# Innovation Attributes as Determinants of the Application of Artificial Intelligence: A Proposed Study

Chinwe Iwuanyanwu
chinweiwuanyanwu@yahoo.com

Diane A. Igoche
igoche@rmu.edu

Robert Morris University
Moon Township, PA

## Abstract

This proposed study will investigate innovation attributes affecting the application of artificial intelligence (AI) using empirical evidence from American companies. The objectives of the study are to: (i) assess the forms of, and overall application level of AI; (ii) determine the areas of application of AI; and (iii) evaluate the innovation attributes affecting the application level of AI. The study will adopt a survey research design. Structured questionnaire will be used to gather data from business and Information technology experts from listed American companies on NASDAQ. Data was analyzed using descriptive statistics, exploratory factor analysis (principal component analysis) and regression analysis. This study will contribute to knowledge by exposing the dimensions of AI applied by American companies. It will also provide empirical evidence of the application of AI in various function areas of business as organizations can do more in improving their uptake of AI as an emerging technology.

**Keywords:** Artificial Intelligence, Innovation Attributes, NASDAQ.

## 1. INTRODUCTION

The fierce competition in the ever-changing business environment is imposing requirements on organizations in the 21st century to come up with innovative ways of managing business operations and activities in order to remain competitive. Technological innovations are now being heavily and increasingly relied upon like never before to deliver the competence businesses require to stay afloat, and one of the emerging disruptive technologies gaining researchers and practitioners attention in recent times is artificial Intelligence ((Werner & Gehrke, 2015).

Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to sometimes mimic human actions. The term may also be applied to any machine that exhibits traits associated with a human mind such as learning and problem-solving. Artificial intelligence, the ability of a computer or computer-controlled robot to perform tasks commonly associated with intelligent beings (Zhou, Fu, & Yang, 2016). In artificial intelligence, an expert system is a computer system that emulates the decision-making ability of a human expert. Expert systems are designed to solve complex problems by reasoning through bodies of knowledge, represented mainly as if–then rules rather than through conventional procedural code (Sumbal, Tsui & See-to, 2017).

AI has made inroads to various aspects and functional areas of business, ultimately ensuring that customers are properly managed and kept satisfied, as customer patronage remains a critical success factor for most organisations, whatever the industry they operate (Spenner & Freeman, 2012).

Customer management is the process, practice, or strategy an organisation deploys to engage with and manage its relationship with its customers. Customer management is also known as customer relationship management. The essential aspects of customer relationship management include understanding the customer, moving beyond transaction-based interaction to long-term relationship, and taking customer feedback seriously (Soobaroyen & Poorundersing, 2008).

Some of the methodologies that can be deployed to build good customer relationship management are communication, maintaining robust customer database, interaction, customer analysis and documentation of customer feedback. The broad spectra of issues in customer management provides opportunity to deploy AI for the purpose of improving customer experience and, ultimately, customer patronage. For instance, properly managed production runs, timely procurement of materials for production, effective internal control mechanisms to checkmate quality of products, a proper accounting system that ensures appropriate billing for customers and an effective marketing/sales strategy ultimately culminate to increase customer satisfaction (Porche, Wilson, Johnson, Tierney & Saltzman, 2014).

Customer satisfaction has been a burning issue, as customer satisfaction has reverberated as one of the critical success factors for business survival in a competitive environment. Customer analysis is also an important aspect of customer management which provides insight into the patronage, profitability, and level of customer satisfaction with the products/services offered by an organisation. An insightful analysis of customers in terms of their level of patronage can reveal 'high-performing' and 'low-performing' customers in terms of their patronage, and this could inform the competitive strategies of the organisation (Oyewo, 2017). Automation of customer management activities through AI can facilitate insightful customer accounting and customer profitability analysis through big data analytics (Baesens, Dejaeger, Lemahieu & Moges, 2013). For instance, the automation of customer activities in a service company, as part of customer management strategy, will enable customers to login to add their service time, view when they are due for service rendition, add issues between services that automatically go into next job sheet, and follow-up on on-going works. Information generated from these activities can be easily analysed when the processes are automated, which becomes useful feedback for improving efficiency of the processes.

The relevance and applicability of AI to different functional areas in business have been documented in prior studies (e.g., Appelbaum, Kogan & Vasarhelyi, 2017; Bibi, Pangil & Johari, 2016). However, empirical investigations into the extent of application of AI in business and management studies are still lacking. Whilst AI is becoming increasingly ubiquitous, little is known as to the factors responsible for its spread or diffusion among organisations. Against this backdrop, the current study will seek to investigate the innovation attributes affecting the application of AI using empirical evidence from American companies. More precisely, the objectives of the study are to: (i) assess the forms of, and overall application level of AI; (ii) determine the areas of application of AI; and (iii) evaluate the innovation attributes affecting the application level of AI. The study is adopting a survey research design. Structured questionnaire will be used to gather data from business and Information technology experts from listed American companies. Result from the analysis of survey data will use descriptive statistics, exploratory factory analysis and regression analysis.

This study will contribute to knowledge by exposing the dimensions of AI applied by American companies. It will also provide empirical evidence that the application level of AI in various function areas of business. The study is seeking to provide empirical evidence about innovation attributes that affect the level of AI deployment.

## 2. LITERATURE REVIEW

### Areas of Application of Artificial Intelligence in Business

Literature suggests that AI can be applied in various functional areas, departments, or strategic business units in an organization, including but not limited to Human Resource Management, Production, Accounts/ Finance, Internal control/ Internal Audit, Procurement, Marketing and Sales, and Customer Service among others (Bondarouk & Brewster, 2016; Appelbaum, Kogan & Vasarhelyi, 2018). In

human resource management, employees are one of the most critical assets of an organisation (Baron, Mustafa & Agustina, 2018)). Big data can be applied to analyse employee performance and design reward system to keep the human/workforce committed and motivated (Boddy, 2012; Abdel Al & McLellan, 2013; Abdullah & Said, 2015).

On a general note, AI can be deployed with respect to performing accounting, finance, and audit function (Zviran, 2015). Given that some organizations complete jobs/services according to the requirement of their customers, and as the tasks required for a job may vary from one customer to another, AI can be incorporated into a job order costing system to develop artificial intelligence in calculating the cost of executing a job/service in conjunction with the invoice management technique. A job order costing system is a form of specific order costing system in which a job is costed based on the tasks to be performed according to customers specification. In effect, the jobs to be executed varies from one job to another; and since the tasks to be executed are tailor-made, specific, or peculiar to the job at hand, the pricing for jobs vary according to the specific requirements. AI can be built into accounting and procurement system to master human intelligence in a short time for the purpose of detecting patterns and making predictions for jobs/ services to be executed, as well as anticipate customers' demands for homogenous products undergoing mass production (Pitcher, 2015).

AI can also find application in product design, procurement, and production management (Rasmussen & Ulrich, 2015). A case in point is the Rapid Application Development (RAD) methodology useful in production/project management. RAD is a form of agile software development methodology that prioritizes rapid prototype releases and iterations. RAD relies extensively on user feedback during the project development stages to ensure the project meets users' specification. In line with the RAD approach, the AI software can be developed to address user requirements covering human resource management, resource management, procurement, and invoicing, among other critical areas of business (Steenbruggen, Tranos & Nijkamp, 2015). As the target audience of a RAD could be Employees and Customers, they (RAD designs) would have to be carried along to ensure flexibility and adaptability to increase their satisfaction and minimise project risks. Such high-level collaboration and coordination between stakeholders (developers, clients, and end users) is expected to ensure timely completion of the project. The RAD collaborative approach will also ensure that employee and customer privacy, as well as data integrity, to guide against fraudsters and hackers (Stone, Deadrick, Lukaszewski & Johnson, 2015).

The application of artificial intelligence to sales, marketing and aftersales customer service could enhance accounting practice and invoice management (Stuart & Norvig, 2016). Accounting involves collecting, collating, analysing, summarising, and interpreting economic transactions to communicate performance to various stakeholders including management. Record keeping and invoice management are part of the accounting processes for documenting transactions. Maintaining accounting records on costs incurred to execute customers' orders is critical to the success of any organisation. Labour cost (which is calculated based on employee hours) and other costs incurred to complete a job or execute a customer's order serve as the basis for calculating pricing and billing for jobs. However, it is crucial that such records are properly maintained to ensure that customers are not under- or over-billed.

The application of artificial intelligence to job scheduling as part of employee/human resource management can ensure that employees are efficiently assigned to jobs in such a manner that no two employees work on a particular job at the same (McRobert, Hill, Smale, Hay & Van der Windt, 2018). Artificial intelligence can also ensure that no job is left out or missing. When costly mistakes such as wrong job scheduling are avoided on account of application of artificial intelligence, operating costs are better managed. Accounting record keeping, including invoice management, is a useful activity in an organisation for assessing the financial performance of an organisation. Owing to the important roles of accounting records and proper book-keeping, it becomes crucial to ensure that costs are correctly captured, and this can be enhanced through the automation of job scheduling processes using artificial intelligence technology (Mohammadpoor & Torabi, 2019).

Employees can be scheduled to perform these tasks using artificial intelligence as part of an efficient job management process (Montuschi, Gatteschi, Lamberti, Sanna & Demartini, 2014). Job management is a concept which refers to a deliberate, systemic, and systematic approach in executing all activities within a job specification or job cycle, whilst leveraging on prior experience

or insight gained in executing past jobs to improve business operations and overall organisational performance. Meanwhile, a job is an activity, a task or piece of work to be executed which requires the application of skills to complete.

As the activities involved in organizations are typically numerous and multifarious, it becomes necessary to break them down into manageable units in terms of functional business areas and jobs to be handled by employees. Job management is therefore required to ensure that the jobs are completed according to predetermined standards by employees. It is important that hours worked performing tasks are properly documented electronically (and manually in logbook), because such records form the basis for invoicing customers and costing jobs executed by employees. Taken together, AI can be innovatively applied in various functional areas, departments, or strategic business units in an organization (Navickas & Gružauskas, 2016).

**Theoretical Framework- Innovation Attributes Affecting the Application of Artificial Intelligence**

To the extent that an organisation switches from a manual system to a system driven by machine learning to manage its activities (O'Donovan, 2019; Searle, 2006), the introduction of AI technology could be considered as an innovation. The theoretical framework applied in the study is therefore the diffusion of innovation study developed by Rogers (2003). According to Rogers (2003), an innovation is a new idea in a new setting or an existing idea in a new setting. Some innovations may have occurred in a particular place or organisation, but once such existing ideas are introduced in a new environment, it becomes an innovation in that environment (Medlin, 2001; Sahin, 2006). There is no doubt that AI is an innovation, considering its prominence and ubiquity in recent times. The characteristics of innovation, namely (i) relative advantage, (ii) compatibility, (iii) complexity, (iv) trialability, and (v) observability may therefore affect the diffusion rate of AI as an innovation:

(I) Relative advantage is the degree to which an innovation is perceived as being better than the idea it supersedes. An innovation is adopted if it is considered more advantageous than an existing practice.

(II) Compatibility is the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters. When an idea is agreeable, compactible, or consistent with a belief system of an individual or organisation, it will witness higher adoption rate. The opposite is true for an idea that is inconsistent or incompatible with the value system of an individual, society or organisation.

(III) Complexity is the extent to which an innovation is perceived as being difficult to comprehend and apply. Innovations that are readily understood by most members of a social system will witness a faster adoption rate and a higher adoption level as compared to more complicated ideas that will be adopted more slowly.

(IV) Trialability refers to the degree to which an innovation may be experimented with on a limited basis. New ideas that can be tried on the instalment plan will generally be adopted more quickly than innovations that are not divisible.

(V) Observability is the degree to which the results (output or benefits) of an innovation-adoption is visible to others. The easier it is for individuals to see the results of an innovation, the more likely they are to adopt (Rogers, 2003).

The contextualization of the diffusion of innovation theory to this study implies that AI deployment is influenced by the consideration that it enhances operational efficiency (relative advantage). Also, the decision to adopt AI is influenced by the need to save cost and time pertaining to repetitive tasks performed by employees in the organization (relative advantage). The decision to adopt AI is informed by the value placed on continuous improvement and innovativeness (compatibility). Adoption of AI may also be affected by the experience of new ideas implemented in the past (compatibility). However, the difficulty of understanding AI and the challenges of implementing AI may affect its adoption level (complexity). The awareness that AI technologies can be partially implemented could promote adoption (trialability). The consideration that AI technologies can be implemented in phases can also affect the adoption decision (trialability). Visible result of AI implementation by other organizations can affect the decision to adopt (observability). On a final note, research on the outcomes of AI implementation can encourage its adoption (observability).

## 3. SUMMARY AND CONCLUSION

The population of the study will be comprised of all publicly quoted companies on NASDAQ (National Association of Securities Dealers Automated Quotations). The NASDAQ is an electronic stock exchange with more than 3,300

company listings. It currently has a greater trading volume than any other U.S. stock exchange, carrying out approximately 1.8 billion trades per day. The choice of NASDAQ was informed by the consideration that it is the second largest stock exchanges in the US, after NYSE (the New York stock Exchange). The NASDAQ trades shares in a variety of companies, but is well known for being a high-tech exchange, trading many new, high growth, and volatile stocks. Furthermore, the NASDAQ resonates well with the subject of the research on IT considering that it is an electronic exchange, with no physical trading floor, which conducts all its trades through a computer and telecommunications system. The companies will be randomly selected, and a copy of questionnaire dispatched to each company. The questionnaire will be accompanied by a cover letter, addressed to senior IT personnel to complete on behalf of their companies because of their level of knowledge about the procedures and policies in the organizations.

The next step of this study is to administer the survey, collect and analyze data and share the results with the wider academic and practitioner community.

## 4. REFERENCES

Abdel Al, S.F., & McLellan, J.D. (2013). Strategy and management accounting practices alignment and its effect on organizational performance. *Journal of Accounting – Business & Management, 20* (1), 1-27.

Abdullah, N. H., & Said, J. (2015). Enhancing the governance of government linked companies via strategic management accounting practices and value creation. Procedia Economics and Finance, 28, 222-229.

Appelbaum, D., Kogan, A., & Vasarhelyi, M.A. (2017). Big data and analytics in the modern audit engagement: Research needs. Auditing: A Journal of Practice & Theory, *36*(4), 1-27.

Appelbaum, D.A., Kogan, A., & Vasarhelyi, M.A. (2018). Analytical procedures in external auditing: A comprehensive literature survey and framework for external audit analytics. *Journal of Accounting Literature, 40,* 83-101

Baesens, B., Dejaeger, K., Lemahieu, W., & Moges, H. (2013). A multidimensional analysis of data quality for credit risk management: new insights and challenges. *Information & Management, 50*, 43-58.

Baron, I.S., Mustafa., & Agustina, H. (2018). The challenges of recruitment and selection systems in Indonesia. *Journal of management and marketing review, 3*(4), 185-192.

Bibi, P., Pangil, F., & Johari, J. (2016). HRM practices and employees' retention: The perspective of job embeddedness theory. *Asian Journal of multidisciplinary study, 4*(5), 41-47.

Boddy, D. (2012). *Essentials of management: A concise introduction*. Essex, England: Pearson Education Limited.

Bondarouk, T., & Brewster, C. (2016). Conceptualizing the future of HRM and technology research. *The International Journal of Human Resource Management, 27*(21), 2652–2671.

McRobert, C.J., Hill J.C., Smale, T., Hay E.M., & Van der Windt D.A. (2018). A multi-modal recruitment strategy using social media and internet-mediated methods to recruit a multidisciplinary, international sample of clinicians to an online research study. *PLoS ONE, 13*(7), 1-23.

Medlin, B.D. (2001). *The factors that may influence a faculty member's decision to adopt electronic technologies in instruction* (Doctoral dissertation, Virginia Polytechnic Institute and State University, 2001). ProQuest Digital Dissertations. (UMI No. AAT 3095210).

Mohammadpoor, M., & Torabi, F. (2019). *Big data analytics in oil and gas industry: An emerging trend*. doi: https://doi.org/10.1016/j.petlm.2018.11.001. Retrieved 25-09-2020.

Montuschi, P., Gatteschi, V., Lamberti, F., Sanna, A., & Demartini, C. (2014). Job recruitment and job seeking processes: how technology can help IT. *IT professional, 16*, 41-49.

Navickas, V., & Gružauskas, V. (2016). Big data concept in the food supply chain: small markets case. *Scientific Annals of Economics and Business, 63* (1), 15-28.

O'Donovan, D. (2019). HRM in the organization: An overview. *Management Science. Management and industrial engineering, 22* (1), 75-110.

Oyewo, B. (2017). Predictors of the effectiveness of management accounting function in Nigerian firms. *Scientific Annals of Economics and Business, 64* (4), 2017, 487-512.

Pitcher, G.S. (2015). Management accounting in support of the strategic management process. *CIMA Executive Summary Report, 11* (1), 1-20. Retrieved from https://www.cimaglobal.com/Research--Insight/Management-accounting-in-support-of-the-strategic-management-process/ (accessed 7-09-2019).

Porche, I. R., Wilson, B., Johnson, E.E., Tierney, S., & Saltzman, E. (2014). Data flood: Helping the Navy address the rising tide of sensor information. RAND Corporation. http://www.jstor.org/stable/10.7249/j.ctt6wq8rr.

Rasmussen, T., & Ulrich, D. (2015). Learning from practice: how HR analytics avoids being a management fad. *Organizational Dynamics, 44*(3), 236–242.

Rogers, E.M. (2003). *Diffusion of innovations* (5th Ed.). New York: The Free Press

Sahin, I. (2006). Detailed review of Rogers' diffusion of innovations theory and educational technology-related studies based on Rogers' theory. *The Turkish Online Journal of Educational Technology, 5* (2), 1-10.

Saunders, M., Lewis, P., & Thornhill, A. (2007). *Research methods for business students*. (4th ed.). England, Essex: Pearson Education Limited.

Searle, R. H. (2006). New technology: the potential impact of surveillance techniques in recruitment practices. *Personnel Review, 35*(3), 336–351.

Soobaroyen, T., & Poorundersing, B. (2008). The effectiveness of management accounting systems: Evidence from functional managers in a developing Country. *Managerial Auditing Journal, 23*(2), 187-219. doi: http://dx.doi.org/10.1108/02686900810839866.

Spenner, P., & Freeman, K. (2012). To keep your customers, keep it simple. *Harvard Business Review, 90*(5), 108-114.

Steenbruggen, J., Tranos, E., & Nijkamp, P. (2015). Data from mobile phone operators: A tool for smarter cities? *Telecommunications Policy, 39*(3), 335–346.

Stone, D. L., Deadrick, D. L., Lukaszewski, K. M., & Johnson, R. (2015). The influence of technology on the future of human resource management. *Human Resource Management Review, 25* (1), 216–231.

Stuart, R., & Norvig, P. (2016). *Artificial intelligence: A modern approach (3rd ed.*). Upper Saddle River: Prentice Hall Press.

Sumbal, M.S., Tsui, E., & See-to, E.W.K. (2017). *Interrelationship between big data and knowledge management: An exploratory study in the oil and gas sector*. doi:10.1108/JKM-07-2016-0262.

Werner, M., & Gehrke, N. (2015). Multilevel process mining for financial audits. *IEEE Transactions on Services Computing, 8* (6), 820-832.

Zhou, K., Fu, C., & Yang, S. (2016*).* Big data driven smart energy management: From big data to big insights. *Renewable and Sustainable Energy Reviews, 56*, 215-225.

Zviran, M. (2015). Relationship between organizational and information systems objectives: some empirical evidence. *Journal of management information systems, 7*(1), 65-84.