Competitive Advantage in the Era of Big Data: A Conceptual Framework

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ABSTRACT

This quantitative conceptual study examines the role of big data analytics and analytics-based decision-making in strengthening competitive advantage across industries. It explores theoretical foundations and empirical evidence on leveraging big data for market competitiveness. The research proposes a framework for organisations to utilise big data to drive innovation, optimise decisions, and achieve sustainable advantage. Analytics-based decision-making serves as a mediating variable to expand existing literature. A quantitative approach will be employed, using surveys to collect data from employees of private organisations in the UAE. The findings will benefit professionals, including project managers, IT managers, coordinators, and policymakers, in enhancing project performance and decision-making.

Keywords: Big Data Analytics, Analytics Based Decision Making, Competitive Advantage, Private Sector, UAE.

INTRODUCTION

The significance of Big Data Analytics (BDA) has grown considerably among IT scholars, practitioners, and corporate leaders (Beier et al., 2020; Gao, 2022; Maheshwari et al., 2020). This awareness has driven global investments worth billions annually (Etzkowitz et al., 2023; Rahman & Reza, 2022). On 25 January 2022, the UAE launched its "Big Data Sustainable Development" initiative, aligning with the UN's 2030 Agenda (UAE Government, 2024). Integrating Big Data into sustainable development remains central to the UAE's national strategy, aiming to enhance quality of life and overall progress. The UAE actively promotes sustainable development through emerging technologies like BDA, yet challenges persist, including data-sharing policies and human expertise (Kadarisman et al., 2022). Government initiatives such as smart grids, healthcare, governance, and public safety have advanced BDA applications (DEWA, 2022). While research has explored BDA's obstacles and benefits (Yadegaridehkordi et al., 2020), studies on key success factors for long-term organisational adoption remain limited. Additionally, the uncertain costs of BDA often hinder its effective implementation, with executives struggling to harness its full potential (Morales-Serazzi et al., 2023).

Despite its critical role in distinguishing high- and low-performing firms (Mızrak, 2023;

Oesterreich et al., 2022), many BDA initiatives fail to meet strategic objectives(Chenger & Pettigrew, 2023). Research indicates that 43% of organisations do not gain substantial benefits from BDA (Seifian et al., 2023). While IT value assessment has gained attention, there is a growing demand for further studies on BDA's strategic impact. Though widely recognised for its role in competitive advantage, the specific mechanisms of BDA remain unclear, preventing organisations from fully capitalising on its potential (Chatterjee et al., 2023; Mikalef & Krogstie, 2020; Rizvi et al., 2023). This study examines the relationship between key BDA dimensions—volume, variety, and velocity—and competitive advantage among UAE firms, with analytics-based decision-making as a mediating factor. It aims to provide empirical evidence of BDA's strategic value, addressing gaps in prior research (Rizvi et al., 2023). The findings will support project leaders and teams in optimising data-driven strategies for improved project outcomes. The integration of advanced analytics into UAE initiatives, such as the UN's Big Data for Sustainable Development projects, has proven essential for national and corporate success (Tabesh et al., 2019). UAE organisations leverage BDA to enhance efficiency, drive innovation, and support sustainable development in key sectors, reinforcing its growing significance in a competitive global landscape (Feroz & Kwak, 2024).

LITERATURE

Competitive Advantage and Big Data Analytics: Global Perspective

Competitive advantage arises when firms implement unique strategies that competitors cannot replicate. Sustaining this advantage depends on competitive equilibrium rather than time. Businesses must navigate internal and external challenges, including rapid growth, technological shifts, and global competition, while enhancing efficiency through innovation, quality, pricing, and customer satisfaction. Achieving competitive superiority requires firms to operate more effectively than rivals in an evolving market shaped by shorter product lifecycles, technological advancements, and globalisation (Azeem et al., 2021). Data analytics has long been integral to strategic decision-making, offering qualitative and quantitative insights to enhance business operations (Mikalef et al., 2018). Over time, analytics has evolved, with Analytics 1.0 relying on structured data, Analytics 2.0 incorporating unstructured data for trend analysis, and Analytics 3.0 leveraging prescriptive analytics for complex decision-making (Koot et al., 2021; Sedkaoui & Khelfaoui, 2020).

BDA offers businesses substantial advantages across industries (Coursera, 2024). A Fortune 1000 survey found that 75% of executives consider BDA crucial for competitiveness (SQream Technologies, 2024). By analysing large datasets, businesses gain insights into customers, competitors, and markets, enhancing performance and strategic positioning (Bose et al., 2023). Effective BDA implementation requires advanced data-handling skills and machine-learning techniques to extract meaningful patterns (Rahman & Reza, 2022). Using regression, classification, and clustering, BDA uncovers complex relationships, enabling informed decision-making (Datamation Editorial Team, 2023). The three defining characteristics of Big Data—volume, variety, and velocity—underscore its transformative potential (Mohammadpoor & Torabi, 2020). Figure 1 illustrates the three fundamental characteristics of Big Data, commonly referred to as the three Vs.

Figure 1: Three Vs of Big Data Described by Yu and Wang (2022).

Benefits of Big Data Analytics

Organisations recognise the benefits of BDA in various areas, including enhanced decision-making (Chen et al., 2021), improved outcomes (Acciarini et al., 2023), operational efficiency (Dubey et al., 2020), revenue growth (Vitari & Raguseo, 2019), market expansion (Lutfi et al., 2022), innovation in products and services (Fadler & Legner, 2021), cost reduction (Jensen et al., 2023), customer experience (Jiwat & Zhang, 2022), and overall performance (Sabharwal & Miah, 2021). Singh et al. (2021) identify three ways information enhances organisational performance: optimising structure, outperforming competitors, and identifying new opportunities. Scholars highlight data analytics as essential for management and decision-making (Tang & Liao, 2021), with successful firms leveraging it as a key differentiator (Spillan et al., 2021). Bushe (2019) notes that executives link poor data management to revenue loss. Given BDA's role in competitive advantage, particularly in the UAE, this study examines the mediating effect of analytics-based decision-making to address gaps in existing research.

Relationship between Big Data Analytics, Analytics-based Decision Making, and Competitive Advantage

Scholars affirm that BDA enhances organisational performance, potentially leading to a competitive advantage (Bartosik-Purgat & Ratajczak-Mrożek, 2018; Popovič et al., 2016). Many high-performing firms view BDA as a key differentiator (Oesterreich et al., 2022). By offering new insights for planning and forecasting, BDA improves efficiency (Xie et al., 2022), increases revenue (Grover et al., 2018), expands markets (Bertello et al., 2020), reduces costs (Chaurasia et al., 2018), and enhances customer satisfaction (Wang et al., 2019). To remain competitive, organisations must invest in advanced tools and technologies for managing vast and complex data (Mhammedi & Gherabi, 2021; Sheikh & Goje, 2021). New analytical methods help organisations interpret Big Data and support managerial decisions (Jahani et al., 2023). BDA also automates business processes, such as recommender systems. Amazon reports that personalised recommendation algorithms boost sales by 29% (Alrumiah & Hadwan, 2021). This success stems from advanced analytics that integrate purchase history, browsing behaviour, and customer preferences. Amazon's item-to-item collaborative filtering applies sophisticated mathematical algorithms to generate tailored recommendations (Hardesty, 2019). Based on the literature, this study proposes the following hypothesis:

Proposition 1: *There is a relationship between big data analytics (Volume, Variety, Velocity) and competitive advantage.*

BDA significantly influences decision-making, enabling managers to better understand their businesses and consumers (Sharma et al., 2023). The trend in BDA favours faster model creation and data processing to analyse Big Data correlations (Feng et al., 2019). Managers rely on analytical results when decisions are precise and reliable (Pan & Zhang, 2021). By processing vast, diverse, and real-time data with advanced algorithms, BDA provides earlier insights, supporting managerial decisions with continuous predictive evidence (de Assis Santos & Marques, 2022). Given its significance, this study proposes the following:

Proposition 2: *There is a relationship between big data analytics (Volume, Variety, Velocity) and analytics-based decision-making (ABDM).*

Data-driven decision-making is expected to enhance organisational performance and competitive advantage (Medeiros & Maçada, 2021). Rational decisions, rather than intuitive ones, improve outcomes (Constantiou et al., 2019). Implementing targeted marketing strategies can increase revenue, profit margins, and market share. Managers who make decisions on data are more likely to achieve a competitive edge. Thus, this study examines the relationship between ABDM and competitive advantage.

Proposition 3: *There is a relationship between analytics-based decision-making (ABDM) and competitive advantage.*

Researchers highlight a strong link between big data analytics and decision-making. Samsudeen (2020) asserts that leveraging BDA enhances managerial decisions and performance, especially when combined with knowledge management. Dubey et al. (2020) and Hamzeh and Aburub (2024) emphasise BDA's role in acquiring decision-useful information. Thus, this study proposes ABDM as a mediator between BDA and competitive advantage.

Proposition 4: *Analytics-based decision-making (ABDM) mediates the relationship between big data analytics and competitive advantage.*

Underpinning Theory

The Resource-Based Theory (RBT) framework identifies key factors influencing a company's competitive advantage and performance. It highlights the importance of unique, hard-to-imitate resources that provide a lasting edge (Barney, 1991). This study builds on RBT and its dynamic capabilities to explore how big data analytics optimises project success. By combining resources like data analytics and talent, organisations can enhance their capacities, especially when resources are difficult to replicate (Agustian et al., 2023). Major studies suggest firms gain an edge by converting internal capabilities into rare, valuable resources that adapt to changing conditions (Tseng & Lee, 2014; Zhang & Jin, 2023). RBT underscores the importance of unique, inimitable assets to maintain a competitive edge (Barney, 1991). It also stresses the need for a combination of resources, such as technology, human capital, and investment, to leverage big data effectively (Wernerfelt, 1984). However, RBT has been criticised for focusing on physical resources without recognising the crucial role of human capital, such as data scientists (Grant, 1996). Critics also argue that RBT does not fully account for the fast-evolving nature of big data and technology (Balazka & Rodighiero, 2020).

Conceptual Framework

This study employed competitive advantage as the dependent variable, big data analytics as the independent variable, and analytics-based decision-making as the mediating variable. The conceptual framework of this study is illustrated in Figure 2.
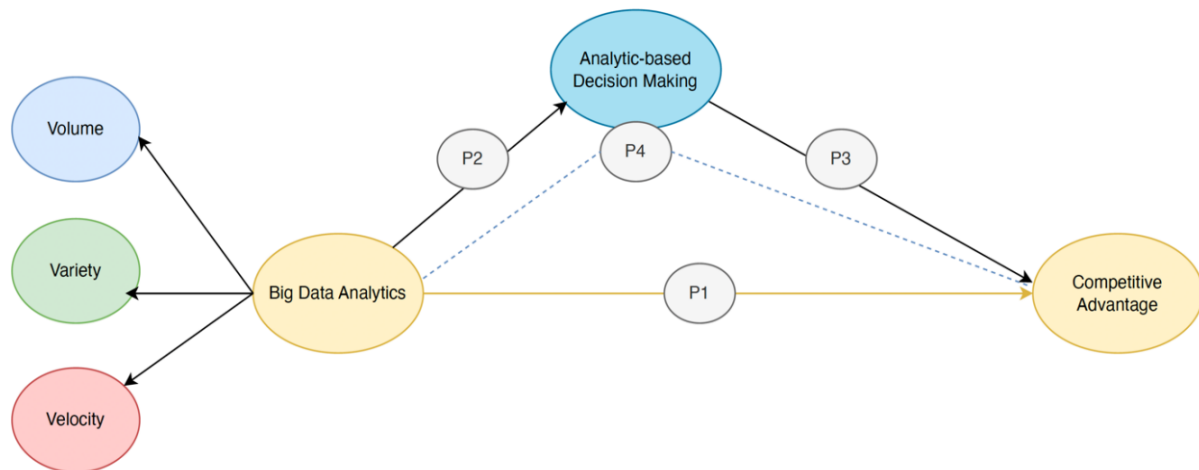

Figure 2: Conceptual Framework

METHODOLOGY

Marczyk et al. (2010) defines research design as a strategy to address a study's central purpose. Quantitative research is used to explore relationships between variables and describe trends, with statistical tools employed to measure them (Creswell & Poth, 2017). Given the study's focus, a quantitative approach will be used to examine the relationships between the variables. This method is chosen for its accuracy in measurement (Connelly, 2008), alignment with a deductive approach, and suitability for hypothesis testing and broader populations. The quantitative method also helps control bias, allowing for generalisable and replicable findings (Polit & Beck, 2010). Quantitative research is used to explore the relationships between variables and describe trends, with statistical tools employed to measure them (Creswell & Poth, 2017). Given the study's focus, a quantitative approach will be used to examine the relationships between the variables. This method is chosen for its accuracy in measurement (Connelly, 2008), alignment with a deductive approach, and suitability for hypothesis testing and broader populations. The quantitative method also helps control bias, allowing for generalisable and replicable findings (Polit & Beck, 2010).

Sampling and Population

The study will target employees of private organisations in the UAE that utilise big data analytics to enhance efficiency. A stratified sampling technique will be employed to select respondents. Data will be collected through surveys, a widely recognised method in management and social sciences (Mohajan, 2018). According to Brenner and Igamberdiev (2021), surveys provide accurate statistical data, while Wennberg and Anderson (2020) highlight their practicality and time-saving benefits, particularly when collecting data from a large population.

Instruments and Measurements

The dependent variable, competitive advantage, will be measured using the scale from Xu et al. (2020), with a reliability coefficient of 0.92. Big data analytics, as the independent variable, will be measured using the scale by Cheng and Shiu (2023), covering the three Vs (volume, velocity, and variety), also with a reliability coefficient of 0.92. Analytics-based decision-making will be measured using the scale from Thirathon et al. (2017), with a reliability coefficient of 0.918. Respondents will use a 5-point Likert scale for competitive advantage and analytics-based decision-making, and a 7-point Likert scale for big data analytics.

Data Sorting and Analysis

SPSS version 28 will be used for initial data entry and descriptive statistics, including mean, standard deviation, frequency, and percentage, to profile respondents. To examine differences in participants' views, statistical summaries such as mean and standard deviation will be applied. For final data analysis, Smart PLS 3.2 will be employed. According to Duarte and Raposo (2009), PLS offers the advantage of assessing relationships between indicators and latent components, as well as constructs (structural model). PLS-SEM will be used to explore the relationships between competitive advantage and big data analytics in organisations, with SEM being the optimal method for evaluating the proposed model due to its ability to assess complex variable networks.

DISCUSSION

Academic and industry discussions on the competitive advantage of Big Data Analytics (BDA) have been extensive. This study, grounded in Resource-Based Theory (RBT), examines BDA's relationship with analytics-based decision-making (ABDM) and competitiveness. It supports the view that BDA contributes significantly to competitive advantage, with the volume, variety, and velocity of data providing organisations with unique resources to adapt to market trends (Mikalef & Krogstie, 2020; Zhang & Jin, 2023). In the UAE, organisations have leveraged BDA to enhance efficiency and integrate technology (Kadarisman et al., 2022), with findings highlighting that combining BDA with resources such as expertise and technology is crucial for gaining an edge (Shehadeh et al., 2023). BDA also facilitates customisation, boosting customer satisfaction by 35% and improving competitiveness (Jha et al., 2020).

ABDM mediates between BDA and competitive advantage, underscoring the importance of data-driven cultures. It enhances decision-making, operational effectiveness, and revenue growth (Pan & Zhang, 2021; Sharma et al., 2023). However, organisational readiness and cognitive biases can hinder the successful implementation of ABDM, highlighting the need for a data-driven culture (Hamzeh & Aburub, 2024). ABDM also aids organisational agility, enabling firms to adjust strategies in dynamic environments (Xie et al., 2022). Additionally, ABDM promotes ethical decision-making, ensuring transparency and accountability in data-driven processes (Acciarini et al., 2023). External factors, such as increased competition, pressure organisations to use superior data to maintain a competitive edge (Oesterreich et al., 2022). Predictive analytics can forecast market trends and optimise decision-making, while data-sharing platforms enhance innovation and value creation (Chenger & Pettigrew, 2023; Tabesh et al., 2019). Firms in competitive environments, such as the UAE, are more likely to adopt advanced BDA procedures to stay ahead (Mızrak, 2023). BDA also improves organisational resilience by enabling proactive responses to market shifts (Erevelles et al.,

2016). This adaptability is crucial for companies in the UAE, where rapid technological advancements require strategic foresight (Al Tawhidi & Bourini, 2024).

Practical and Future Implications

Practically, these findings suggest that companies should invest not only in BDA tools but also in developing their employees and organisational processes. Employees may require comprehensive training in data literacy and advanced analysis techniques (Grant, 1996). Additionally, cross-functional collaboration can facilitate the integration of BDA across departments, enhancing its impact on organisational goals (de Assis Santos & Marques, 2022). Collaboration with academic institutions and research organisations can further advance BDA capabilities, providing access to innovative ideas and improving strategic insight (Beier et al., 2020). The study's conceptual framework offers insights into the interplay between these constructs and their role in driving organisational success. Future research could explore the influence of contextual factors, such as industry characteristics and regulatory environments, on the effectiveness of BDA-driven strategies (Akter et al., 2020). While this study defines strategic BDA components, it also highlights areas for further investigation, such as the scalability of BDA systems, which can be costly for small and medium-sized enterprises. Research focused on cost-effective solutions for these businesses could enhance their competitive position. Moreover, the ethical implications of BDA warrant further exploration, particularly concerning data security and confidentiality. As companies increasingly rely on vast datasets, understanding how to balance BDA's benefits with ethical concerns will provide valuable insights for policymakers and practitioners.

CONCLUSION

This study aims to enhance the existing knowledge by exploring the strategic role of big data analytics (volume, variety, and velocity) in strengthening competitive advantage, with analytics-based decision-making as a mediating variable. It seeks to guide organisations in navigating the complexities of BDA adoption to achieve sustainable competitive superiority. The findings will offer valuable theoretical and practical insights. Using a resource-based theory perspective, this research enhances understanding of how BDA, through analytics-based decision-making, contributes to competitive advantage. The study lays a foundation for future research on sub-dimensional BDA, helping identify key elements for project managers to focus on when managing large datasets, ensuring successful outcomes. Ultimately, the research supports the view that extensive use of BDA significantly boosts organisational competitive advantage.

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