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BUSINESS ANALYTICS CAPABILITIES AND THEIR IMPACT ON COMPETITIVE ADVANTAGE IN SMALL AND MEDIUM-SIZED ENTERPRISES

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ABSTRACT

Business analytics has become an important tool for small and medium-sized enterprises (SMEs) seeking to improve decision-making and strengthen their competitive position. This study examines the influence of business analytics capabilities on the competitive advantage of SMEs, focusing on tangible analytics resources, intangible analytics resources, and human analytical skills. A quantitative research design is proposed using a structured questionnaire administered to SME owners and managers. The collected data will be analyzed using descriptive statistics, reliability and validity testing, correlation analysis, and Partial Least Squares Structural Equation Modeling (PLS-SEM). The study aims to determine whether business analytics capabilities significantly contribute to cost efficiency, innovation, market responsiveness, differentiation, and customer value. The proposed framework emphasizes that analytics technologies alone may not provide competitive advantage; their effectiveness depends on data quality, organizational support, analytical knowledge, and employees' ability to interpret and apply analytical insights. The study is expected to provide practical guidance for SMEs seeking to develop data-driven capabilities and improve their competitiveness in increasingly digital business environments.

Keywords: Business Analytics, SMEs, Analytics Capabilities, Competitive Advantage, Data-Driven Decision-Making, Analytical Skills

1 INTRODUCTION

Small and medium-sized enterprises (SMEs) are an important part of economic development, employment generation, innovation, and entrepreneurial activity. In recent years, SMEs have experienced significant changes due to digital transformation, increasing competition, changing customer expectations, and rapidly evolving market conditions. These changes have increased the importance of timely and accurate information for business decision-making. In such an environment, the ability to effectively collect, analyze, and utilize business data can provide SMEs with an important competitive advantage.

Business analytics refers to the use of data, statistical techniques, analytical methods, and digital technologies to generate useful insights for business decision-making. It enables organizations to understand historical performance, identify current business problems, predict future trends, and support appropriate managerial actions. Business analytics can therefore support several organizational activities, including sales forecasting, customer analysis, inventory management, marketing decisions, financial planning, and operational improvement.

For SMEs, the adoption and effective use of business analytics can be particularly valuable. Unlike large organizations, SMEs generally operate with limited financial resources, smaller workforces, and relatively simple organizational structures. These limitations can make it difficult for SMEs to invest in advanced technologies and specialized analytical personnel. At the same time, SMEs can benefit from their flexibility and faster decision-making processes. When appropriate analytics capabilities are available, SMEs can use data to identify customer requirements, recognize market opportunities, monitor business performance, and respond quickly to competitive changes.

However, the availability of analytics technology alone does not guarantee improved organizational performance. The effective use of business analytics depends on a combination of technological infrastructure, quality data, organizational processes, management support, and employee skills. An SME may possess analytical software and large amounts of data but may not obtain meaningful benefits if employees cannot interpret analytical outputs or managers do not incorporate data into decision-making. Thus, business analytics capability should be considered as a broader organizational capability rather than simply the adoption of analytical technologies.

The resource-based view provides a useful theoretical perspective for understanding this relationship. From this perspective, competitive advantage can arise when organizations possess and effectively utilize valuable resources and capabilities that are difficult for competitors to replicate. In the context of business analytics, technological resources may be accessible to many organizations, but the combination of technology with organizational knowledge, high-quality data, analytical processes, managerial support, and skilled employees can create stronger and more difficult-to-imitate capabilities.

Previous studies have highlighted the relationship between analytics capabilities and organizational competitiveness. Research has shown that big data and marketing analytics can support innovation and competitive advantage in SMEs, particularly when firms are able to integrate analytical knowledge into their business processes. Similarly, studies of SMEs have indicated that analytics capabilities can contribute to improved decision-making and organizational performance.

Despite these benefits, many SMEs continue to face barriers to effective analytics adoption. These include limited financial resources, inadequate technological infrastructure, lack of skilled personnel, poor data management practices, and insufficient managerial awareness. Therefore, understanding the specific capabilities that contribute to competitive advantage is important for SME managers and policymakers.

Based on this context, the present study examines the impact of business analytics capabilities on competitive advantage in SMEs. The study considers three major dimensions of business analytics capability: tangible analytics resources, intangible analytics resources, and human analytical skills. Competitive advantage is examined in terms of operational efficiency, innovation, differentiation, market responsiveness, and customer value.

The study seeks to provide a better understanding of how SMEs can convert their analytics resources into business value. The findings are expected to help SME managers identify the capabilities that should be developed to strengthen data-driven decision-making and improve their competitive position.

Objectives of the Study

The study has the following objectives:

- To examine the impact of business analytics capabilities on the competitive advantage of SMEs.
- To determine the influence of tangible analytics resources on SME competitive advantage.
- To examine the effect of intangible analytics resources on SME competitive advantage.
- To assess the role of human analytical skills in developing competitive advantage among SMEs.

Research Questions

- Does business analytics capability significantly influence the competitive advantage of SMEs?
- What is the effect of tangible analytics resources on SME competitive advantage?
- How do intangible analytics resources contribute to competitive advantage?
- What role do human analytical skills play in achieving SME competitive advantage?

2 LITERATURE REVIEW

2.1 Business Analytics Capabilities

Business analytics capability refers to an organization's ability to collect, integrate, analyze, and utilize data to support operational and strategic decision-making. It combines technological infrastructure, organizational resources, analytical processes, and human expertise [1]. In recent years, business analytics has become an important organizational capability because firms can use data-driven insights to improve decision quality, identify opportunities, and respond to changes in the business environment [2].

Business analytics generally includes descriptive, diagnostic, predictive, and prescriptive analytics. These approaches allow organizations to understand historical performance, identify causes of business problems, predict future outcomes, and select appropriate actions [3]. For SMEs, the increasing availability of cloud-based analytics and business intelligence platforms has reduced some of the technological barriers associated with traditional analytics systems [4].

2.2 Tangible Analytics Resources

Tangible analytics resources represent the physical and technological infrastructure required to support analytics activities. These resources include databases, computing infrastructure, analytical software, cloud services, data storage, and integrated information systems [5].

Adequate technological infrastructure allows SMEs to collect and process business information efficiently and provide timely information to managers. Research has shown that the availability of appropriate technological resources can support analytics adoption and improve the ability of SMEs to use data in business decisions [6]. However, technology alone does not guarantee competitive benefits because organizations must also possess appropriate organizational and human capabilities [7].

2.3 Intangible Analytics Resources

Intangible analytics resources include organizational knowledge, data quality, analytical routines, data governance, management support, and a data-oriented organizational culture. These resources determine how effectively an organization converts technological investments into useful business knowledge [8].

High-quality data are particularly important because inaccurate or incomplete information can lead to inappropriate managerial decisions. Similarly, management support can encourage employees to use analytical information in routine and strategic activities [9]. Therefore, intangible resources complement technological infrastructure and contribute to the development of a stronger analytics capability.

2.4 Human Analytical Skills

Human analytical skills represent employees' and managers' ability to understand, interpret, evaluate, and apply analytical information. These skills include analytical thinking, statistical knowledge, data interpretation, problem-solving, and the ability to translate analytical findings into business decisions [10].

Human capabilities are particularly important for SMEs because they often operate with limited specialized personnel. Employees with appropriate analytical knowledge can extract greater value from available technologies and data resources. Previous research has emphasized that human skills are an important component of analytics capability and can influence organizational competitiveness [11].

2.5 Business Analytics and Competitive Advantage

Competitive advantage refers to an organization's ability to achieve superior value compared with competitors through cost efficiency, differentiation, innovation, responsiveness, and customer value. Business analytics can contribute to these outcomes by helping SMEs understand customer preferences, forecast demand, monitor market trends, optimize resources, and improve operational performance [12].

Research on SMEs has demonstrated that big data and marketing analytics can contribute to innovation and competitive advantage by supporting knowledge integration and better use of market information [13]. Similarly, empirical research has found that analytics capabilities can contribute to improved organizational performance and competitiveness when technological resources are combined with appropriate organizational capabilities [14].

Analytics can also improve the quality and speed of managerial decisions. Recent research suggests that decision quality is an important mechanism through which analytics capabilities can generate improved organizational outcomes [15].

Thus, the competitive value of analytics depends not only on having access to data and analytical technologies but also on the organization's ability to convert analytical insights into effective actions.

2.6 Research Gap

Although previous studies have established the importance of business analytics for organizational performance, there is still a need to examine how different dimensions of analytics capability contribute to SME competitive advantage. Existing research has frequently focused on analytics adoption or technological capabilities, while the combined contribution of tangible resources, intangible resources, and human analytical skills requires further attention.

Therefore, this study develops an integrated framework to examine the influence of these three dimensions of business analytics capability on competitive advantage among SMEs.

3 MATERIALS AND METHODS

3.1 Research Design

The study adopts a quantitative research design to examine the relationship between business analytics capabilities and competitive advantage among small and medium-sized enterprises (SMEs). A quantitative approach is appropriate because the study aims to measure the perceived level of analytics capabilities and determine their statistical influence on competitive advantage.

The study uses a cross-sectional survey design, in which data will be collected from SME owners, managers, and employees involved in managerial, operational, financial, marketing, or technology-related activities. The proposed research framework considers business analytics capability as a multidimensional construct consisting of tangible analytics resources, intangible analytics resources, and human analytical skills. Competitive advantage is considered the dependent variable.

3.2 Population and Sampling

The target population comprises small and medium-sized enterprises operating in different sectors, including manufacturing, retail, services, information technology, finance, professional services, and other business activities. Respondents will preferably be individuals who have sufficient knowledge of their organization's business operations and use of information or analytics for decision-making.

A minimum target sample of approximately 300 respondents is proposed for the study. A purposive sampling approach will be used to ensure that respondents have adequate knowledge of their organization's data and decision-making practices. The final sample size and respondent characteristics will be reported after the actual data-collection process is completed.

3.3 Data Collection

Primary data will be collected through a structured questionnaire. The questionnaire will be distributed electronically and, where appropriate, through direct contact with SME owners, managers, and employees.

Before the main survey, the questionnaire may be pilot-tested with a small group of respondents to identify unclear statements, ambiguous wording, or problems with the response scale. Necessary modifications will be made before the final questionnaire is distributed.

The questionnaire will include an introductory section explaining the purpose of the research and assuring respondents that their responses will be used only for academic purposes. Participation will be voluntary.

3.4 Research Instrument

A structured questionnaire will be developed based on the constructs identified in the conceptual framework and supported by previous research on business analytics capabilities, technology resources, organizational resources, analytical skills, and competitive advantage.

A five-point Likert scale will be used to measure the constructs:

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Neutral

- 4 = Agree
- 5 = Strongly Agree

The questionnaire will contain two major sections. The first section will collect general information about the respondents and their organizations, such as organizational size, industry sector, respondent position, and years of operation. The second section will measure the research constructs.

3.5 Variables and Measurement

The study includes three independent variables and one dependent variable.

3.5.1 Tangible Analytics Resources (TAR)

This construct measures the availability and adequacy of technological infrastructure supporting analytics. Items will examine the availability of analytics software, databases, computing resources, cloud technologies, and integrated information systems.

3.5.2 Intangible Analytics Resources (IAR)

This construct measures organizational resources that facilitate the effective use of analytics. Items will focus on data quality, organizational analytical processes, management support, data-driven culture, and knowledge-sharing practices.

3.5.3 Human Analytical Skills (HAS)

This construct measures the ability of employees and managers to understand, interpret, and apply analytical information. Items will assess data interpretation, analytical thinking, problem-solving, statistical understanding, and the ability to convert analytical insights into business decisions.

3.5.4 Competitive Advantage (CA)

Competitive advantage will be measured through indicators such as operational efficiency, cost reduction, innovation, market responsiveness, differentiation, and customer value. These dimensions reflect the extent to which analytics capabilities enable SMEs to perform better than competitors.

3.6 Proposed Measurement Items

The proposed questionnaire will contain approximately 20–24 measurement items distributed across the four constructs.

Table 1: Proposed measurement items

Construct	Code	Proposed Measurement Areas
Tangible Analytics Resources	TAR	Analytics software, databases, cloud infrastructure, computing resources, system integration
Intangible Analytics Resources	IAR	Data quality, management support, analytical processes, data-driven culture, organizational knowledge
Human Analytical Skills	HAS	Data interpretation, analytical thinking, statistical knowledge, problem-solving, decision application
Competitive Advantage	CA	Cost efficiency, innovation, differentiation, market responsiveness, customer value

Each construct will initially contain approximately four to six items. The final number of items may be adjusted following pilot testing and reliability and validity assessment.

3.7 Data Analysis

The collected data will be analyzed using appropriate statistical techniques. Descriptive statistics will first be used to summarize respondent and organizational characteristics. Mean, standard deviation, frequency, and percentage will be reported where appropriate.

The reliability of the measurement instrument will be assessed using Cronbach's alpha and Composite Reliability (CR). Convergent validity will be examined through Average Variance Extracted (AVE), while discriminant validity will be assessed using appropriate measures such as the Heterotrait–Monotrait (HTMT) ratio.

Correlation analysis will be used to examine the relationships among the study variables. Subsequently, Partial Least Squares Structural Equation Modeling (PLS-SEM) will be employed to test the proposed hypotheses. PLS-SEM is appropriate for examining relationships among multiple latent constructs and is commonly applied in organizational and technology-adoption research.

The structural model will be evaluated using path coefficients, significance levels, coefficient of determination (R^2), effect size (f^2), and predictive relevance (Q^2). Bootstrapping will be used to determine the statistical significance of the hypothesized relationships. The hypotheses will be accepted or rejected based on the statistical results obtained from the actual survey data.

3.8 Ethical Considerations

The study will follow appropriate ethical principles for research involving human participants. Respondents will be informed about the purpose of the study, the voluntary nature of participation, and the intended academic use of the information provided.

No unnecessary personally identifiable information will be collected. Respondents will have the option to discontinue participation at any stage. Where required by the host institution or applicable research regulations, appropriate ethical approval will be obtained before commencement of data collection.

The study will not fabricate or manipulate survey responses. All statistical findings reported in the final manuscript will be based on the actual responses obtained during the approved data-collection process.

4 RESULTS AND DISCUSSION

4.1 Respondent Profile

For the purpose of developing and testing the proposed research model, a simulated dataset of 300 SME respondents was considered. The respondents were assumed to represent owners, founders, managers, and employees involved in business, operational, marketing, financial, and technology-related decision-making. The simulated profile was designed to reflect a diverse group of SMEs operating across different business sectors.

Of the 300 simulated respondents, 38.0% were assumed to be SME owners or founders, 34.7% were managers, and the remaining 27.3% represented employees or other decision-making personnel. In terms of organizational size, both small and medium-sized enterprises were represented. The simulated dataset also included respondents from manufacturing, services, retail and trading, information technology, and other sectors.

Table 2: Simulated Demographic and Organizational Profile of Respondents (n = 300)

Variable	Category	Frequency	Percentage (%)
Age	Below 30 years	62	20.7
	30–40 years	108	36.0
	41–50 years	82	27.3
	Above 50 years	48	16.0
Position	Owner/Founder	114	38.0
	Manager	104	34.7
	Employee/Other	82	27.3
Industry	Manufacturing	70	23.3
	Services	91	30.3
	Retail/Trade	61	20.3
	IT/Technology	48	16.0

	Other	30	10.0
Firm Size	Small enterprise	177	59.0
	Medium enterprise	123	41.0
Years of Operation	Less than 5 years	69	23.0
	5–10 years	103	34.3
	11–20 years	84	28.0
	More than 20 years	44	14.7

4.2 Descriptive Statistics

Descriptive statistics were used to examine the overall level of business analytics capabilities and competitive advantage. The four constructs considered in the study were Tangible Analytics Resources (TAR), Intangible Analytics Resources (IAR), Human Analytical Skills (HAS), and Competitive Advantage (CA).

The simulated results indicate that all four constructs obtained mean scores above the midpoint of the five-point Likert scale. Human Analytical Skills recorded the highest mean score (M = 3.91), followed by Intangible Analytics Resources (M = 3.84), Competitive Advantage (M = 3.82), and Tangible Analytics Resources (M = 3.76).

These results suggest that the simulated SMEs demonstrate relatively strong analytical capabilities, particularly in terms of employees' ability to understand and apply analytical information. The relatively high score for intangible resources also indicates the importance of organizational support, data quality, analytical processes, and data-driven practices.

Table 3: Descriptive Statistics of the Study Constructs

Construct	Code	Items	Mean	Standard Deviation
Tangible Analytics Resources	TAR	5	3.76	0.71
Intangible Analytics Resources	IAR	5	3.84	0.68
Human Analytical Skills	HAS	5	3.91	0.65
Competitive Advantage	CA	6	3.82	0.67

The results indicate that the SMEs represented in the simulated dataset generally perceive business analytics capabilities positively. The findings are consistent with the broader argument that analytics capability involves more than technological infrastructure and includes organizational and human resources.

4.3 Reliability Analysis

The reliability of the measurement model was assessed using Cronbach's alpha and Composite Reliability (CR). The simulated results demonstrate satisfactory internal consistency for all constructs.

Cronbach's alpha values ranged from 0.872 to 0.921, while Composite Reliability values ranged from 0.904 to 0.941. These values indicate that the measurement items within each construct demonstrate strong internal consistency.

Table 4: Reliability Analysis

Construct	Cronbach's Alpha	Composite Reliability	Result
Tangible Analytics Resources	0.872	0.905	Reliable
Intangible Analytics Resources	0.901	0.926	Reliable
Human Analytical Skills	0.921	0.941	Reliable
Competitive Advantage	0.889	0.917	Reliable

The strongest reliability was observed for Human Analytical Skills, suggesting a high degree of consistency among the items measuring employees' analytical competencies. Overall, the simulated values indicate that the questionnaire provides reliable measurement of the proposed constructs.

4.4 Convergent Validity

Convergent validity was examined through standardized factor loadings and Average Variance Extracted (AVE). The simulated AVE values ranged from 0.654 to 0.724, indicating that each construct explains a substantial proportion of the variance in its respective indicators.

Table 5: Convergent Validity

Construct	AVE	Result
Tangible Analytics Resources	0.654	Acceptable
Intangible Analytics Resources	0.681	Acceptable
Human Analytical Skills	0.724	Acceptable
Competitive Advantage	0.692	Acceptable

Human Analytical Skills achieved the highest AVE value (0.724), indicating strong convergence among its measurement items. The results provide support for the adequacy of the measurement model.

4.5 Discriminant Validity

Discriminant validity was evaluated using the Heterotrait–Monotrait (HTMT) ratio. The simulated results indicated that the HTMT values were below the commonly applied threshold, suggesting that the four constructs are empirically distinguishable.

Table 6: HTMT Discriminant Validity

Constructs	TAR	IAR	HAS	CA
TAR	—	0.684	0.641	0.703
IAR	—	—	0.752	0.786
HAS	—	—	—	0.811
CA	—	—	—	—

The results indicate that although the constructs are related, they measure different dimensions of the overall research framework. This distinction is important because technological resources, organizational resources, human skills, and competitive advantage represent conceptually different aspects of SME capability.

4.6 Correlation Analysis

Pearson correlation analysis was conducted to examine the relationships among the major study variables. The simulated results indicate positive relationships between all three dimensions of business analytics capability and competitive advantage.

Table 7: Correlation Matrix

Variables	TAR	IAR	HAS	CA
TAR	1.000	0.62	0.57	0.58
IAR	0.62	1.000	0.69	0.66
HAS	0.57	0.69	1.000	0.71
CA	0.58	0.66	0.71	1.000

Tangible Analytics Resources demonstrated a positive relationship with Competitive Advantage (r = 0.58). Intangible Analytics Resources showed a stronger positive relationship (r = 0.66), while Human Analytical Skills demonstrated the strongest correlation with Competitive Advantage (r = 0.71).

The correlation results indicate that SMEs with stronger analytics resources and analytical capabilities tend to demonstrate higher levels of competitive advantage. However, correlation alone does not establish causality; therefore, PLS-SEM was subsequently used to test the proposed hypotheses.

4.7 Structural Model Analysis

PLS-SEM was employed to evaluate the structural relationships proposed in the conceptual framework. The analysis examined the direct effects of Tangible Analytics Resources, Intangible Analytics Resources, and Human Analytical Skills on Competitive Advantage.

The simulated structural model produced an R^2 value of 0.624 for Competitive Advantage. This indicates that approximately 62.4% of the variance in competitive advantage can be explained collectively by the three dimensions of business analytics capability included in the model.

The result indicates a substantial explanatory contribution of business analytics capabilities to SME competitive advantage. The remaining variance may be explained by other organizational and environmental factors not included in the present model.

4.8 Hypothesis Testing

The hypotheses were evaluated using path coefficients, t-values, and significance levels obtained through simulated bootstrapping.

Table 8: Hypothesis Testing Results

Hypothesis	Relationship	β	t-value	p-value	Decision
H1	Business Analytics Capabilities → Competitive Advantage	0.681	14.327	<0.001	Supported
H2	TAR → Competitive Advantage	0.214	4.186	<0.001	Supported
H3	IAR → Competitive Advantage	0.326	6.742	<0.001	Supported
H4	HAS → Competitive Advantage	0.391	8.215	<0.001	Supported

The results show that all four proposed hypotheses are supported in the simulated analysis.

4.9 Effect of Tangible Analytics Resources on Competitive Advantage

H2 proposed that Tangible Analytics Resources have a significant positive effect on competitive advantage. The simulated results indicate a positive and statistically significant relationship (β = 0.214, t = 4.186, p < 0.001).

This finding suggests that access to suitable analytical technologies, databases, cloud infrastructure, software, and integrated information systems can help SMEs improve their competitive position. Technological infrastructure provides the foundation through which business data can be collected, processed, and transformed into useful information.

However, the comparatively smaller path coefficient indicates that technological resources alone may have a limited effect when compared with organizational and human capabilities. This supports the argument that analytics technologies should be combined with complementary organizational resources to generate greater business value.

4.10 Effect of Intangible Analytics Resources on Competitive Advantage

H3 proposed a positive relationship between Intangible Analytics Resources and Competitive Advantage. The simulated analysis provides strong support for this hypothesis (β = 0.326, t = 6.742, p < 0.001).

The result indicates that organizational data quality, management support, analytical routines, knowledge-sharing practices, and data-driven culture can significantly contribute to SME competitiveness. Intangible resources determine how effectively an organization uses its technological infrastructure.

The result is consistent with previous research indicating that knowledge integration and organizational capabilities are important for converting analytics resources into innovation and competitive outcomes. Therefore, SMEs should not focus exclusively on purchasing analytics technologies but should also develop organizational processes that encourage the effective use of analytical information.

4.11 Effect of Human Analytical Skills on Competitive Advantage

H4 proposed that Human Analytical Skills significantly influence Competitive Advantage. Among the three independent variables, Human Analytical Skills demonstrated the strongest direct effect ($\beta = 0.391$, $t = 8.215$, $p < 0.001$).

This finding indicates that employees' ability to understand data, interpret analytical results, identify patterns, solve problems, and translate insights into managerial actions can make an important contribution to SME competitiveness.

The result highlights the human dimension of business analytics capability. Even when SMEs possess advanced analytical technologies, the value of these technologies depends on the ability of employees and managers to understand and apply the information generated by analytical systems. This observation is consistent with research emphasizing the importance of human and organizational capabilities in successful analytics implementation.

4.12 Overall Effect of Business Analytics Capabilities on Competitive Advantage

H1 proposed that Business Analytics Capabilities have a significant positive effect on Competitive Advantage. The simulated structural analysis produced a strong positive relationship ($\beta = 0.681$, $t = 14.327$, $p < 0.001$), supporting H1.

The result suggests that SMEs with stronger overall analytics capabilities are likely to achieve greater competitive benefits. These benefits may arise through improved operational efficiency, better understanding of customers, faster market responses, improved innovation, and stronger differentiation.

The finding is broadly consistent with previous SME research demonstrating that analytics capabilities can contribute to innovation and competitive advantage. It also supports the Resource-Based View, according to which organizational capabilities can create competitive value when resources are effectively combined and utilized.

4.13 Discussion of Findings

The overall findings suggest that business analytics capability is an important contributor to SME competitive advantage. The simulated model explains 62.4% of the variance in competitive advantage, indicating that analytics-related resources can represent an important strategic capability.

Among the three dimensions, Human Analytical Skills demonstrated the strongest direct effect, followed by Intangible Analytics Resources and Tangible Analytics Resources. This pattern indicates that simply possessing analytical technologies may not be sufficient for SMEs to obtain substantial competitive benefits.

Tangible resources provide the technological foundation for analytics activities. However, intangible resources determine how these technologies are incorporated into organizational processes, while human analytical skills determine whether employees can effectively interpret and apply the resulting information.

The findings therefore support a capability-based perspective in which competitive advantage emerges from the combination of technology, organizational resources, and human expertise. This interpretation is consistent with previous studies that emphasize complementary capabilities and decision quality as important mechanisms through which analytics can create organizational value.

The results also have practical significance for SME managers. Investments in analytics software and infrastructure should be accompanied by employee training, data-quality improvement, management support, and the development of data-driven decision-making practices. SMEs that develop all three dimensions simultaneously may be better positioned to obtain sustainable benefits from analytics.

4.14 Comparison with Previous Studies

The findings are broadly consistent with earlier research examining analytics and SME competitiveness. Cadden et al. reported that big data and marketing analytics can support innovation and competitive advantage when SMEs effectively integrate knowledge and analytical capabilities. The present simulated findings similarly indicate that analytics capabilities can contribute to competitive outcomes.

Behl et al. also demonstrated the importance of big data analytics capabilities for sustainable competitive advantage among Indian MSME service firms. The present framework extends this perspective by explicitly separating tangible analytics resources, intangible analytics resources, and human analytical skills.

Recent research has further emphasized that analytics capabilities are most valuable when they are connected to organizational decision-making and complementary capabilities. The relatively strong effect of human analytical skills in the present model reinforces this argument.

The findings are also consistent with evidence that making data and performance information more accessible can encourage small businesses to engage in more data-driven decision-making and improve business outcomes. Therefore, analytics should be viewed as an organizational capability involving technology, people, and processes rather than simply as a technological investment.

Summary of Hypothesis Results

All four hypotheses proposed in the study were supported by the simulated analysis. The results indicate that business analytics capability has a significant positive relationship with competitive advantage. Among the individual dimensions, human analytical skills showed the strongest influence, followed by intangible analytics resources and tangible analytics resources.

Table 9: Summary of Hypothesis Results

Hypothesis	Statement	Result
H1	Business analytics capabilities significantly influence competitive advantage.	Supported
H2	Tangible analytics resources significantly influence competitive advantage.	Supported
H3	Intangible analytics resources significantly influence competitive advantage.	Supported
H4	Human analytical skills significantly influence competitive advantage.	Supported

Overall, the simulated results suggest that SMEs can strengthen their competitive position by developing a balanced analytics capability that integrates technological infrastructure, organizational resources, and human analytical competencies.

5 IMPLICATIONS

5.1 Theoretical Implications

The study provides several theoretical implications. First, it contributes to the business analytics literature by treating analytics capability as a multidimensional organizational capability rather than focusing only on technology adoption.

Second, the study extends the application of the Resource-Based View to the SME analytics context. The results suggest that technological resources may provide the foundation for analytics, but organizational and human resources are essential for converting these resources into competitive value.

Third, the findings emphasize the importance of human analytical skills. The relatively stronger contribution of human capabilities indicates that employees' ability to interpret and apply data may be particularly important for realizing the strategic benefits of analytics.

Finally, the proposed framework provides an integrated perspective by examining tangible resources, intangible resources, and human analytical skills within a single model. This can provide a foundation for future studies examining additional factors such as organizational agility, innovation capability, decision quality, or digital transformation.

5.2 Practical Implications

The findings provide useful implications for SME owners and managers. First, SMEs should develop an appropriate technological foundation for analytics by investing in suitable databases, cloud platforms, business intelligence tools, and integrated information systems.

Second, technological investment should be supported by improvements in data quality and organizational processes. SMEs should establish appropriate procedures for data collection, storage, sharing, analysis, and utilization. Management should also encourage employees to use analytical information when making business decisions.

Third, employee training should receive greater attention. SMEs can provide training in data interpretation, business intelligence, statistical techniques, visualization, and analytical decision-making. Developing these skills can help employees convert analytical outputs into practical business actions.

Fourth, SMEs should encourage a data-driven organizational culture. Managers should promote the use of evidence and analytical insights rather than relying exclusively on intuition or past experience. Regular performance monitoring can help organizations identify problems and opportunities at an earlier stage.

Finally, SME managers should evaluate analytics investments according to their business value rather than simply the sophistication of the technology. Affordable cloud-based and scalable analytics solutions may be particularly appropriate for SMEs with limited financial and technical resources.

Limitations of the Study

The study has several limitations. First, the research framework focuses on three dimensions of business analytics capability and does not include all possible organizational and environmental factors that may influence competitive advantage.

Second, the proposed study uses a cross-sectional research design. Such a design provides information about relationships at a particular point in time but does not fully capture how analytics capabilities and competitive advantage develop over a longer period.

Third, the proposed measurement relies primarily on respondents' perceptions. Perceptual measures may be influenced by individual experience or subjective assessment. Future studies could combine survey responses with objective indicators such as revenue growth, productivity, customer retention, cost reduction, or market performance.

Fourth, the proposed sampling approach may limit the generalizability of the findings to all SMEs. Business analytics requirements can vary considerably across industries, geographical regions, and organizational sizes.

Finally, the numerical findings presented in this manuscript are based on a simulated dataset because actual primary data were not collected. Therefore, the reported statistical results should be treated only as an illustrative demonstration of the proposed analytical model and must be replaced with genuine empirical results before journal submission.

5.3 Future Research Directions

Future research can extend the proposed framework in several ways. Longitudinal studies could examine how analytics capabilities develop over time and whether improvements in these capabilities lead to sustained competitive advantage.

Future researchers could also examine mediating variables such as decision quality, innovation capability, organizational agility, or digital transformation capability. Moderating factors such as firm size, industry type, technological readiness, and management experience could also be incorporated into the research model.

Comparative studies between different countries and regions could provide additional insights into how institutional and technological environments influence SME analytics capabilities. Similarly, future studies could investigate the role of artificial intelligence, predictive analytics, generative AI, and automated business intelligence in developing SME competitiveness.

Another important research direction is the economic evaluation of analytics investments. Future studies could examine whether the benefits obtained from analytics technologies justify the financial and organizational resources invested by SME's

6 CONCLUSION

Business analytics has increasingly become an important organizational capability for SMEs operating in competitive and rapidly changing business environments. The present study examined the relationship between business analytics capabilities and competitive advantage by considering three major dimensions: tangible analytics resources, intangible analytics resources, and human analytical skills.

Based on the simulated analysis of 300 respondents, the findings indicate a positive relationship between business analytics capabilities and competitive advantage. The overall business analytics capability demonstrated a strong positive effect on competitive advantage ($\beta = 0.681$, $p < 0.001$). The three individual dimensions also demonstrated significant positive relationships with competitive advantage.

Among the three dimensions, human analytical skills demonstrated the strongest direct influence ($\beta = 0.391$), followed by intangible analytics resources ($\beta = 0.326$) and tangible analytics resources ($\beta = 0.214$). These results suggest that technological infrastructure alone may not be sufficient to generate competitive benefits. Instead, SMEs need to combine technological resources with appropriate organizational processes and skilled employees.

The findings support the Resource-Based View by demonstrating that competitive value can emerge from the effective combination of technological, organizational, and human resources. Business analytics should therefore be considered not simply as an information technology investment but as a strategic organizational capability.

The study concludes that SMEs can potentially strengthen their competitive position by improving their ability to collect and analyze data, establishing data-driven organizational practices, supporting analytical decision-making, and developing employees' analytical competencies. These capabilities can contribute to improved operational efficiency, innovation, market responsiveness, differentiation, and customer value.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

The authors declare that there are no financial or non-financial conflicts of interest associated with this study.

Statement of ethical approval

Ethical approval was not applicable at the manuscript-development stage because the present version of the study is based on a simulated dataset and no actual human-participant data were collected.

For the final empirical study, appropriate ethical approval will be obtained from the relevant institutional ethics committee before collecting data from human participants, where required by the institution and applicable regulations.

Statement of informed consent

No actual human participants were recruited or surveyed for the simulated analysis presented in this manuscript. Therefore, informed consent was not applicable to the present simulated dataset.

For the final study involving actual SME respondents, informed consent will be obtained from all participants before questionnaire administration. Participation will be voluntary, and participants will be informed about the purpose of the study and their right to withdraw from participation.

Data Availability

The statistical results presented in the current manuscript were generated using a simulated dataset for methodological and manuscript-development purposes. Therefore, these results should not be interpreted as empirical findings from actual SME respondents. The simulated dataset can be made available by the authors for methodological demonstration upon reasonable request. Actual empirical data availability will be stated after the completion of the proposed survey.

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