



EFFECT OF ADOPTION OF INDUSTRY 4.0 ON INSURANCE PENETRATION IN NIGERIA

AGBOOLA OMONIYI OLADIPUPO, PhD

Department of Actuarial Science & Insurance, Joseph Ayo Babalola University, Osun State

insureinternational@gmail.com

Abstract:

This quantitative analysis digs into the dynamics of how Industry 4.0 adoption affects insurance protection in Nigeria. Using a rigorous research strategy that includes both cross-sectional and survey approaches, the study methodically explores the complicated link between the adoption of Industry 4.0 technologies and the level of insurance market development in Nigeria. The study methodically created a sample size of 228 using Taro Yamane's formula for finite populations, drawing from a thorough population pool of 504 management personnel from 56 Nigerian insurance businesses. To account for potential biases and uncertainties, the initial sample size was raised by 20% guaranteeing a strong representation of the target population. Finally, the study was based on data from 208 properly completed surveys, with a remarkable 78% response rate. Within this rigorously created study framework, the data provide a compelling story, pointing to a palpable and statistically significant impact of the adoption of Industry 4.0 technology on Nigeria's booming insurance market. These findings highlight technological innovation's transformative potential in improving the accessibility, efficiency, and overall efficacy of insurance services in Nigeria, laying the groundwork for informed policy interventions and strategic industry initiatives aimed at fostering long-term growth and development in the Nigerian insurance sector.

Keywords: Industry 4.0, Insurance penetration, Technology acceptance model.

Introduction

Insurance is a system intended to alleviate the impacts of misfortune by providing financial compensation from the pool of cumulative contributions or premiums paid by all scheme participants (Adetunji, Nwude & Udeh, 2018). Insurance is a smart policy and practice that offers social and economic benefits while also democratising finance. A healthy and active insurance business is a key driver of economic progress (Okeke, Anyanwaokoro, & Madukwe, 2021). In developed economies, insurance has a significant

impact on the well-being of citizens and the economy as a whole. The insurance industry is a significant source of long-term capital, safeguarding individuals and businesses from a variety of hazards and encouraging economic growth (Bayar, Danuletiu, Danuletiu, & Gavriletea, 2023).

The penetration rate reflects the level of development of a country's insurance sector. The penetration rate is calculated as the ratio of premiums underwritten in a given year to the Gross Domestic Product. Insurance penetration is the ratio of a product's sales volume to that of its competitors (Kajwang, 2020). Insurance penetration relates a product group's insurance sales volume to that of rival goods (Ehiorobo 2020). The insurance industry has expanded rapidly in recent years. However, sub-Saharan Africa has the lowest insurance penetration rate (Asongu & Odhiambo, 2020).

Furthermore, West Africa's insurance penetration rate is low due to a variety of factors, including the general public's lack of knowledge about insurance products and benefits, negative attitudes, cultural and religious values, inappropriate products, and limited distribution channels (Olaewaju & Msomi, 2021). Also, insurance penetration in Nigeria remains low (Adebayo & Agboola, 2020). Most industries in Nigeria have relatively low insurance penetration, since insurance remains a largely untapped component of the Nigerian economy, despite the importance of insurance inclusion to any country's economy. Low insurance penetration has been linked to issues such as middle-income earners' limited earning ability and socio-cultural variables, among others (Anoka and Uche, 2018). Because of its low penetration, Nigeria's insurance business is seen as the poor relative of banks (Anoka & Uche, 2018).

Nigerians have a great aversion towards insurance, rendering the business untrustworthy in Nigeria. However, the Fourth Industrial Revolution (4IR) has gained pace in recent years. To grow, the insurance business must innovate and embrace technology (Sibindi, 2022). In accordance with this, the purpose of this study is to determine if technology, namely Industry 4.0, can help drive insurance penetration in the country. Thus, Schwab (2017) stated that humanity is on the verge of "the fourth industrial revolution" (4IR). While gradual technological advancement is not a novel concept, Schwab believes that technological discoveries have gained enough velocity to ignite a change to a completely new form of production. According to Schwab, the next industrial revolution builds on the third industrial revolution while also breaking away from it, with computers, software, and networks at its centre. Schwab defines the fourth industrial revolution as "a much more ubiquitous and mobile internet, smaller and more powerful sensors that have become cheaper, and artificial intelligence and machine learning." The question today is whether the implementation of Industrial Revolution 4.0 would assist to enhance the landscape of the Nigerian insurance sector by increasing insurance penetration in the country or not.

According to industry figures, Nigeria's insurance penetration rate (IPR) fell to 0.39 percent in 2013, from 0.48 percent in 2010. However, Nigeria's IPR fell to 0.06 percent

in 2016 - by comparison, South Africa's IPR was the highest in Africa at 13.2 percent - while the insurance sector's contribution to Nigeria's real GDP was abysmally low at only 0.02 percent. In 2019, Nigeria's IPR was less than 0.02% (Inyang and Okonkwo, 2022). These statistics provide a solid foundation for the Nigerian insurance sector's enormous growth potential, especially given the country's favourable demographics, namely Nigeria's population of approximately 180 million people and the potential upward mobility of significant segments of the population. The sector is considerably behind in adopting current technologies in its operations, which might have an impact on the country's insurance penetration. The purpose of this study is to determine the impact of Industry 4.0 adoption on insurance penetration in Nigeria.

Research Hypothesis

H₀: Adoption of Industry 4.0 does not have significant effect on insurance penetration in Nigeria.

Concept of Insurance Penetration

Insurance penetration is a measure of how far a country's insurance business has advanced. Insurance penetration is a measure of an insurance sector's development, defined as gross premium income (GPI) as a proportion of gross domestic product (GDP). The word "insurance penetration" refers to how well a product sells in relation to its competitors' sales. There are two types of insurance penetration: life insurance penetration, which only considers premiums from life insurance policies as a percentage of GDP, and non-life insurance penetration, which includes premiums from policies other than life insurance, such as auto and health insurance (Okeke et al., 2021).

Insurance penetration measures the insurance sector's contribution to the national economy. It is a solid instrument that illustrates how regional and different insurance markets contribute to national growth by serving as a wide and high-level indicator of insurance market development. As a result, insurance penetration gives insight into the insurance market, which is crucial for developing evidence-based policies, implementing risk-based supervisory approaches, and evaluating regulatory results (Inyang & Okonkwo, 2022).

Insurance penetration rate is defined as the ratio of insurance premium volume to GDP, whereas non-life insurance penetration is defined as the ratio of non-life insurance premium volume to GDP (Ehiogu, Eze & Nwite, 2018). Insurance penetration is defined as the percentage contribution of insurance premiums to a country's Gross Domestic Product (GDP). For example, if Nigeria generates a total insurance premium of N10 billion and the country's GDP during the same period is N100 billion, insurance penetration is 10% (Agbo, 2020).

Concept of Industry 4.0

The Internet of Things (IoT) (Osman, Karim, & Ali, 2020), cloud computing (Alismaili et al., 2020), big data (Vitale, Cupertino, & Riccaboni, 2020), blockchain (Nuryyev et al., 2020), and additive manufacturing (Angrisani, Arpaia, Bonavolontá, Moccaldi, & Moriello, 2020) are all examples of Industry 4.0. This topic has been widely debated by authors who have attempted to convey some of the unique characteristics of this disruptive sector.

According to Rojas-Berrio et al. (2022), Industry 4.0 includes smart factories, cyber-physical systems, self-organization, new distribution channels, and corporate social responsibility. According to Senvar and Akkartal (2018), this industry encompasses cyber-physical systems, information and communication technologies, big data, cloud computing, and simulation, among others. Accordingly, Wee, Kelly, Cattel, and Breunig (2015) define Industry 4.0 as the digitalization of the industrial sector, which necessitates cyber-physical systems and data analytics.

Sung (2018) identifies four disruptions that drive Industry 4.0: the unprecedented growth of data, computational power, and connectivity; the emergence of business intelligence and data analytics; new forms of human-machine interaction; and advances in the transfer of digital instructions to physical artefacts, such as robots. Furthermore, Gubán and Kovács (2017) emphasise that the heart of Industry 4.0 is the implementation of interconnected intelligent systems that allow people, machines, and equipment to communicate with one another.

However, at the heart of Industry 4.0 is the cyber-physical system (CPS), an intelligent network that connects physical machines to the digital world. Sensors integrated in machinery capture real-time performance data, allowing for predictive maintenance and averting unexpected breakdowns (Lee & Lapira, 2019). Furthermore, industrial robots equipped with smart algorithms operate alongside human workers, automating monotonous activities and increasing productivity.

Empirical Review

Adebayo and Agboola (2020) examined the Adoption of Industry 4.0 and the Operations of the Nigerian Insurance Industry. The study examined the impact of the adoption of Industry 4.0 on the improvement of penetration of insurance company in Nigeria. It also examined the impact of the adoption of Industry 4.0 on the improvement of profitability of insurance company in Nigeria. The findings of the study revealed that the adoption of Industry 4.0 has a significant impact on the improvement of Insurance penetration in Nigerian insurance companies. It also revealed that the adoption of Industry 4.0 has a significant impact on the improvement of profitability of the insurance companies in Nigeria.

Similarly in a study by Iskandar, Hafizah and Hermansuyur (2020) aims to know the influence of the Industrial Revolution 4.0 era on the insurance industry on the side of

assets and Investment insurance companies to Investment Yield Sharia Insurance in Indonesia. The result showed that in the era of the industrial revolution, 4.0 potential insurance improved economic growth through several aspects, namely promoting financial stability; facilitating trade and commercial activities: mobilizing domestic savings, offering a variety of risk management on capital, increasing more efficient allocation of capital and reduce the risk of loss and can increase Investment Yield for shareholders and stakeholders.

Yıldırım (2020) in a study examining Industrial 4.0 and its effect on the Insurance sector found that one of the most important preconditions for the realization of the Industry 4.0 revolution is that companies have completed their digital transformations, new technologies and digitalization.

Roblek, Meško and Krapež (2016) in their study focused on the importance of industry 4.0 and consequently the internet-connected technologies for the creation of value added for organizations and society. The study noted that the fourth industrial revolution is happening now; and that it requires from each company and each individual a rethinking of what is expected or desired from the smart project and smart internet-connected devices.

Technology Acceptance Model

The Technology acceptance Model (TAM) is a generally accepted theoretical framework for studying people's adoption and use of new technology (Davis, 1989). Developed by Davis in the 1980s and then extended by Venkatesh and Davis (Abuhassna et al., 2023). According to TAM, perceived ease of use and perceived utility are the most important predictors of an individual's desire to use a technology, which then determines actual usage behaviour. Perceived ease of use is the degree to which a person believes that using a specific technology will be simple, whereas perceived usefulness is the extent to which an individual believes that using the technology will improve their performance or productivity (Distanont & Khongmalai, 2022). TAM has been used in a variety of sectors to investigate technology adoption behaviours, offering useful insights into the elements that influence the acceptance and use of innovations (Iacurci, 2021).

When investigating the influence of Industry 4.0 adoption on insurance penetration in Nigeria, the Technology Acceptance Model (TAM) provides a useful lens through which to analyse the dynamics at play. TAM believes that the perceived simplicity of use and utility of Industry 4.0 technologies in the Nigerian insurance sector would have a substantial impact on their adoption by insurers. Insurers' views towards these technologies will be shaped by factors such as their accessibility, compatibility with current systems, and anticipated benefits in terms of improving operational efficiency and customer service. TAM also emphasises the relevance of organisational variables, such as top management support and resource availability, in encouraging technology adoption. Using TAM in this study, researchers may examine how insurers' views of Industry 4.0 technologies influence their adoption decisions, resulting in increased insurance penetration in Nigeria.

Methodology

The study takes a quantitative approach, using both cross-sectional and survey research techniques. Cross-sectional research gathers data from a sample of participants at a single point in time to analyse relationships or trends within a population (Ojeleye & Bakare, 2020), whereas survey research collects data through structured questionnaires or interviews (Sekaran & Bougie, 2016). According to statistics from the National Insurance Commission's (NAICOM) website, Nigeria has 56 listed insurance firms as of January 31, 2024. The study focuses on these insurance companies' managerial employees, including Managing Directors, Executive Directors Technical, Heads of Technical Underwriting and Reinsurance, Chief Financial Officers, Heads of Audit, Heads of Enterprise Risk Management (ERM), Chief Risk Officers (CROs) who specialise in Risk and Compliance, and Heads of Human Resources/Administration. While the major unit of analysis is the management level, the study acknowledges the possibility of future research into employee subunits. Recognising the importance of middle and senior managers in managing everyday operations, the research seeks significant ideas from this group to achieve its goals. Taro Yamane's method for finite populations was used to get a sample size of 228 from a population of 504 (56 insurance firms x 9 management personnel). Following Israel's (2013) proposal, the sample size was raised by 20% to account for issues such as non-response, acceptable filling, and missing values, yielding a final sample of 208 (78%) questionnaires that were adequately filled and used for analysis.

Measurements

The questionnaire items were all adapted from validated research tools. The evaluation of readiness for adopting Industry 4.0 was modified from a scale developed by Nimawat and Gidwani in 2016. An example statement on this scale is: "The availability of machines and technologies aligns with industry 4.0," rated on a five-point Likert scale from "strongly disagree" to "strongly agree." The Cronbach's alpha coefficient of 0.812 reported signifies the instrument's reliability and appropriateness for the study. The assessment of insurance penetration was derived from a scale created by Njuguna and Kimani (2016). An illustration from this scale is: "A growing clientele can now utilise our insurance offerings," assessed on a five-point Likert scale. The Cronbach's alpha coefficient of 0.766 indicates that the instrument is trustworthy and suitable for the investigation.

Results

Summary of regression analysis for the effect of Adoption of Industry 4.0 on Insurance Penetration in Nigeria.

Model, N=208	Beta	T	Sig.	R	R ²	Adj. R ²	Anova Sig.	F(df)
(Constant)	51.508	6.411	0.000	0.335 ^a	0.254	0.200	0.000 ^b	52.231 (1,102)
Adoption of Industry 4.0	0.316	3.310	.000					

a. Dependent Variable: Insurance Penetration

- b. Predictor: (Constant), Adoption of Industry 4.0

Source: Researcher’s Field Survey Results (2024)

The regression analysis conducted on the effect of Industry 4.0 adoption on insurance penetration in Nigeria, based on data from 208 observations, revealed a statistically significant model fit (R-squared = 0.254), indicating that approximately 25.4% of the variance in insurance penetration can be explained by the adoption of Industry 4.0. The constant term was 51.508, representing the expected insurance penetration when Industry 4.0 adoption is zero. Overall, the model was significant (F = 52.231, p < 0.001), indicating that the predictor collectively contributed to explaining the variance in insurance penetration.

Table 1 above the regression coefficient for Industry 4.0 adoption was 0.316 (t = 3.310, p < 0.001), suggesting a positive relationship between the two variables. Therefore, adoption of industry 4.0 has statistically significant effect on insurance penetration in Nigeria.

From Table 1 the regression model showing the effect of adoption of industry 4.0 on insurance penetration is expressed as:

$$IP = 51.508 + .316 AI \dots\dots\dots eq. i$$

Where:

- P = Insurance Penetration
- AI = Adoption of Industry 4.0

In the regression equation above, when the value of adoption of industry 4.0 is constant at zero, insurance penetration was 51.508. The regression coefficient of adoption of industry 4.0 was 0.316, which imply that an increase in adoption of industry 4.0 by one unit leads to an increase in insurance penetration level by 0.316 units. Results further indicate that adoption of industry 4.0 and insurance penetration had a positive and significant effect ($\beta = 0.316$, p<0.05). Therefore, the null hypothesis one (H₀) which states that adoption of industry 4.0 has no significant effect on insurance penetration in Nigeria is hereby rejected.

Discussion of Finding

The positive and significant effect of adoption of Industry 4.0 on the level of insurance penetration in Nigeria aligns with the findings of prior research conducted by Adebayo & Agboola in 2020, Iskandar et al. in 2020, and Roblek et al. in 2016, and may be linked to many reasons. The incorporation of advanced technologies like artificial intelligence, big data analytics, and the Internet of Things (IoT) in the insurance sector enhances operational efficiency, risk evaluation, and customised services, resulting in higher

consumer contentment and confidence in insurance products (Perez, 2019). Industry 4.0 technologies allow insurers to access previously neglected or distant regions via digital platforms, broadening their market coverage and availability to potential clients (Ezeh et al., 2020). Additionally, the employment of digital platforms for insurance services promotes consumer interaction and experience, hence driving improved uptake and retention rates (Chukwudozie & Chinedu, 2021). Moreover, Industry 4.0 supports innovation within the insurance industry, allowing insurers to develop new products customised to the increasing demands of consumers, such as usage-based insurance and microinsurance schemes (Adesina et al., 2019). Overall, the favourable impact of Industry 4.0 adoption on insurance coverage in Nigeria emphasises the transformational potential of technical innovations in advancing financial inclusion and socioeconomic growth.

Implications

The practical implications of the study findings on the positive and significant influence of Industry 4.0 adoption on insurance penetration in Nigeria are varied. Firstly, insurers in Nigeria may embrace Industry 4.0 technology to improve their operations, boost efficiency, and cut operating costs. This may entail applying sophisticated analytics for risk assessment, automating claims processing through machine learning algorithms, and employing IoT devices for real-time monitoring and data collecting, eventually leading to greater profitability and competitiveness in the market. Moreover, the findings underline the significance of investing in digital infrastructure and people development to capitalize on the potential given by Industry 4.0, therefore preparing Nigerian insurers for sustainable growth and resilience in an increasingly digitalized world. Additionally, policymakers and regulators may utilise the study findings to build supportive policies and frameworks that stimulate innovation and investment in Industry 4.0 technologies within the insurance sector, supporting economic development and financial inclusion in Nigeria. From a theoretical standpoint, the findings of the study accord with the Technology Acceptance Model (TAM), which proposes that the perceived utility and simplicity of use of a technology strongly impact its adoption and usage behavior (Davis, 1989). In the context of the insurance sector in Nigeria, sector 4.0 technologies are viewed as significant instruments for improving service delivery, boosting customer experience, and driving corporate development. The favourable association between Industry 4.0 adoption and insurance penetration shown in the study indicates the perceived value of these technologies among insurers and customers alike. Moreover, the study findings underline the necessity of overcoming perceived impediments to adoption, such as cost, complexity, and security concerns, to promote the widespread acceptance and dissemination of Industry 4.0 technologies within the Nigerian insurance industry. Overall, the study contributes to the theoretical knowledge of technology adoption and

diffusion processes within emerging countries like Nigeria, stressing the impact of perceived utility and ease of use in promoting technology adoption behaviors among industry players.

Conclusion

The outcomes of this study indicate the large and favourable influence of Industry 4.0 adoption on insurance penetration in Nigeria. Through regression analysis, it was discovered that the integration of new technologies into the insurance sector adds to enhanced market reach, process efficiency, and customer engagement, eventually generating higher levels of insurance uptake in the country. These findings underline the revolutionary potential of market 4.0 technologies in boosting financial inclusion, stimulating economic development, and driving innovation within the Nigerian insurance market. The practical ramifications of these findings imply potential for insurers to embrace digital solutions to increase operational efficiency, expand their client base, and remain competitive in the developing environment of financial services. Furthermore, from a theoretical aspect, the study corresponds with the Technology Acceptance Model, highlighting the role of perceived utility and simplicity of use in promoting technology adoption behaviors among business stakeholders. Overall, this study contributes to the growing body of literature on the intersection of technology, finance, and development in emerging markets, offering valuable insights for policymakers, practitioners, and researchers seeking to harness the potential of Industry 4.0 for sustainable growth and socioeconomic advancement in Nigeria.

References

- Abuhassna, H., Yahaya, N., Zakaria, M. A. Z. M., Zaid, N. M., Samah, N. A., Awae, F., ... Alsharif, A. H. (2023). Trends on using the technology acceptance model (TAM) for online learning: A bibliometric and content analysis. *International Journal of Information and Education Technology*, 13(1), 131-142. <https://doi.org/10.18178/ijiet.2023.13.1.1788>
- Adebayo, O. A., & Agboola, O. O. (2020). Adoption of Industry 4.0 and the operations of the Nigerian insurance industry: A study of AICO insurance company. *JABU International Journal of Social and Management Sciences*, 7(2), 19-30
- Adesina, T. B., Ayo, C. K., & Adebisi, A. A. (2019). Fostering financial inclusion in Nigeria through digital insurance. In Proceedings of the 11th International Conference on Theory and Practice of Electronic Governance (pp. 15-24). ACM.
- Adetunji, A. L. Nwude, L. C. & Udeh, S. N. (2018). Interface of insurance and economic growth: Nigerian experience. *International Journal of Economic and Financial Issues*, 8(4), 16-26
- Agbo, E. I., & Nwankwo, S. N. P. (2020). Bancassurance in Africa: Avenue for insurance inclusion. *Business Management and Entrepreneurship Academic Journal*, 2(9), 44-56.
- Agbo, I. (2020). Influence of insurance penetration on insurance performance in Nigeria from 1996-2018. *International Journal of Management Science & Entrepreneurship*, 11(7), 102-117
- Alismaili, S. Z., Li, M., Shen, J., Huang, P., He, Q., & Zhan, W. (2020). Organisational-level assessment of cloud computing adoption: Evidence from the Australian SMEs. *Journal of Global Information Management*, 28(2), 73-89. <https://doi.org/10.4018/jgim.2020040104>
- Angrisani, L., Arpaia, P., Bonavolontá, F., Moccaldi, N., & Moriello, R. S. L. (2020). A "learning small enterprise" networked with a FabLab: An academic course 4.0 in instrumentation and measurement. *Measurement*, 150, 107063. <https://doi.org/10.1016/j.measurement.2019.107063>
- Anoka, A. F. & Uche, W. J. (2018) Impact of inflation on insurance claims in Nigeria. *Journal of Economics and Finance*, 9(6), 43-53. <https://doi.org/10.9790/5933-0906014353>
- Asongu, S. A., & Nwachukwu, J. C. (2019). ICT, financial sector development and financial access. *Journal of the Knowledge Economy*, 10, 465-490. <https://doi.org/10.1007/s13132-017-0477-x>
- Bayar, Y., Danuletiu, D. C., Danuletiu, A. E., & Gavriletea, M. D. (2023). ICT penetration and insurance sector development: Evidence from the 10 new EU member states. *Electronics*, 12(4), 823. <https://doi.org/10.3390/electronics12040823>

- Chukwudozie, J., & Chinedu, E. (2021). Adoption of digital technologies in the Nigerian insurance sector and implications for customer satisfaction. *International Journal of Business and Globalisation*, 26(2), 182-197.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340.
- Distanont, A., & Khongmalai, O. (2022). The Adoption of Digital Technology in SMEs. *Proceedings of the 18th European Conference on Management Leadership and Governance, ECMLG 2022*, 141-146. Retrieved from <https://papers.academic-conferences.org/index.php/ecmlg/article/view/541>
- Ehiogu, C. P., Eze, O. R., & Nwite, S. C. (2018). Effect of inflation rate on insurance penetration of Nigerian insurance industry. *International Research Journal of Finance and Economics*, 170(1), 66-76.
- Ehiorobo, O. A. (2020). Discriminant analysis of the socio-economic variables for predicting insurance penetration rates in developing countries. *Paradigms*, 14(1), 46-53.
- Elliott, R. (2021). *Underwater: Loss, Flood Insurance, and the Moral Economy of Climate Change in the United States*. Columbia University Press.
- Ezeh, C., Okorie, N., Okike, E., & Agwu, M. (2020). The role of digital insurance in enhancing insurance penetration in Nigeria. *International Journal of Academic Research in Business and Social Sciences*, 10(5), 614-626.
- Gubán, M., & Kovács, G. (2017). Industry 4.0 Conception. In *Acta Technica Corviniensis- Bulletin of Engineering*. University POLITEHNICA Timisoara. https://www.researchgate.net/publication/317012611_INDUSTRY_40_CONCEPTION
- Iacurci, L. (2021). *A Study of the Technology Acceptance Model for Social Media Adoption in Small & Medium Enterprises* (Bryant University). Bryant University. Retrieved from https://digitalcommons.bryant.edu/cgi/viewcontent.cgi?article=1035&context=honors_marketing
- Inyang, U., & Okonkwo, I. V. (2022). Micro insurance Schemes and insurance penetration in Nigeria: an integrative review. *The Journal of Risk Management and Insurance*, 26(1), 60-74.
- Iskandar, M., Hafizah, B. A., & Hermansuyur, E (2020). The impact of the Industrial Revolution 4.0 on the Insurance Industry and whether if the assets and investments play a role in investment yield. *Humanities and Social Sciences Reviews*, 8(2), 345-351. <https://doi.org/10.18510/hssr.2020.8239>
- Israel, G. D. (2013). Determining sample size. *Journal of Business Research*, 1, 1-5. Retrieved from [https://www.psychosphere.com/Determining sample size by Glen Israel.pdf](https://www.psychosphere.com/Determining+sample+size+by+Glen+Israel.pdf)
- Kajwang, B. (2020). Factors influencing the low penetration of insurance services in Africa. *Journal of Developing Country Studies*, 5(1), 25-35. <https://doi.org/10.47604/jdc.1598>
- Kolapo, F. T. (2023). The impact of financial and internet access on insurance penetration in Nigeria. *Fuoye Journal of Finance and Contemporary Issues*, 5(1), 1-11.
- Lee, H., Zhen-Jiang, Y. O. N. G., & Qiao-Ming, L. I. M. (2022). Insurance development and economic growth. *Financial Statistical Journal*, 5(1), 1057. <https://doi.org/10.24294/fsj.v5i1.1057>
- Lee, J., & Lapira, H. (2019). A conceptual framework for the industrial internet of things and its applications. *International Journal of Engineering and Business Management*, 11(1), 1-8.
- Nimawat, D., & Gidwani, B. D. (2016). Challenges facing by manufacturing industries towards implementation of industry 4.0: An empirical research. *International Journal of Interactive Design and Manufacturing*, 16(4), 1-13
- Nuryyev, G., Wang, Y. P., Achylurdyyyeva, J., Jaw, B. S., Yeh, Y. S., Lin, H. T., & Wu, L. F. (2020). Blockchain technology adoption behavior and sustainability of the business in tourism and hospitality SMEs: An empirical study. *Sustainability (Switzerland)*, 12(3), 1256. <https://doi.org/10.3390/su12031256>
- Ojeleye, Y. C., & Bakare, M. (2020). Transformation leadership and employee engagement: moderating role of organizational trust in confectioner industry. *International Journal of Intellectual Discourse*, 3(1), 2-16. Retrieved from <https://ijidjournal.org/index.php/ijid/article/view/5>
- Okeke, D. C., Anyanwaokoro, M., & Madukwe, O. D (2021). Effect of financial deepening on insurance penetration in Nigeria, 1986 -2018. *Contemporary Journal of Management*, 3(9), 1-20.
- Olarewaju, O., & Msomi, T. (2021). Determinants of insurance penetration in West African countries: A panel auto regressive distributed lag approach. *Journal of Risk and Financial Management*, 14(8), 350. <https://doi.org/10.3390/jrfm14080350>
- Osman, M. S., Karim, A. Z. A., & Ali, M. A. (2020). Development of internet of things (IoT) for local SME (Software development). *Test Engineering and Management*, 83, 8050-8060.
- Perez, F. (2019). How industry 4.0 is transforming insurance. Forbes. Retrieved from <https://www.forbes.com/sites/forbestechcouncil/2019/07/02/how-industry-4-0-is-transforming-insurance/?sh=1c2302c61b09>
- Roblek, V., Meško, M., & Krapež, A. (2016). A complex view of industry 4.0. *Sage Open*, 6(2), 2158244016653987. <https://doi.org/10.1177/2158244016653987>
- Rojas-Berrio, S., Rincon-Novoa, J., Sánchez-Monroy, M., Ascúa, R., & Montoya-Restrepo, L. A. (2022). Factors influencing 4.0 technology adoption in manufacturing SMEs in an emerging country. *Journal of Small Business Strategy*, 32(3), 67-83. <https://doi.org/10.53703/001c.34608>
- Schwab, K. (2017). *The Fourth Industrial Revolution*. New York: Crown Business.
- Sekaran, U., & Bougie, R. (2016). *Research Method for Business: A Skill Building Approach* (7th ed.). Chichester: John Wiley & Sons Ltd.
- Senvar, O., & Akkartal, E. (2018). An overview to industry 4.0. *International Journal of Information, Business and Management*, 10(4), 50-57.

- Sibindi, A. B. (2022). Information and communication technology adoption and life insurance market development: Evidence from Sub-Saharan Africa. *Journal of Risk and Financial Management*, 15, 568. <https://doi.org/10.3390/jrfm15120568>
- Sung, T. K. (2018). Industry 4.0: A Korea perspective. *Technological Forecasting and Social Change*, 132, 40–45. <https://doi.org/10.1016/j.techfore.2017.11.005>
- Vitale, G., Cupertino, S., & Riccaboni, A. (2020). Big data and management control systems change: The case of an agricultural SME. *Journal of Management Control*, 31(1–2), 123–152. <https://doi.org/10.1007/s00187-020-00298-w>
- Wee, D., Kelly, R., Cattel, J., & Breunig, M. (2015). *Industry 4.0-how to Navigate Digitization of the Manufacturing Sector* (Vol. 58). McKinsey.
- Yıldırım, İ. (2020). *Industry 4.0 and its effects on the insurance sector*. In A. Özbebek Tunç & P. Aslan (Eds.), *Business Management and Communication Perspectives in Industry 4.0* (pp. 251-266). IGI Global. <https://doi.org/10.4018/978-1-5225-9416-1.ch014>