



# BUSINESS INTELLIGENCE-DRIVEN OPERATIONAL EFFICIENCY AND COST OPTIMIZATION IN U.S. SMES: A REVIEW OF OPPORTUNITIES AND CHALLENGES

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## ABSTRACT

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*Business Intelligence (BI) is established as an enabler of strategic operational efficiency, cost optimization, and customer engagement for Small and Medium-sized Enterprises (SMEs). This paper integrates emerging empirical and systematic review literature on BI adoption among U.S. SMEs, which is seen as converting raw data into useful information for business decision-making. The results suggest BI systems allow for the consolidation of multi-source data, have predictive analysis, and are used for real-time monitoring as part of SMEs to manage processes better, resource allocation, operating costs reduction, and effective inventory and supply chain management. Case studies involving an international online retailer and a major telecommunications company illustrate the real-world impact for BI: Predictive analytics and tailored interventions drove customer retention up, service quality improved, and actual returns on revenue growth. However, SMEs face barriers including lack of technical staff, high costs in the set-up process, data quality problems and organizational resistance and cyber threats. Effective adoption demands strong data governance, compatibility with the organizational strategy, capability building and staged implementation. In general, BI guides SMEs to adopt proactive instead of reactive management and will assist evidence-driven decisions in areas related to widening the organization's competitive edge, improving operating performance, and financial results. The research highlights the relevance of BI in addressing technological and strategic challenges within a complex digital economy.*

**KEYWORDS:** Business Intelligence, Operational Efficiency, Cost Optimization, Predictive Analytics, U.S. SMEs

## INTRODUCTION

The digital age has brought with it a revolutionary shift in the business landscape, characterized by the widespread embrace of new technologies. The technological advancement changed the way organizations conduct their operations, magnified competitive pressures, and modified how value can be delivered (Islam, et al., 2023). Small and Medium-sized Enterprises (SMEs) are widely known for making the largest contribution in the overall economic development and production, particularly giving birth to high employment opportunities, invention, and a life enhancement of countries (Thorne & Mbedu, 2025). In today's markets, SMEs are faced with various challenges such as intensified competition and changing consumer preferences and sophisticated operational and market dynamics (Gladwin & Martha, 2024). Addressing these difficult challenges requires taking advantage of new solutions that help drive operational efficiencies and maximize profitability. Among the major forces that are pushing for such transformation is the digitalization of business, in combination

with the strategic use of Business Intelligence (BI) tools (Gladwin & Martha, 2024).

Empirical research indicates that SMEs adopting digital technologies can measure improvements in productivity, cost and customer satisfaction. Cloud computing technologies mobile applications and e-commerce platforms improved communication and facilitated automation process, operational efficiency among others help SMEs to effectively compete with larger, resource-intensive firms (Gladwin & Martha, 2024). The intermediary role of Business Intelligence in raw data and actionable insights has made it a vital area of research and practice. Although large firms have huge IT budgets and have implemented advanced data warehouses and analytics platforms, SMEs face a set of distinct opportunities and constraints in BI adoption (Thorne & Mbedu, 2025). BI encompasses a combination of technologies, applications and methodologies, all needed for collecting, integrating, analyzing and presenting business information (Gadiparthi, 2024).

Historically, BI grew out of the early management information systems and decision support systems emphasis on structured reporting and online analytical processing (OLAP) within integrated data warehouses (Hozyfa Shafa, 2025). BI systems strive for turning big data to actionable insights by, among others, providing dashboards, visual aids and reporting tools (Siemens, et al., 2022). Through the adoption of BI, firms will have ability to locate new opportunities for generating income through improving their pricing and inventory policies and by implementing data driven promotion initiatives the customer targeting and retention process which ultimately is key to conversion increase (Gladwin & Martha, 2024).

In spite of these benefits, SMEs encounter barriers to adoption such as limited digital capability and lack of ability to induce organization change; they also have inadequate IT infrastructure and worry about data governance, according to Liu et al. (2020). The faster rise of digital solutions in the wake of the COVID-19 pandemic, which forced remote working and customer interaction over online platforms, once again remind us about the compelling need for SMEs to quickly embrace their digital transformation journey to keep pace with competition (Islam, et al., 2023).

The objective of this study is to review and synthesize recent empirical and systematic literature in BI adoption for SMEs, specifically concerning operational efficiency, cost effectiveness and overall organizational performance. It aims to uncover the underlying process that BI supports the improved performance, summarize existing opportunities and challenges, and provide evidence-tested research agenda for future studies as well as real-world practice.

## LITERATURE REVIEW

### Business Intelligence: Concept and Definition

Business Intelligence (BI) is an important technological arm of the organization that helps in keeping up with a competitive edge in a data-driven markets. BI is broadly described as organized processes and tools that help to convert data into useable information for making evidence-based decisions (Faruk, 2025); (Gadiparthi, 2024). These are systems which offer firms an integrated approach to converting raw data into useful information that will be used in operational, tactical and strategic decision making (Dhanekula, 2025). As (Siemens, et al., 2022) describe, BI contains architectural and analytical items such as data warehousing, online analytical processing (OLAP), dashboards and reporting tools all of which support rigorous and timely business analysis.

In a recent conceptual model, BI is considered to include four main activities; data capture, aggregation, data analysis and report presentation, which are mapped to operational, managerial, and strategic scorecards topology that links internal information flow with organizational objectives (Alsibhawi, Yahaya, & Mohamed, 2023). The BI model focuses on multipartite processing of information from data acquisition to company strategy development. This view of BI is in line with the definition on which Gartner bases it that defines BI as an interactive process to retrieve trends and patterns from structured data to support managerial decision making, which also include performance monitoring (Alsibhawi, Yahaya, & Mohamed, 2023).

Large establishment and SMEs are increasingly provided with BI systems possession features which improve decision quality, operational timeliness and enterprise capability. According to (Ragazou, Passas, Garefalakis, & Zopounidis, 2023), BI enables companies to convert complicated data into meaningful and up-to-date information that can be accessed through user-friendly systems. These systems are able to support dynamic data categorization, real-time information flows and knowledge construction on the basis of historical trends. Thus, firms are better able to read the changes coming from markets, re-allocate resources and devise strategies that build competitive advantage.

While BI is typically perceived as a data analytics tool, its strategic role is to enable organizations extract actionable insights from data that can be leveraged to enhance customer engagement, product efficiency and overall business performance (Gadiparthi, 2024). In modern contextual setting BI is increasingly linked with high-level analytical solutions such as data mining, predictive modeling and automatic reporting systems, thus all contribute towards SMEs ability to make informed and dynamic decisions (Thorne & Mbedu, 2025).

### Business Intelligence and Operational Efficiency

A recurring message in the literature is that implementing BI has been shown to considerably enhance operational efficiency through improved process visibility, better support for data-informed decision making, and the ability to react quickly to operational bottlenecks. A broad systematic review on SME analytics adoption from 2014-2024 shows that Big Data and BI programs continuously produce gains in operational efficiency, process optimization, and competitive advantages (Kgakatsi, Galeboe, Molelekwa, & Thango, 2024). Operational efficiency, which is the capacity to execute processes with minimal waste and friction (Thorne & Mbedu, 2025), can be enhanced when SMEs apply BI tools in ensuring that they monitor their workflows for continuous improvement.

BI capabilities facilitate this metamorphosis via auto-reporting systems, real-time dashboards, integrated decision support systems (IDSS), which have led to seamless flows of data and minimization of information asymmetry in firms (Mgbame, Akpe, Abayomi, Ogbuefi, & Adeyelu, 2022). The use of dashboards offers SMEs the opportunity to utilize centralized platforms for the visualization of data, allowing businesses to monitor performance measures on a regular and consistent basis, reducing deviations and the potential impact on utilizing existing data sources.

Empirical evidence further reinforces the contribution of BI to operational performance. (Mbima & Tetteh, 2023), using 216 SMEs and structural equation model, find that BI adoption has a positive effect on operational performance and supply chain ambidexterity mediates this relationship. It's the ability to manage that flexibility vs. efficiency trade-off that provides an organization with the opportunity to leverage BI in more impactful ways, showing how BI can best be utilized in organizations when part of a more agile operational environment.

This evidence is complemented with results obtained in (Orero-Blat, Palacios-Marqués, Leal-Rodríguez, & Ferraris, 2025) that show how companies endowed with a strong business analytics capability, as proposed by dynamic capabilities theory, are more capable of innovating and reconfiguring internal processes to survive through operational resilience. Notwithstanding these benefits, widespread adoption of BI by SMEs continues to be limited by financial constraints, insufficient digital skills, and readiness deficits in organizations ( Kgakatsi, Galeboe, Molelekwa, & Thango, 2024).

BI combines the supply chain management perspective of business intelligence toward improving process visibility, decision support, and flexible supply chain execution. But the possibility of SMEs making such claims depends on their levels of readiness for data, ability to allocate resources, and integrate BI with wider operational systems.

### **Business Intelligence and Cost-Optimization**

BI has also been reported in the literature as a critical enabler for cost optimizations throughout business processes. In the past, cost optimization driven by technology was limited to repetitive activities but BI allows restructuring of cost related activities more broadly by providing detailed information on resource use, consumption patterns and customer behavior (Ragazou, Passas, Garefalakis, & Zopounidis, 2023). BI can be employed by SMEs to gather and analyze customer demographic, psychographic, and behavioral information that enables them to develop differentiated products and targeted marketing actions that lead to satisfied customers profitability (Ragazou, Passas, Garefalakis, & Zopounidis, 2023).

BI-enabled customer intelligence is the keystone to effective resource allocation for an organization, from designing specific offers and delivery channels for clients to timing interventions. These observations reinforce customer satisfaction and enable more effective allocation of both operational and marketing resources. In addition, cutting-edge analytics and machine learning models allow firms to predict customer needs and interests in advance, minimizing the waste in inefficient spending, bettering engagement results (Gadiparthi, 2024).

Researches by Adeniran, Akinyemi and Aremu (2016) as well as James et al. (2019) as cited in (Mgbame, Akpe, Abayomi, Ogbuefi, & Adeyelu, 2022), stress the fact that successful BI system implementation enhances decision quality and shortens reporting cycle while enables SMEs to manage scarce resources more efficiently. Moreover, according to empirical evidence in ( Kgakatsi, Galeboe, Molelekwa, & Thango, 2024), there is also a substantive proof that SMEs using analytics and BI as decision making tools achieve substantial cost reduction levels and enhance their economic performance.

Cost saving advantages are also enhanced when BI tools are integrated with highly scalable cloud-based services which reduces the cost of infrastructure and increases accessibility to analytics functions (Thorne & Mbedu, 2025). BI as related to supply chain ambidexterity also leads to cost reductions through better inventory management, reducing waste, and the ability to quickly react to variations in the supply (Mbima & Tetteh, 2023).

Nevertheless, a successful cost optimization is subject to managerial support, organizational readiness, and investments in the foundational data infrastructures ( Jiménez-Partearroyo & Medina-López, 2024). BI provides a good foundation for cost-effective operations, but its success depends on the SMEs being able to integrate other related organizational and technological capabilities.

### **Case Studies: Business Intelligence in Enhancing Customer Experience and Engagement**

The cases of a key global online retailer and leading telecommunications company have demonstrated how BI architecture can be leveraged to address customer-centric issues through data integration, predictive analytics, and real-time decisions (Gadiparthi, 2024).

Gadiparthi (2024) reports on a global e-commerce retailer that found its customer loyalty decreasing and its revenue growth stagnant in a hyper-competitive digital market. The key issue was that the company relied on a homogeneous, undifferentiated approach, “one-size-fits-all” to customer interaction, that could not handle the variation in consumer preferences and behavior. To address this, the retailer implemented an integrated BI system that combined multi-source data from web navigation trails, transactional history, and customer feedback into a single analytical environment (Gadiparthi, 2024).

The BI infrastructure leveraged highly sophisticated analytics and machine-learning algorithms to develop rich customer profiles and predict purchasing propensities. This made it possible to implement a number of policy interventions. First, personalized product recommendation engines, which were used to capitalize on individual-level browsing behavior and make better-targeted product recommendations. Second, dynamic pricing mechanisms leveraged predictive analytics to segment price sensitive customers and target promotions in real time. Third, the BI platform empowered targeted customer retention programs, which identified users with high risk of churning and automatically initiated personalized engagement campaigns (Gadiparthi, 2024).

The results were significant: the retailer recorded a measurable rise in customer retention, increased repeat purchase frequencies, and higher revenue from targeted promotional activities. Customized experiences enhanced the satisfaction of customers and promoted continued use of the platform. These results highlight how BI-driven personalization can increase marketing efficiency and influence consumer behavior in digital retail settings.

Another case demonstrated by Gadiparthi (2024) is a leading telecommunications provider tackling high churn rates due to poor service quality and lack of timely response in customer support calls. The company developed a BI system to process real-time customer interaction data pulled into the enterprise from call centers, digital channels, and social media. This fusion allowed a complete measurement of service quality and customer attitude.

Three fundamental approaches were made possible by such implementation. First, real-time response systems facilitated live tracking of customer complaints, which allowed for immediate action and resolution. Second, predictive customer service models were developed to detect customers who are likely to experience dissatisfaction with a service and proactively approach them at an early stage before dissatisfaction led to disengagement. Third approach is that BI system was used for improving network performance by identifying fault in service and isolating the geographical or technical bottleneck which required targeted investment or maintenance (Gadiparthi, 2024).

The results revealed that service quality-related metrics such as increases in customer satisfaction scores and reduction in churn were significantly improved. Within 12 months of implementation, the carrier saw tangible improvements in customer retention. This is an example of how a service-based industry can transition from reactive to predictive and preventative based service delivery models.

Taken together, the cases demonstrate that BI can be applied across multi-sectorial organizations with varied operational missions. In the retail context, BI has been used as a tool for behavioral customization where companies could control when and how to trigger consumer behaviors. The case in the telecommunications industry demonstrates however, BI as value driver along two dimensions with regard to improving service quality; real-time transparency and predictive analytics are necessary for operational reliability and customer loyalty (Gadiparthi, 2024).

This cross-case analysis finds that BI consistently improves customer experience, when organizations consider multi-source data integration and predictiveness for customer experience, as well as real-time responsiveness to customers. Yet, results also suggest that the efficiency of BI is reliant upon organizational ability to transform analytical thinking into practical interventions.

## DISCUSSION

The study of Business Intelligence (BI) adoption in U.S. SMEs shows that BI is a transformative technology that significantly improve the effectiveness of their operations, reduce costs, and engage with customers. Two cases of a global online retailer and a large telecommunications provider demonstrate the multifaceted use of BI in different business settings. In the retail case, predictive analytics was applied for personalized products recommendations, dynamic pricing, and targeted customer retention campaigns, resulting in increased repeat purchases frequency, enhanced customer satisfaction levels, and more revenue generated from promotional activities (Gadiparthi, 2024). Equally, the telecom provider applied BI to monitor real-time customer interactions, forecast service disruptions, and improve network efficiency, which led to considerable reduction in churn and improved customer loyalty within a year of implementation (Gadiparthi, 2024). These cases present empirical proof that BI can translate complicated data into producing better operational and customer-focused results.

From these applications, it can be concluded that multi-source data is to be integrated if the entire potential of BI systems is

to be exploited. Such SMEs integrate both internal and external data sets, which, together with transactional histories, web browsing behavior, and customer feedback becomes a rich source of knowledge for evidence-based decision making. Real-time analytics go a step further, providing even faster decision making capabilities that allow proactive responses to newly developing operational or customer service concerns before they escalate. Predictive analytics specifically has emerged as a powerful tool for proactive engagement, enabling SMEs to predict customer behavior, foresee service issues, and take targeted actions that impact retention and loyalty (Gadiparthi, 2024). BI's value, however, depends on organizational linkage; the BI systems "seen" by users should provide useful insights as to what they should do in addressing issues that impede progress before such systems can generate performance improvements. Cross-industry relevance is demonstrated here, with BI facilitating behavior-based personalization in retail and service quality improvement within the telecommunications sector, underlining its potential for SMEs from different operational domains.

The introduction of BI in SME brings about challenges, but also valuable opportunities. Increased operational transparency; one of the most important advantages is the better visualization feature, and BI dashboards and reporting systems permit managers to observe workflow processes, pinpoint bottlenecks, and understand where resources can be used more effectively, leading to increased productivity and process performance (Mgbame, Akpe, Abayomi, Ogbuefi, & Adeyelu, 2022). Predictive models and analytics also can increase customer engagement and retention, helping SMEs to pinpoint profitable customers, create tailored marketing strategies, and lower churn rates; collectively boosting sales as well as lifetime value of customers (Gadiparthi, 2024). Furthermore, BI ensures cost management as SMEs are able to monitor resource allocation, minimize the waste of production operation, and enhance inventory and supply chain management (Mbima & Tetteh, 2023). Business Intelligence, by giving timely and accurate visibility to a company's business activity, increases the agility of decision making, permitting SMEs to react quickly to changes in market dynamics or operational results. Companies which adopt BI strategically are then able to enhance their competitive position by using fact-based data to improve processes, drive innovation, and create better customer experiences (Thorne & Mbedu, 2025).

However, even though BI has a lot to offer there are also challenges. Data quality and fragmentation of data remain challenges as inaccurate or incomplete datasets can compromise the accuracy of analyses, hampering decision-making (Kgakatsi, Galeboe, Molelekwa, & Thango, 2024). The high costs of implementation which include software purchase, infrastructure, and manpower may be a barrier for SMEs that already operate in resource-constrained environments (Thorne & Mbedu, 2025). The lack of technical know-how in SMEs also requires to be complemented through the help of external consultants or by training employees extensively for them to make better use of BI functionalities (Mbima & Tetteh, 2023). Organizational resistance to change, can also hinder the adoption when employees are used to traditional legacy systems and are skeptical to adopt statistical models for managing data. Furthermore, the connection between sensitive operational and

customer data from countless platforms can also bring about cyber security and data privacy fears (Gadiparthi, 2024). Integration problems with other IT systems can further limit the seamless application and interoperability of BI infrastructures. These limitations highlight the need of strategic planning, organizational readiness, and building of capacity in enabling BI to reach its full potential within SMEs.

To reap the benefits of BI and address its challenges, SMEs must make use of evidence-based strategies. Strengthening data governance structures is key to the accuracy, completeness, and consistency of analytics results. Building in-house analytics capability increases organizational self-reliance and addressing reliance on external consultancies. An incremental implementation that begins with dashboards or focused predictive models and progressively extends to an organization-wide platform, allows for risk mitigation, and organizational acclimation. Investing in information security such as control access, encryption, and real-time tracking is important to protect sensitive data. Just as critical a consideration is the guiding of BI investments towards organizational strategy, so that findings can be translated into concrete actions throughout its operations, marketing, and customer service. By developing a data-driven culture with support from the top management, stakeholder involvement, and structured change management, SMEs can improve adoption and use of BI systems. Finally, tracking and analyzing BI performance with a set of KPIs for operating efficiency gains, cost reduction, and customer results, drive iterative improvements to sustain value creation.

In summary, Business Intelligence is a strategic facilitator for U.S. SMEs providing measurable gains in operational efficiencies, expense control & customer interaction. Based on the case studies, it has been demonstrated that real and measurable benefits are available for SMEs by integrating BI with multi-sourced data of integrated systems; analytics in real time as well as predictive models that correspond with SMEs' strategies. Although adoption barriers including data quality, implementation costs, technical skills, and cybersecurity remain, however, SMEs strategic initiatives to overcome these barriers will enable them to embrace BI for competitive advantage. On balance, BI offers an organized process for SMEs to move from reactive to proactive management by applying both operational and financial performance in the increasingly competitive and data-driven markets.

## CONCLUSION

This research shows that BI is a driver of competitive advantage for operational efficiency, cost optimization, and customer engagement in U.S. SMEs. Evidence from literature and case studies suggest that BI adoption enables SMEs to combine data from multiple sources, convert the combined information into actionable insights that facilitate informed decision-making for enhancing process efficiency and resource utilization (Gadiparthi, 2024); (Mbima & Tetteh, 2023). Predictive analytics, continuous monitoring, and personalized interventions increase customer retention, improve inventory management efficiency, and lower operational costs with quantifiable increases in revenue and service quality.

Notwithstanding the benefits, SMEs are subjected to challenges such as lack of technical know-how; cost of implementation

including maintenance costs; data quality challenges; organizational resistance, and security risks ( Kgakatsi, Galeboe, Molelekwa, & Thango, 2024); (Thorne & Mbedu, 2025). Successful adoption depends heavily on strong data governance, strategic alignment with the business objectives, capacity building, and stepped-approach in implementation.

To conclude, BI facilitates the process of moving SMEs from reaction-based to action-based management, making evidence-based decisions which further enhance competitiveness and performance. By implementing BI in a structured manner, SMEs can potentially receive operational and financial benefits and improve customer experiences which emphasizes the importance of BI as an enabling mechanism for SMEs from both technological and strategic perspectives in the current digital economy.

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