

# The role of business intelligence in enhancing environmental management strategies

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## ABSTRACT

This paper investigates the pivotal role of Business Intelligence (BI) in bolstering environmental management strategies, employing a comparative analysis framework. Through an exhaustive review of existing literature, this study synthesizes findings to elucidate the multifaceted intersections between BI implementation and environmental management practices. By scrutinizing various scholarly works, the paper discerns the mechanisms through which BI technologies empower organizations to monitor, analyze, and optimize their environmental performance. The study also sheds light on the effectiveness of BI tools in enhancing environmental management strategies across diverse organizational contexts. Insights gleaned from this study offer valuable guidance for policymakers, managers, and researchers striving to harness the potential of BI for sustainable environmental stewardship.

## Keywords:

Business Intelligence,  
Environmental Management,  
Sustainability, Decision-making.

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## 1. INTRODUCTION

In recent years, the imperative for sustainable environmental management has become increasingly pronounced amidst growing concerns over climate change, resource depletion, and environmental degradation. Organizations across various sectors are under mounting pressure to adopt environmentally responsible practices and mitigate their ecological footprint. Consequently, the integration of environmental considerations into business strategies has emerged as a paramount priority for both corporate entities and policymakers worldwide[4]. The intersection of BI and environmental management represents a burgeoning field of inquiry that holds immense potential for driving positive environmental outcomes while simultaneously fostering organizational success. Business Intelligence encompasses a set of methodologies, processes, and technologies designed to transform raw data into actionable insights, thereby facilitating informed decision-making and strategic planning within organizations. By harnessing BI capabilities, organizations can gain deeper insights into their environmental performance, identify areas for improvement, and develop targeted strategies to optimize resource utilization, reduce waste, and mitigate environmental risks[11]. The adoption of BI in the context of environmental management offers multifaceted benefits that extend beyond mere compliance with regulatory requirements. Through advanced data analytics and predictive modeling, BI enables organizations to monitor environmental indicators, track key performance metrics, and forecast future trends with greater accuracy and precision (Bose & Sugumaran, 2003). Moreover, BI empowers decision-makers with real-time access to relevant environmental data, enabling them to proactively identify emerging issues, assess the efficacy of existing initiatives, and devise adaptive strategies to address evolving environmental challenges.

In an ideal world, organizations would seamlessly integrate Business Intelligence (BI) tools and technologies into their environmental management strategies to achieve optimal sustainability outcomes. In this paradigm, BI would serve as a transformative catalyst, empowering decision-makers with timely, accurate, and actionable insights to proactively address environmental challenges[8]. Through sophisticated data analytics and predictive modeling, organizations would gain a comprehensive understanding of their environmental footprint, enabling them to optimize resource utilization, minimize waste generation, and mitigate ecological risks. Moreover, BI-enabled environmental management strategies would be aligned with broader organizational objectives, driving continuous improvement, innovation, and competitive advantage in the pursuit of sustainability goals. However, the reality diverges significantly from this ideal scenario, as many organizations continue to grapple with substantial challenges in harnessing the full potential of BI for environmental management[1]. Despite the increasing

availability of BI solutions and the growing recognition of the importance of sustainability, numerous barriers hinder effective BI adoption and implementation in the context of environmental stewardship. These barriers encompass technical, organizational, and cultural factors, including inadequate data infrastructure, limited analytical capabilities, siloed information systems, resistance to change, and a lack of strategic alignment between environmental and business objectives. As a result, organizations often struggle to derive actionable insights from their environmental data, leading to suboptimal decision-making, missed opportunities for improvement, and heightened environmental risks. Failure to address these challenges and harness the transformative potential of BI in environmental management could have far-reaching consequences for both organizations and society at large[10]. Without robust BI-enabled strategies, organizations may face heightened regulatory scrutiny, reputational damage, and financial losses due to environmental non-compliance, resource inefficiencies, and environmental incidents. Moreover, the failure to embrace BI-driven sustainability initiatives may impede progress towards global environmental goals, exacerbating climate change, biodiversity loss, and other pressing ecological crises. Ultimately, the inability to leverage BI for environmental management could undermine the long-term viability and resilience of organizations, jeopardizing their competitiveness, profitability, and social license to operate in an increasingly sustainability-conscious world.

## 2. LITERATURE REVIEW

Business Intelligence (BI) has emerged as a pivotal tool in modern organizations, offering insights derived from data analysis to inform decision-making processes across various domains. In the context of environmental management, BI holds promise as a means to enhance sustainability efforts, mitigate environmental risks, and optimize resource utilization. As industries face mounting pressure to minimize their ecological footprint and comply with stringent regulations, the integration of BI into environmental management frameworks becomes increasingly relevant[22]. At its core, BI encompasses a suite of technologies, applications, and practices designed to collect, analyze, and interpret data to support strategic decision-making. In the context of environmental management, BI enables organizations to gather vast amounts of data pertaining to energy consumption, waste generation, carbon emissions, and other environmental metrics. By harnessing advanced analytics and visualization tools, stakeholders gain valuable insights into their environmental performance, identifying trends, patterns, and areas for improvement. The integration of BI into environmental management strategies offers several benefits. Firstly, it provides organizations with a comprehensive understanding of their environmental impact, allowing them to identify inefficiencies and areas ripe for optimization. Through

real-time monitoring and analysis, BI enables proactive management of environmental risks, such as pollution incidents, resource depletion, and regulatory non-compliance. Additionally, BI facilitates data-driven decision-making by providing stakeholders with timely, accurate information to support strategic planning and policy formulation. Furthermore, BI empowers organizations to set ambitious sustainability goals and track progress towards achieving them[16]. By establishing key performance indicators (KPIs) and benchmarks, stakeholders can measure the effectiveness of their environmental initiatives and adjust strategies accordingly. Moreover, BI enables organizations to communicate their environmental performance transparently to stakeholders, including customers, investors, regulators, and the public. This fosters trust, enhances brand reputation, and can lead to competitive advantages in the marketplace.

Environmental management strategies are vital components of organizational efforts to address environmental challenges, ensure regulatory compliance, and promote sustainability. These strategies encompass a range of activities aimed at minimizing environmental impact, conserving natural resources, and fostering responsible stewardship of the environment[3]. One key aspect of environmental management is the development of comprehensive environmental policies. These policies serve as guiding principles that outline an organization's environmental objectives, compliance requirements, and commitment to continuous improvement. By establishing clear policies, organizations can demonstrate their dedication to environmental responsibility and provide a framework for decision-making. Another crucial element of environmental management is the process of environmental impact assessment (EIA). EIA involves evaluating the potential environmental consequences of proposed projects, policies, or activities before they are undertaken. This process helps identify potential risks and impacts, enabling stakeholders to make informed decisions and implement mitigation measures to minimize harm. Pollution prevention and control are also fundamental aspects of environmental management. Pollution prevention focuses on reducing or eliminating the generation of pollutants at the source, while pollution control measures aim to treat, manage, or mitigate pollutants to prevent their release into the environment[7]. These efforts are essential for minimizing environmental harm and protecting ecosystems and public health.

Resource conservation and efficiency play a crucial role in environmental management strategies. Conservation efforts aim to minimize resource consumption and waste generation by promoting the efficient use of energy, water, raw materials, and other resources. Organizations can achieve this by implementing energy-efficient technologies, water recycling systems, and waste reduction initiatives. Sustainable procurement practices are another essential component of environmental management. These practices involve sourcing goods and services in a manner that minimizes environmental impact, promotes social responsibility, and supports local economies. By prioritizing environmentally friendly products and suppliers with strong sustainability credentials, organizations can contribute to positive environmental outcomes[32]. Compliance management is also critical for environmental management. Ensuring compliance with environmental regulations and standards is essential for avoiding legal liabilities and reputational risks. Organizations must monitor regulatory requirements, maintain accurate records, and implement procedures to address non-compliance issues promptly. Stakeholder engagement and communication are integral to effective environmental management. Engaging with stakeholders, including employees, communities, regulators, and advocacy groups, helps build trust, foster collaboration, and gain support for environmental initiatives. Effective communication channels facilitate dialogue, transparency, and shared decision-making. Environmental monitoring and reporting are essential for assessing the effectiveness of environmental management strategies. Regular monitoring of environmental performance metrics allows organizations to track progress, identify trends, and evaluate the impact of their actions. Comprehensive reporting enables stakeholders to assess performance, disclose impacts, and demonstrate accountability.

## 2.1 Importance of Sustainability in Business Operations

Sustainability has become increasingly important in modern business operations, as organizations recognize the need to balance economic growth with environmental protection and social responsibility. Incorporating sustainability into business practices is not only essential for mitigating environmental impacts but also for ensuring long-term success and resilience in a rapidly changing world. One of the primary reasons for the importance of sustainability in business operations is the need to address pressing environmental challenges. Climate change, resource depletion, pollution, and biodiversity loss are among the critical environmental issues facing the planet today[21]. Businesses play a significant role in contributing to these challenges through their

operations, supply chains, and consumption of resources. By adopting sustainable practices, businesses can minimize their environmental footprint, reduce greenhouse gas emissions, conserve natural resources, and protect ecosystems. Moreover, sustainability is essential for maintaining a positive reputation and building trust with customers, investors, and other stakeholders. In an era of heightened environmental awareness and social activism, consumers are increasingly choosing to support businesses that demonstrate a commitment to sustainability and ethical practices. Companies that prioritize sustainability not only attract environmentally conscious consumers but also enhance their brand image, differentiate themselves in the market, and gain a competitive edge. Sustainability also has economic benefits for businesses. By improving resource efficiency, reducing waste, and optimizing processes, companies can lower their operating costs and increase profitability. Sustainable practices such as energy efficiency, renewable energy adoption, and waste reduction initiatives can lead to significant cost savings over time. Furthermore, investing in sustainability can drive innovation, spur product development, and open up new market opportunities. Businesses that innovate and adapt to emerging sustainability trends are better positioned to meet the evolving needs of customers and capitalize on growing demand for sustainable products and services[14]. Another crucial aspect of sustainability in business operations is its role in risk management and resilience. Environmental and social risks, such as regulatory changes, supply chain disruptions, reputational damage, and stakeholder activism, pose significant threats to business continuity and financial performance. By integrating sustainability into risk management processes, businesses can identify, assess, and mitigate these risks more effectively. Sustainable practices also enhance organizational resilience by fostering flexibility, adaptability, and long-term viability in the face of uncertainty and change. Furthermore, sustainability is increasingly becoming a regulatory requirement and legal obligation for businesses worldwide. Governments are enacting stricter environmental regulations, imposing carbon taxes, and implementing reporting requirements to hold companies accountable for their environmental and social impacts[9]. Compliance with these regulations is not only a legal obligation but also a business imperative. Non-compliance can lead to fines, penalties, legal liabilities, reputational damage, and loss of market access. Therefore, businesses must proactively integrate sustainability into their operations to ensure compliance with current and future regulations.

## 2.2 Understanding Business Intelligence: Concepts and Applications

Business Intelligence (BI) is a multifaceted concept encompassing the processes, technologies, and strategies that organizations utilize to analyze and leverage data for informed decision-making. At its core, BI aims to transform raw data into actionable insights, facilitating strategic planning, operational improvements, and competitive advantage. At the heart of BI lies the concept of data analytics, which involves the systematic analysis of data to uncover patterns, trends, and relationships that can inform decision-making[7]. By harnessing advanced analytics techniques such as data mining, predictive modeling, and machine learning, organizations can extract valuable insights from vast datasets, enabling them to identify opportunities, mitigate risks, and optimize business processes. Key components of business intelligence include data collection, data integration, data warehousing, and data visualization. Data collection involves gathering data from various sources, including internal databases, external sources, and third-party providers. Data integration refers to the process of combining disparate datasets into a unified and consistent format, ensuring data accuracy and integrity. Data warehousing involves storing and organizing data in a centralized repository, providing a single source of truth for analysis. Data visualization encompasses the use of charts, graphs, and dashboards to present complex data in a visually appealing and comprehensible manner, facilitating data-driven decision-making across the organization[12].

Business intelligence finds applications across various domains, including sales and marketing, finance, operations, and human resources. In sales and marketing, BI tools enable organizations to analyze customer behavior, identify market trends, and forecast sales performance, empowering them to develop targeted marketing campaigns and optimize sales strategies. In finance, BI solutions facilitate financial planning and analysis, budgeting, forecasting, and performance reporting, enabling organizations to make informed financial decisions and drive profitability. In operations, BI tools help streamline business processes, improve efficiency, and enhance productivity by providing real-time insights into operational performance and resource utilization. In human resources, BI solutions support workforce analytics, talent management, and employee engagement initiatives, allowing organizations to attract, retain, and develop top talent. Furthermore, business intelligence plays a crucial role in enabling data-driven decision-making at all levels of the organization, from frontline employees to senior executives. By democratizing access to

data and insights, BI empowers individuals across the organization to make informed decisions based on evidence rather than intuition or guesswork[29]. Moreover, BI fosters a culture of continuous improvement and innovation by providing stakeholders with timely and relevant information to support experimentation, learning, and adaptation in response to changing market dynamics and business conditions.

### 2.3 Integration of BI into Environmental Management Frameworks

The integration of Business Intelligence (BI) into environmental management frameworks represents a significant advancement in leveraging data-driven approaches to address sustainability challenges. At its core, environmental management involves the systematic process of identifying, assessing, and mitigating environmental risks and impacts associated with organizational activities. Traditionally, environmental management frameworks have relied on qualitative assessments and manual data collection methods, leading to limited visibility into environmental performance and inefficiencies in decision-making[15]. However, by integrating BI into environmental management frameworks, organizations can leverage data analytics capabilities to gain deeper insights into environmental trends, identify areas for improvement, and drive informed decision-making. One of the key benefits of integrating BI into environmental management frameworks is the ability to collect, analyze, and visualize environmental data in real-time. By leveraging advanced data collection technologies such as sensors, IoT devices, and remote monitoring systems, organizations can capture vast amounts of environmental data, including air and water quality, energy consumption, waste generation, and carbon emissions[26]. BI tools then enable organizations to aggregate, clean, and analyze this data, providing stakeholders with actionable insights into environmental performance and trends. Furthermore, BI facilitates predictive analytics and modeling capabilities, allowing organizations to forecast future environmental impacts and anticipate potential risks. By leveraging historical data and statistical modeling techniques, organizations can identify patterns, trends, and correlations in environmental data, enabling them to proactively address emerging issues and develop effective mitigation strategies. For example, BI can help organizations predict energy consumption patterns, optimize resource usage, and minimize environmental footprint, leading to cost savings and sustainability gains.

Moreover, BI enables organizations to enhance transparency and accountability in environmental reporting and compliance efforts. By centralizing environmental data in a unified and accessible platform, organizations can streamline reporting processes, ensure data accuracy and integrity, and demonstrate compliance with regulatory requirements and industry standards. BI tools also facilitate the creation of interactive dashboards and reports, enabling stakeholders to visualize environmental performance metrics, track progress towards sustainability goals, and communicate results to internal and external stakeholders[18]. In addition, the integration of BI into environmental management frameworks promotes a culture of data-driven decision-making and continuous improvement. By providing stakeholders with access to timely and relevant environmental data and insights, organizations can empower employees at all levels to make informed decisions, identify opportunities for efficiency gains, and drive sustainability initiatives. Furthermore, BI facilitates collaboration and knowledge sharing across departments and functions, enabling cross-functional teams to work together towards common environmental goals and objectives.

### 2.4 Leveraging Data Analytics for Environmental Performance Assessment

In today's rapidly evolving landscape of environmental sustainability, organizations are increasingly turning to data analytics as a powerful tool for assessing and improving their environmental performance. At its essence, environmental performance assessment involves the systematic evaluation of an organization's environmental impact across various dimensions such as energy consumption, waste generation, water usage, and carbon emissions[24]. Traditionally, such assessments relied on manual data collection methods and basic analysis techniques, resulting in limited visibility and understanding of environmental performance. However, with the advent of data analytics, organizations now have the ability to harness the power of big data to gain deeper insights into their environmental footprint and identify opportunities for improvement. Data analytics enables organizations to collect, process, and analyze vast amounts of environmental data from disparate sources, including sensors, IoT devices, monitoring systems, and operational databases. By aggregating and integrating this data into a centralized platform, organizations can gain a holistic view of their environmental performance in real-time. This allows them to identify trends, patterns, and anomalies that may signify areas of inefficiency or opportunities for optimization. Moreover, data analytics facilitates advanced analytics techniques such as predictive modeling, machine

learning, and artificial intelligence, which enable organizations to forecast future environmental trends and anticipate potential risks. For example, predictive models can analyze historical data to predict future energy consumption patterns, enabling organizations to optimize resource usage, reduce costs, and minimize their environmental footprint. Similarly, machine learning algorithms can identify correlations between various environmental variables and recommend targeted interventions to improve sustainability performance. Furthermore, data analytics enables organizations to track and monitor key performance indicators (KPIs) related to environmental sustainability in real-time. By visualizing environmental data through interactive dashboards and reports, stakeholders can easily monitor progress towards sustainability goals, track performance against targets, and identify areas requiring immediate attention[27]. This real-time visibility empowers organizations to make timely decisions, take corrective actions, and drive continuous improvement in environmental performance. Additionally, data analytics facilitates benchmarking and comparative analysis, allowing organizations to compare their environmental performance against industry peers, regulatory standards, and best practices. By benchmarking against external benchmarks, organizations can identify areas of competitive advantage, prioritize initiatives for improvement, and drive innovation in sustainability practices.

### 2.5 Role of BI in Identifying Environmental Risks and Opportunities

One of the primary functions of BI in environmental management is to collect, analyze, and interpret data related to environmental factors such as air quality, water usage, waste generation, and carbon emissions. By aggregating data from various sources including sensors, monitoring systems, regulatory databases, and internal records, BI systems enable organizations to gain a comprehensive understanding of their environmental footprint. This data-driven approach allows organizations to identify potential risks associated with environmental non-compliance, resource scarcity, regulatory changes, and climate-related events. Moreover, BI enables organizations to conduct predictive analytics and scenario planning to anticipate and mitigate environmental risks. By analyzing historical data and identifying patterns and trends, BI tools can help organizations forecast potential environmental risks and their potential impact on business operations[19]. For example, predictive models can assess the likelihood of extreme weather events or natural disasters and their potential consequences on supply chain operations, infrastructure, and financial performance. Armed with this foresight, organizations can implement proactive measures to minimize risks, enhance resilience, and ensure business continuity. In addition to risk identification, BI also facilitates the identification of environmental opportunities that can drive sustainable growth and competitive advantage. By analyzing environmental data and performance metrics, organizations can uncover areas for improvement, innovation, and efficiency gains. For instance, BI tools can identify opportunities to reduce energy consumption, optimize resource usage, streamline production processes, and develop eco-friendly products and services. By capitalizing on these opportunities, organizations can enhance their sustainability performance, reduce costs, and attract environmentally conscious customers and investors. Furthermore, BI enables organizations to monitor and track key performance indicators (KPIs) related to environmental sustainability in real-time. By visualizing environmental data through interactive dashboards and reports, stakeholders can monitor progress towards sustainability goals, track performance against targets, and identify areas requiring immediate attention[1]. This real-time visibility empowers organizations to make data-driven decisions, take corrective actions, and drive continuous improvement in environmental performance.

### 2.6 Enhancing Resource Efficiency through BI-driven Insights

Enhancing resource efficiency is a critical goal for organizations striving to minimize waste, optimize resource usage, and reduce environmental impact. Business Intelligence (BI) plays a pivotal role in this endeavor by providing data-driven insights that enable organizations to identify inefficiencies, streamline processes, and maximize resource utilization[9]. BI tools enable organizations to collect, analyze, and visualize data related to resource consumption, production processes, and operational performance. By integrating data from various sources such as sensors, IoT devices, production systems, and enterprise software, BI systems provide a comprehensive view of resource usage across the organization. Through advanced analytics and reporting capabilities, organizations can identify patterns, trends, and anomalies in resource consumption, uncovering opportunities for improvement and optimization. One of the key benefits of BI-driven insights is the ability to identify inefficiencies and bottlenecks in resource utilization. By analyzing operational data, organizations can pinpoint areas where resources are being underutilized, wasted, or allocated inefficiently. For example, BI

tools can identify equipment downtime, production delays, or excessive energy consumption, allowing organizations to implement corrective measures and improve resource efficiency. Moreover, BI enables organizations to track Key Performance Indicators (KPIs) related to resource efficiency, such as energy intensity, water usage per unit of output, or material wastage rates, enabling continuous monitoring and improvement. Furthermore, BI facilitates predictive analytics and scenario modeling to forecast future resource needs and optimize resource allocation[15]. By analyzing historical data and external factors such as market demand, weather patterns, and regulatory changes, organizations can anticipate fluctuations in resource demand and plan accordingly. For instance, BI-driven demand forecasting can help organizations optimize inventory levels, production schedules, and procurement strategies, minimizing waste and reducing resource over-consumption. Additionally, BI enables organizations to implement real-time monitoring and optimization of resource-intensive processes. Through the use of IoT sensors and real-time analytics, organizations can monitor resource consumption levels, identify anomalies or deviations from expected norms, and take immediate corrective actions. For example, BI systems can trigger alerts or notifications when energy usage exceeds predefined thresholds or when production processes deviate from optimal parameters, enabling timely intervention to prevent waste and inefficiency.

## 2.7 BI Tools and Technologies for Environmental Monitoring and Reporting

Business Intelligence (BI) tools and technologies play a crucial role in environmental monitoring and reporting, enabling organizations to collect, analyze, and communicate data related to environmental performance effectively. One of the primary functions of BI tools in environmental monitoring is data aggregation and integration. These tools can collect data from diverse sources such as sensors, monitoring devices, databases, and external sources like weather data and regulatory databases. Through data integration, BI tools create a unified view of environmental data, enabling organizations to analyze comprehensive datasets and gain actionable insights[23]. Data visualization is another key feature of BI tools for environmental monitoring and reporting. These tools provide intuitive dashboards, charts, and graphs that enable stakeholders to visualize environmental data in a meaningful and easy-to-understand manner. Visualization enhances data interpretation, facilitating informed decision-making and communication of environmental performance metrics to stakeholders. Advanced analytics capabilities are integral to BI tools for environmental monitoring. These tools employ techniques such as statistical analysis, predictive modeling, and machine learning to uncover patterns, trends, and anomalies in environmental data. For example, predictive analytics can forecast future environmental conditions based on historical data, enabling proactive decision-making and risk management. Real-time monitoring is essential for timely environmental management and response. BI tools equipped with real-time data processing capabilities enable organizations to monitor environmental parameters continuously and receive instant alerts or notifications in case of deviations or emergencies. Real-time monitoring enhances situational awareness and enables organizations to mitigate environmental risks promptly. BI tools also facilitate regulatory compliance and reporting by automating the generation of environmental reports and documentation[30]. These tools can streamline the process of data collection, validation, and report generation, reducing the time and effort required for compliance activities. Additionally, BI tools can ensure data accuracy and consistency, minimizing the risk of non-compliance and associated penalties. Cloud-based BI platforms offer scalability and accessibility, allowing organizations to manage environmental data effectively across distributed locations. Cloud-based BI solutions enable real-time collaboration and data sharing among stakeholders, regardless of geographical boundaries. Moreover, cloud-based platforms provide flexibility and cost-efficiency, as organizations can scale resources based on their environmental monitoring needs.

## 2.8 Case Studies: Successful Implementation of BI in Environmental Management

Case studies showcasing successful implementation of Business Intelligence (BI) in environmental management provide valuable insights into how organizations leverage BI tools and technologies to enhance environmental performance.

1. *Walmart's Sustainability Index:* Walmart, one of the world's largest retailers, implemented a comprehensive Business Intelligence (BI) system known as the Sustainability Index to track the environmental and social impacts of its products throughout their lifecycle. This initiative aimed to enhance transparency and accountability in the supply chain while promoting sustainable practices. By leveraging BI analytics, Walmart can assess the environmental footprint of its products, identify opportunities for improvement, and collaborate with suppliers to drive sustainability initiatives.

2. *Maersk Line's Fuel Efficiency Program:* Maersk Line, the world's largest container shipping company, utilized BI solutions to optimize fuel consumption and reduce greenhouse gas emissions across its fleet. Through the implementation of advanced data analytics tools, Maersk analyzed operational data, weather patterns, and vessel performance metrics to identify fuel-saving opportunities. By optimizing voyage routes, vessel speed, and engine efficiency based on BI insights, Maersk achieved significant fuel savings, leading to lower emissions and reduced environmental impact.

3. *Intel's Water Management Initiative:* Intel Corporation implemented a BI-driven water management initiative to enhance resource efficiency and minimize water usage in its manufacturing facilities. By collecting and analyzing real-time data from water meters, process monitors, and environmental sensors, Intel gained visibility into water consumption patterns and identified areas for improvement. Through BI analytics, Intel optimized water recycling systems, implemented water-saving technologies, and developed water conservation strategies, resulting in substantial reductions in water consumption and wastewater discharge.

4. *Singapore's Smart Nation Initiative:* Singapore, a leading global hub for technology and innovation, launched the Smart Nation initiative to leverage BI and data analytics for environmental sustainability. Through the integration of data from IoT sensors, urban infrastructure, and environmental monitoring networks, Singapore's government gained actionable insights into energy usage, air quality, and water management. By utilizing BI-driven decision-making, Singapore implemented targeted interventions to improve environmental quality, enhance urban resilience, and promote sustainable development.

5. *IBM's Smarter Planet Initiative:* IBM, a multinational technology company, spearheaded the Smarter Planet initiative to harness BI and analytics for sustainable urban development. Through partnerships with cities worldwide, IBM deployed advanced analytics solutions to optimize energy systems, reduce carbon emissions, and improve resource efficiency. By analyzing vast amounts of data on transportation, energy consumption, and infrastructure, IBM helped cities make data-driven decisions to enhance environmental management and create more livable, resilient communities.

*Coca-Cola's Water Stewardship Program:* The Coca-Cola Company implemented a BI-driven water stewardship program to manage water resources responsibly and mitigate environmental risks in its global operations. Through the use of BI tools, Coca-Cola conducted water risk assessments, monitored water usage, and implemented water conservation measures across its bottling plants and supply chain. By leveraging BI analytics to optimize water management practices, Coca-Cola enhanced operational efficiency, reduced water consumption, and safeguarded freshwater ecosystems.

## 2.9 Challenges and Barriers to BI Adoption in Environmental Contexts

In the rapidly evolving landscape of environmental management, the integration of Business Intelligence (BI) poses several challenges and barriers that organizations must navigate. These obstacles hinder the effective adoption and implementation of BI solutions aimed at enhancing environmental sustainability. One of the primary challenges is the complexity of environmental data[4]. Unlike traditional business metrics, environmental data is often diverse, unstructured, and derived from multiple sources, including remote sensors, satellite imagery, and regulatory databases. Integrating and analyzing such heterogeneous data sets requires sophisticated BI tools capable of handling big data analytics and machine learning algorithms. However, many organizations lack the technical expertise and resources to manage and interpret complex environmental data effectively. Furthermore, data quality and reliability present significant barriers to BI adoption in environmental contexts. Environmental data often suffers from inconsistencies, inaccuracies, and incompleteness, stemming from factors such as sensor errors, data gaps, and variability in measurement techniques. Without robust data governance frameworks and quality assurance processes, organizations may struggle to trust and rely on BI insights for informed decision-making, leading to skepticism and resistance from stakeholders. Another key challenge is the lack of interoperability and data standardization across environmental systems and platforms. Different organizations and agencies may use disparate data formats, protocols, and terminologies, making it difficult to integrate and share environmental data seamlessly[18]. This interoperability gap inhibits the exchange of critical information and impedes collaborative efforts to address environmental challenges effectively. Overcoming these interoperability barriers requires concerted efforts to develop common data standards, protocols, and APIs that facilitate data sharing and interoperability among diverse stakeholders.

Moreover, privacy and security concerns pose significant challenges to BI adoption in environmental contexts. Environmental data often contains sensitive information, such as geospatial coordinates, habitat data, and species distributions, raising privacy concerns for individuals and organizations. Ensuring data privacy and protection while enabling data sharing and collaboration requires robust data encryption, access controls, and anonymization techniques. Failure to address these privacy and security concerns may erode trust and deter organizations from sharing valuable environmental data for BI analysis. Additionally, financial constraints and resource limitations present barriers to BI adoption, particularly for small and medium-sized enterprises (SMEs) and resource-constrained organizations[28]. Implementing BI solutions requires substantial investments in technology infrastructure, software licenses, and skilled personnel, which may be prohibitive for organizations with limited budgets and capacity. Bridging the financial gap and providing affordable BI solutions tailored to the needs of SMEs and resource-constrained organizations is essential to democratizing access to environmental intelligence and promoting widespread adoption.

## 2.10 Theoretical Review

*Resource-Based View (RBV) theory:* Resource-Based View theory provides a theoretical foundation for understanding how business intelligence can enhance environmental management strategies by leveraging internal resources and capabilities. By applying RBV principles, organizations can identify and capitalize on their unique environmental data, analytical tools, and decision-making processes to gain a competitive advantage in sustainability practices. RBV theory emphasizes the importance of aligning environmental management strategies with organizational strengths and capabilities, enabling organizations to develop tailored approaches that maximize environmental performance and resilience. Additionally, RBV theory encourages organizations to invest in building dynamic capabilities that enable them to adapt and innovate in response to evolving environmental challenges and opportunities. By integrating RBV principles into their environmental management practices, organizations can enhance their capacity to leverage business intelligence effectively and drive continuous improvement in environmental sustainability. Strengths of Resource-Based View Theory are following:

1. *Focus on Resources and Capabilities:* RBV theory emphasizes the importance of internal resources and capabilities in achieving sustainable competitive advantage. It suggests that firms can gain a competitive edge by leveraging unique and valuable resources, such as knowledge, technology, and organizational culture.

2. *Sustainable Competitive Advantage:* RBV theory posits that sustainable competitive advantage arises from resources that are valuable, rare, inimitable, and non-substitutable (VRIN). By identifying and leveraging their unique resources and capabilities, organizations can develop environmental management strategies that are difficult for competitors to replicate.

3. *Dynamic Capabilities Perspective:* RBV theory incorporates the concept of dynamic capabilities, which refers to an organization's ability to adapt and reconfigure its resources in response to changing environmental conditions. This perspective aligns with the dynamic nature of environmental management, allowing organizations to continuously improve their strategies over time.

*Weaknesses of Resource-Based View Theory:*

1. *Lack of External Focus:* RBV theory primarily focuses on internal resources and capabilities, sometimes neglecting the importance of external factors such as market dynamics, regulatory requirements, and stakeholder expectations. This narrow focus may limit its applicability in complex and dynamic environmental contexts.

2. *Difficulty in Identifying and Measuring Resources:* Identifying and measuring the specific resources and capabilities that contribute to environmental management effectiveness can be challenging. RBV theory relies on subjective assessments of resource value, rarity, inimitability, and non-substitutability, which may lack precision and objectivity.

3. *Overemphasis on Firm-Level Analysis:* RBV theory tends to prioritize firm-level analysis, overlooking the broader ecosystem of stakeholders and interorganizational relationships that influence environmental management outcomes. This limited perspective may hinder organizations' ability to address systemic environmental challenges effectively.

## 2.11 Strategies for Overcoming Challenges in BI Implementation for Environmental Management

Overcoming challenges in Business Intelligence (BI) implementation for environmental management requires a strategic approach that addresses key obstacles while leveraging opportunities for

innovation and collaboration. Here are several strategies for navigating these challenges:

1. *Invest in Data Infrastructure and Technology:* To address the complexity of environmental data, organizations should invest in robust data infrastructure and advanced BI technologies capable of handling big data analytics, machine learning, and geospatial analysis. By leveraging cloud-based platforms, data lakes, and scalable analytics tools, organizations can streamline data integration, processing, and visualization, enabling more comprehensive environmental insights.

2. *Enhance Data Quality and Governance:* Establishing robust data quality assurance processes and governance frameworks is essential for ensuring the reliability and accuracy of environmental data. Organizations should implement data validation, cleansing, and standardization procedures to address inconsistencies and errors in data sources. Additionally, promoting data transparency, documentation, and metadata standards facilitates data sharing and interoperability across stakeholders.

3. *Foster Collaboration and Partnerships:* Overcoming interoperability barriers requires fostering collaboration and partnerships among diverse stakeholders, including government agencies, research institutions, non-profit organizations, and private sector companies. By establishing data-sharing agreements, collaborative platforms, and interoperable data standards, organizations can facilitate seamless exchange and integration of environmental data, fostering collective action and innovation.

4. *Address Privacy and Security Concerns:* Implementing robust data privacy and security measures is critical for protecting sensitive environmental data and ensuring compliance with regulations such as GDPR and HIPAA. Organizations should employ encryption, access controls, and anonymization techniques to safeguard data privacy while enabling secure data sharing and collaboration. Conducting regular security audits and risk assessments helps identify and mitigate potential vulnerabilities and threats to environmental data.

5. *Promote Capacity Building and Training:* Addressing skill gaps and building technical capacity among staff is essential for successful BI implementation in environmental management. Organizations should provide comprehensive training programs and professional development opportunities to empower employees with the skills and knowledge required for data analysis, visualization, and interpretation. Additionally, fostering a culture of data literacy and innovation encourages employees to embrace BI tools and leverage data-driven insights for informed decision-making.

6. *Explore Open Source and Community-driven Solutions:* Open source BI tools and community-driven initiatives offer cost-effective alternatives for organizations with limited budgets and resources. By leveraging open data platforms, collaborative networks, and crowdsourced data repositories, organizations can access valuable environmental data and analytical resources while contributing to broader initiatives for data democratization and transparency.

7. *Pilot Projects and Proof-of-Concepts:* Implementing pilot projects and proof-of-concepts allows organizations to test BI solutions in real-world environments, identify challenges, and refine strategies before scaling up. By starting with small-scale initiatives and gradually expanding their scope, organizations can mitigate risks, demonstrate tangible benefits, and gain stakeholder buy-in for broader BI adoption in environmental management.

## 2.12 Future Trends and Innovations in BI for Environmental Sustainability

Future trends and innovations in Business Intelligence (BI) for environmental sustainability are poised to revolutionize how organizations collect, analyze, and act on environmental data. Here are several key trends and innovations shaping the future of BI in environmental sustainability:

1. *Advancements in Artificial Intelligence and Machine Learning:* As AI and machine learning technologies continue to evolve, they will play an increasingly prominent role in BI for environmental sustainability. These technologies enable predictive modeling, anomaly detection, and optimization algorithms that can identify emerging environmental risks, predict future trends, and optimize resource allocation for maximum sustainability.

2. *Internet of Things (IoT) Integration:* The proliferation of IoT devices embedded with sensors and actuators offers unprecedented opportunities for collecting real-time environmental data at scale. By integrating IoT data streams with BI platforms, organizations can monitor environmental parameters such as air quality, water usage, and energy consumption in real time, enabling proactive decision-making and resource management.

3. *Blockchain for Environmental Transparency:* Blockchain technology holds promise for enhancing transparency, traceability, and accountability in environmental management. By leveraging blockchain-based platforms, organizations can securely record and verify environmental data, transactions, and certifications, facilitating trust and transparency across supply chains, carbon markets, and sustainability initiatives.

4. *Geospatial Analysis and Remote Sensing:* Geospatial analysis and remote sensing techniques provide valuable insights into spatial patterns and trends in environmental data. By combining satellite imagery, GIS mapping, and spatial analytics with BI tools, organizations can visualize and analyze complex environmental datasets, identify hotspots of environmental degradation, and prioritize interventions for maximum impact.

5. *Big Data Analytics for Environmental Insights:* The exponential growth of big data generated from diverse sources presents both challenges and opportunities for BI in environmental sustainability. Advanced analytics techniques such as data mining, natural language processing, and sentiment analysis enable organizations to extract actionable insights from large and complex environmental datasets, uncovering hidden trends, correlations, and causal relationships.

6. *Citizen Science and Crowdsourced Data:* Harnessing the power of citizen science and crowdsourced data initiatives empowers individuals and communities to actively participate in environmental monitoring and stewardship. By integrating crowdsourced data streams with BI platforms, organizations can augment traditional monitoring efforts, validate scientific findings, and engage stakeholders in co-creating solutions for environmental challenges.

7. *Circular Economy Analytics:* The transition to a circular economy requires innovative approaches to measuring, analyzing, and optimizing resource flows and material lifecycles. BI solutions tailored for circular economy analytics enable organizations to track resource inputs, outputs, and flows across supply chains, identify opportunities for waste reduction and resource recovery, and quantify the environmental and economic benefits of circular business models.

8. *Regulatory Compliance and Reporting Solutions:* With increasing regulatory scrutiny and reporting requirements related to environmental sustainability, there is a growing demand for BI solutions that streamline compliance management and reporting processes. Integrated regulatory compliance and reporting platforms leverage automation, data visualization, and audit trail capabilities to simplify regulatory reporting, reduce compliance risks, and demonstrate corporate environmental responsibility.

### 2.13 Ethical and Social Implications of BI Utilization in Environmental Decision Making

The utilization of Business Intelligence (BI) in environmental decision-making presents various ethical and social implications that merit careful consideration. While BI offers valuable insights and data-driven solutions for addressing environmental challenges, its implementation raises ethical concerns related to data privacy, equity, transparency, and social justice. One of the primary ethical considerations is the privacy of individuals and communities whose data is collected and analyzed for environmental monitoring and management purposes[10]. BI systems often rely on large-scale data collection from diverse sources, including IoT devices, satellite imagery, and social media platforms. The indiscriminate collection and use of personal or sensitive data without informed consent can infringe upon individuals' privacy rights and lead to unintended consequences such as surveillance, discrimination, and exploitation. Moreover, the unequal distribution of environmental risks and benefits across different socio-economic groups can exacerbate existing disparities and inequities within society. BI-driven environmental decision-making processes must account for environmental justice principles, ensuring that marginalized communities have a voice in decision-making processes and equitable access to environmental resources and opportunities. Failure to address environmental justice concerns can perpetuate environmental racism and exacerbate social tensions. Transparency and accountability are also essential ethical considerations in BI utilization for environmental decision-making. Stakeholders, including citizens, policymakers, and advocacy groups, should have access to transparent information about data collection methods, algorithms, and decision-making processes to ensure accountability and foster trust in BI systems. Lack of transparency can erode public trust, undermine legitimacy, and lead to resistance or backlash against BI-driven environmental initiatives. Furthermore, BI technologies have the potential to amplify biases and reinforce existing power dynamics if not carefully designed and implemented[30]. Algorithmic biases, data inaccuracies, and subjective decision-making criteria can lead to unintended consequences, including environmental injustice, discrimination, and unfair resource allocation. Ethical AI

principles, such as fairness, accountability, and transparency, should guide the development and deployment of BI systems to mitigate biases and ensure ethical decision-making outcomes. Addressing the ethical and social implications of BI utilization in environmental decision-making requires a multi-stakeholder approach that involves collaboration between government agencies, industry stakeholders, civil society organizations, and affected communities. Ethical guidelines, codes of conduct, and regulatory frameworks should be developed to govern the responsible use of BI in environmental management and ensure that ethical considerations are integrated into decision-making processes from data collection to implementation.

### 3. RECOMMENDATIONS FOR ORGANIZATIONS SEEKING TO HARNESS BI FOR ENVIRONMENTAL IMPROVEMENT

For organizations seeking to harness Business Intelligence (BI) for environmental improvement, several recommendations can guide effective implementation and maximize the benefits of BI-driven environmental initiatives:

1. *Develop a Clear Strategy:* Begin by defining clear objectives and goals for leveraging BI in environmental management. Establish a comprehensive strategy that outlines the organization's priorities, desired outcomes, and key performance indicators (KPIs) for environmental improvement.

2. *Invest in Data Quality and Integration:* Ensure that data collected from various sources, including sensors, satellites, and internal systems, is accurate, reliable, and consistent. Invest in data integration tools and processes to centralize and harmonize disparate data sets for comprehensive analysis.

3. *Deploy Advanced Analytics and AI:* Utilize advanced analytics techniques, such as predictive modeling, machine learning, and geospatial analysis, to uncover actionable insights from large volumes of environmental data. Leverage AI-driven algorithms to automate data processing, identify patterns, and predict future environmental trends.

4. *Embrace Real-time Monitoring and Reporting:* Implement real-time monitoring systems to continuously track environmental parameters, such as air quality, water quality, and carbon emissions. Develop interactive dashboards and visualization tools to communicate environmental performance metrics to stakeholders in a timely and transparent manner.

5. *Promote Data-driven Decision Making:* Foster a culture of data-driven decision-making within the organization by providing employees with access to BI tools, training, and resources. Encourage interdisciplinary collaboration between environmental scientists, data analysts, and business leaders to leverage insights for informed decision-making.

6. *Prioritize Environmental Sustainability:* Embed environmental sustainability principles into the organization's core values, operations, and business processes. Integrate environmental considerations into strategic planning, product development, supply chain management, and corporate governance to drive continuous improvement.

7. *Engage Stakeholders and Partners:* Collaborate with external stakeholders, including government agencies, industry partners, academic institutions, and community organizations, to share data, best practices, and resources for collective environmental action. Foster partnerships that promote knowledge exchange, innovation, and collective impact.

8. *Ensure Regulatory Compliance and Risk Management:* Stay abreast of environmental regulations, standards, and guidelines relevant to the organization's operations and industry sector. Implement robust risk management processes to identify, assess, and mitigate environmental risks while ensuring compliance with legal requirements.

9. *Monitor and Evaluate Performance:* Establish metrics and benchmarks to monitor environmental performance, track progress towards goals, and evaluate the effectiveness of BI-driven initiatives. Conduct regular reviews and audits to assess the impact of environmental interventions and identify areas for improvement.

10. *Continuously Innovate and Adapt:* Embrace a culture of continuous improvement and innovation by exploring emerging technologies, best practices, and market trends in environmental management and BI. Stay agile and adaptable to evolving environmental challenges and opportunities, seeking new ways to leverage BI for sustainable outcomes.

### 4. CONCLUSION

The role of Business Intelligence (BI) in enhancing environmental management strategies cannot be overstated. Through the integration of

advanced analytics, real-time monitoring, and data-driven decision-making, BI empowers organizations to unlock valuable insights from environmental data, optimize resource utilization, and drive sustainable practices. By leveraging BI tools and technologies, organizations can identify environmental risks and opportunities, improve resource efficiency, and enhance overall environmental performance. Moreover, BI facilitates the integration of environmental considerations into strategic planning, operational processes, and stakeholder engagement, fostering a culture of environmental stewardship and accountability. With BI-driven insights, organizations can make informed decisions, prioritize environmental sustainability, and drive positive environmental outcomes. As we look to the future, the importance of BI in environmental management will only continue to grow. Rapid advancements in technology, coupled with increasing awareness of environmental challenges, underscore the need for organizations to harness the full potential of BI for environmental improvement. By embracing innovation, collaboration, and data-driven approaches, we can pave the way towards a more sustainable and resilient future for our planet. In the words of environmentalist and author Rachel Carson, "The more clearly we can focus our attention on the wonders and realities of the universe about us, the less taste we shall have for destruction." Let us harness the power of BI to deepen our understanding of the natural world, mitigate environmental risks, and preserve the beauty and diversity of our planet for nature, humanity and generations to come.

## REFERENCES

- [1] Ahmad, S., Miskon, S., Alabdan, R., & Tiili, I. (2020). Towards sustainable textile and apparel industry: Exploring the role of business intelligence systems in the era of industry 4.0. *Sustainability*, 12(7), 2632.
- [2] Asghari, S., Targholi, S., Kazemi, A., Shahriyari, S., & Rajabion, L. (2020). A new conceptual framework for identifying the factors influencing the effectiveness of competitive intelligence. *Competitiveness Review: An International Business Journal*, 30(5), 555-576.
- [3] Awawdeh, H., Abulaila, H., Alshanty, A., & Alzoubi, A. (2022). Digital entrepreneurship and its impact on digital supply chains: The mediating role of business intelligence applications. *International Journal of Data and Network Science*, 6(1), 233-242.
- [4] Aydiner, A. S., Tatoglu, E., Bayraktar, E., Zaim, S., & Delen, D. (2019). Business analytics and firm performance: The mediating role of business process performance. *Journal of business research*, 96, 228-237.
- [5] Calof, J., Arcos, R., & Sewdass, N. (2020). Competitive intelligence practices of European firms. In *Corporate Foresight and Innovation Management* (pp. 34-47). Routledge.
- [6] De las Heras-Rosas, C., & Herrera, J. (2021). Innovation and competitive intelligence in business. A bibliometric analysis. *International Journal of Financial Studies*, 9(2), 31.
- [7] Du Toit, A. S. A. (2013). Comparative study of competitive intelligence practices between two retail banks in Brazil and South Africa. *Journal of Intelligence Studies in Business*, 3(2).
- [8] Eidizadeh, R., Salehzadeh, R., & Chitsaz Esfahani, A. (2017). Analysing the role of business intelligence, knowledge sharing and organisational innovation on gaining competitive advantage. *Journal of Workplace Learning*, 29(4), 250-267.
- [9] Gračanin, Š., Kalac, E., & Jovanović, D. (2015). Competitive intelligence: Importance and application in practice. *Review of innovation and competitiveness: a journal of economic and social research*, 1(1), 25-44.
- [10] Hassani, A., & Mosconi, E. (2022). Social media analytics, competitive intelligence, and dynamic capabilities in manufacturing SMEs. *Technological Forecasting and Social Change*, 175, 121416.
- [11] Hassani, A., & Mosconi, E. (2021). Competitive intelligence and absorptive capacity for enhancing innovation performance of SMEs. *Journal of Intelligence Studies in Business*, 11(1).
- [12] Kehinde, S. I., Moses, C., Borishade, T., Busola, S. I., Adubor, N., Obembe, N., & Asemota, F. (2023). Evolution and innovation of hedge fund strategies: a systematic review of literature and framework for future research. *Acta Innovations*.
- [13] Kehinde, S., Moses, C., Borishade, T., Kehinde, O., Simon-Ilogho, B., & Kehinde, K. (2023). A study of great resignation on work-life balance: global perspective. *International Journal of Finance, Economics and Business*, 2(4), 280-300.
- [14] Maritz, R., & Du Toit, A. (2018). The practice turn within strategy: Competitive intelligence as integrating practice. *South African Journal of Economic and Management Sciences*, 21(1), 1-14.
- [15] Mohammed, A. B., Al-Okaily, M., Qasim, D., & Al-Majali, M. K. (2024). Towards an understanding of business intelligence and analytics usage: evidence from the banking industry. *International Journal of Information Management Data Insights*, 4(1), 100215.
- [16] Park, Y., El Sawy, O. A., & Fiss, P. (2017). The role of business intelligence and communication technologies in organizational agility: a configurational approach. *Journal of the association for information systems*, 18(9), 1.
- [17] Rakhin, S., Calantone, R. J., & Wang, J. F. (2016). Managing market intelligence: The comparative role of absorptive capacity and market orientation. *Journal of Business Research*, 69(12), 5569-5577.
- [18] Ranjan, J., & Foropon, C. (2021). Big data analytics in building the competitive intelligence of organizations. *International Journal of Information Management*, 56, 102231.
- [19] Rouhani, S., Ashrafi, A., Zare Ravasan, A., & Afshari, S. (2016). The impact model of business intelligence on decision support and organizational benefits. *Journal of Enterprise Information Management*, 29(1), 19-50.
- [20] Nasri, W. (2011). Competitive intelligence in Tunisian companies. *Journal of Enterprise Information Management*, 24(1), 53-67.
- [21] Negash, S. (2004). Business intelligence. *Communications of the association for information systems*, 13(1), 15.
- [22] Negro, A. R., & Mesia, R. (2020). The Business Intelligence and its influence on decision making. *Journal of Applied Business and Economics*, 22(2).
- [23] Nithya, N., & Kiruthika, R. (2021). Impact of Business Intelligence Adoption on performance of banks: a conceptual framework. *Journal of Ambient Intelligence and Humanized Computing*, 12(2), 3139-3150.
- [24] Sassi, D. B., Frini, A., Abdessalem, W. B., & Kraiem, N. (2015, May). Competitive intelligence: History, importance, objectives, process and issues. In *2015 IEEE 9th International Conference on Research Challenges in Information Science (RCIS)* (pp. 486-491). IEEE.
- [25] Sewdass, N., & Du Toit, A. S. (2015). Competitive intelligence in emerging economies: A comparative study between Brazil and South Africa. *TD: The Journal for Transdisciplinary Research in Southern Africa*, 11(1), 113-132.
- [26] Tahmasebifard, H. (2018). The role of competitive intelligence and its sub-types on achieving market performance. *Cogent Business & Management*, 5(1), 1540073.
- [27] Tej Adidam, P., Gajre, S., & Kejriwal, S. (2009). Cross-cultural competitive intelligence strategies. *Marketing Intelligence & Planning*, 27(5), 666-680.
- [28] Waithaka, P. (2016). Competitive intelligence practices and performance of firms listed on the Nairobi Securities Exchange, Kenya. *European Scientific Journal*, 12(19), 107-126.
- [29] Viviers, W., & Muller, M. (2005). Competitive intelligence: an instrument to enhance South Africa's competitiveness: economic. *South African Journal of Economic and Management Sciences*, 8(2), 246-254.
- [30] Wang, J., Omar, A. H., Alotaibi, F. M., Daradkeh, Y. I., & Althubiti, S. A. (2022). Business intelligence ability to enhance organizational performance and performance evaluation capabilities by improving data mining systems for competitive advantage. *Information Processing & Management*, 59(6), 103075.
- [31] Wu, Q., Yan, D., & Umair, M. (2023). Assessing the role of competitive intelligence and practices of dynamic capabilities in business accommodation of SMEs. *Economic Analysis and Policy*, 77, 1103-1114.
- [32] Zafary, F. (2020). Implementation of business intelligence considering the role of information systems integration and enterprise resource planning. *Journal of intelligence studies in business*, 1(1).