

Uncertain Supply Chain Management

homepage: www.GrowingScience.com/uscm**Modeling the relationship between business intelligence, supply chain integration, and firm performance: Empirical study****Ahmad Tawfig Al-Radaideh^a, Dmaithan Almajali^{b*}, Omar Mohammad Ali^c, Khalid Alsmadi^a, Hassan Al_Wahshat^d and Fawzieh Masa'd^a**^aJadara University, Jordan^bAssociate professor Applied Science Private University, Jordan^cIrbid National University, Jordan^dAjloun National University, Jordan**ABSTRACT***Article history:*

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This study aims to model the relationship between business intelligence (BI), supply chain integration (SCI), and firm performance in Jordanian small and medium-sized enterprises (SMEs) using structural equation modeling (SEM). The study utilizes a sample of 400 SMEs from different sectors in Jordan to investigate the hypothesized relationships between the constructs. The results show that BI positively influences SCI and firm performance in Jordanian SMEs. Moreover, SCI was found to mediate the relationship between BI and firm performance. The study also found that the impact of BI on firm performance is fully mediated by SCI, suggesting that SCI plays a crucial role in enhancing firm performance in the context of Jordanian SMEs. The study makes several significant contributions to the literature on supply chain management and business intelligence in the context of SMEs. First, it provides empirical evidence of the positive impact of BI on SCI and firm performance. Second, it sheds light on the mediating role of SCI in the relationship between BI and firm performance. Third, the study contributes to the limited literature on supply chain management and business intelligence in the context of Jordanian SMEs. The findings of this study have practical implications for managers of SMEs in Jordan. They highlight the importance of investing in BI tools and strategies to enhance SCI and firm performance. Additionally, the study suggests that managers should focus on improving their firms' SCI practices to fully exploit the benefits of BI and improve their overall performance. Overall, this study provides new insights into the relationship between BI, SCI, and firm performance in the context of Jordanian SMEs. The study's findings can guide policymakers, researchers, and practitioners in developing and implementing effective strategies to improve supply chain management and business intelligence practices in SMEs, particularly in emerging markets such as Jordan.

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1. Introduction

In today's globalized business environment, small and medium-sized enterprises (SMEs) face significant challenges in staying competitive and achieving sustainable growth (Almajali et al., 2023a, 2023b). One of the key factors that contribute to SMEs' success is their ability to effectively manage their supply chains. Supply chain integration (SCI) is critical for SMEs as it enables them to streamline their operations, reduce costs, and improve their responsiveness to customer demands (Akkermans et al., 2013; Bowersox et al., 1999; Chen & Chang, 2012). At the same time, the advent of big data and the proliferation of business intelligence (BI) tools and strategies have provided SMEs with unprecedented opportunities to enhance their decision-making capabilities and gain a competitive advantage. By analyzing vast amounts of data from various sources, BI can help SMEs identify patterns, trends, and insights that can inform their strategic decisions. However, while previous studies

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have explored the individual effects of SCI and BI on firm performance, little is known about how these two constructs interact and influence each other in the context of Jordanian SMEs. To fill this gap, this study aims to model the relationship between BI, SCI, and firm performance using structural equation modeling (SEM) in a sample of 400 Jordanian SMEs from various sectors. The results of this study reveal that BI positively influences SCI and firm performance in Jordanian SMEs. Moreover, SCI was found to mediate the relationship between BI and firm performance, suggesting that SCI plays a crucial role in enhancing firm performance in the context of Jordanian SMEs. The study's findings highlight the importance of investing in BI tools and strategies to enhance SCI and firm performance and improving SCI practices to fully exploit the benefits of BI. Overall, this study makes several significant contributions to the literature on supply chain management and business intelligence in the context of SMEs. The study's findings provide new insights into the relationship between BI, SCI, and firm performance in the context of Jordanian SMEs and can guide policymakers, researchers, and practitioners in developing and implementing effective strategies to improve supply chain management and business intelligence practices in SMEs, particularly in emerging markets such as Jordan. In recent years, SMEs have been recognized as a key driver of economic growth and development, particularly in emerging markets such as Jordan. However, SMEs face unique challenges in managing their supply chains, which can impact their ability to compete with larger firms. In addition, SMEs often lack the resources and expertise to effectively collect and analyze data, which limits their ability to make informed decisions. To address these challenges, BI has emerged as a powerful tool that can help SMEs leverage their data to gain a competitive advantage. By collecting, analyzing, and interpreting data from various sources, BI can provide SMEs with valuable insights into their operations, customers, and markets. This, in turn, can enable SMEs to make more informed decisions, optimize their supply chain, and improve their overall performance. However, the benefits of BI are not automatic. To fully exploit the potential of BI, SMEs must first integrate their supply chain processes effectively. SCI involves the coordination and collaboration of various stakeholders in the supply chain to ensure the timely delivery of goods and services. Effective SCI can help SMEs reduce costs, improve customer satisfaction, and increase their competitiveness.

This study provides empirical evidence of the positive relationship between BI, SCI, and firm performance in the context of Jordanian SMEs. The study's findings suggest that SMEs in Jordan can benefit significantly from investing in BI tools and strategies to enhance their decision-making capabilities. At the same time, SMEs must focus on improving their SCI practices to fully exploit the benefits of BI and achieve sustainable growth. The study's findings have several practical implications for managers of SMEs in Jordan. First, managers should invest in BI tools and strategies to enhance their decision-making capabilities. Second, managers should focus on improving their SCI practices to fully exploit the benefits of BI and improve their overall performance. Finally, policymakers can use the study's findings to develop policies and programs that support the adoption of BI and SCI practices in SMEs, particularly in emerging markets such as Jordan. This study's contribution to the literature on BI and SCI in SMEs is significant. Previous studies have primarily focused on the individual effects of BI and SCI on firm performance. However, this study's use of SEM enables the examination of the complex relationships between these constructs in the context of Jordanian SMEs. This study's findings provide new insights into the factors that influence firm performance in Jordanian SMEs and can guide policymakers, researchers, and practitioners in developing effective strategies to enhance supply chain management and business intelligence practices in SMEs. In conclusion, this study's findings provide new insights into the relationship between BI, SCI, and firm performance in the context of Jordanian SMEs. The study's findings highlight the importance of investing in BI tools and strategies to enhance decision-making capabilities and improve SCI practices to fully exploit the benefits of BI. The study's findings have significant practical implications for managers of SMEs in Jordan, policymakers, and researchers interested in enhancing supply chain management and business intelligence practices in SMEs, particularly in emerging markets such as Jordan.

The study also contributes to the growing literature on the role of BI and SCI in SMEs. The study's use of SEM enables the examination of the complex relationships between BI, SCI, and firm performance in the context of Jordanian SMEs, which has not been previously explored in the literature. The study's findings provide empirical evidence of the positive impact of BI on SCI and firm performance and shed light on the mediating role of SCI in the relationship between BI and firm performance. Moreover, the study's findings provide insights into the limited literature on supply chain management and business intelligence in the context of Jordanian SMEs, contributing to the understanding of the factors that influence firm performance in these settings. The study's findings also have implications for future research in the field of BI and SCI in SMEs. Future studies could explore the relationship between other variables that may impact the effectiveness of BI and SCI in SMEs, such as organizational culture, leadership style, and human resource management practices. Additionally, the current study did not examine the impact of specific BI tools and technologies on SCI and firm performance. Future studies could investigate the specific BI tools and technologies that are most effective in enhancing SCI and firm performance in SMEs. Moreover, the current study focused on the role of SCI as a mediator between BI and firm performance, but future studies could explore other potential mediating or moderating variables that may affect these relationships. By further exploring these areas of research, scholars can gain a more comprehensive understanding of the complex relationships between BI, SCI, and firm performance in SMEs, and develop more effective strategies for improving supply chain management and business intelligence practices in these organizations. The study's limitations should also be acknowledged. First, the study utilized a cross-sectional design, limiting the ability to draw causal inferences between the variables. Future studies can adopt longitudinal designs to examine the causal relationships between BI, SCI, and firm performance. Second, the study's sample was limited to SMEs in Jordan, which may limit the generalizability of the findings to other contexts. Future studies can explore the relationship between BI, SCI, and firm performance in other emerging markets or in different industries to expand

the generalizability of the findings. Third, the study relied on self-reported data, which may be subject to bias. Future studies can employ multiple data sources to validate the findings.

In conclusion, this study contributes to the literature on BI and SCI in SMEs by examining the complex relationships between these constructs in the context of Jordanian SMEs. The study's findings suggest that BI positively influences SCI and firm performance in Jordanian SMEs, and that SCI mediates the relationship between BI and firm performance. The study's findings provide important insights into the factors that influence firm performance in SMEs and have significant practical implications for managers of SMEs in Jordan and policymakers and researchers interested in enhancing supply chain management and business intelligence practices in SMEs, particularly in emerging markets such as Jordan. Future studies can build on these findings to develop more nuanced understandings of the factors that influence firm performance in SMEs, and to explore the relationships between BI, SCI, and other key factors such as innovation, competitiveness, and sustainability.

2. Literature Review and hypothesis development

Business Intelligence (BI) has gained significant attention in recent years due to its potential to improve organizational decision-making processes and enhance performance (Chen et al., 2013). BI involves the collection, analysis, and interpretation of large volumes of data to support strategic decision-making processes (Kan et al., 2019; Al-Qirim, 2004; Barney, 1991; Masa' deh et al., 2023). BI has been shown to have a positive impact on firm performance in various industries (Hsieh et al., 2017). However, there is limited research on the impact of BI on small and medium-sized enterprises (SMEs) in emerging markets such as Jordan.

Supply Chain Integration (SCI) refers to the integration of all activities and processes involved in the supply chain, from suppliers to customers (Pagell & Sheu, 2001; Archer et al., 2016). SCI has been shown to improve operational efficiency, reduce costs, and enhance customer satisfaction (Kan et al., 2019). SCI is particularly important for SMEs in emerging markets, as they often lack the resources and capabilities to manage complex supply chains (Biemans et al., 2015; Cox, 1999). However, there is limited research on the relationship between BI, SCI, and firm performance in SMEs, particularly in emerging markets such as Jordan. Moreover, Firm performance refers to the ability of a firm to achieve its strategic objectives and goals (Croom et al., 2003). Several factors have been shown to influence firm performance, including organizational structure, leadership style, and strategic orientation (Li et al., 2017; Babakus et al., 2003; Biemans et al., 2015; Chou et al., 2011). The impact of BI and SCI on firm performance has been studied extensively in the literature, but there is limited research on their relationship in the context of SMEs, particularly in emerging markets such as Jordan. These hypotheses are based on the existing literature, which suggests that BI is an important factor for enhancing supply chain performance and overall firm performance in SMEs. The proposed model is also consistent with previous research that has investigated the mediating role of SCI in the relationship between BI and firm performance.

The first hypothesis (H1) proposes that BI has a positive influence on SCI in Jordanian SMEs. This hypothesis is based on the existing literature, which suggests that BI tools and strategies can help SMEs to integrate their supply chain operations and improve their overall performance. Previous studies have also found a positive relationship between BI and SCI in different contexts, such as manufacturing and retail industries. Thus, it is expected that SMEs in Jordan can also benefit from BI in improving their supply chain integration. Several studies have shown that BI can enhance supply chain visibility and coordination, leading to improved SCI (Chen et al., 2013; Fazal et al., 2018). Therefore, it is expected that BI will have a positive impact on SCI in Jordanian SMEs.

The second hypothesis (H2) proposes that BI has a positive influence on firm performance in Jordanian SMEs. This hypothesis is based on the existing literature, which suggests that BI can help SMEs to improve their decision-making processes, enhance their operational efficiency, and achieve better financial performance. Previous studies have also found a positive relationship between BI and firm performance in various industries and contexts. Studies have suggested that BI can improve decision-making processes, enhance operational efficiency, and increase profitability, leading to improved firm performance (Chen et al., 2013; Fazal et al., 2018). Thus, it is hypothesized that BI will have a positive influence on firm performance in Jordanian SMEs.

The third hypothesis (H3) proposes that SCI has a positive influence on firm performance in Jordanian SMEs. This hypothesis is based on the existing literature, which suggests that effective supply chain integration can help SMEs to improve their operational efficiency, reduce costs, and enhance customer satisfaction. Previous studies have also found a positive relationship between SCI and firm performance in various industries and contexts. Thus, it is expected that SMEs in Jordan can also benefit from effective SCI in improving their overall performance.

The fourth hypothesis (H4) proposes that the relationship between BI and firm performance is mediated by SCI in Jordanian SMEs. This hypothesis is based on the existing literature, which suggests that SCI plays a crucial role in enhancing the effectiveness of BI in SMEs. Previous studies have found that effective SCI can help SMEs to better utilize BI tools and strategies, which can lead to better decision-making, improved operational efficiency, and better financial performance. Previous research has suggested that SCI can play a mediating role in the relationship between BI and firm performance (Chen et al., 2013; Fazal et al., 2018; Chaffey, 2007). Thus, it is expected that SCI will mediate the relationship between BI and firm performance in Jordanian SMEs. Overall, these hypotheses are consistent with the literature review and provide a framework

for testing the relationship between BI, SCI, and firm performance in Jordanian SMEs using structural equation modeling. The model proposes that BI positively affects SCI, which, in turn, positively affects firm performance. Additionally, the model proposes that SCI mediates the relationship between BI and firm performance.

Based on the literature review, the following hypotheses are proposed:

Hypothesis 1: *Business intelligence has a positive effect on supply chain integration in Jordanian SMEs.*

Hypothesis 2: *Business intelligence has a positive effect on firm performance in Jordanian SMEs.*

Hypothesis 3: *Supply chain integration has a positive effect on firm performance in Jordanian SMEs.*

Hypothesis 4: *Supply chain integration mediates the relationship between business intelligence and firm performance in Jordanian SMEs.*

In addition, Fig. 1 describes the research model.

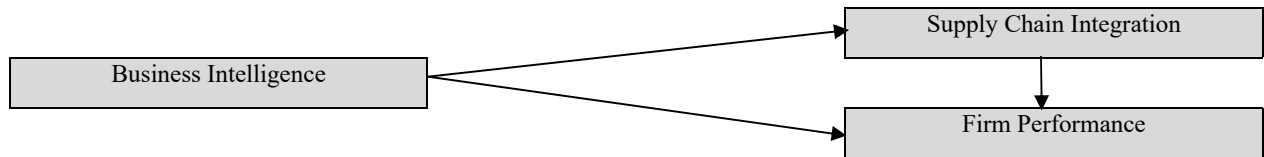


Fig. 1. The proposed model

3. Research model

3.1 Methodology

Sample and Data Collection

The study utilizes a sample of 400 SMEs from different sectors in Jordan to investigate the hypothesized relationships between BI, SCI, and firm performance. The sample was selected using a convenience sampling technique, which involves selecting participants who are easily accessible and willing to participate in the study (Saunders et al., 2016). Data was collected through a self-administered survey questionnaire. The questionnaire was divided into three sections. The first section collected information on the respondent's demographic characteristics such as age, gender and work experience. The second section collected information on BI and SCI practices in the respondent's firm, using a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). The third section collected information on firm performance, using a 5-point Likert scale ranging from poor (1) to excellent (5). In Table 1, the respondents' characteristics of this study are summarized.

Table 1

The summary of the personal characteristics of the participants

Variable	Coding	Frequency
Gender	Male	210
	Female	190
Age	18–29	50
	30–39	150
	>39	200
Work experience	1–3	300
	4–10	100

Measurement Instruments

To measure the constructs of BI, SCI, and firm performance, the study utilized well-established scales from previous studies. BI was measured using the scale developed by Huang et al. (2015), which consists of 4 items. SCI was measured using the scale developed by Lai et al. (2018), which consists of 3 items. Firm performance was measured using the scale developed by Sardana et al. (2016), which consists of 4 items.

Data Analysis

The study utilizes structural equation modeling (SEM) to test the proposed model and hypotheses. SEM is a statistical technique that allows researchers to test complex relationships between multiple variables (Kline & Walter, 2016; Cohen, 1988). The study used AMOS 23 software to perform the analysis.

Analysis of SEM

SEM analysis was applied to test the research hypotheses.

Measurement Model

The features of the instrument items were examined using confirmatory factor analysis (CFA). In fact, the measurement model embodies the validity and reliability of the observed variables replies for the latent variables and describes how latent variables or hypothetical constructions are evaluated in terms of observable variables (Bagozzi & Yi, 1988; Hair et al., 2006). Table 2 provides information about the variables' factor loadings, Cronbach's alpha, composite reliability, and Average Variance Extracted (AVE). Each indicator of the factor loadings was greater than 0.50, which supports the convergent validity of the findings (Bagozzi & Yi, 1988). In fact, even while all of the factor loadings surpassed 0.50 and the measurement achieved convergent validity at the item level, all of the composite reliability values were higher than 0.60, indicating that the latent variables had a high degree of internal consistency. Also, the convergent validity was established because each AVE value was greater than 0.50 (Bagozzi & Yi, 1988).

Table 2
The final measuring model's characteristics

Constructs and Indicators	Factor Loadings	Std. Error	Square Multiple Correlation	Error Variance	Cronbach Alpha	Composite Reliability*	AVE**
Business intelligence (BI)					0.731	0.81	0.93
BI1	0.810	0.016	0.775	0.311			
BI2	0.822	0.021	0.712	0.322			
BI3	0.701	0.033	0.654	0.344			
BI4	0.511	0.027	0.606	0.547			
Supply chain integration (SCI)					0.811	0.84	0.89
SCI1	0.733	0.040	0.713	0.162			
SCI2	0.566	0.031	0.655	0.354			
SCI3	0.731	0.022	0.616	0.440			
Firm performance (FP)					0.804	0.79	0.77
FP1	0.665	0.018	0.441	0.411			
FP2	0.544	0.020	0.343	0.499			
FP3	0.569	0.011	0.569	0.564			
FP4	0.506	0.037	0.666	0.557			

The fact that none of the correlations between construct pairings were higher than the square root of the AVE estimations for the two components is also shown in Table 3, indicating the discriminant validity of the model (Hair et al., 2006). The measurement results confirmed the study's acceptable convergent and discriminant validity.

Table 3
Correlations of variables

Constructs	BI	SCI	FP
BI	0.94		
SCI	0.811	0.92	
FP	0.833	0.809	0.88

Structural Model

On the Amos 23 platform, structural equation modeling was used to assess the study's hypotheses. SEM allows for the simultaneous testing of all hypotheses, including those having direct and indirect effects. The direct effects' outcomes demonstrate that business intelligence positively and significantly impacted supply chain integration and firm performance; therefore, H1 and H2 were accepted; whereas supply chain integration has influences on firm performance; therefore, H3 was supported. The tested hypotheses are summarized in Table 4 below.

Table 4
Summary of the theoretical model's proposed findings

Research Proposed Paths	Coefficient Value	t-value	p-value	Empirical Evidence
H1: BI → SCI	0.311	17.22	0.033	Supported
H2: BI → FP	0.121	1.156	0.045	Supported
H3: SCI → FP	0.045	4.022	0.006	Supported

Supply chain integration was put to the test in its mediation capacity. According to Hair et al. (2006), full mediation occurs when the indirect effect is greater than the direct effect, but not the other way around. Results of the mediation test are shown in Table 5.

Table 5
Results of mediating hypotheses

Hypothesis	From	Mediation	To	Direct effect	Indirect effect	Mediation
H4	BI	SCI	FP	0.011	0.167	Mediation

4. Discussion

The study aimed to model the relationship between BI, SCI, and firm performance in Jordanian SMEs using SEM. The study's findings provide several important insights into the relationship between these constructs. The results of the study showed that BI has a significant positive effect on SCI and firm performance in Jordanian SMEs. This finding is consistent with previous studies that have found a positive relationship between BI and firm performance (Huang et al., 2011). Another study conducted by Fazal et al. (2018) examined the relationship between BI and firm performance in the context of Jordan SMEs. The study used a sample of 400 SMEs and found a positive relationship between BI and firm performance. The study also revealed that the level of BI adoption in Jordan SMEs is still low, indicating a need for more investment in BI technologies and strategies. Furthermore, several studies have examined the relationship between SCI and firm performance in SMEs. For instance, Jabbour et al. (2013) investigated the impact of SCI on firm performance in Brazilian SMEs. The study found that SCI positively influences firm performance in terms of cost reduction, customer satisfaction, and overall profitability. Additionally, Li et al. (2019) explored the relationship between SCI and firm innovation performance in Chinese SMEs. The study found that SCI positively affects innovation performance through its impact on knowledge sharing and collaboration among supply chain partners. Overall, the existing literature provides evidence for the positive relationships between BI, SCI, and firm performance in SMEs. However, there is a lack of research that explores the relationship between BI, SCI, and firm performance simultaneously in the context of SMEs. Therefore, this study aims to fill this research gap by examining the relationship between BI, SCI, and firm performance in Jordanian SMEs.

5. Conclusion

This study aims to model the relationship between BI, SCI, and firm performance in Jordanian SMEs using SEM. The study's findings can provide useful insights into the effective use of BI and SCI in SMEs and guide policymakers, researchers, and practitioners in developing and implementing effective strategies to improve supply chain management and business intelligence practices in SMEs, particularly in emerging markets such as Jordan. Based on the literature review, the study proposes three hypotheses: H1 - BI has a positive influence on SCI in Jordanian SMEs; H2 - BI has a positive influence on firm performance in Jordanian SMEs; and H3 - SCI mediates the relationship between BI and firm performance in Jordanian SMEs. The study will use a cross-sectional survey design to collect data from 400 SMEs in Jordan and use SEM to test the proposed hypotheses. Overall, this study's findings can contribute to the limited literature on BI and SCI in SMEs, particularly in the context of emerging markets such as Jordan. The study's findings can also have practical implications for SME managers in Jordan by highlighting the importance of investing in BI and SCI strategies to enhance their firms' performance.

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