatives and promote entrepreneurship in the region:

(1) Strengthen innovation ecosystems: policymakers and stakeholders should focus on developing a robust innovation ecosystem by fostering collaboration between governments, private sectors, academia, and civil society. This includes creating platforms for knowledge sharing, providing access to resources and expertise, and encouraging a culture of innovation

(2) Address local context and needs: open data initiatives should be tailored to the local context and address the specific needs and capacities of the target communities. This includes involving local stakeholders in the planning and implementation process and providing relevant training and support to build local capacities

(3) Improve data quality and trust: governments and data providers should ensure the quality, accuracy, and timeliness of the data being released. This can be achieved by implementing data quality assurance mechanisms and promoting transparency in data collection and management processes. Building trust in open data is crucial for its successful adoption and use by entrepreneurs

(4) Enhance data accessibility and usability: open data platforms should be designed to be user-friendly and accessible to a wide range of users, including entrepreneurs, researchers, and the general public. This includes ensuring that the data is available in machine-readable formats, providing comprehensive metadata, and offering user support and guidance on data usage

(5) Promote enabling environments for entrepreneurship: governments should create an enabling environment for entrepreneurship to thrive by implementing supportive policies and regulations, providing access to finance, and offering mentorship and networking opportunities for entrepreneurs

(6) Monitor and evaluate open data initiatives: continuous monitoring and evaluation of open data initiatives are essential for identifying areas of improvement and measuring their impact on entrepreneurship. Regular assessments should be conducted to gather feedback from users and stakeholders and inform the design and implementation of future open data programs

Implementing these recommendations can help mitigate the challenges identified in this study and maximize the potential of open data initiatives to positively impact entrepreneurial ability in sub-Saharan Africa.

This study seeks to the provide answers to question "What is the impact of open data implementation on entrepreneurial ability in sub-Saharan Africa?". Open data implementation has a negative impact (0.06) on entrepreneurial ability in sub-Saharan Africa. However, the impact is insignificant. As such, H1 is rejected. For open data implementation to induce entrepreneurial development in sub-Saharan Africa, likened to the global impact according to Ekundayo [27], it must improve its open data implementation practices.

Data Availability

The data that support the findings of this study are publicly available in Open Data Barometer at https://opendatabarometer.org/doc/4thEdition/ODB-4thEdition-GlobalReport.pdf and Global Entrepreneurship Index at http://thegedi.org/downloads/ for 2016. The quantitative data used to support the findings of this study have been deposited in the Mendeley data repository (doi:10.17632/yk5vfdvpxg.1).

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

Every named author cocontributed to the design and implementation of the research, to the analysis of the results, and to the writing of the manuscript.

References

[1] T. Ekundayo, *Entreprofitology: The Study of Successful Entrepreneurship*, Notion Press, 2019.

[2] S. Bergner, J. Auburger, and D. Paleczek, "The why and the how: a nexus on how opportunity, risk and personality affect entrepreneurial intention," *Journal of Small Business Management*, vol. 1, pp. 1–34, 2021.

[3] S. Z. Al-Harthi and S. Z. Alharthi, "Entrepreneurs are not born nor made (issue 11)," 2013, https://www.researchgate.net/publication/308719945.

[4] L. Bosch, "Entrevista al professor Cristopher Fennell," *Llengua Societat i Comunicaci*, vol. 17, no. 17, pp. 86–90, 2019.

[5] D. P. Forbes, ""Born, not made" and other beliefs about entrepreneurial ability," in *The Wiley Handbook of Entrepreneurship*, pp. 273–291, John Wiley & Sons, Ltd., 2017.

[6] Open Data Charter, "International Open Data Charter," 2015, Open Data Charter, September, 1–9. https://opendatacharter.net/wp-content/uploads/2015/10/opendatacharter-charter_F.pdf%0Ahttps://opendatacharter.net/principles-es/%0Ahttp://opendatacharter.net%0Ahttp://opendataday.org/.

[7] T. Davies, *Open Data Barometer: 2013 Global Report*, World Wide Web Foundation and Open Data Institute, 2013.

[8] World Wide Web Foundation, "Open Data Barometer-Leaders Edition," in *Public Performance and Management Review*, Open Data Barometer Organization, 2018.

[9] P. Brous and M. Janssen, "Trusted decision-making: data governance for creating trust in data science decision outcomes," *Administrative Sciences*, vol. 10, no. 4, p. 81, 2020.

[10] M. Janssen, Y. Charalabidis, and A. Zuiderwijk, "Benefits, adoption barriers and myths of open data and open government," *Information Systems Management*, vol. 29, no. 4, pp. 258–268, 2012.

[11] A. Zuiderwijk, M. Janssen, and Y. K. Dwivedi, "Acceptance and use predictors of open data technologies: drawing upon the unified theory of acceptance and use of technology," *Government Information Quarterly*, vol. 32, no. 4, pp. 429–440, 2015.

[12] I. Ajzen, "The theory of planned behavior," *Organizational Behavior and Human Decision Processes*, vol. 50, no. 2, pp. 179–211, 1991.

[13] T. Jetzek, M. Avital, and N. Bjørn-Andersen, "The sustainable value of open government data," *Journal of the Association for Information Systems*, vol. 20, no. 6, pp. 702–734, 2019.

[14] M. Kassen, "A promising phenomenon of open data: a case study of the Chicago open data project," *Government Information Quarterly*, vol. 30, no. 4, pp. 508–513, 2013.

[15] B. Ndemo and T. Weiss, *Digital Kenya: an entreprenurial revolution in the making*, Palgrave Macmillian, 2017.

[16] D. de Clercq and M. Voronov, "The role of cultural and symbolic capital in entrepreneurs' ability to meet expectations

about conformity and innovation," *Journal of Small Business Management*, vol. 47, no. 3, pp. 398–420, 2009.

[17] A. Morrison, J. Breen, and S. Ali, "Small Business Growth: Intention, Ability, and Opportunity," *Journal of Small Business Management*, vol. 41, no. 4, pp. 417–425, 2003.

[18] P. Brough, J. Holt, R. Bauld, A. Biggs, and C. Ryan, "The ability of work—life balance policies to influence key social/organisational issues," *Asia Pacific Journal of Human Resources*, vol. 46, no. 3, pp. 261–274, 2008.

[19] M. Goncalves, "Leadership styles: the power to influence others," *International Journal of Business and Social Science*, vol. 4, no. 4, 2013 https://www.ijbssnet.com/.

[20] L. Szerb, Z. J. Acs, É. Komlósi et al., *The Global Entrepreneurship Index (GEI)-European Dataset Report Describing Pan European Database with Time Series of New GEDI-Indicators*, Financial and Institutional Reforms to build an Entrepreneurial Society (FIRES), 2018.

[21] Z. J. Acs and L. Szerb, *The Global Entrepreneurship and Development Index (GEDI)*, DRUID Conference at Imperial College Business School, London, UK, 2010.

[22] H. Jaakkola, T. Mäkinen, and A. Eteläaho, "Open data - opportunities and challenges," in *ACM International Conference Proceeding Series*, p. 883, Ruse Bulgaria, 2014.

[23] I. Egger-Peitler and T. Polzer, "Open Data: European Ambitions and Local Efforts. Experiences from Austria," in *Open Government. Public Administration and Information Technology, vol 4*, M. Gascó-Hernández, Ed., Springer, New York, NY, 2014.

[24] O. Bello, V. Akinwande, O. Jolayemi, and A. Ibrahim, "Open data portals in Africa: an analysis of open government data initiatives," *African Journal of Library, Archives & Information Science*, vol. 26, no. 2, p. 97, 2016.

[25] V. M. Mmbengwa, X. Qin, and V. Nkobi, "Determinants of youth entrepreneurial success in agribusiness sector: the case of Vhembe district municipality of South Africa," *Cogent Social Sciences*, vol. 7, no. 1, 2021.

[26] M. A. Mamabolo, M. Kerrin, and T. Kele, "Entrepreneurship management skills requirements in an emerging economy: a South African outlook," *The Southern African Journal of Entrepreneurship and Small Business Management*, vol. 9, no. 1, p. 10, 2017.

[27] T. Ekundayo, "Leveraging data governance to drive economic change," *Organization Leadership and Development Quarterly*, vol. 3, pp. 30–46, 2021.

[28] T. Ekundayo, "The role of open data implementation (ODI) impacts entrepreneurial attitude in Europe and Central Asia," *Organization Leadership and Development Quarterly*, vol. 2, pp. 47–59, 2022.

[29] S. A. Asongu and J. C. Nwachukwu, "Openness, ICT and entrepreneurship in sub-Saharan Africa," *Information Technology and People*, vol. 31, no. 1, pp. 278–303, 2018.

[30] D. Corrales-Garay, E. M. Mora-Valentín, and M. Ortiz-de-Urbina-Criado, "Entrepreneurship through open data: an opportunity for sustainable development," *Sustainability*, vol. 12, no. 12, p. 5148, 2020.

[31] E. G. Park, "How to improve government openness for sustainable development: the interaction of four factors in African countries," *Sustainability*, vol. 13, no. 14, p. 8000, 2021.

[32] J. Lindman, T. Kinnari, and M. Rossi, "Industrial open data: Case studies of early open data entrepreneurs," in *2014 47th Hawaii International Conference on System Sciences*, pp. 739–748, Waikoloa, HI, USA, 2014.

[33] M. N. K. Saunders, P. Lewis, and A. Thornhill, ""Research methods for business students" Chapter 4: understanding research philosophy and approaches to theory development," 2007, In Researchgate. Net (Issue January). https://www.pearson.com/uk/.

[34] L. Felline, "Scientific explanation between principle and constructive theories," *Philosophy of Science*, vol. 78, no. 5, pp. 989–1000, 2011.

[35] C. S. Ding, "Using regression mixture analysis in educational research," *Practical Assessment, Research, and Evaluation*, vol. 11, no. 11, 2006.

[36] A. S. Hess and J. R. Hess, "Linear regression and correlation," *Transfusion*, vol. 57, no. 1, pp. 9–11, 2017.

[37] P. Sedgwick, "Correlation versus linear regression," *BMJ*, vol. 346, no. apr26 1, p. f2686, 2013.

[38] N. A. Constantine, "Regression analysis and causal inference: cause for concern?," *Perspectives on Sexual and Reproductive Health*, vol. 44, no. 2, pp. 134–137, 2012.

[39] N. Kshetri, *Global Entrepreneurship 2016*, Global Entrepreneurship., 2016.

[40] M. S. Reis, A. H. Ladio, and N. Peroni, *ODB Global Report Third Edition*, The World Wide Web Foundation, 2016, http://opendatabarometer.org/doc/3rdEdition/ODB-3rdEdition-GlobalReport.pdf.

[41] A. G. Barnett, J. C. van der Pols, and A. J. Dobson, "Regression to the mean: what it is and how to deal with it," *International Journal of Epidemiology*, vol. 34, no. 1, pp. 215–220, 2004.

[42] T. E. Becker, G. Atinc, J. A. Breaugh, K. D. Carlson, J. R. Edwards, and P. E. Spector, "Statistical control in correlational studies: 10 essential recommendations for organizational researchers," *Journal of Organizational Behavior*, vol. 37, no. 2, pp. 157–167, 2016.

[43] T. Ekundayo, A. Bhaumik, and J. Chinoperekweyi, *Identifying the core data governance framework principle: a framework comparative analysis*, Organization and Leadership Development Network Quarterly (OLDN), 2023.

[44] Open Data Barometer, *Global report fourth edication*, Open Data Barometer Organization, 2017.

[45] Tim Davies, "Open Data Barometer: 2013 Global Report," p. 45, 2013, http://www.opendataresearch.org/project/2013/odb.

[46] M. P. Canares and S. Shekhar, "Open data and subnational governments: lessons from developing countries," *The Journal of Community Informatics*, vol. 12, no. 2, 2016.

[47] M. Ekekwe Rivera-Santos, D. Eze Holt, D. Littlewood, and A. Kolk, "Social entrepreneurship in sub-saharan Africa," *Academy of Management Perspectives*, vol. 29, no. 1, pp. 72–91, 2010.