

A Critical Analysis of the Impact of Business Intelligence on the Competitive Advantage for Business in Trinidad and Tobago

Ginelle Gill

The University of Trinidad and Tobago
Email: ginelle.gill@utt.edu.tt

Laurice Phillips

Assistant Professor
The University of Trinidad and Tobago
Email: laurice.phillips@utt.edu.tt

Abstract

The business landscape is rapidly changing due to advances in technology, economic factors, societal transformations such as the COVID-19 epidemic, and fast-shortening product life cycles. These factors have made the business environment highly competitive. Therefore, businesses should acquire further sophisticated technologies to keep pace with competitive markets. As such, businesses should implement digital transformation strategies, particularly in the realm of business intelligence. The Republic of Trinidad and Tobago's current agenda aims to transition into a digital economy. Therefore, the deployment of business intelligence architecture is critical because businesses in Trinidad and Tobago face many obstacles resulting from insufficient, inaccurate, partial, or inadequate business intelligence strategies, processes, and technologies. These shortcomings make it difficult for businesses to acquire trustworthy customer information and to accurately predict future trends and behaviours; an equally significant, if not more significant, challenge that is crucial for data-driven decision-making and strategic planning. As a result, organisational process inefficiencies continue to exist, hindering competitive advantage and economic growth. To address this issue, this research employs a systematic literature review to examine existing literature, and collect, classify, evaluate, and combine ideas on business intelligence systems adoption, use, benefits, barriers, and their relation to competitive advantage. Drawing from studies published between 2017 and 2024, the review concludes that business intelligence enhances organisational productivity and decision-making, improving competitive edge. Barriers to business intelligence are organised by the Technology Organisation Environment Framework, illustrating technological and organisational as well as environmental concerns. Most importantly, the study identifies the absence of research concerning business intelligence adoption in Trinidad and Tobago, highlighting that this oversight may explain the slow adoption locally. Further research is needed to better understand the local business environment and its influence on the successful adoption of business intelligence.

Keywords: business intelligence, competitive advantage, Trinidad and Tobago

Ginelle Gill is an avid researcher and information professional at the University of Trinidad and Tobago (UTT), where she currently serves as a Senior Library Assistant, supporting students in accessing resources and navigating digital databases. She previously worked at UTT Procurement Department before transitioning to the library. Ginelle holds a Bachelor of Science in Information Technology from the University of Hertfordshire, a Master of Science in Innovation Manufacturing Management and Entrepreneurship from UTT and an Advance Diploma in Computer Science from the Association of Computer Professionals (ACP). She is currently pursuing a Doctor of Philosophy (PhD) in Information and Communication Technology, with research focus on the impact of business intelligence on competitive advantage for business in Trinidad and Tobago, exploring how organisations can leverage data driven insights to improve decision making, optimize performance, and maintain a competitive advantage.

Dr Laurice Phillips is an Assistant Professor in the Centre for Information & Communication Technology at The University of Trinidad and Tobago where he also serves as the Programme Leader for the Masters in ICT. Dr Phillips holds a BSc in Computer Science & Management, an MSc in Computer Science and a PhD in Computer Science from the University of the West Indies. Dr Phillips's doctoral research specialised in digital fingerprint classification where he was awarded local and international patents for a novel technique in digital fingerprint classification using Regular Expression Machine Learning through the University of the West Indies. Dr Phillips has over (20) years of teaching, research and professional experience in computer science and information & communication technology. His main areas of research include Digital Image Processing, Biometric Recognition and Machine Learning techniques.

Introduction

The World Health Organisation (WHO) 2024 declared the novel coronavirus (COVID-19) outbreak a global pandemic on March 11, 2020. As a result, all countries ceased activities, including Trinidad and Tobago (T&T). The then Prime Minister, Dr the Honourable Keith Christopher Rowley, introduced several policies and procedures to control the spread of the virus, which affected businesses and society and exposed several vulnerabilities within T&T society. These measures successfully lowered COVID-19 transmission; however, prolonged lockdowns negatively impacted productivity across all sectors, subsequently affecting T&T's economic growth. According to Review of the Economy 2021, "for the first quarter of 2021, the CSO estimates that real GDP at Basic prices also fell by 7.4 percent primarily as a result of a 9.5 percent contraction in Energy Sector activity" (Ministry of Finance, Trinidad and Tobago, 2021, p. 13). The twin-island Republic also experienced a decline in tourism revenue. Additionally, retrenchment notices and other indicators monitored by the Central Bank of Trinidad and Tobago (CBTT, 2021) suggest that labour market conditions remained constrained in 2021. As such, many individuals sought alternative sources to generate income.

T&T relies heavily on revenue from natural resources, oil and gas, and the energy sector to provide fiscal stability for the government (Ministry of Energy and Energy Industries, n.d.). However, the COVID-19 pandemic and recent global oil and gas market instabilities have revealed the country's economic vulnerability. The Media Institute of the Caribbean (2022) noted that the Prime Minister of T&T sought funding from financial institutions such as the “Development Bank of Latin America (CAF), the Inter-American Development Bank (IDB), and the World Bank (WB) to overcome these challenges.” This scenario emphasises the need for diversification and digital transformation to maintain economic stability.

In the fiscal 2020–2021 budget presentation, Finance Minister Colm Imbert highlighted that T&T was set to become a digital economy (Imbert, 2020). However, the specific strategies and initiatives for this transition were not clearly defined. On July 12, 2021, ‘Digital transformation’ was officially established as the Ministry of Digital Transformation (MDT), displaying the government's dedication to enhancing T&T's digital agenda. By separating digital transformation from the Ministry of Public Administration and forming a distinct ministry, the government demonstrated a strong commitment to promoting digital initiatives and using technology to improve governance, public services, and economic growth.

In the year 2023, the National Strategy for a Digital T&T: 2023–2026 was developed, which comprised five cross-cutting themes that focused on the digital society. The digital society encompasses not only the digital economy and related digital services but also e-government, regional linkages, and global networks. The MDT sought to improve the position of the country's digital technologies concerning the supply of goods and services to the market. This transition was expected to encourage T&T businesses to develop new strategies that would change the way consumers interact with businesses. This ministry also highlighted the significance of digital technology adoption after the COVID-19 pandemic. Similarly, research by Liu et al. (2022) concluded that the way to overcome the COVID-19 pandemic was through digital technology, such as business intelligence (BI). Currently, “it has become even more popular because it includes concepts like analytics, big data and artificial intelligence that form an integral part of digital transformation, an important concept for business executives in companies of all sizes and industries, also in the public sector” (Suša Vugec, Bosilj Vukšić, & Pejić Bach, 2020, p. 2).

The evolution of BI

The origin of BI can be traced back to the 1950s, when the concept emerged as a response to the increasing need for data-driven decision-making within an organisation (Omol et al., 2024). This concept laid the groundwork for BI, which involves collecting, storing, and analysing and then using information to act on sound decisions based on the situation at hand. Hans Peter Luhn, a scientist, wrote an article, "A Business Intelligence System," which first introduced the concept of

BI. He used it to describe an automatic method to provide current awareness services to scientists and engineers (Luhn, 1958).

Subsequently, several scholars have defined BI. According to Nyanga et al. (2019), BI is recognised as a set of technologies, tools, and software that allow a business to collect information, automate processes, and produce data that will be transformed into meaningful information used to make data-driven decisions. Ahmad et al. (2020) expanded this definition to include a framework that compiles, modifies, and displays structured information from diverse sources. These authors took a more comprehensive approach, extending the scope beyond technology to include decision support systems. In contrast, Majdijalalalsaaideh (2021, p.13044) emphasised that “BI ensures stronger return on investment (ROI), as businesses can significantly increase revenue, reduce costs, improve profit margins, drive cost avoidance, and so on.” Additionally, by enhancing strategic decision-making, BI can produce a competitive advantage, as noted by Ragazou et al. (2023). This aligns with Michael E. Porter’s foundational concept of competitive advantage, introduced in 1985, which states that competitive advantage “grows fundamentally from the value a firm is able to create” (Porter, 1985, p.3). According to Porter (1985), the key to achieving a competitive edge lies in a firm’s ability to deliver superior value to its customers. In this context, BI enhances competitive advantage by offering useful insights that help companies make better strategic decisions. Businesses may improve their value proposition, maximise operational efficiencies, and eventually outperform rivals in terms of profit margins by using BI to leverage data to drive data-driven decisions.

For this systematic literature review (SLR), the researcher focused on BI as it relates to competitive advantage. This focus was chosen because businesses in T&T encounter several challenges due to inadequate, inaccurate, partial, or poor BI strategies, procedures, and infrastructure. As a result, organisational process inefficiencies continue to exist, hindering competitive advantage and economic growth.

The Emergence of AI and Data Analytics in BI

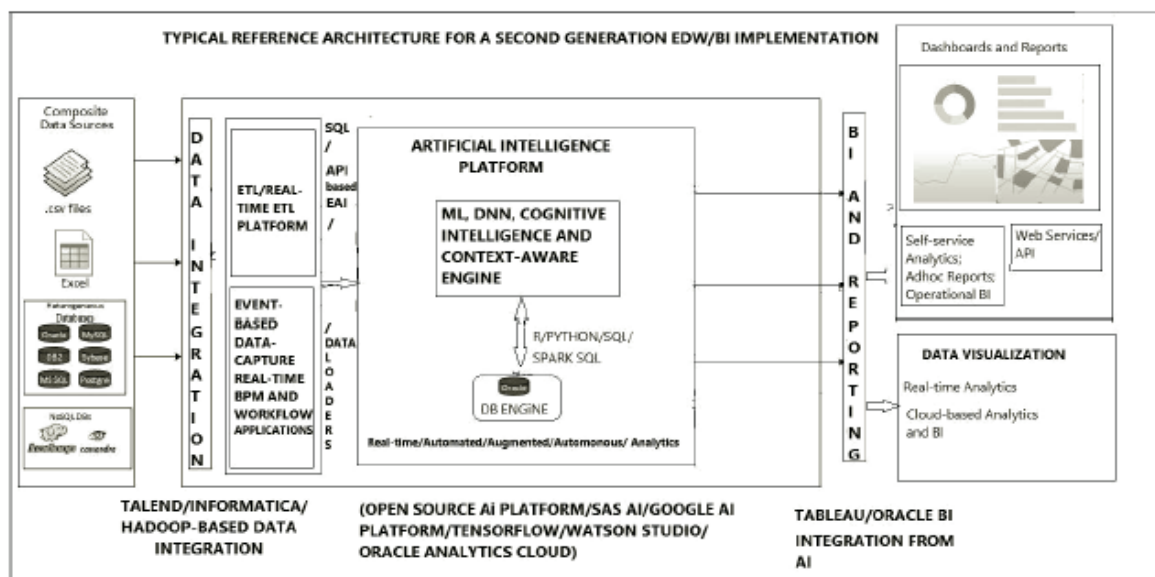
According to Bulusu and Abellera (2020), the first generation of BI was built on BI 1.0, which was mostly an OLAP-based solution that worked with relational data formats and used Extract, Transform, Load (ETL) to combine data. The Enterprise Data Warehouse (EDW) was designed using the STAR schema, which was relational as well and could be extended to Multidimensional Online Analytical Processing (MOLAP).

BI 2.0 incorporated analytics into the broader BI practice and data warehousing capabilities, as well as improvements to EDW and data additions. Furthermore, it advanced the idea of self-service BI analytics, where users could execute many BI processes independently and create their key performance indicators through ad hoc queries (Alghamdi & Al-Baity, 2022).

BI 3.0 represents the latest advancement, which involves the integration of big data technology and predictive analytics in BI, especially for decision-making (Chen et al., 2022). “This integration has led to the emergence of intelligent business analytics, a domain that combines traditional BI with the innovative capabilities of AI and big data” (Eboigbe et al., 2023, p.287). The introduction of AI technologies, coupled with machine learning, has taken BI to the next level with automation and high-level structuring, especially during the outbreaks of the COVID-19 disease (Jiménez-Partearroyo & Medina-López, 2024).

According to Zohuri and Moghaddam (2020), AI deals with many algorithms compared to the traditional BI approach. This comparison clarifies why AI is increasingly pivotal in data and business analysis, with its predictive capability surpassing all conventional BI tools at more complex structures. Figure 1, referenced in Bulusu and Abellera’s (2020) study, visually represents the integration of BI and AI. The advancement of BI is at the core of improving the performance of all other technologies and driving the progress of Industry 4.0 (Romero et al., 2021). This integration shows a shift from traditional BI methods to more advanced, AI-driven approaches that offer deeper insights and automation, as depicted in Figure 1.

Figure 1
Third-generation AI Meets BI Architecture.



Note. From: *AI meets BI: Artificial intelligence and business intelligence* (Bulusu & Abellera, 2020)

The article “Government AI Readiness Meta-Analysis for Latin America and the Caribbean” stated that “governments of developing countries continue to shift to more advanced digital platforms; they have adopted practices and policies that have a direct impact on the future of AI-based technology” (Montoya & Rivas, 2019, sec. Conclusion VI). Given T&T’s ongoing shift

towards advanced digital platforms, the policies and guidelines implemented by the MDT will soon affect the advancement and implementation of AI technologies.

Because of this integration, businesses can now make more informed decisions by utilising vast amounts of data. The advanced technologies utilised in intelligent business analytics in modern companies include advanced data processors, AI modules, and advanced data visualisation tools that enable a better understanding and perception of business operations (Eboigbe et al. 2023). In addition, Ragazou et al.'s (2023) study took the further approach of looking into the "BI scenarios" where the BI capabilities will grow at the same pace as the expectations and demands of consumers in the future. Therefore, businesses must improve their pace to remain competitive.

The evolution of "BI into AI-driven BI 3.0 enables the decision-making process to become more automated with the use of Machine Language (ML), Natural Language Processing (NLP), and many other technologies that facilitate analytical activities" (Bulusu & Abellera, 2020, as cited in Alghamdi & Al-Baity, 2022, p.4). This evolution, if harnessed correctly, will enable businesses in T&T to gain strategic insights and maintain a competitive edge in T&T's evolving digital landscape. In this context, this research explores and analyses the following topics: the impact of BI on the competitive advantage of businesses operating in T&T; the factors influencing the adoption of BI architecture in the business; challenges encountered during the adoption and implementation process; the perceived benefits of BI; and the relationship between BI and competitive advantage for companies within T&T's evolving digital business landscape. BI has progressed from traditional BI 1.0 to a more advanced version incorporating AI capabilities. BI 3.0 technologies enable businesses to use these innovations to maintain and enhance their competitive advantage in the modern marketplace.

If conducted effectively, this research will provide valuable insights into how companies can integrate BI with AI to improve their competitiveness during T&T's shift towards a digital economy, making it pertinent for policymakers, academics, and industry professionals. Moreover, in T&T, the president of the Trinidad and Tobago Manufacturing Association (TTMA) notes that there are already entities in T&T that have invested in AI and continue to reap the rewards with minimal human intervention (Kowlessar-Alonzo, 2023).

Research Aims

The main aim of this SLR is to analyse the impact of BI in achieving competitive advantage in T&T, taking into consideration the challenges and limitations associated with BI implementation. To ensure that the research objectives were met, the researchers framed the following research questions:

Research Question 1: What are the challenges and barriers to BI adoption?

Research Question 2: What are the advantages of adopting BI in the local business context?

Research Question 3: How does the effective use of BI improve competitive advantage within specific sectors?

Rationale for the Study

The rationale for conducting this SLR is to examine more closely the critical factors impacting business competitiveness and their relation to economic stability as T&T navigates towards a digital economy.

Literature Review

BI Tools

A BI architecture is a framework for arranging data, information management, and technological components to build BI systems for reporting and data analytics (Djerdjouri, 2020). BI comprises six components:

1. OLAP (On-line Analytical Processing): It pertains to the methods business users employ to analyse data using advanced tools, facilitating the exploration of dimensions like time or hierarchies.
2. Advanced Analytics: This involves data mining, forecasting, or predictive analytics, utilising statistical analysis techniques to predict or provide certainty measures on facts.
3. Corporate Performance Management (Portals, Scorecards, Dashboards): This typically provides a framework for various components to integrate and collectively narrate a story.
4. Real-time BI: This enables the real-time distribution of metrics through emails, messaging systems, and interactive displays.
5. Data Warehouse and Data Marts: The data warehouse acts as a centralised repository where large amounts of data from multiple sources within an organisation are stored. It is a strategic component that facilitates the collection, storage, and processing of large volumes of data, which in turn allows for detailed analysis and more informed decision-making in organisations, essential for BI, aiding in the physical transmission of data for integration, cleansing, aggregation, and query tasks. Data marts store historical operational data for trend analysis and strategy formulation.
6. Data Sources: These may include diverse data types, such as operational, historical, and external data from market research or existing data warehouse environments (Jiménez-Partearroyo & Medina-López, 2024).

In T&T, unfortunately, there are still many gaps in published academic literature on BI adoption and implementation. These gaps present an opportunity for future research to explore how various sectors—such as manufacturing, tourism, energy, agriculture, and services can effectively adopt and implement BI systems. Exploring these factors can provide a better understanding of the

challenges and opportunities for BI adoption, which is crucial and pertinent due to BI's strategic and competitive importance.

As such, further research is needed to gain a deeper understanding of how different sectors in T&T, such as manufacturing, energy, and service sectors, can adopt and implement BI, including challenges and barriers, and the correlation between BI and competitive advantage in the local business context. The results may clarify opportunities and specific issues for each industry. Questionnaires or case studies can be helpful when it comes to venturing into the businesses in T&T supporting data warehousing and BI, and why.

Global Market Insights (2019) noted an expected over 12% compound annual growth rate (CAGR) between 2019 and 2025 growth in the global data warehousing market. This highlights the increasing importance of data analytics, and BI is worth considering when discussing Trinidad and Tobago's (T&T) transformation agenda. This global trend highlights the growing importance of advanced data management and analytics, which can provide significant benefits and competitive advantages for T&T's businesses.

Advantages of Implementing Business Intelligence in a Business

Implementing BI systems in businesses has many advantages that markedly improve the efficiency of business operations, decision-making processes, and the business's competitive edge. By gathering, storing, and analysing data, BI systems enhance the ability of decision-makers (Nyanga et al., 2019). Furthermore, Khaddam's (2024) research demonstrates that businesses utilising BI tools are better equipped to make strategic decisions of superior quality, as BI facilitates the identification and capitalisation of new opportunities while monitoring existing capabilities.

Another critical benefit of BI is its capacity to fuel creativity and the sharing of knowledge across the organisation. Research conducted by Kusmantini et al. (2021) indicates that BI motivates the engagement of employees' knowledge-sharing behaviours, which in turn benefits the organisation's capacity for innovation. Similarly, Eidizadeh et al. (2017) found that BI not only supports knowledge sharing but also directly contributes to gaining a competitive edge through enhanced innovation.

In addition, research conducted by Suša Vugec et al. (2020) noted that BI alignment has a significant and positive impact on organisational performance. With less time spent on data collection given to non-technical people, and more time balanced to 'intelligent interpretation', staff can focus on these important activities, thus creating strategies to help their organisations grow. This efficiency increases productivity and profit, thereby delivering a higher ROI, as noted by Majdijalalalaaideh (2021).

The positive effects of introducing BI systems in the organisation include better decision-making, solid strategic capabilities, high operational efficiency, and improved innovative ability thanks to

supportive knowledge sharing. Additionally, BI systems strengthen competitiveness and contribute significantly to success in today's highly competitive business environment (Chi & Mahmud, 2020).

Factors that influence the adoption of BI Implementation

The factors influencing the adoption of BI architecture in a business can be divided into three headings: organisational, technological, and environmental. These factors can hinder overall success, so understanding these challenges is crucial for organisations aiming to leverage BI for competitive advantage. Organisational readiness plays a role in BI acceptance. According to Ali et al. (2018), the effectiveness of BI implementation is heavily influenced by competencies like managerial expertise and technological resources, as well as the skills of personnel involved in the process. For instance, Hapsari et al. (2022) highlighted that the progress and acceptance of BI could face obstacles due to coordination and teamwork, between IT departments and business units. In addition, the lack of skills and training, especially among employees, remains a notable challenge to adopting BI.

The concept known as the Technology-Organisation-Environment (TOE) paradigm is frequently used to explore the impact of organisational preparedness on BI adoption, as outlined by (Ahmad et al., 2020). This framework considers how various factors such as organisation readiness, technology, and the environment influence BI adoption. Furthermore, how well business intelligence is integrated with the company's technological systems can either help or hinder its adoption. This depends on how compatible and interoperable the technologies are. Additionally, AI-driven BI 3.0 enables the decision-making process to become more automated with the use of Machine Language (ML), Natural Language Processing (NLP), and many other technologies that facilitate analytical activities" (Bulusu & Abellera, 2020, as cited in Alghamdi & Al-Baity, 2022). External forces such as compliance with policies and market dynamics influence the uptake rate of BI. Besides, the competitive landscape may propel firms to adopt BI solutions to remain competitive, as businesses strive for sustainability and market relevance (Ahmad et al., 2020). The rapid changes in the business environment that necessitate the analysis and reporting of data within a short duration also provide a way of understanding the need for BI systems.

Effectiveness of BI in Sustaining Competitive Advantage

Integrating BI into company operations promotes knowledge sharing while fostering innovation to improve decision-making processes and operational efficiency, thereby enabling a business to sustain and maintain a competitive advantage. As stated by Ragazou et al. (2023), the successful use of BI systems enables companies to enhance their strategic management decision-making capabilities and thus afford a strategic competitive advantage. This strategy has gained more attention in the competing business milieu, which has made organisations regard BI technologies as a performance improvement strategy and a strategy for legal or policy tolerance (Suša Vugec et al., 2020).

The dynamic relationship between BI sharing knowledge within an organisation and facilitating innovation is important, if not critical, in attempting to maintain an advantage (Kusmantini et al., 2021). BI systems allow knowledge to be accumulated and enable more energy devoted to innovation for the company's benefit. Comprehending the means through which BI systems promote these behaviours as well as tackling the implementation challenges will present more insights regarding the competitive advantage offered by such systems.

Methodology

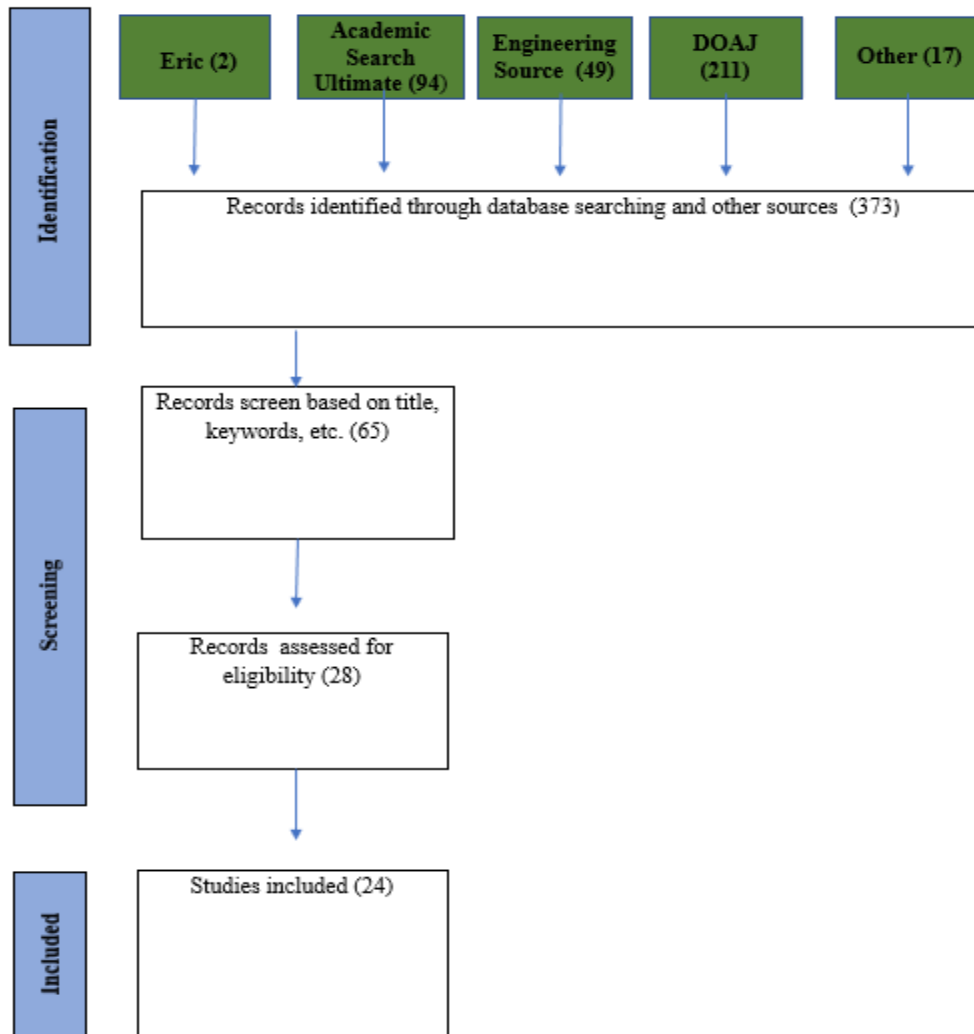
The research used a SLR following Xiao and Watson's (2017) guidelines. This method analyses and synthesises existing research on the topic and involves systematically searching for relevant articles, critically assessing their content, and identifying key themes and trends in the literature. The process typically includes the selection of articles based on specific criteria, such as publication date or relevance to the research questions. The identified articles are then analysed to extract themes and subthemes that represent the main findings and perspectives in the field. This review provides a comprehensive and organised overview of the existing literature, allowing researchers to identify research gaps, propose future research directions, and provide theoretical and practical implications.

Search Strategy

The researchers conducted the SLR using both manual and automatic search techniques. For the automated search, the University of Trinidad and Tobago (UTT) has one search engine across databases, including Academic Search Ultimate, Engineering Source, Education Resources Information Centre (ERIC), and Directory of Open Access Journals (DOAJ). The search queries included keywords such as "BI" and "competitive advantage," focusing on identifying articles that significantly contribute to BI concepts, trends, and the interplay between BI and competitive advantage.

During the study, the researchers used articles published from 2017 to 2024, and added some literature dating further back to those that establish the basis for BI and competitive advantage. Additionally, two textbooks were utilised which provide foundational knowledge on BI generations and concept competitive advantage. The researchers also examined reference lists (bibliographies) of relevant articles to find other sources relevant to the objectives of this research. The flow diagram in Figure 2 depicts the search strategy used by the author to address the research questions posed in this study.

Figure 2
Search Strategy



Selection Criteria

The carefully chosen articles provide data that are considered substantial enough for inclusion in the review. As such, the research established four inclusion criteria (IC) as detailed in Table 1 below:

Table 1

Inclusion Criteria

Criterion	Description
IC 1	Only peer-reviewed journal articles, book chapters, and conference materials published in reputable sources were included.
IC 2	The articles must be in PDF format to ensure accessibility and ease of use during the review process.
IC 3	The articles must explicitly discuss the concept of BI and its related terms.
IC 4	The study must be published in the English language and retrieved from recognised online databases.

In addition, any articles unrelated to BI concepts, BI advantages, disadvantages, and competitive advantages were excluded from the review. The search engine automatically removed duplicated articles from the same study.

Quality Assessment

After determining the inclusion and exclusion criteria, assessing the quality of the primary studies was considered a crucial step (Kitchenham, 2004). The assessment objective was to evaluate the overall quality of the selected studies used for guiding the interpretation of the findings and determine the strength of the inferences of the selected studies. The following quality assessment questions were used, as detailed in the table 2 below:

Table 2

Quality Assessment

Assessment Question	Description
QA1	Are the research topics addressed in the paper directly related to BI?
QA2	Does the context of the study pertain to businesses?
QA3	Does the study relate to competitive advantage concepts?

Data Extraction and Synthesis

The research used the headings author, year of publication, country, journal source, title, aim, objective, and methodology to arrange the retrieved data. The articles were systematically sorted, allowing for easy reference. The next phase involved analysing and synthesising the collected data to ensure accuracy and consistency in data entry, enabling a thorough analysis of the primary studies.

Systematic Literature Review Results

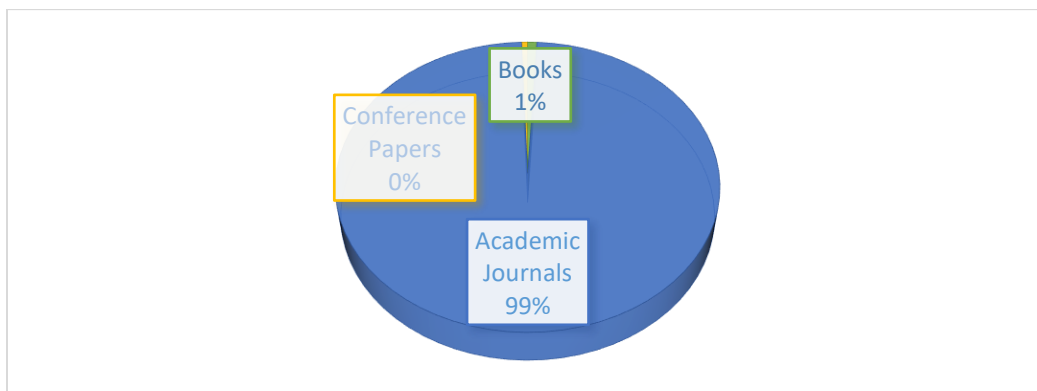
To give a thorough overview of the research landscape, the researchers must complete the statistical findings section of the SLR. This section consists of temporal reviews, citation status, publication sources, and conclusions. These are important parts of this analysis that help clarify the field's history, significance, and potential future directions.

Publication Source

The primary studies analysed by the researchers are published in academic journals, reflecting the prevalent practice of disseminating research findings through peer-reviewed journal articles, which ensures that the research meets high standards of quality and credibility. In contrast, fewer studies were sourced from conference materials and books. Figure 3 presents a pie chart showing the distribution of the primary studies based on the sources of their publications.

Figure 3

Distribution per Publication Source



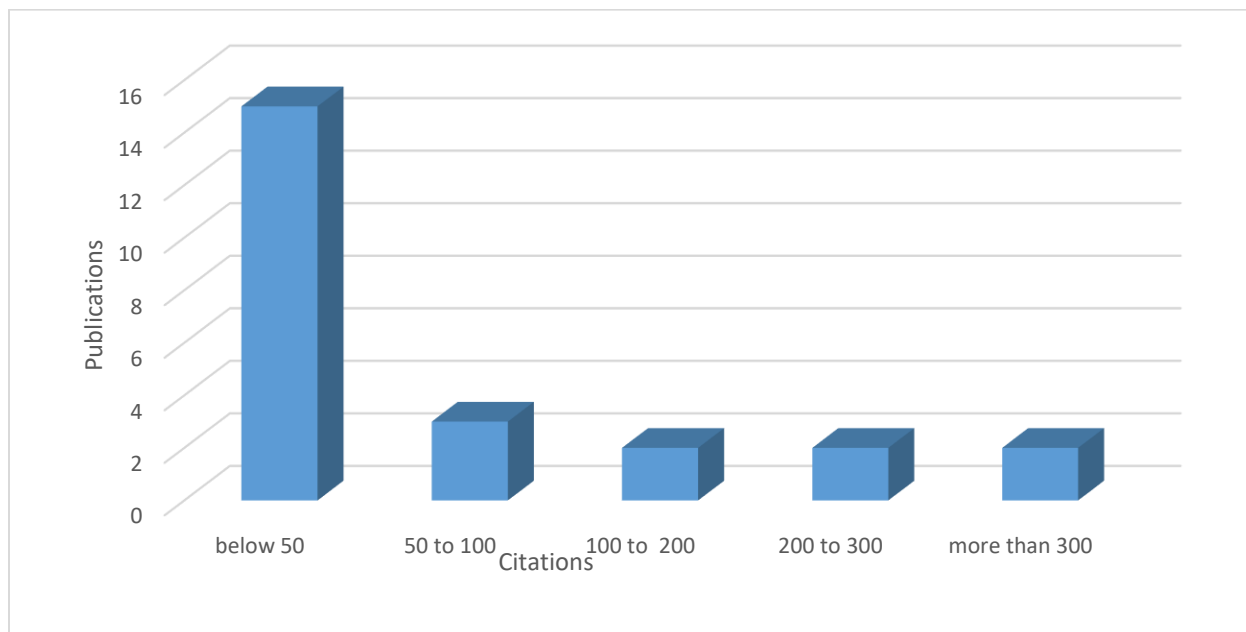
Citation Status

Figure 4 presents a bar graph that displays the number of citations for the chosen publications, which were obtained using Google Scholar. The findings revealed that other academic publications mentioned the reviewed journal, which suggests that these findings have influenced scholarly conversation and have been referenced in subsequent research. Among the articles included in the dataset, the following publications stand out for their particularly high citation counts and significant impact in the field of BI.

1. A Business Intelligence System
2. Analysing the Role of Business Intelligence, Knowledge Sharing, and Organisational Innovation on Gaining Competitive Advantage
3. Towards a Sustainable Textile and Apparel Industry: Exploring the Role of Business Intelligence Systems in the Era of Industry 4.0
4. Business Intelligence: Business Evolution After Industry 4.0

This figure illustrates the total number of citation counts received by each publication included in the study. Variations in citation counts reflect the scholarly impact of each publication, with some studies receiving higher citations due to factors like publication year, and topic relevance.

Figure 4.
Citation Count



Temporal Reviews

Figure 5 shows the distribution of the final set of selected studies over the years, offering valuable insights into the temporal evolution of research activity in this field. The data reveal several notable trends and fluctuations. Based on the analysis, the year 1958 represents a foundational moment, possibly marking the inception of formal academic inquiry into this domain. There is a noticeable increase in the number of studies carried out in 2019 and 2020. This surge can be a result of factors such as the rapid advances in technology spurred by the COVID-19 pandemic, which accelerated the adoption of digital tools and methodologies across disciplines.

Figure 5

Distribution of the primary studies throughout the years

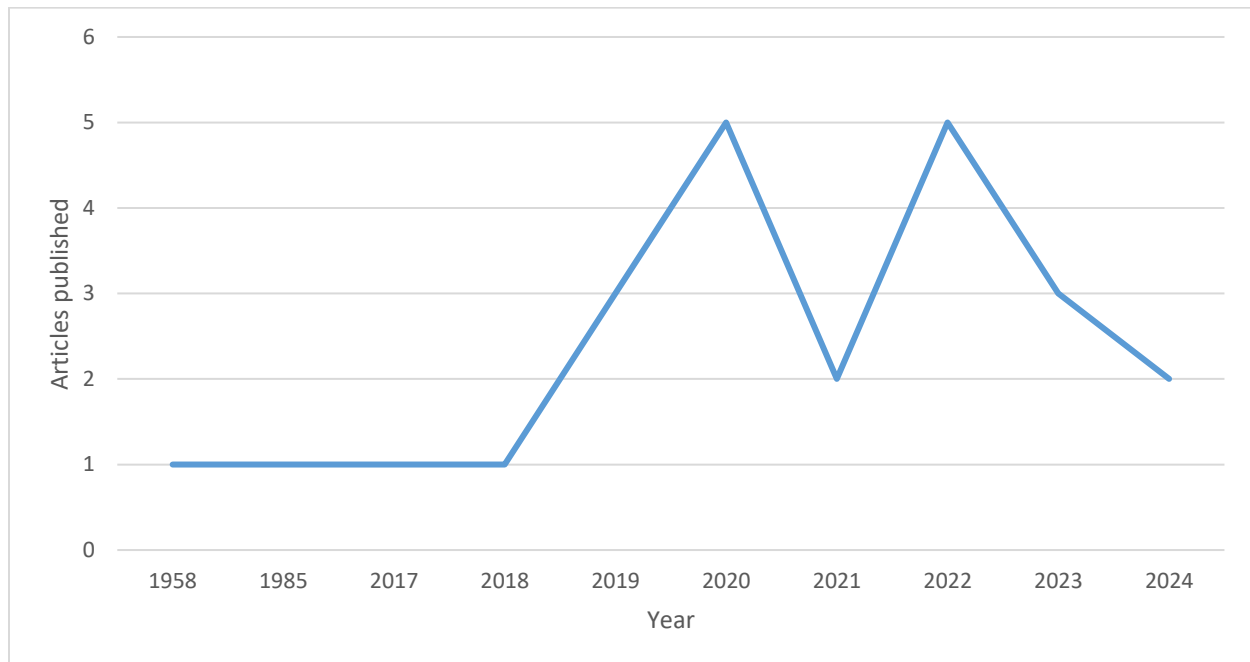


Figure 5 shows the number of primary studies included, highlighting trends in research activity and offering a visual representation of how research activity in the field has evolved over time.

Conclusion

This paper investigated existing literature to classify, evaluate, and combine ideas on business intelligence systems, benefits, barriers, and the relation between business intelligence and competitive advantage. The paper provides an overview of the publications on business intelligence and competitive advantage through a systematic literature review using studies published between 2017 and 2024. The literature suggests that business intelligence enhances the efficiency of business operations and decision-making processes, thereby enhancing competitive advantage. Conversely, the Technology- Organisation- Environment framework aligns with the three categories of technological, organisational, and environmental barriers.

Most importantly, the results yielded during the search strategy revealed a clear gap and absence of research literature on business intelligence adoption in Trinidad and Tobago, thus it can be inferred that it may be a major contributing factor to the slow adoption of business in Trinidad and Tobago. As such, it is necessary for additional research to be carried out to have a deeper understanding of the local business environment and its impact on business intelligence adoption.

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