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SYSTEMATIC LITERATURE REVIEW AND RESEARCH MODEL TO EXAMINE DATA ANALYTICS ADOPTION IN ORGANIZATIONAL CONTEXTS

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ABSTRACT

Data analytics offers a wide variety of opportunities across all industries enabling improvements in all business operations. Data analytics adoption has several associated complexities making it cumbersome and challenging for organizations. In particular, small and medium businesses (SMB) and nonprofit organizations lag behind data analytics adoption, even though they are crucial for the economy and would benefit most from data-driven decisions. This paper aims to identify factors that influence data analytics adoption by organizations. We conduct a systematic literature review to identify articles relevant to data analytics adoption studies performed using survey methodology. We synthesize literature review results to propose a research model to investigate data analytics adoption in small & medium businesses and nonprofit organizations. The proposed research model was developed primarily based on Technology Organization Environment (TOE) framework, combined with other factors relevant to data analytics adoption found in the literature. The research model investigates the influences of data analytics, organization, and environment characteristics on data analytics adoption by SMBs and nonprofits. We hope that further progress with this research will provide insights into helping SMBs and nonprofits adopt data analytics technologies.

Keywords

Data analytics, systematic literature review, research model, data analytics characteristics, organizational characteristics, environmental characteristics

INTRODUCTION

As information systems for data collection continue to be developed, we are deluged with large volumes of data on every aspect of our life, including social activities, science, work, health, and infrastructure (Dash, Shakyawar, Sharma, & Kaushik, 2019). Thus, the amount of data that can be harnessed for analytic purposes increases exponentially. As the world transforms into a data-centric economy, becoming a data-driven organization is fundamentally important for survival (Amerian, 2021). As businesses try to stay on the cutting edge of competition, many large organizations have already adopted the capability to implement data analytics tools (Davenport & Harris, 2017).

Data analytics tools allow businesses to identify and predict trends and keep up with supply and demand (Dash et al., 2019). The tools to analyze data sets are robust and varied, but the access to the tools and talents are not universally accessible to all organizations. The data analytic adoption process is not simple; its complexity can differ for every organization. Numerous factors affect an organization's journey to data analytics adoption, including access to tools, data transparency, data governance, organizational change, digital transformation strategy, and motivating employees to have a data-driven mindset (Amerian, 2021). While many large organizations have stable frameworks for adopting new technology, that is not usually the case with small to medium organizations. Additionally, the data analytics adoption process for non-traditional businesses, chiefly nonprofit organizations, has not been studied thoroughly. As there is an inadequate understanding, this study investigates how small and medium businesses and nonprofit organizations adopt, use, and benefit from data analytics. Small & Medium businesses, nonprofits, and public sector organizations are backbone of our economic and play a deterministic role on quality of life. As a long-term impact of this research, we hope to provide helpful insights for information systems researchers on making practical contributions to these organizations utilizing data-driven decision-making.

In this paper, we conduct a systematic literature review on data analytics adoption in organizational contexts to gain a better understanding. The review offers a detailed summary of the data analytics adoption studies presenting the relevant theoretical framework, research methodology, and statistical analysis methods. We then combine the literature review findings to propose a research model to investigate the adoption of data analytics in small & medium enterprises and nonprofit organizations.

METHODOLOGY

In this section, we describe the steps followed in conducting a systematic literature review using guidelines suggested by Kitchenham (2004).

Search Strategy

We used Google Scholar as the main search engine to find relevant articles for the research study, as it provides the most widespread coverage of journal and conference articles published on the data analytics topic. The keywords used in the search were a combination of “data analytics adoption”, “business analytics adoption”, “data science adoption”, “survey method”, and “benchmark” to identify relevant articles. The search was restricted to articles published from 2010 to 2022, as the data analytics topic emerged in the late 2000s and early 2010s.

Inclusion and Exclusion

The base inclusion criteria consisted of articles that were free to access, written in English, and published through a peer-review process. Articles that were journals, conference proceedings, workshop papers, and book chapters were considered. Articles that were unrelated to data analytics adoption or their full texts were not available were excluded. Further, when different versions of an article were found, only one of the complete versions was included, while the others were excluded. In Figure 1, we depict the steps followed for inclusion and exclusion using the PRISMA flow diagram (Page et al., 2021). As Figure 1 illustrates, the initial search yielded 102 articles. After exclusion criteria were applied, a total of 13 articles remained.

Data Extraction and Synthesis

The data collection process was performed by carefully reading each of the 13 articles, extracting related data, and documenting it in a Microsoft Excel file. We extracted data on article title, first author affiliation location, research method, study focus, whether survey questions were included, theoretical framework, statistical analysis, and organization focus.

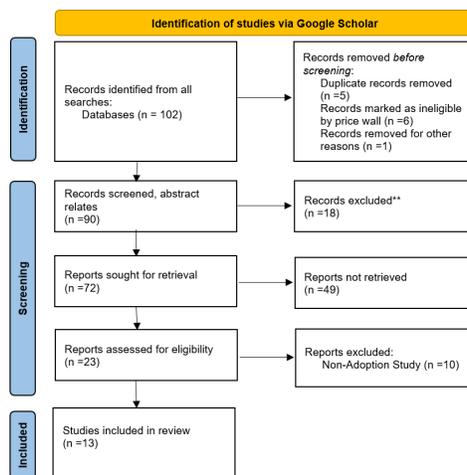


Figure 1. PRISMA Flow diagram for systematic literature review

FINDINGS OF SYSTEMATIC LITERATURE REVIEW

This section summarizes the systematic literature review on data analytics adoption. Figure 2 provides a summarized view of the results of the systematic literature review.

Methodology of Data Analytics Adoption Studies

Of the 13 studies, 10 were employed using a quantitative survey method. Two other papers used an interview and case study to study the adoption methods, and the findings were evaluated with thematic analysis. While one study employed mixed methods utilizing survey and case study analysis. The 11 studies incorporated quantitative surveys using the Likert scale to score the surveys. Eight studies used 5-point Likert scale surveys, two used a 7-point Likert scale, and one did not specify their scale. Of the 11 studies, 9 used survey instruments for gathering data on data analytics adoption in the published article.

Theoretical Framework

Many theoretical foundations have been used to study data analytics adoption. These include the Technology Acceptance Model (TAM), the Motivation Model (MM), the Diffusion of Innovations (DOI), the Unified Theory of Acceptance and Use

of Technology (UTAUT), Technology Organization Environment (TOE) framework, Resourced based, Relative Advantage, Situation Complication Question and Answer (SCQA), Complexity Theory, and Institutional Theory. Of these methods, TOE was used the most (5 out of 13) as the theoretical analysis of these adoption studies. The reason that TOE was such a widely used model can be attributed to the robust nature of the model. The model focuses on the environmental aspects of the organizations while also sharing some overlaps with other theories, such as the DOI theory (Ilin, Ivetić, & Simić, 2017).

Analysis Performed

While most studies were quantitative survey adoption studies, two utilized qualitative case studies. Both qualitative studies used thematic analysis and interviews to conduct their research. Of the quantitative studies, seven studies used Partial Least Squares (PLS) or PLS Structural Equation Model (PLS-SEM). Other analyses that were used included neural networks, factor analysis, and regression. PLS is commonly used in studying quantitative survey data on data analytics adoption.

Organization Size and Industry Sector

This investigation focuses on Small and Medium Enterprises (SME) and nonprofit organizations, but insight can also be gained from studying other sectors. Many studies were not focused on the business size; therefore, various organization sizes were most frequent in the selected review studies. Only three studies focused on SMEs, while one focused on medium and large organizations. Similarly, most studies were not focused on any particular industry sector either. Of those identified, two studies focused on manufacturing, one on construction, one on healthcare, one on retail, and one on governance services.

Country of Study

Asia was most frequented with seven studies from the articles identified, with three studies on Malaysia, two on India, one on Taiwan, and one on Pakistan. There were four European studies, one on Greece, one on France, one on Spain, and one on the United Kingdom. In contrast, there was one study on Colombia from South America and one on Cameroon from Africa. The lack of studies on North American countries is a research gap that must be addressed.

Research Focus

Out of 13, nine studies focused on big data analytics, while others focused on social media data, business analytics, and technological implementation. Regarding research focus, there were four studies on firm performance; other studies focused on unique areas, which included the COVID-19 crisis, organizational context factors, strategic determinants, continual usage, process innovation, predicting adoption, technology readiness, project management, sustainability, and transformational leadership.

Upon deeper dive into factors of data analytics adoption identified by review studies, there were considerable commonalities. Complexity, compatibility, technological readiness, organizational readiness, and openness to novelty were studied in multiple adoption papers. Various support systems, such as managerial, financial, and technological support, were also considered across multiple studies. These factors overlap under different adoption research frameworks, including the TOE and DOI theories. This overlap can explain the shared themes in many of the adoption studies. These themes will be used to create the research model proposed in this paper.

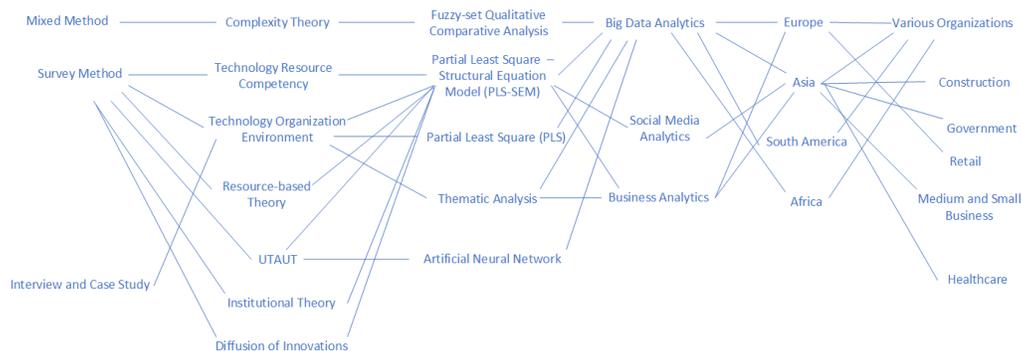


Figure 2. Systematic Literature Review Results

RESEARCH MODEL

The purpose of this study is to inductively develop a research model for data analytics adoption for SMEs and nonprofit organizational contexts through articles found using the systematic literature review. The systematic literature review indicated that the TOE framework is the most useful theory for investigating data analytics adoption. The TOE framework identifies

three characteristics that impact whether an organization will adopt a technological innovation: (1) the technological context, (2) the organizational context, (3) and the environmental context (Ilin et al., 2017). DOI is a framework that shares many similarities with TOE but predates TOE. DOI and TOE frameworks both focus on innovation characteristics and technological context. However, TOE focuses more on organizational factors, while DOI assigns the responsibility of different factors to individuals within the organization, such as the top management.

The proposed research model is built using characteristics of the TOE to examine factors that influence data analytics adoption with organizations as the unit level of analysis. The research model was developed using articles and factors identified from the systematic literature review. We also supplemented thesis studies found (that were excluded) during the initial search to strengthen the development of the research model. In this way, the research model allows for examining the adoption studies in the context of other studies (using the TOE framework) while also attempting to account for other factors that may not have been studied thoroughly in previous adoption surveys. Figure 3 displays the research model proposed in this paper to study data analytics adoption by SMEs and nonprofit organizations. Below, we clarify the research model items.

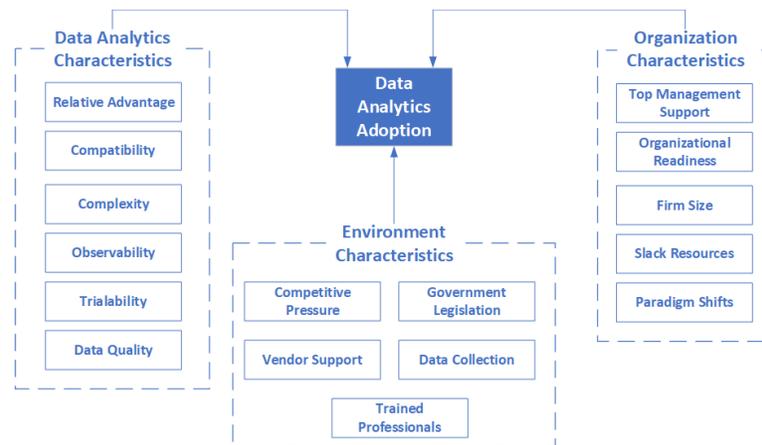


Figure 3. Research Model for Investigating Data Analytics Adoptions

Data Analytics Characteristics

Relative Advantage describes how technology can better serve a business than its current implementation (Chun-Hong & Ai-Ping, 2021). In previous studies, the relative value of innovation was found to be positively related to the adoption endeavors (Chun-Hong & Ai-Ping, 2021; Ghaleb, Dominic, Fati, Muneer, & Ali, 2021). Research indicates that if a consumer has a perceived advantage or utility of a new technology over an old one, they will be more likely to take it on (Chun-Hong & Ai-Ping, 2021). *Compatibility* refers to the degree to which an invention aligns with potential adopters' expectations or current practices (Chun-Hong & Ai-Ping, 2021). Some research indicates that compatibility is the deciding factor for product adoption (Chun-Hong & Ai-Ping, 2021), while other research indicates that compatibility has an insignificant association with adoption (Ghaleb et al., 2021). *Compatibility* can refer to the degree of fit after continual adjustments between business and information systems across the different organizational levels, ranging from the strategic, process, operational, social, cultural, and group levels to the individual level (Hung, Chen, Hoon Seok Choi, & Ractham, 2021). *Complexity* refers to the extent to which an invention is hard to understand and use (Chun-Hong & Ai-Ping, 2021). Complex products require more effort to learn to use and implement. Since there will already be a learning curve associated with adopting data analytics, complexity only steepens that curve. Previous studies indicate that technological complexity can prevent companies from implementing and adopting new technological innovations (Chun-Hong & Ai-Ping, 2021). *Observability* refers to how much the results of an innovation are visible to outsiders and is defined as "the process by which companies observe the success factor of other firms that have already adopted that technology" (Jayashree et al., 2021). In this way, it shares some overlaps with relative advantage, as both aspects are rooted in the perceived outcomes of adopting an existing technique to a different process. Not many studies have found observability to be a key factor in adoption studies. A few have found a significant relationship, but overall, it is accepted as controversial and weak (Jayashree et al., 2021). *Trialability* is when potential adopters feel they have the chance to experiment with technology before adopting it fully (Jayashree et al., 2021). It reduces the anxieties of potential adopters because it reduces the risk involved and reduces the complexity by getting employees exposed to the technology before it is adopted. Trialability can be important because it makes benefits of technology revealed faster, which will in turn, speed up implementation (Jayashree et al., 2021). Research indicates that the chance to trial a technology improves the likelihood of implementation. An organization can maximize its data analytics adoption utility when it has access to quality data. The

availability of relevant, timely, reliable, and accurate data directly influences the organization's decision-making. *Access to quality data*, thus, would encourage organizations to adopt data analytics technologies.

Organization Characteristics

Organizational characteristics describe the context influencing technology adoption tendencies through communication and control mechanisms. One such mechanism is *top management support* which refers to the organization's decision-makers physical and mental assistance in adopting new technologies (Chong & Lim, 2022). The decision maker's optimistic perspective about the potential advantages of technology adoption is more likely to provide managerial and financial support and take action to implement them. The extent of management support depends on *organizational readiness*, which refers to resource availability (Chong & Lim, 2022). Organization readiness is the availability of assets for investing and managing the adoption process. *Firm size* has been cited as a major indicator of adoption success in previous studies. This influence is due to the resources and funding available to larger firms that smaller businesses cannot draw from (Chaurasia & Verma, 2020). Small firms are less likely to be able to adopt data analytics because of the lack of resources. Since this study will focus on SMEs and nonprofits, it will be necessary to determine an impactful substitution or interpretation of firm size. *Slack Resources* refers to the number of unused resources available to a business (Entzenberg & Söderqvist, 2020). There is some degree of built-in slack, where resources, such as employees, have some degree of free or discretionary time available and availability of opportunities to the business, such as a network of connections. Firms with no slack would have their resources fully utilized. Not many studies focus on the impact of an organization's slack on the adoption of data analytics. Still, a few have found that slack aids in adoption, as resources are not stretched thinner in the adoption process. Data analytics disrupt traditional decision-making processes by forcing executives to make data-driven decisions instead of relying on their gut. *Paradigm shifts* are required to embrace analytical thinking and adopt data analytics technologies (Walker & Brown, 2019). Thus, an organization's ability to carry forward a paradigm shift in its decision-making may influence its intent to adopt data analytics.

Environmental Context

Environmental context refers to the external pressures felt by external forces in the form of business competitors, partners, and government regulations and legislations (Entzenberg & Söderqvist, 2020). If a competing business adopts data analytics, it might cause pressure on its competitors. *Competitive pressure* has positively impacted technology adoption among organizations across all sectors. *Government legislation* might cause a need for better data analytics, which would act as an external pressure, leading organizations to adopt. However, in the case of non-profits and small businesses, government support programs sometimes can cause positive pressure to adopt new technologies. Access to technology service providers is essential for SMEs and nonprofits to adopt newer technologies. Lack of commitment, viable pricing methods, or effective tooling would slow data analytics adoption (Walker & Brown, 2019). Thus, *vendor support* would positively influence SMEs and nonprofits data analytics adoption. *Access to data collection* information systems is essential to collecting quality data, affecting the organization's decision-making effectiveness. Thus, the availability of data collection tools would affect an organization's adoption of data analytic tools. Using data analytics tools requires access to employees with relevant technical skill sets. A study on big data adoption has identified a lack of skills as a prominent challenge in implementing big data analytic tools (Fredriksson, 2016). Thus, the *availability of trained professionals* with relevant skills and capabilities to perform data analytics tasks is crucial for adoption.

CONCLUSION

Data analytics is emerging as a key technology essential for organizations to survive the current business environmental changes. This study's objective is to investigate data analytics adoption in the context of small & medium businesses and nonprofit organizations, as they are known to be late adopters and underexamined contexts. We first conducted a systematic literature review on data analytics adoption studies. Literature review results indicated that many studies shared common themes, such as utilizing the quantitative survey method as methodology, partial least squares for statistical analysis, focused on varying business sizes, and the majority of the studies were conducted in Asia and European countries. The systematic review indicated that Technology-Organization-Environment was the most used theoretical framework for investigating the adoption of data analytics. We propose a research model to explore data analytics adoption by SMEs and nonprofits by synthesizing information gathered from review articles and other supplementary sources. As a part of future work, a survey instrument would be compiled based on survey questions identified from review articles. These survey questions will be submitted to the Institutional Research Board (IRB) for approval. Once approved, the survey will be administered to small & medium businesses and nonprofit organizations. We hope that further progress with this research will provide insights for information systems and data scientist professionals into helping small & medium businesses and nonprofit organizations adopt data analytics technologies.

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