



SCIENTIFIC OASIS

Decision Making: Applications in Management and Engineering

Journal homepage: www.dmame-journal.org
ISSN: 2560-6018, eISSN: 2620-0104

Leveraging the Influence of Business Analytics Capability in Enhancing Sustainability through Improving Decision-Making Quality: Moderating Influence of Data-Driven Culture

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ARTICLE INFO

Article history:

Received 06 Jan 2026

Received in revised form 11 May 2026

Accepted 14 June 2026

Available online 30 June 2026

Keywords:

Sustainability, Business analytical capabilities, Decision making quality, SMEs.

ABSTRACT

The study focused on testing the influence of business analytics capabilities on sustainability through decision-making quality in SMEs. The study also used the data-driven culture as a moderating variable to increase the impact of business analytics capabilities on sustainability. Using a self-administered questionnaire, data were collected from 400 employees of SMEs using a convenience sampling technique. The structural model results showed that business analytics capabilities positively and significantly influence decision-making quality. On the other hand, decision-making quality also positively and significantly influences sustainability. Further, an indirect mediating effect showed that decision-making quality partially mediated the relationship between business analytics capabilities and sustainability. On the other hand, a data-driven culture also positively and significantly moderated the relationship between business analytics capabilities and decision-making quality. The study with the above findings contributed that business analytics capabilities and sustainability literature were demonstrating that decision-making quality serves as a key mechanism through which business analytics capability enhances sustainability, while also establishing the contingent role of a data-driven culture in strengthening this relationship. The study also contributed practical insights for the managers through highlighting that investments in business analytics capabilities and the development of a strong data-driven culture can improve decision-making quality that could lead to improve the sustainability.

1. Introduction

In the current dynamic environment, sustainability has become an integral strategic priority in the organizations to remain competitive [1]. This is reason, research emphasizes that sustainability is not only a peripheral objective but it is also a core organizational long term survival determinant [2]. Firms that integrate sustainability into their decision-making processes tend to achieve improved resource efficiency, stronger stakeholder relationships, and enhanced resilience in uncertain environments [3];

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4]. Prior studies identified that business analytics capabilities (BAC) significantly improve the company's sustainability when the companies have stronger decision-making quality [5]. The BAC develop effective technological infrastructure and effective human analytical skills which helps to companies to transform the raw data in the meaningful insights [3; 6] which increases the company's sustainability. Other study also highlighted that companies with the stronger capabilities are also better equipped to forecast demand, optimize operations, and reduce waste which leads to improve the sustainability [7]. In addition, BAC also increases the companies' ability to identify those opportunities which are related to sustainability, which increase the company's sustainability [8]. Theoretically, Resource-Based View (RBV) also suggests that companies with the unique capabilities which are valuable, rare, and inimitable resources helps to sustain a competitive advantage when effectively utilized [9; 10]. However, recent literature also emphasizes that analytics capabilities alone are insufficient unless they are embedded into organizational decision-making processes [11].

Therefore, despite those technological capabilities helps companies in increasing their sustainability. Along with these, BAC fundamentally transformed how the companies make their effective decision for achieving competitive advantage in the contemporary environment [12]. This is the reason, the companies are required to be more focused on data driven insights to improve their effective decision making not on the intuition-based decision-making to remain sustainable [13]. Other study also highlighted that BAC has become an integral strategic resource which helps to improve the decision making quality of the employees to extract value from data by converting it into actionable knowledge for decision-making and performance improvement [14]. Further it is also highlighted that BAC has become an integral factor in improving the decision-making quality to improve sustainability dynamic markets [6; 7; 15]. In other perspectives, BAC trend is also a specifically important for the SMEs, which face resource constraints but increasingly operate in data-rich and highly competitive environments, making analytics adoption a necessity rather than an option [3; 11; 16] which effective to the company's sustainability.

Extant literature shown that decision making quality (DMQ) played an integral in translating the analytical capabilities to improve the sustainability [3]. DMQ is being referred to the extant which helps to improve the decisions timely, rationally and aligning with the organizational objectives to improve the sustainability [6; 7]. Other study also highlighted that high DMQ also enable to the companies to effectively evaluate alternatives, reduce uncertainty, and implement strategies that align with long-term sustainability goals [17]. Further studies also demonstrated that DMQ enhances organizational performance, innovation, and environmental outcomes [3; 15]. However, the effectiveness of BAC in improving sustainability is largely dependent on whether analytical insights are properly integrated into managerial decisions [18]. Therefore, DMQ is acting as a critical mechanism which transforms the analytical capabilities into tangible sustainability outcomes through ensuring effective utilization of data-driven insights. Therefore, study focused on influence of BAC on sustainability through DMQ.

Furthermore, data driven culture (DDC) also further effects the effectiveness of analytics capabilities in improving DMQ. DDC refers to an organizational environment where decisions are systematically guided by data, evidence, and analytical reasoning rather than intuition or hierarchical judgment [19; 20]. If the companies have stronger DDC then it raises the analytical thinking, and continuous learning, which increases the utilization of business analytics systems [21]. Further research also indicated that even if companies have stronger analytical technologies fail to deliver expected value in organizations where employees lack trust in data or continue relying on subjective judgment [16; 22]. Other research also indicated that DDC increases the company's analytical capabilities through increasing the adoption and application of analytical insights in decision-making process [23]. In this regard, DDC acts as a critical boundary that determines the effectiveness of BAC

in improving DMQ, which leads to improving the sustainability [24]. The dynamic capabilities theory (DCT) also extended this perspective by emphasizing that companies' ability to sense environmental changes, seize opportunities, and reconfigure resources to maintain competitiveness in dynamic environments [25]. This shown that BAC enable to the companies to obtain the market trends when the companies have better cultures which helps to ensures the effective DMQ through structured decision processes and adaptive organizational behavior [10; 11]. Therefore, this study added the DDC as a moderating variable between BAC and DMQ to improve sustainability.

Despite the extensive studies on BAC, DMQ, DDC, and sustainability, various gaps still exist in prior literature. Prior studies have examined the direct effects of BAC on DMQ and on sustainability. For instance, Awan et al. [15] found that BAC significantly enhances DMQ. Similarly, Alzghoul et al. [26] and Abdellatif et al. [6] demonstrate that BAC improve decision speed, comprehensiveness, and quality. Research also confirms that DMQ significantly improves sustainability [3; 4]. Moreover, studies also highlighted that DDC enhances the effectiveness of analytics capabilities through promoting evidence-based DMQ practices across organizational levels [20; 22]. As there is a growing body of literature on above relationships but there is limited attention on focusing on integrated moderated mediated model. Therefore, this study overcomes the prior limitation after adding DMQ as a mediating variable to improve the impact of BAC on sustainability particularly in SME contexts. Moreover, study also added the moderating variable of DDC which remains unexplored in the prior literature in developing economies, where digital maturity and analytics adoption are still evolving. This moderate mediation is important for the companies for increasing theoretical understanding and providing practical insights into how organizations can fully leverage analytics capabilities to achieve sustainability outcomes. Therefore, study focused on testing the influence of BAC on sustainability through DMQ in SMEs. Study also tested the moderate variable of DDC. Rest of the paper was divided into further four chapters.

2. Literature Review

2.1 Theoretical Framework Development

The study framework is being developed in two theories, namely RBV and DCT. According to RBV theory, companies achieve their competitive advantage through the valuable, rare, inimitable, and non-substitutable resources [9]. Business analytical capabilities (BAC) are considered to be recognized strategic organizational resources because they enable firms to collect, process, and transform large volumes of data into actionable insights [27]. Literature supported that BAC increase the managerial understanding of market conditions, customer preferences, and operational performance, which improves the company's decision making [15] to improve the company's sustainability. On the other hand, RBV is being suggested that if the companies have minimum resources, then the companies in achieving competitive advantage also decreased [28]. Therefore, companies must effectively utilize these resources through appropriate managerial processes and organizational mechanisms. Hence, the decision making quality is being served as a critical factor in which BAC increase the company's sustainability [29]. Moreover, data-driven culture strengthens the utilization of analytical resources through encouraging evidence-based decision-making practices throughout the organization [19; 20]. There are various studies where RBV theory has been used, suggesting that resources in the organizations increase the sustainability of the companies.

Along with RBV, DCT also provided further theoretical support for the proposed relationship. In the companies, dynamic capabilities referred to the organizations ability to sense opportunities, seize emerging market trends, and reconfigure resources in response to environmental changes [25]. BAC always helps to the SMEs in developing stronger dynamic capabilities through facilitating the identification of opportunities and threats through data-driven insights [11]. Other study also

highlighted that managers needed a more effective decision making quality and it is more effective when the companies have better BAC [1]. On the other hand, an effective DDC also increase the analytical capabilities because employees and managers are more likely to rely on analytical evidence rather than intuition when making decisions [22]. Therefore, RBV and DCT integration provides a comprehensive theoretical explanation for the effect of BAC sustainability with the moderating role of data-driven culture, and the mediating role of decision-making quality in SMEs. The above predicted variables are depicted in Figure.1 below



Fig.1: Research Framework

2.2 Hypothesis Development

2.2.1 Business Analytics Capabilities and Decision-Making Quality

BAC is being referred to company's abilities to support the managerial and strategic decision-making [27]. Big data analytical capabilities consisted of various analytical capabilities, organizational learning mechanism which helps to transform data in the meaningful form to increase the company's DMQ [6; 15]. In other words, BAC has been emerged as a critical organizational resource because companies are living in data-rich and highly competitive environments where evidence-based decision-making is essential for success [16; 27]. Furthermore, BAC also helps to the managers in reducing uncertainty, identify opportunities, improve forecasting accuracy, and support strategic planning activities [7; 11]. Other study also highlighted that companies with stronger analytical capabilities are better able to sense environmental changes, seize opportunities, and reconfigure resources to address market challenges [11]. Therefore, BAC facilitate superior decision-making through improving information quality, reducing ambiguity, and enhancing managerial understanding of complex business situations [6; 26]. Awan et al. [15] empirically also found that BAC significantly enhances data-driven insights, which subsequently improve DMQ. Alzghoul et al. [26] study also found that BAC positively influences decision speed and decision comprehensiveness, leading to better managerial decisions. In addition, Abdellatif et al. [6] demonstrated that BAC improves DMQ through enhanced information processing and strategic evaluation. Fattah [7] study results also found that BAC significantly strengthens the impact of business analytics capabilities on DMQ. These prior studies highlighted that a stronger BAC positively and significantly improves DMQ and accordingly hypothesis is,

H1: Business analytical capability significantly improves the company's decision-making quality.

2.2.2 Decision-Making Quality and Sustainability

DMQ refers to those factors which shown that managerial decisions are accurate, and are being aligned with the company's goals [1]. Better DMQ consisted of systematic evaluation of alternatives, and better use of information [6; 7]. DMQ is also important because limitation of resources also enhances the consequences of strong errors which minimizes the sustainability of companies [29]. This is reason literature highlighted that companies which have DMQ are more likely to achieve operational efficiency which leads to sustainable growth [1; 15]. Other study also enforced that

company's sustainability achievement is entirely based on making effective decisions in utilization of resources, stakeholder management, environmental protection, and innovation investments [4]. In other perspectives, DMQ also played an effective role in ensuring that company's actions are being aligned with sustainability objectives because effective decisions support long-term value creation and responsible business practices [15]. Awan et al. [15] empirical study also highlighted that DMQ positively increases the sustainability through enabling firms to adopt environmentally sustainable practices. Anwar et al. [3] study also found that company's utilization of data driven decision making process also helps to achieve the sustainability of the companies. Szukits and Móricz [19] similar study also found that analytics-supported decisions improve resource efficiency and environmental performance. Escandon-Barbosa and Salas-Paramo [42] further demonstrated that effective DMQ enhances organizational sustainability through facilitating efficient resource utilization and stakeholder satisfaction. These prior studies highlight that DMQ is an integral component to increase the sustainability of the companies, and accordingly, the hypothesis is,

H2: Decision-making quality significantly improves sustainability.

2.2.3 Moderating Role of Data-Driven Culture

DDC consisted of a company environment where employees and managers use their data, analytical insights to improve their decision-making system [19]. Literature supported that companies that have a better DDC always encourage it in the organization through sharing their information and improving analytical thinking which increase the company's sustainability [19; 20]. DDC also helps the companies in maximizing their values which are derived from the business analytics investment, by encouraging managers to incorporate analytical insights into their daily operations and strategic decisions [16; 22]. Although organizations may possess advanced analytical technologies and business intelligence systems, the benefits of these resources depend largely on organizational culture. Research suggests that analytics capabilities alone are insufficient unless managers trust and actively use analytical information during decision-making [20]. In this regards, DDC could help to improve the company's BDAC to improve DMQ through encouraging evidence-based managerial behavior [16; 22]. Szukits and Móricz [19] study empirically also found that analytical culture significantly promotes data-driven decision-making by encouraging managers to rely on evidence-based practices. Wong and Ngai [20] demonstrated that data-driven culture strengthens the positive effect of analytics capability on organizational performance and operational effectiveness. Hurbean et al. [22] study also found that companies with strong DDC achieve greater benefits from business intelligence systems because managers utilize analytical outputs more effectively. Ragazou et al. [16] further observed that SMEs adopting BDAC achieve better DMQ when supported by a culture emphasizing analytical thinking. These prior studies suggested that DDC significantly increase the effectiveness of BAC to improve the DMQ and accordingly hypothesis is,

H3: Business analytical capabilities significantly increase the decision-making quality with moderating role of big data culture.

2.2.4 Mediating Role of Decision-Making Quality

Previous studies have shown that effect of business analytics capabilities has been tested directly with a limited attention of DMQ as mediating effect. DMQ is being recognized an integral mechanism which helps to increase the effect of BAC on sustainability [29]. Because the BAC provide organizations with access to valuable information, insights, and predictive knowledge, these resources create value only when they are effectively utilized in managerial decision-making [6; 15]. Consequently, DMQ quality serves as an important intermediary that converts analytical resources into strategic actions and organizational performance improvements [7; 11] which could lead to improve the sustainability. Other study also suggested that BAC contribute to sustainability through

complementary managerial decisions [27]. Other study also emphasized that organizations derive value from analytical resources when managers transform analytical insights into effective decisions and strategic actions [11]. Based on these studies, it is highlighted that BAC are expected to improve sustainability indirectly through enhanced DMQ, which enables organizations to allocate resources effectively, reduce inefficiencies, and achieve long-term sustainability goals [1; 15]. Awan et al. [15] empirical study also found that BAC improves sustainability through effective DMQ. Anwar et al. [3] study also found that analytics adoption positively influences sustainability through DMQ. Abdellatif et al. [6] study also further established that BAC improves sustainability through enhanced decision-making comprehensiveness. These prior studies emphasized that the sustainability of the companies is increased when the companies effectively focus more on improving decision making through BAC. In this regard, DMQ could serve as an essential pathway through which BAC contributes to sustainability and accordingly hypothesis is,

H4: Business analytical capacities significantly improve sustainability with mediating effect of decision-making quality.

3. Research Methods

The study adopted a quantitative research approach where empirical tested the association among institutional pressures, EMS, mechanical operational efficiency, green organizational culture, and sustainable performance. A quantitative research approach provides objective, reliable, and statistically measurable results that can be generalized to a larger population [30]. The data was collected from employees of banking sector using self-administered survey instrument. Therefore, cross sectional research design is most appropriate for the current study where data collected on one time. The cross sectional research design was used because it enables researchers to collect data from a large population at a single point in time, making it a cost-effective and efficient approach for examining relationships among variables [31].

3.1 Research Instrument Development and Sampling Technique

Research instrument taken from previous studies, where it already used and tested. For instance, business analytics capabilities comprised with five items of [32]. Similarly, data driven culture comprised from also five items [33]. Furthermore, decision making quality comprised with 4 items of [34]. Lastly, sustainability comprised with six items of [34]. Each of the above items was ranked on five-point likert scale. Study target population was the employees of SMEs where total 500 questionnaires were distributed among SMEs employees using convenient sampling techniques. The convenient sampling technique was employed due to accessibility, time constraints, and organizational limitations [35]. Moreover, this approach was selected due to its practicality in accessing manufacturing employees across different organizations and geographical locations. As questionnaires was distributed among 500 employees and out of these 400 valid responses were returned, yielding a response rate of 70%, which is considered adequate for multivariate analysis and structural equation modeling (SEM) [36]. Distributed questionnaire consisted of two sections: demographic information and measurement items using a five-point Likert scale

4. Data Analysis and Results

4.1 Demographic Analysis

This section shown the demographic characteristics of the study which shown that among 400 respondents most of the respondents male 254 respondents (63.5%), while 146 respondents (36.5%) were female. While the age distribution, most of the respondents are between the ages 31 to 40 years, accounting for 134 respondents (33.5%), followed by those aged 41–50 years with 121

respondents (30.3%). Respondents aged 20–30 years represented 78 individuals (19.5%), while 67 respondents (16.7%) were above 50 years of age. In terms of educational qualifications, most respondents held a master’s degree (201 respondents, 50.3%), followed by a bachelor’s degree (132 respondents, 33.0%). A smaller proportion possessed MPhil/MS qualifications (48 respondents, 12.0%), while only 19 respondents (4.7%) held a PhD degree. Concerning SME experience, the largest category included respondents with 5–10 years of experience (141 respondents, 35.3%), followed by those with 11–15 years of experience (109 respondents, 27.2%). Additionally, 86 respondents (21.5%) had less than 5 years of experience, whereas 64 respondents (16.0%) reported more than 15 years of SME experience. Above results are in Table.1.

Table 1

Demographic Profile

Demographic Variable	Category	Frequency	Percentage (%)
Gender	Male	254	63.5
	Female	146	36.5
Age	20-30 Years	78	19.5
	31-40 Years	134	33.5
	41-50 Years	121	30.3
	Above 50 Years	67	16.7
Education	Bachelor	132	33.0
	Master	201	50.3
	MPhil/MS	48	12.0
	PhD	19	4.7
SME Experience	Less than 5 Years	86	21.5
	5–10 Years	141	35.3
	11–15 Years	109	27.2
	Above 15 Years	64	16.0

4.2 Common Method Biased

In the current study, the common method biased was assessed using the collinearity test where the Variance Inflation Factor (VIF) was examined for all the constructs. Findings indicated that all VIF values were less than the recommended threshold values 3.3, which indicates that multicollinearity and common method bias are not serious concerns in the data [37]. Since none of the constructs exceeded the critical value, it can be concluded that the relationships among the variables are not substantially influenced by a single source of measurement error. Therefore, the study demonstrates adequate protection against common method bias, supporting the validity and reliability of the findings. The above results are in Table.2.

Table 2

Common Method Bias

Relationship	VIF
BAC → DMQ	1.98
BAC → SUS	2.31
DMQ → SUS	2.55
DDC → DMQ	1.76
BAC×DDC → DMQ	2.09

4.3 Convergent Validity

Results of the study were interpreted using Partial Least Square (PLS)-Structural Equation Modeling (SEM) in two measurement and structural models. Constructs convergent validity was being

assessed using the factor loadings, Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE). Convergent validity refers to the degree to which multiple indicators of the same construct converge and share a high proportion of variance [38]. The study results show that all factor loadings value greater than threshold of 0.70 which indicates that the indicators adequately represent their respective constructs. Moreover, Cronbach's alpha values were above 0.70, which is demonstrating satisfactory internal consistency reliability among the measurement items [39]. In the same vein, all composite reliability was above 0.70 which shows the strong construct reliability and consistency. In addition, the AVE values exceeded the threshold of 0.50, indicating that each construct explained more than 50% of the variance in its indicators, thereby establishing adequate convergent validity [40]. Below are all results shown that construct fulfill the requirement of convergent validity [38].

Table 3

Measurement Model Assessment

Construct	Cronbach α	CR	AVE
BAC	0.901	0.924	0.671
DMQ	0.893	0.921	0.701
DDC	0.885	0.915	0.684
SUS	0.914	0.932	0.696

Note: Business analytics capability, DMQ-decision making quality, DDC-data driven culture, SUS-sustainability.

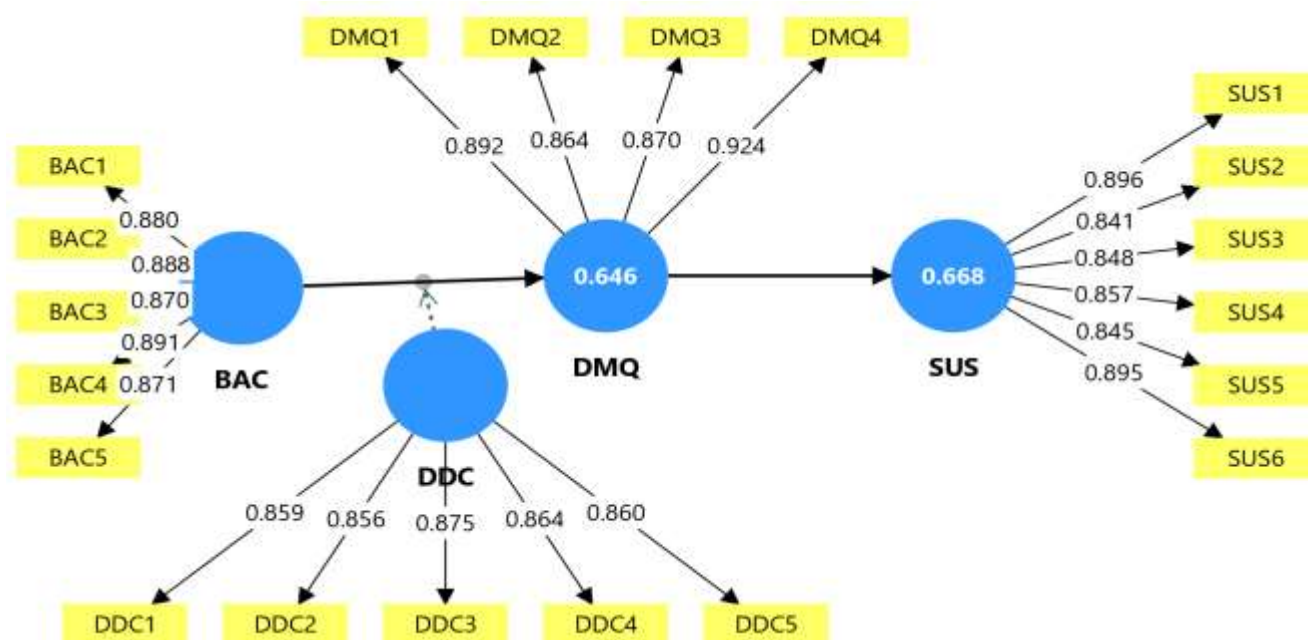


Fig.2: Measurement model

4.4 Discriminant Validity

Construct discriminant validity was being assessed using the Heterotrait–Monotrait Ratio (HTMT), which evaluates the degree to which a construct is empirically distinct from other constructs in the model [41]. Findings show that all HTMT values are being less than from recommended values 0.85 which shows the adequate discriminant validity among the constructs. All these findings show that each construct captures a unique phenomenon and shares greater variance with its own indicators than with indicators of other constructs. Therefore, the measurement model exhibits satisfactory discriminant validity, confirming that the latent variables are conceptually and empirically distinct from one another [38; 41]. Results are in Table.4.

Table 4

HTMT Discriminant Validity

Construct	BAC	DMQ	DDC	SUS
BAC	-			
DMQ	0.721	-		
DDC	0.613	0.664	-	
SUS	0.694	0.785	0.618	-

4.5 R Square and Q square

In the model, coefficient of determination shown that all independent variables the 64.6% of the variance in DMQ and 66.8% of the variance in Sustainability. According to Hair et al. [38], these values represent moderate explanatory power, suggesting that the predictor variables adequately explain both endogenous constructs. In this regard, structural model demonstrates satisfactory predictive accuracy and explanatory capability, and the results are in Table.5.

Table 5

Coefficient of Determination (R^2)

Endogenous Variable	R^2
DMQ	0.646
SUS	0.668

Furthermore, predictive relevance (Q^2) of the structural model was assessed using the blindfolding procedure. Findings indicated that DMQ has 0.372 Q square values while the sustainability has 0.378 Q square values. As the Q square values are above 0 where the model demonstrates satisfactory predictive relevance for both endogenous constructs, and this is showing that model has adequate capability to predict DMQ and sustainability [38]. The results are in Table.6.

Table 6

Predictive Relevance (Q^2)

Construct	SSO	SSE	Q^2
DMQ	2000	1346	0.327
SUS	2400	1492	0.378

4.6 Hypothesis Results

Structural model results show that BAC has a significant and positive ($\beta = 0.593$, $t = 11.432$, $p < 0.001$) effect on DMQ, supporting H1 and suggesting that organizations with stronger business analytics capabilities achieve higher-quality decision-making. Moreover, the DMQ also significantly ($\beta = 0.468$, $t = 8.764$, $p < 0.001$), enhances SUS supporting H2 and indicating that effective decision-making contributes to improved sustainability outcomes. On the other hand, moderation results reveal that DDC positively ($\beta = 0.214$, $t = 4.173$, $p < 0.001$) strengthens the relationship between BAC and DMQ, supporting H3 and implying that the positive impact of business analytics capability on decision-making quality becomes stronger in organizations with a robust data-driven culture. Moreover, indirect mediating effect results show that DMQ significantly mediates the relationship between BAC and Sustainability ($\beta = 0.277$, $t = 6.592$, $p < 0.001$), supporting H4 and demonstrating that business analytics capability contributes to sustainability indirectly through its positive influence on decision-making quality. These results show that BAC plays a critical role in enhancing sustainability through improving decision-making processes, particularly in organizations that foster a strong DDC and above results are in Table.7.

Table 7

Structural Model Results

Relationship	B	T-value	P-value	Decision
BAC → DMQ	0.593	11.432	0.000	Supported
DMQ → SUS	0.468	8.764	0.000	Supported
BAC×DDC → DMQ	0.214	4.173	0.000	Supported
BAC → DMQ → SUS	0.277	6.592	0.000	Supported

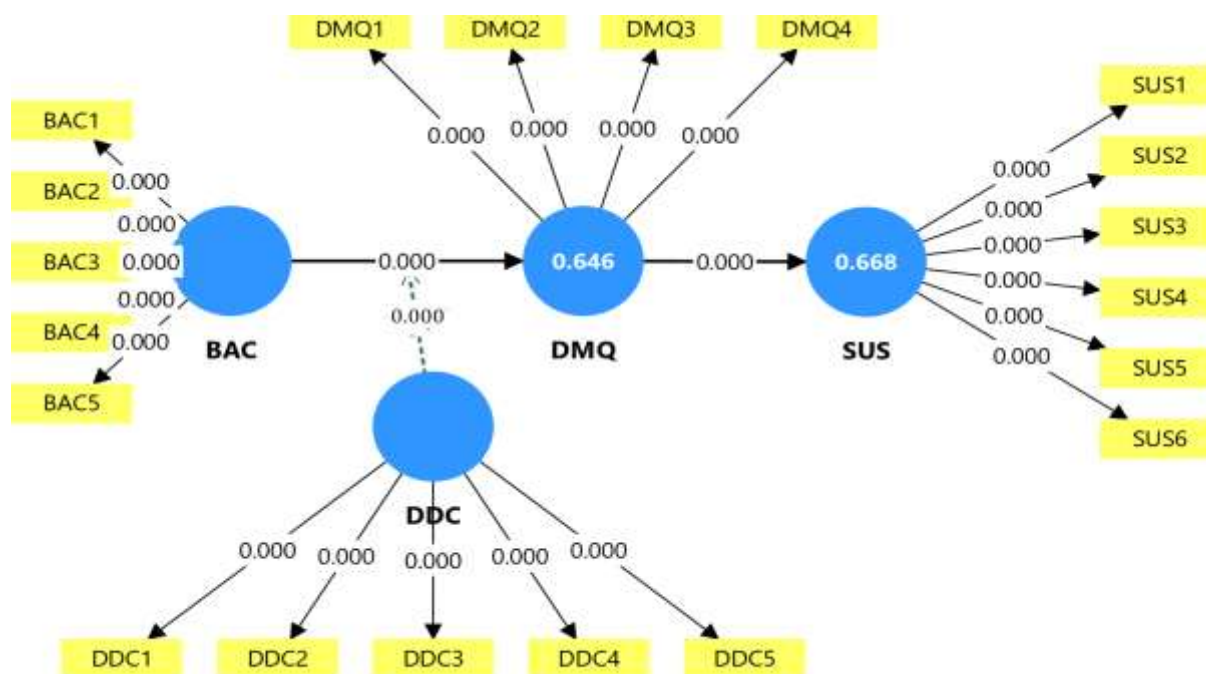


Fig.3: Structural Model

5. Discussion

Research focused on testing the influence of BAC on sustainability through DMQ in SMEs. Study also tested the moderate variable of DDC. Rest of the paper was divided into further four chapters. The study results show that BAC has significantly positive effects on DMQ in SMEs. This result indicates that SMEs possessing stronger analytical capabilities are more likely to make accurate, timely, and evidence-based decisions. The positive coefficient indicated that investments in analytical technologies, data management systems, and analytical skills substantially improve managerial decision-making processes. The results also highlighted that BAC enables managers to access relevant information, identify business opportunities, evaluate alternatives effectively, and reduce uncertainty during decision-making. The study results are consistent with the study of Awan et al. [15] where they found that BAC significantly enhances data-driven insights, which subsequently improve DMQ. Alzghoul et al. [26] results also found that BAC positively influences decision speed and decision comprehensiveness which significantly improve the DMQ. Abdellatif et al. [6] further demonstrated that business analytics capabilities improve decision quality through enhanced information processing and strategic evaluation. Likewise, Fattah [7] concluded that analytics competency and big data literacy significantly strengthen managerial decision-making performance. Study findings are more important for the SMES because SMEs often operate under resource constraints and uncertain market conditions. Unlike large organizations, SMEs generally have limited financial and human resources, making decision quality a critical factor for survival and growth. Thus, study findings suggested that SMEs could improve their competitiveness through developing analytical capabilities

that support strategic and operational decisions. Thus, based on these findings it is argued that SMEs should always have larger investment in effective digital technologies to improve analytical competencies and such initiatives can significantly enhance DMQ and overall organizational performance.

Further results show that DMQ also positively and significantly increases the sustainability of SMEs. These results show that SMEs which have stronger quality decisions are more able to achieve sustainability objectives. These results show that SMEs have accurate, timely, and well-informed decisions which enable them to optimize resource utilization, reduce operational inefficiencies, improve environmental performance, and achieve long-term business success. The significant positive relationship also demonstrates that sustainability outcomes depend heavily on managerial decisions that balance economic, environmental, and social considerations. The results is in line with the study of Awan et al. [15] where they found found that DMQ significantly improves sustainability through facilitating environmentally DMQ quality positively influences sustainability among SMEs by supporting effective sustainability initiatives. Novicka and Volkova [1] study results also found that organizations utilizing better DMQ are more successful in achieving sustainability. Safranek and Zváčková [4] further emphasized that real-time data-driven decision-making contributes significantly to sustainable organizational behavior and resource efficiency. As the findings of the present study align with the growing body of literature suggesting that decision quality is a critical antecedent of sustainability performance. Therefore, results are important for SMEs because for these organizations sustainability has become a key determinant of long-term competitiveness and survival because the SMEs majorly face challenges related to limited resources, environmental regulations, changing customer expectations, and market uncertainty. High QDM always enables SMEs to address these challenges effectively through selecting sustainable strategies, managing risks proactively, and allocating resources efficiently. Therefore, it is argued that SMES which are focusing more on DMQ then are more able to achieve sustainable growth, improve stakeholder relationships, and strengthen their market position which could increase the company's sustainability. For this purpose, SMEs managers should be properly established effective and formal decision-making procedures which help to incorporate data analysis, performance monitoring, and sustainability considerations.

In addition to direct effect, further moderating effect results shown that DDC positively moderated in between BAC and DMQ of SMEs. These results indicated that BAC effect on DMQ becomes stronger when the SMEs possess a stronger DDC. In other words, analytics capabilities generate greater benefits when employees and managers actively utilize data and analytical evidence during decision-making processes. The findings suggest that analytical technologies alone are insufficient; organizations must also cultivate a culture that values data-driven decision-making. The results is supported with the study of Szukits and Móricz [19] where they found that DDC significantly promotes DDC through encouraging managers to rely on evidence-based management practices. Wong and Ngai [20] study also found that DDC strengthens the positive impact of analytics capability on sustainability. Hurbean et al. [22] study also reported that organizations with strong DDC greater value from business intelligence and analytics systems. Ragazou et al. [16] further found that SMEs achieve superior decision-making outcomes when analytical technologies are supported by a culture that emphasizes data utilization and analytical thinking. These prior findings and study results lie in the fact that most of the SMEs are investing more in analytical tools but are still unable to achieve their expected results because employees do not fully utilize available analytical information. For this purpose, DDC encourages employees to trust data, engage in analytical thinking, and incorporate evidence into managerial decisions. Therefore, it is enforced that SMEs must be possessing more of both strong analytical capabilities and a strong data-driven culture to improve DMQ which could lead to improve sustainability. This finding emphasizes the role of organizational culture as a critical success factor in digital transformation initiatives. Therefore, it is argued that SME managers should

focus on cultivating a DDC through encouraging evidence-based management practices, promoting data literacy, and rewarding analytical behavior that could strengthen the effectiveness of BAC to improve DMQ which could improve the sustainability.

Further results indicated that DMQ also partially mediated in between BAC and sustainability in SMEs. This mediating effect shows that BAC positively and significantly increases the SMEs sustainability through improving the quality of managerial decisions. Although BAC provides organizations with access to valuable information and insights, sustainability benefits are realized only when managers effectively utilize these insights in decision-making processes. In this regard, DMQ is being served as a crucial mechanism through which analytics capabilities influence sustainability. The result is supported with the prior study of Awan et al. [15] where they demonstrated BAC capability improves sustainability through data-driven insights and decision-making processes. Abdellatif et al. [6] results also found that BAC improve organizational outcomes through enhanced decision quality, decision speed, and decision comprehensiveness. Anwar et al. [3] findings also found that analytics adoption positively influences sustainability through improved managerial DMQ. Novicka and Volkova [1] further argued that sustainability performance depends on the organization's ability to transform analytical resources into effective strategic decisions. These studies collectively support the mediating role of decision-making quality identified in the present research. Therefore, study findings are significantly relevant for the SMEs because these findings are highlighting the right pathway in taking investment on BAC could improve DMQ to enhance sustainability. Consequently, it is enforcing that SMEs should focus not only on acquiring analytical technologies but also on enhancing decision-making processes to maximize the sustainability benefits of analytics investments which could help to achieve long-term competitive advantage.

6. Theoretical Implications

This study contributed to the existing literature by enhancing the understanding of how Business Analytics Capabilities (BAC) influence Sustainability through Decision-Making Quality (DMQ) in SMEs. The findings contributed empirical evidence that business analytics capabilities are valuable organizational resources that improve decision-making quality and ultimately enhance sustainability performance. The significant relationship between BAC and DMQ contributed to the growing body of knowledge by confirming that organizations derive greater value from analytical resources when they improve managerial decision processes. Additionally, the significant effect of DMQ on Sustainability contributed to the literature by highlighting decision-making quality as an important factor in achieving long-term organizational success and sustainability outcomes.

The study further contributed to theory by validating both the moderating role of Data-Driven Culture (DDC) and the mediating role of Decision-Making Quality. The findings contributed by demonstrating that the effectiveness of business analytics capabilities depends on the presence of a culture that encourages evidence-based decision-making. Moreover, the mediation findings contributed by explaining the mechanism through which analytics capabilities influence sustainability outcomes. The validated moderated mediation model therefore contributed to a more comprehensive framework for understanding the relationships among analytics capabilities, organizational culture, decision-making quality, and sustainability within SMEs.

7. Practical Implications

The findings of this study contributed to important practical implications for SME managers and business practitioners. The significant impact of Business Analytics Capabilities on Decision-Making Quality contributed evidence that investments in analytics technologies, business intelligence systems, and employee analytical skills can improve managerial effectiveness. Similarly, the significant influence of Decision-Making Quality on Sustainability contributed to practical insights indicating that SMEs can achieve better economic, environmental, and social performance through

evidence-based decision-making. Therefore, SME managers should invest in analytical infrastructure, data management practices, and employee training programs to strengthen decision-making capabilities and improve sustainability outcomes. Furthermore, the findings contributed practical guidance by demonstrating that Data-Driven Culture strengthens the effectiveness of business analytics capabilities. This suggests that SMEs should not only invest in analytical technologies but also develop a workplace culture that encourages the use of data in managerial decisions. The mediation findings further contributed to practical understanding by showing that analytics capabilities create sustainability value primarily through improved decision-making quality. Therefore, SME owners, policymakers, and support institutions should focus on promoting data literacy, analytical competencies, and evidence-based management practices to maximize the benefits of digital transformation initiatives and enhance long-term sustainability performance.

8. Conclusion and Future directions

The study focused on testing the influence of business analytics capabilities on sustainability through decision making quality in SMEs. Study also used data-driven culture as a moderating variable to increase the impact of business analytics capabilities on sustainability. Using a self-administered questionnaire, data was collected from 400 employees of SMEs using a convenient sampling technique. The structural model results show that business analytics capabilities positively and significantly influence decision making quality. On the other hand, decision making quality also positively and significantly influence sustainability. Further indirect mediating effects show that decision making quality is partially mediated between business analytics capabilities and sustainability. On the other hand, data driven culture is also positively and significantly moderated between business analytics capabilities and decision-making quality. The study with the above findings contributed that business analytics capabilities and sustainability literature through demonstrating that decision-making quality serves as a key mechanism through which business analytics capability enhances sustainability, while also establishing the contingent role of a data-driven culture in strengthening this relationship. The study also contributed practical insights for the managers through highlighting that investments in business analytics capabilities and the development of a strong data-driven culture can improve decision-making quality that could lead to improved sustainability.

The study has various limitations and future directions. For instance, a study tested the moderated mediating effect but ignored the direct effect of business analytics capabilities on sustainability. In this regard, further research could be conducted on the direct effect of business analytics capabilities on sustainability. Moreover, a study using cross-sectional research design while ignoring longitudinal research design. Therefore, further research could be conducted on longitudinal research because the decision-making process has changed in various stages. Lastly, study was mainly focused on quantitative research while ignoring the qualitative research approach. To remove these limitations, further research could be explored on mixed methods of both qualitative and quantitative research approach to increase study generalizability.

Funding

This work was supported by the Deanship of Scientific Research, Vice Presidency for Graduate Studies and Scientific Research, King Faisal University, Saudi Arabia [Grant Number KFU263496].

Acknowledgement

The authors would like to acknowledge and thank Prince Sultan University for its facilities, support and incentives.

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