

# Uncertain Supply Chain Management

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## Evaluating the impact of project procurement strategies on supply chain efficiency: The role of vendor relationship management as a mediator variable

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### ABSTRACT

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This study evaluates the impact of project procurement strategies on supply chain efficiency in the Jordanian construction industry, with vendor relationship management as a mediating variable. The target population was the 25000 construction industry specialists in Jordan. According to purposeful sampling technique and more specifically, stratified random sampling, 454 subjects were asked to complete questionnaires. Partial least squares structural equation modeling was employed for the analysis of data for the test of the hypotheses. This research also revealed that the project procurement strategies which are Just-In-Time, Multiple Sourcing, and Single Sourcing have positive impacts with a statistical significance to the supply chain efficiency dimensions of Demand Forecasting, Supply Chain Integration and Collaboration and Communication. Vendor relationship management was also a partial mediator to these relations. These implications can be summed up for the construction firms and policymakers in Jordan to understand how strategic procurement approach and proper relations with the vendors can improve the performance of the supply chain. This work aims to benefit the academia as it fills a gap in the existing literature by analysing the relationship between procurement strategies, its actors (vendors), and supply chain performance within a developing country environment. The analysis with the help of PLS-SEM enables us to look at both the direct and the indirect effects in such relationships.

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## 1. Introduction

In the last decades, the construction industry has faced numerous challenges that have significantly impacted project performance and supply chain efficiency. Such challenges have been more evident especially among the developing countries like Jordan where the construction Industry has been deemed strategic in the overall development of the country's economy as pointed out by Al-Werikat (2017). Due to the stakeholder involvement and because construction project supply chain is usually composed of numerous and differentiated orders, procurement strategies and supply chain management have received attention regarding the Project management practices and the influence they exert on project success (Maqsoom et al., 2018). In particular, the issue has been the choice and execution of the right purchasing tactics as one of the major problematic areas. Lam (2013) to support the above assertion opined that the conventional procurement strategies have been inadequate in a bid to satisfy various needs of the construction industry due to increased incidences of inefficiency, cost control failure, and project delay. Depending on the type of procurement chosen, there will be certain consequences on the overall project one, and even the supply chain relations (Eriksson & Westerberg, 2011). Just like other construction industries in the developing countries, the Jordanian construction industry has not been in a position to embrace the new procurement and supply chain practices. This has led to more or less the achievement of suboptimal project performance and hampered the sector's call to support the nation's economic development (Al-Hazim et al., 2017; Fraihat, et al., 2023a). This has added to the above

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challenges by having no systematic method to measure the effectiveness of various procurement approaches on the supply chain.

Procurement strategies can be best described as the social capital that mediates between an organization and its supply chain productivity. It includes factors of risk distribution, integration of stakeholders, information sharing and utilization of resources (Love et al., 2014; Alwaely, et al., 2024). Specifically, for the Jordanian situation, whereby conventional procurement practices are predominant, it is crucial to ascertain the impact that various procurement strategies exert on the supply chain and hence project outcomes. In addition, the extent to which vendor relationship management (VRM) helps to act as a moderator between procurement strategies and supply chain responsiveness has emerged as a pertinent research area over the years. Based on a systematic literature review, it is evident that the use of VRM practices can facilitate cooperation, help in improving the communication process, and create sustainable relationships with other supply chain members with the overall goal of optimal supply chain management (Chen et al., 2019). However, the level of impact of VRM on the relation between procurement strategies and supply chain effectiveness in the Jordanian construction fraternity is still under research. The problems regarding construction projects in Jordan are magnified by some issues like low technology integration, poor skills and knowledge among the construction project's participants, and no strict adherence to processes of procurement mostly in the supply chain (Al-Abbadi & Agyekum-Mensah, 2019; Alkhawaldeh, et al., 2023). These issues have, therefore, stemmed from a continuous perpetuation of inefficiencies, quality, and missed chances at innovation and enhancement of the sector.

However, still, very little has been done to explore the existing relationship between the procurement strategies and SCMs using construction projects in the developing countries such as the Hashemite Kingdom of Jordan. Prior research has largely investigated the relation of development economics to LCC or has compared procurement structures and supply chain effectiveness individually, without the moderating role of vendor relationship management. For example, Meng (2012) explored the relationship between relationship management on project success in the UK construction industry but excluded the research on procurement strategies. What is more, Eriksson (2015) investigated the impact of procurement strategies on project performance in Sweden, although it did not present information about how the vendor relationship management moderated the efficiency of the supply chain. Previous studies in the Middle Eastern environment include Al-Hazim et al. 's (2017) that outlined factors that generate time and cost overruns in construction projects in Jordan, and the need for effective procurement systems. Nevertheless, their assessment did not differentiate the effects of various types of procurement organisation on the supply chain effectiveness. Similarly, Aloini et al. (2015) discussed risk management in construction supply chain; however, they did not focus on the part procurement strategy or vendors' relationship management in controlling such risks.

Other similar works performed by other scholars include Love et al., (2014) and Chen et al., (2019) have provided useful understanding of relationship management and multiple source procurement strategies for construction projects. Furthermore, these studies were conducted independently in a different geographical and economic environment and are therefore not directly transferable to the Jordanian construction industry environment. The absence of other studies in this literature is further highlighted by the lack of robust studies that analyze modern procurement strategies, vendor relationship management practices, and supply chain performance in the construction sector of developing countries using PLS-SEM. Due to these gaps in the literature, there is a research gap that aims to identify the impact of project procurement strategies on supply chain effectiveness in the Jordanian construction sector, taking into account vendor relationship management.

Therefore, the aim of the present research is to assess how the project procurement strategies influence the Jordanian construction industry's supply chain performance, with an emphasis on the impact of vendor relationship management as the mediating variable. Thus, using PLS-SEM, the study will capture complex interactions that exist between the above latent variables and achieve its objective of furnishing a more enriched understanding of the various research variables. The main value of the present research is derived from its theoretical impact on the scholarly domains of construction management, supply chain management, and procurement. From a theoretical viewpoint, the current study contributes to the existing knowledge in the following manners. First, it provides a foundation for building an enhanced theoretical framework consisting of procurement and supply chain tactics and strategies integrated with the management of vendor relationships in construction markets. Combined with the essence of these two ideas and the analysis of their interactions, the study gives a clearer picture of the circumstances that define the results of project usage and enhance the supply chain.

Second, the research contributes to the development of the literature on the use of PLS-SEM in construction management research, by proving the usefulness of the approach for the analysis of complex relationships in the field. This means that the orderly approach increases the ability to analyse direct effects as well as secondary effects most effectively and thus enhances the development of theoretical models in the given field of knowledge. Thirdly, the study adds further to the knowledge in the field of vendor relationship management by examining the factors that this concept mediates a construction procurement and supply chain effectiveness. This further enriches extant research concerning relationship management in construction and underlines its significance for the achievement of project goals. Finally, being a study about Jordanian construction industry, the research adds to the knowledge of procurement and supply chain management theories and their application and modification in developing countries. This adds to the current literature on the generality and contexts in the construction sector about the management theories.

## 2. Theories

Among the theoretical foundations, it is possible to identify Transaction Cost Economics (TCE) that were introduced by Williamson (1979) in order to highlight the procurement strategies and supply chain effectiveness. In TCE, it is believed that organizations align themselves to different governance structures in order to reduce transaction costs referring to the cost of making deals, costs of monitoring and costs of implementing contracts (Williamson, 1985). When regarding construction projects, TCE is useful for understanding why some procurement options are selected over others, and how this contributes to minimizing the cost of transactions and improving supply chain operations. According to TCE the conditions that give rise to high transaction cost as a result of asset specificity, uncertainty, and the frequency of transactions lead organisations to opt for integrated governance structures such as partnering or alliance-based procurement instead of opting for market-based transactions as indicated in the work of Winch, (2001). This theory may show why a number of procurement procedures might result in better supply chain annualized arrangements due to the decrease in opportunism and increase in business cooperation between project members.

The other theoretical framework is the Resource-Based View (RBV) that was christened by Barney in 1991. The RBV provides theorisations on resources and capabilities in organisational contexts that are critical for this research. VRIO framework by Barney proposes that a resource-based view of a firm suggests that firm's resources are valuable, rare, costly to imitate and have no close substitutes (2008). With regards to construction projects and supply chain and management logistics, RBV can be used to decipher how contracting strategies and the management of vendor relationships as a means of creating value, which leads to improvement of the supply chain. According to RBV, vendor relationship management can be considered as the strategic asset that enables firms to manage access to external resources, which, in turn, can explain the increase in the scale of supply chain efficiency (Cousins et al., 2006; Ismaeel, et al., 2023). By understanding this theory, one can identify why some organisations have been more effective at deploying specific strategies in procurement and relations with the vendor, and thus supply chain effectiveness. Hence, through combining both of the aforementioned theories, the study can offer a richer insight into how and through which mechanism procurement choices affect the supply chain effectiveness, with vendor relationship management as the mediator. TCE can help in understanding the decision regarding the procurement strategies based on transaction costs while RBV offers the understanding of the ways in which such strategies and vendor relationships can be utilized to build up new resources that can improve the efficiency of the supply chain.

### 2.1 Supply Chain Efficiency

Supply chain efficiency in the construction industry is a multifaceted concept that encompasses various aspects of project performance and resource utilization. It can be considered as the overall representation of a supply chain's ability to deliver construction projects to their stipulated times, cost, and quality. Analyzing the situation in the context of Jordanian construction industry, it is possible to define the importance of supply chain efficiency due to the fact that construction industry is actively developing branch and it plays an important role in the national Jordanian economy as well as it has the potential to become the key stimulator of the country's economic growth (Al-Werikat, 2017). Another element that is critical in amenable supply chain management is cost efficiency in the context of project completion within the set budget, but not exceeding the said amounts in the utilization of resources. This comprises the reduction of waste, avoidant of rework, and proper management of procurement costs across the chain (Love et al., 2014). Time performance is another important aspect and it relates to the punctuality on any project and elimination of postponements. Integrated supply chains of construction entail smooth flow of materials and information together with timely delivery of construction materials, and coordination with others in achieving proposed project timelines (Ze Elena, 2012). Quality performance is a sub-element of supply chain operations, which covers the operation's capability to deliver meeting project and customer requirements. This includes guaranteeing the virtue of the work done, fresh material used, and the general outcome of the construction projects (Eriksson & Westerberg, 2011). Risk management is also a notable activity as optimized supply chains have the required measures for risk identification and evaluation to determine how they may affect a project or in terms of compromised performance (Aloini et al., 2015; Wahshat et al., 2024). In addition, the construction supply chain management entails factors touching on the work of the participants to foster improved information transfers. It is agreed that information sharing and collaboration and coordination contribute to decrease uncertainties, increase in decision-making efficacy and total supply chain efficacy (Chen et al., 2019; Fraihat, et al., 2023b). Given that most traditional procurement methods are still present within the Jordanian setting, enhancing such aspects of supply chain management could significantly enhance undertakings performance and productivity within the sector.

### 2.2 Project Procurement Strategies

Project procurement strategies in construction refer to the approaches and methods used to acquire goods, services, and works required for project execution. They are useful in defining the factors that determine the profile of a project and the interactions within the supply chain. Al-Hazim et al., 2017 reveal that decisions on the type of procurement system can greatly affect the success of the construction projects and the overall performance of the construction sector of Jordan. The conventional procuring strategies like design- bid- build are also common in Jordan as well in many other developing countries. These methods normally incorporate a structural contract to determine the design and another to cover the construction and these all

depend on the lower offer as the means to select the contractors (Eriksson, 2015; Alkhawaldeh, et al., 2022). Simple and commonly used practices may yield antagonistic contracts, low creativity, and unfavourable allocation of risk bearing between project stakeholders. On the other hand, Integrated procurement strategies such as design-build and construction management at risk, are geared towards creating a teamwork atmosphere as well as establishing contracts that are beneficial to all the people involved in the project. They are mostly characterised by increased involvement of the contractor at the project feasibility stage, allocation of risks, emphasis on value for money other than the price (Love et al., 2014). Such approaches may help in attaining better project performance because of proper integration, minimization of interference, and possibilities of creativity. Partnership and alliance are even a further development of collaboration, being viewed as the more recent variation of integration. These approaches focus on the development of long-term partnerships, mutual goals and on the dealing with issues by the project participants (Meng, 2012). Though not as frequent in Jordanian practices, combined initiatives have raised the quality of work of projects and the supply chain in other countries. The type of procurement strategy Inter Connect selected to use also determines the distribution of risks and risk management in the project supply chain. Risk sharing arrangements adopted for any set strategy alter the manner in which participants to projects behave and or decide, with direct implications for performance (Aloini et al., 2015; Alkhawaldeh, & Mahmood, 2021; Alhawamdeh, et al., 2024). particularly in the Jordan construction industry because risk management practices may not be efficiently developed; the proper choice of procurement techniques, which precisely select and control risks associated with carrying out construction works, will play a crucial role. Additionally, the procurement strategies that are used in the construction industry affect the degree of competition and innovation in the supply chain. Measures that can advance fair competition as well as flexibility within the project's implementation corresponds towards the enhanced supply chain performance contributing to the overall development of this sector (Chen et al., 2019; Fraihat, et al., 2024). As for utilization of technologies and innovation in the construction industry in Jordan, the given procurement strategies can be very effective in terms of further development of the sector in the country and expanding the use of innovative solutions in construction.

### *2.3 Vendor Relationship Management*

Vendor Relationship Management (VRM) serves as a critical mediating factor between procurement strategies and supply chain efficiency in the construction industry. VRM covers the activities, methods and actions needed to support the management of communications and business relations with suppliers and subcontractors during the project life cycle. In the context of Jordanian construction industry, it has been identified that the advancement of VRM can support improvement of procurement strategies' supply chain (Al-Abbadi & Agyekum-Mensah, 2019). One of the major concepts of VRM is the ongoing formation of and cooperation with sustained partnerships with strategic suppliers. This means shifting from being a mere advertiser among many to a level where companies seek to create a long-term relationship with the advertising agency with the understanding that it will be beneficial to both (Meng, 2012; Fraihat, et al., 2023c); Alhawamdeh, et al., 2024). This way, relationships will be developed and deepened, communication will be more efficient, knowledge will be transferred more, and better problem-solving will be oriented in the supply chain, thus contributing to higher efficiency and successful project completion. Sound VRM practice also embraces vendor identification and assessment criteria which add up to price determinants such as quality, reliability, innovation capacity and compatibility to the project 's goals among others. Thus, the sound criteria for vendors' selection and the adequate performance evaluation methodologies will help construction firms to select suitable and efficient supply chain partners capable of fulfilling the necessary project demands (Eriksson & Westerberg, 2011; Fraihat, & Al-Afeef, 2022). Coordination and collaboration are an adjunct to VRM, mainly concerning communication and exchanging of information among the parties involved in a project. Due to the fact that customer relationship management is relatively new to Jordanian organizations, and particularly since traditional communication methods are more popular in this region, the introduction of proper information sharing systems and practices highly improves the understanding of supply chain visibility and supply chain responsiveness factors of a firm. This can result into good decisions, less risks and hence enhancement of the supply chain performance. Risk sharing and management is the other major component of VRM, whereby risks resulting from the vendor relationships are dealt with appropriately. Thus, co-creating the risk management culture with a focus on transparency in construction firms, construction companies can better manage potential risks together with their vendors (Aloini et al., 2015). It is proactive in managing risks which in turn can help to lead to more effective project delivery and improved supply chain arrangements. In addition, since the construction supply chain is complex and dynamic, VRM has great potential in terms of leading innovation and the creation of continuous improvement. Thus, construction firms have an opportunity to increase supply chain efficiency and project performance by supporting and rewarding vendors for proposing better solutions and technologies as well as focusing on the collaborative problem-solving process (Love et al., 2014; Alhawamdeh, et al., 2023). Since the diffusion of innovation in the Jordanian construction industry might not be high, effective VRM practices could stimulate the usage of technology and enhance work processes.

### **3. Empirical Literature Review and Hypothesis Development**

Vendor relationship management and its link with supply chain and project procurement strategies in the construction industry has been of interest to many empirical researchers. Therefore, the current literature review compiles data from different studies and can be used for developing hypotheses.

### 3.1 Project Procurement Strategies and Supply Chain Efficiency

The studies confirm that the procurement strategies greatly affect the supply chain performance in construction projects. In a similar vein, Oyegoke et al. (2009) established that integrated project delivery methods have enhanced the flow of logistics and, thereby cut down the supply chain distortions. Likewise, Eriksson & Westerberg (2011) revealed that cooperative procurement procedures affected project performance in terms of time, cost, and quality. (Khalifeh et al., 2024; Manu et al. 2015) focused on the construction projects of the United Kingdom and noted that integrated supply chain practices in procurement improved the risk management of the projects. Pesämaa et al. (2009) supported these findings stating that this kind of long-term partnership arrangements enhanced the purchasing and business relationships for better project results as well as supply chain management in construction organisations of Sweden. Thus, procurement strategies may also have significant differences in their effectiveness depending on the characteristics of the project and the environment. In the study conducted by Ghadge et al. (2017), the authors' revealed that the effectiveness of various procurement strategies in supporting supply chain performance depended on the project characteristics such as complexity and uncertainty. In the same manner, Ruparathna and Hewage identified that the consequence of practicing sustainable procurement on supply chain performance fluctuated with the types of construction projects. Another factor that is affected by the type of procurement strategy used is the innovation and knowledge sharing in the supply chain. Blayse and Manley (2004) discovered that some procurement strategies, especially those which endorse early contractor involvement had had the ability to nurture innovation in construction projects. Similarly, Khalfan et al. (2015) established that IDP techniques improved the flow of knowledge and learning within the supply chain networks and improved the efficiency of the construction systems. Similarly, in the context of developing countries, Adekunle et al. (2018) concluded that the implementation of modern procurement approaches enhances construction projects' performance and supply chain management in Nigeria. In the same year and in the same region, Alhroub et al. (2019) noted that collaborative procurement strategies have some positive impacts on the supply chain responsiveness in the Jordan construction industry. Hence, we propose the following hypothesis:

**H<sub>1</sub>:** *Project procurement strategies (Just-In-Time, Procurement, Multiple Sourcing, and Single Sourcing) have a significant positive impact on supply chain efficiency (Demand Forecasting, Supply Chain Integration, and Collaboration and Communication) in the Jordanian construction industry.*

### 3.2 Vendor Relationship Management and Supply Chain Efficiency

The capability with regards to VRM and its contribution in the arrangements of supply chain have been examined in numerous industries such as construction. Meng (2012) revealed that good relationship management had a positive impact on the project performance and supply chain consequences in the UK construction industry. Jelodar et al., (2016) also endorsed these findings indicating that trust with the supplier positively affected the rate of successful project and supply chain efficiency.

These findings were confirmed by Jelodar et al. (2016), who revealed that the existence of trust-based relationships with the supplier leads to improvement in project success level and supply chain performance in Malaysian context. According to Pala et al. (2014), Carlotta Pala and her associates' study showed that there are positive effects of collaborative relationships with strategic suppliers through information flows and Integration impacting the efficiency of the construction supply chains. On the same note, Fulford and Standing (2014) noted that the five 5 SRM best practices enhanced project performances and SC effectiveness in the construction sector in Australia. In most cases, the effect of VRM on the supply chain efficiencies is translated in one way or the other by enhanced information exchange. Hence other researchers such as Khalfan et al. (2007) have confirmed the above by noting that long term relationships with the supplier enables organizational knowledge transfer and learning to allow increased efficiency of the supply chain. Such observations are supported by Akintoye and Main (2007) in finding improved information exchange and problem solving offered by jointly managed construction supply chains. Manu et al. (2015) studying the relation between SRM practices and supply chain performance in the construction industry of developing nation, Ghana, concluded that proper implementation of the above SRM practices helped Ghana's construction industry in enhancing its supply chain performance. Likewise, Yadav and Ray (2015) revealed that integration with suppliers improved the project's performances and supply chain in the Indian construction industry. Effectiveness of VRM not only has an effect on the direct supply chain partners but it causes effects throughout the project supply chain associates. By the same observation, Bygballe et al. (2010) showed that understanding and managing relationships across the project networks in an effective way resulted in enhancement of coordination in construction projects in Norway. This was in agreement with another study by Eriksson (2015) who concluded that multi-level relationship management within the construction supply chain improved the performance of projects and productivity. Based on these empirical findings, we propose the following hypothesis: Based on these empirical findings, we propose the following hypothesis:

**H<sub>2</sub>:** *Vendor relationship management has a significant positive impact on supply chain efficiency (Demand Forecasting, Supply Chain Integration, and Collaboration and Communication) in the Jordanian construction industry.*

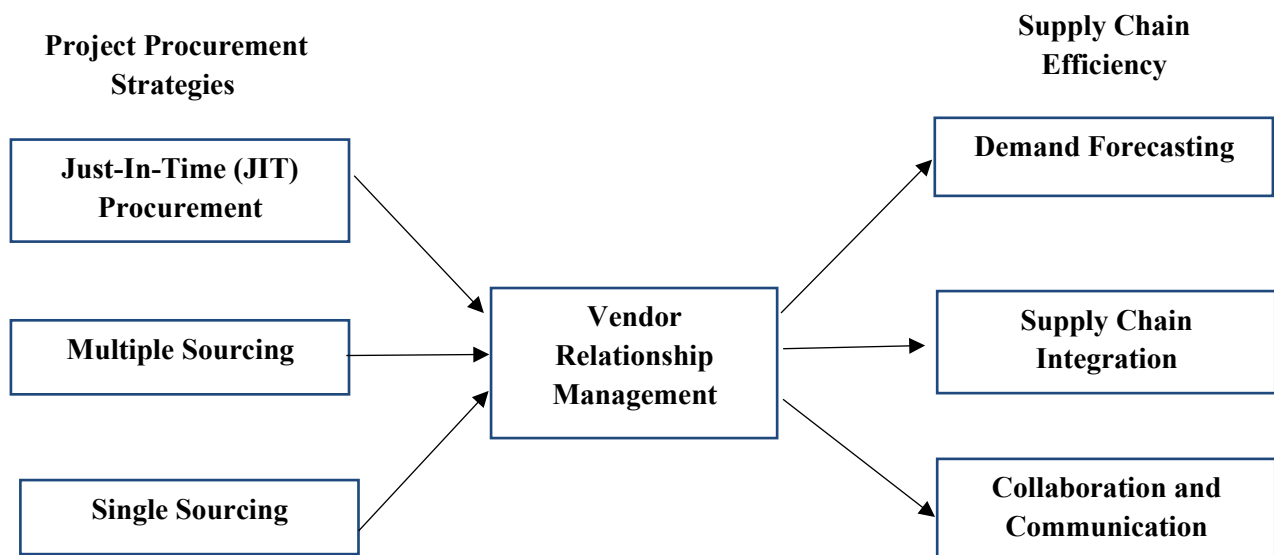
### 3.3 Project Procurement Strategies, Vendor Relationship Management, and Supply Chain Efficiency

The direct impacts of procurement strategies and VRM; the precise relationship between supply chain, procurement and VRM has been investigated. Eriksson (2010) showed that top management procurement strategies exhibiting collaborative

characteristics enhance relationship management practices with suppliers resulting in improved project outcomes. In the same fashion, Pesämaa et al. (2009) showed that the formation of cooperative procurement procedures was found to increase the quality of supplier relations and thus, the supply chain performances. According to Meng (2012), it was established that the effect of the procurement strategies on the project performance, was partially latitude by the quality of the relationships between the project stakeholders. Jelodar et al (2016) corroborated these findings by noting that How effectively the various procurement strategies helped deliver supply chain improvements depended on the trust and cooperation in the supplier relations. In a thorough research work that involved the construction industry of the United Kingdom, Khalfan et al. (2015) established that integrated project delivery solution strategies enhanced supplier relationships that thus helped in enhancing knowledge sharing and supply chain outcomes. Similarly, Adekunle et al (2018) have suggested that its implementation in Nigeria's construction industry resulted in vendors' relations and general supply chain management. As it has been established, the mediating role of VRM in the relationship between procurement strategies and the efficiency of supply chains has been noted in other areas as well. The results revealed that the measures used in procurement strategies had significant relationship with project performance in the Australian construction sector; and that the supplier relationship had a moderation effect on the findings of Fulford et al. (2014). Similar conclusions were made by Alhroub et al. (2019; AlKhalwaldeh, et al., 2024), who proved that the beneficial impact of collaborative procurement strategies for Jordan's construction industry was supported by good SRM practices. Therefore, owing to the aforementioned empirical evidence, the authors developed the following hypothesis:

**H<sub>3</sub>:** *Vendor relationship management mediates the relationship between project procurement strategies and supply chain efficiency in the Jordanian construction industry.*

Based on the above evidences this study developed the research framework in Fig. 1.



**Fig. 1.** Research Framework

#### 4. Research Methodology

This research adopted a quantitative cross-sectional study to establish the connections between the project procurement strategies, vendor relationship management and supply chain performance in the Jordanian construction industry. The proposed target population for this study involved the Jordanian construction industry employees in the capacity of project managers and coordinators, procurement and supply chain experts, senior management officials, construction firms and consultancy firms, and government agencies related to construction projects. JCCA (2023) estimated that there were about 3,500 construction contractors in Jordan out of which 1000 companies are Jordanian-owned companies and the rest are international contractors, providing employment to an estimated 25000 professional managers and executives.

In this case, based on the target population size, Krejcie and Morgan (197), sample size was estimated and determined. The recommended sample size by Krejcie and Morgan (197) Table is 378 for a population of 25000. To ensure against non-response and invalid responses in estimation of the proportion, a ten percent addition to the above sample size was added which makes the final sample size to be 454. In the study, the authors adopted the stratified random sampling technique taking into account different parts of the construction industry would be sampled. This approach was deemed reasonable because a broad spectrum of participants from companies of different sizes, engaged in different types of projects, and located in various regions throughout Jordan was reached, thereby increasing the external validity of the study's results (Sekaran and Bougie 2016).

Under the category of method used in the research, the tool used was a structured questionnaire constructed from existing scales that were deemed valid in other studies. The project procurement strategies section (Just-In-Time (JIT) Procurement, Multiple Sourcing (MS), and Single Sourcing (SS)) section adopted from Eriksson and Westerberg (2011) and Khalfan et al. (2015) contains 16 items that investigated procurement approach aspects. The vendor relationship management (VRM) section comprised 8 items and was adopted from scales constructed by Meng (2012) and Jelodar et al. (2016). The supply chain efficiency section which includes Demand Forecasting (DF), Supply Chain Integration (SCI), and Collaboration and Communication (CC) sub-sections comprised of 12 items were adopted from Adekunle et al., (2019), Alhroub et al., (2019). Some of the aspects that were changed were adapted to the context of the construction industry in Jordan.

With the help of web-based instruments, data were collected by employing a set of questions, which were sent to the sample through e-mails. All measurement items employed a 7-point Likert scale that includes strongly disagree (1) and strongly agree (7). Instead of a 5-point Likert scale this scale was adopted as it offers a broader range of choices which may enhance the reliability and validity of the measurement (Finstad, 2010). The questionnaire items were first piloted with 10 professionals from the industry to help in the identification of ambiguous, irrelevant, or missing items that may be included in the main data collection instrument. Slight changes were done as per the feedback that was received from the patients in order to enhance the instrument. Next, a pilot study was conducted with a sample of 50 subjects from the target population for the purpose of identifying the scales' reliability and validity. The internal reliability of the measures used in the current research was estimated with the Cronbach's alpha coefficients that varied from 0.82 to 0.91, which is acceptable as per Hair et al., (2019) hence establishing moderate to high internal reliability of the scale. PLS-SEM analysis of returned questionnaires was carried out using SmartPLS ver. 4 software. This method was chosen because this allows it to work with models that contain many constructs, and is used both in testing theoretical hypotheses and in predicting (Hair et al., 2019). The sampled data were analyzed using method estimation that entailed an assessment of the measurement model and the structural model, whereby the former focused on the reliability and validity, whereas the latter considered hypothesis testing and mediation analysis. Sensitivity to ethical considerations was made through receiving participants' informed consent during interviews, giving an assurance on anonymity of the responses contributed in the study, and offering the participants an opportunity to withdraw from the study if they desired to do so. This study's research protocol was reviewed and cleared by the institutional ethics committee.

## 5. Results

### 5.1 Measurement Model and Variance Inflation Factor (VIF)

The measurement model comprises the most important elements to evaluate the reliability and validity of the constructs employed in the research; these are evident in Table 1.

**Table 1**  
Measurement Model

Constructs	Factor Loadings	Cronbach's alpha	Composite reliability (rho a)	Composite reliability (rho c)	Average variance extracted (AVE)	VIF
<b>Collaboration and Communication</b>		<b>0.780</b>	<b>0.789</b>	<b>0.857</b>	<b>0.601</b>	
CC1	0.801					1.542
CC2	0.799					1.643
CC3	0.753					1.575
CC4	0.745					1.410
<b>Demand Forecasting</b>		<b>0.875</b>	<b>0.881</b>	<b>0.914</b>	<b>0.727</b>	
DF1	0.827					1.802
DF2	0.883					2.838
DF3	0.892					2.998
DF4	0.806					1.939
<b>Just-In-Time</b>		<b>0.906</b>	<b>0.906</b>	<b>0.928</b>	<b>0.681</b>	
JIT1	0.777					1.887
JIT2	0.793					2.081
JIT3	0.840					2.670
JIT4	0.875					1.380
JIT5	0.862					2.087
JIT6	0.801					2.018
<b>Multiple Sourcing</b>		<b>0.899</b>	<b>0.900</b>	<b>0.926</b>	<b>0.713</b>	
MS1	0.812					2.080
MS2	0.847					2.467
MS3	0.866					2.657
MS4	0.858					2.572
MS5	0.838					2.226
<b>Single Sourcing</b>		<b>0.918</b>	<b>0.919</b>	<b>0.939</b>	<b>0.754</b>	
SCI1	0.820					1.879
SCI2	0.862					2.379
SCI3	0.884					2.431
SCI4	0.867					2.500

**Table 1**  
Measurement Model (Continued)

Constructs	Factor Loadings	Cronbach's alpha	Composite reliability (rho a)	Composite reliability (rho c)	Average variance extracted (AVE)	VIF
<b>Supply Chain Integration</b>		<b>0.881</b>	<b>0.890</b>	<b>0.918</b>	<b>0.737</b>	
SS1	0.840					2.376
SS2	0.883					1.090
SS3	0.881					2.888
SS4	0.830					2.487
SS5	0.904					2.772
<b>Vendor Relationship Management</b>		<b>0.936</b>	<b>0.938</b>	<b>0.948</b>	<b>0.723</b>	
VRM1	0.844					1.511
VRM2	0.857					1.741
VRM3	0.866					1.268
VRM4	0.878					1.530
VRM5	0.898					2.949
VRM6	0.842					1.042
VRM7	Deleted					
VRM8	0.760					2.030

As the findings show, the overall psychometric qualities of all the constructs are rather robust. As can be seen, the factor loadings of all items exceed 0.7. Hence, the following essential research questions were formulated: 7 (Hair et al., 2019). This also shows that each item has to do a lot with the said construct supporting the reliability of the indicators. The possible Cronbach's alpha values are as follows; Cronbach's alpha values vary between 0.780 to 0.936, it is also higher than the accepted level of 0.7 (Nunnally & Bernstein, 1994). This means high internal consistency reliability for all the constructs being used in the study. Likewise, the rho c values or the composite reliability of the constructs lie in-between 0.857 to 0.948, that is significantly higher than the limiting rate of 0.7 threshold according to Fornell and Larcker (1981) which enhances the level of its reliability of the constructs applied. All the AVE values of all the constructs are above 0 as follows. 5, ranging from 0.601 to 0.754. This means that, for every construct, more than 50% of the variance of its indicators are accounted for. This is a confirmation of convergent validity as postulated by Bagozzi & Yi, (1988). The calculated VIF levels for all the variables are below 3 and this is well below the benchmark of 5 advocated by Hair et al. (2019). This indicates that multicollinearity could not have affected the model since none of the variables is closely correlated with the others. However, it should be noted that VRM7 was removed from the analysis because of its low factor loading. This practice of item deletion is not a rarity when it comes to scale refinement to enhance the construct validity and reliability (DeVellis, 2016).

## 5.2 Discriminant Validity

Table 2 involves Fornell-Larcker criterion, this is one of the traditional methods for assessing discriminant validity in structural equation modeling (Fornell & Larcker, 1981). This criterion divides the square root of each construct's Average Variance Extracted (AVE) by the correlations the construct has with other constructs. The diagonal elements, identified by the bold font, are the square root of each construct's AVE and the off-diagonal elements are the construct correlations. If discriminant validity is to hold, diagonal values should be higher than off-diagonal already in the corresponding row and column (Hair et al., 2017). In this case, all diagonal values are greater than respective off diagonal values which implies that their discriminant validity is good. This indicates that each construct has higher verification with the indicators that belong to it than with any of the constructs in the model (Henseler et al., 2015).

**Table 2**  
Fornell Larcker Criterion

Constructs	Collaboration and Communication	Demand Forecasting	Just-In-Time	Multiple Sourcing	Single Sourcing	Supply Chain Integration	Vendor Relationship Management
Collaboration and Communication	<b>0.775</b>						
Demand Forecasting	0.637	<b>0.853</b>					
Just-In-Time	0.493	0.584	<b>0.825</b>				
Multiple Sourcing	0.481	0.589	0.727	<b>0.845</b>			
Single Sourcing	0.480	0.619	0.780	0.645	<b>0.868</b>		
Supply Chain Integration	0.525	0.747	0.578	0.561	0.555	<b>0.859</b>	
Vendor Relationship Management	0.463	0.627	0.654	0.712	0.694	0.561	<b>0.850</b>

Table 3 also indicates the Heterotrait-Monotrait (HTMT) ratio that is an important criterion in assessing the discriminant validity of the constructs in PLS-SEM models. The HTMT ratio is perceived to be more reliable than other methods such as the Fornell-Larcker criterion as indicated by Henseler et al. (2015). Every value in the table of HTMT is lower than 0.85, while the lower limit of which is considered to be the conservative value according to Kline (2011). The value that represents the highest fresh fruit and vegetable exposure is 0.775 for Multiple Sourcing and Vendor Relationship Management; still below the cut off. This simply means that discriminant validity, as a feature of the model, means that the various constructs



under consideration are indeed different from each other (Hair et al., 2019). The low HTMT ratios, therefore, offer support to the study's assertion that the constructs are fairly distinct in conceptual and empirical terms. This is especially so because there are likely to be interactions between some of the concepts such as Just-In-Time procurement, Multiple Sourcing, and Single Sourcing. The study findings corroborate the idea that all the constructs are distinct, thereby strengthening the general validity of the research model and the reliability of further structural models' tests.

**Table 3**  
Heterotrait-Monotrait Ratio

Constructs	Collaboration and Communication	Demand Forecasting	Just-In-Time	Multiple Sourcing	Single Sourcing	Supply Chain Integration	Vendor Relationship Management
Collaboration and Communication							
Demand Forecasting	0.762						
Just-In-Time	0.583	0.655					
Multiple Sourcing	0.569	0.659	0.616				
Single Sourcing	0.560	0.686	0.654	0.628			
Supply Chain Integration	0.684	0.749	0.644	0.626	0.610		
Vendor Relationship Management	0.531	0.687	0.709	0.775	0.747	0.612	

### 3.3 Common Method Bias

As shown in Table 4, to evaluate the problem of common method variance (CMV), exploratory factor analysis (EFA) was performed for the current self-reported survey data (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). The table also depicts the total amount of variance accounted by the extracted factors. Specifically, the first factor contributes 49.331% of the total variance, which is quite reasonable compared to the Going back to Harman's single-factor test, which indicates that the tolerance level should be below 50%, we can definitively conclude that the present study is free from this type of reflect a high level of common method variance, as the numbers reported above the acceptable limit of 50% The authors also conducted a Harman's single-factor test whose tolerance rate This means that relationship between CMB and this study is not a glaring issue with the study as assumed earlier. Additionally, due to the fact that more than one factor has eigenvalue greater than 1 (Kaiser criterion), it can be stated that in the given case the data variance cannot be explained by a sole common factor only (Hair et al., 2019). As for the total explained variance, because of all factors (73.279%) which is quite acceptable and so the overall fitness of the model is satisfactory. The spread of the variance over different factors again confirms the lack of severe CMB.

**Table 4**  
Common Method Bias

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	17.266	49.331	49.331	17.266	49.331	49.331	6.402	18.292	18.292
2	3.111	8.889	58.220	3.111	8.889	58.220	5.450	15.571	33.863
3	1.481	4.231	62.452	1.481	4.231	62.452	4.951	14.144	48.008
4	1.247	3.563	66.015	1.247	3.563	66.015	2.951	8.431	56.439
5	1.033	2.951	68.966	1.033	2.951	68.966	2.929	8.369	64.808
6	.769	2.198	71.163	.769	2.198	71.163	1.856	5.303	70.110
7	.741	2.116	73.279	.741	2.116	73.279	1.109	3.169	73.279

### 3.4 Model's Explanatory and Predictive Capabilities

Table 5 also provides the R-square and Q-square adjusted values to the endogenous construct of the model. The calculated R-square values touched 0. The following table gives an idea of how the R-square values look like. 214 to 0.542, which is of moderate to substantial value according to Hair and his colleagues (2019). Vendor Relationship Management again yields the highest R-square (0.542), meaning the model has a good explanatory power concerning the variability of the construct. All the Q-square adjusted values are positive and lie between 0.124 to 0.388, suggests the degree of the model's predictiveness (Geisser, 1974; Stone, 1974). These values only show that all the endogenous constructs are well predicted by the model; vendor relationship management has the highest value of 0.388.

**Table 5**  
R-square and Q-square adjusted

Constructs	R-square	Q-square adjusted
Collaboration and Communication	0.214	0.124
Demand Forecasting	0.393	0.227
Supply Chain Integration	0.315	0.280
Vendor Relationship Management	0.542	0.388

3.5 Structural Results

Table 6 and Fig. 2 demonstrate the path coefficients and the structural model that aim at unveiling the interactions between the project procurement strategies, vendor relationship management, and supply chain efficiency in the Jordan construction environment. The Work results align with the Hypothesis 1, Purchase strategies (Just-In-Time, Multiple Sourcing, Single Sourcing) are positively correlated to the Supply chain efficiency factors (Demand Forecasting, Supply Chain Integration, Collaboration and Communication). Multiple Sourcing indicates a higher impact significantly through (0.227, 0.203, 0.167;  $p < 0.001$ ), followed by Single Sourcing (0.178, 0.159, 0.131;  $p < 0.001$ ), Whereas, Just-In-Time (0.084, 0.075, 0.062). According to Williamson's Transaction Cost Economics theory, it is revealed that only the right approach to procurement management means cutting down transaction costs and thus improving the position of the supply chain. Hypothesis 2 is also supported because Vendor Relationship Management has positive and significant impacts on all the supply chain efficiency measures. The regression coefficients are;  $\beta = 0.627, 0.561, 0.463$  (all  $p < 0.001$ ). This is in concordance with the Resource-Based View; hence, sound vendor relationships are a critical resource and means of enhancing supply chain performance (Barney, 1991). The results partially supported Hypothesis 3, demonstrating that procurement strategies significantly influence Vendor Relationship Management (Just-In-Time: Multiple Sourcing: ( $\beta = 0.362, p < 0.001$ ); Single Sourcing: ( $\beta = 0.284, p < 0.001$ ); Supplier Portfolios ( $\beta = 0.134, p < 0.000$ ). This implies that Vendor Relationship Management has a moderating effect on the procurement strategy and supply chain efficiency as proposed in this study in consonance with prior researches that have portrayed an essential function of relationship management when it comes to construction endeavour (Meng, 2012; Jelodar et al., 2016). Thus, these findings build on the literature by Eriksson and Westerberg (2011) and Adekunle et al. (2018) that investigated the factors that affect project performance, specifically concerning procurement strategies and vendor relationships. The identified conclusions also stand in favor of relationship management in construction supply chains that has been underlined by Chen et al. (2019).

**Table 6**  
Path Coefficients

Path Relationship	Original sample (O)	Standard deviation (STDEV)	T statistics ( O/STDEV )	P values
Just-In-Time → Demand Forecasting	0.084	0.035	2.423	0.015
Just-In-Time → Supply Chain Integration	0.075	0.031	2.429	0.015
Just-In-Time → Collaboration and Communication	0.062	0.026	2.41	0.016
Multiple Sourcing → Demand Forecasting	0.227	0.031	7.209	0
Multiple Sourcing → Supply Chain Integration	0.203	0.029	7.048	0
Multiple Sourcing → Collaboration and Communication	0.167	0.025	6.764	0
Single Sourcing → Demand Forecasting	0.178	0.032	5.514	0
Single Sourcing → Supply Chain Integration	0.159	0.03	5.369	0
Single Sourcing → Collaboration and Communication	0.131	0.025	5.215	0
Just-In-Time → Vendor Relationship Management	0.134	0.055	2.449	0.014
Multiple Sourcing → Vendor Relationship Management	0.362	0.05	7.265	0
Single Sourcing → Vendor Relationship Management	0.284	0.049	5.828	0
Vendor Relationship Management → Collaboration and Communication	0.463	0.029	15.947	0
Vendor Relationship Management → Demand Forecasting	0.627	0.024	26.457	0
Vendor Relationship Management → Supply Chain Integration	0.561	0.027	20.59	0



**Fig. 2.** Graphical Results

#### 4. Discussion of the Study

The study results based on the Jordanian construction industry highlight the proof of the multi-dimensional hypotheses concerning the connection of project procurement techniques, vendor management strategies and supply chain performance. Therefore, these studies provide important insights about the nature and management of construction projects and the performance of the supply chain in a developing country environment. Hypothesis 1 Since the associations of procurement strategies with supply chain efficiency dimensions were positive and significant, It will be appropriate to accept. This is in line with Transaction Cost Economics (TCE) theory whereby Williamson (1985) states that organizations will select the modes of governance that will reduce the transaction costs to the minimum level. In the construction environment, correct adjustment can minimize risks and other up heuristic issues, facilitating contract coordination and supply chain performance. These findings expand upon prior research done by Eriksson & Westerberg (2011), where they revealed the positive impact for the performance of the cooperative procurement procedures. The results also support the claims made by Adekunle et al., (2018), on the fact that procurement methods on their part greatly influence project performance in Nigeria construction industry. Surprisingly, Multiple Sourcing took the lion share of the impact of the procurement strategies on those desirable supply chain efficiency dimensions. This implies that in the construction context in Jordan, it is more strategic to build relations with multiple vendors than relying on a single vendor for supplies. This finding complies with the risk management view conceptualized in supply chain scholarship by suggesting the need to avoid risks and improve performance by diversifying supply sources (Ghadge et al., 2017). Though it partly differs with the findings highlighted in more developed economies where mostly long-term single source relations are advocated for (Bemelmans et al., 2012). Thus, by choosing the right strategy of procurement, it increases the significance of studying the context in which it will take place.

In light of the above analysis and affirmatively significant correlations obtained for all the supply chain efficiency dimensions, the research findings lend support to the second hypothesis: 'SRM has positive and strong effects on Vendor Relationship Management'. The broad understanding of this hypothesis against the backdrop of the RBV of the firm has been captured above. As argued in RBV, a firm's ability to build and manage a good relationship with its vendors is a valuable, rare and inimitable resource that can create competitive advantage (Barney, 1991). For construction projects where the jobs are normally characterized by chains of suppliers and subcontractors, the nature and management of the suppliers' relationships can affect the projects. These findings add to the study conducted by Meng (2012) that established the benefits of relationship management to project performance in the UK construction industry. They also endorse Chen et al.'s (2019) focus on the relationship management in construction supply chain. The partial support for Hypothesis 3 that states procurement strategies have a significant impact on Vendor Relationship Management means that the relationship between these factors is more complex than what has been theorised. Consequently, this implies that while different procurement strategies indeed impact supply chain performance, they also depict the type and form of the vendor relationship that is developed. The following multi-facet impact of procurement strategies provides a social proof why they are strategic to construction project management. It thus emphasizes on the strategic procurement approach, which acknowledges short-term project requirements in addition to the future relations between the supply chain partners. The fact that Vendor Relationship Management assumes the mediating position in the procurement strategy-supply chain efficiency relationship is something novel about the significant findings. Thus, the mediation effect provided evidence that procurement strategies are significant but its contribution to supply chain efficiency depends partly on vendor relationships. This is in support of the relational view of inter organizational competitive advantage as described by Dyer and Singh, 1998 suggest that firms can obtain relational rents through efficient inter firm relationship. In the construction context, this means that besides choosing right procurement strategies, more attention should be paid to using these strategies as the means for enhancing and developing appropriate relationships with the vendors.

Nevertheless, Sazali et al., (2012) emphasize that the significance of the relationships is contingent on the choice of the distinguished procurement strategies and supply chain efficiency dimensions. Such fluctuations imply that the application of one or another type of procurement strategy could be contingent on certain characteristics of a project or supply chain goals. For example, weaknesses of Just-In-Time procurement systems depict lesser impact as compared to Multiple Sourcing and Single Sourcing systems. This could be due to the fact that Just-In-Time management principles used in Toyota could not very well fit in the construction environment as it is full of many unfathomable fluctuations (Fearne & Fowler, 2006). The findings of the study also shed some light into the current discourses on the globalization and standardization of management theories and practices. The obtained results confirm some of the major assumptions of the theoretical framework like TCE, RBV although the patterns themselves indicate a possibility that the application of these theories may require country specific adjustments especially in the construction industry of the emergent economy like Jordan. This corresponds with the need for context-sensitive research outlined in the project management and supply chain literature (Söderlund, 2004; Meixell & Gargeya, 2005).

#### 5. Implication of the Study

The findings of this study hold major implications in various fields and domains. As for the future research, managers in the Jordanian construction industry should pay adequate attention to the procurement strategies in general, and multiple sourcing in particular. He should also enhance the strengthening of the vendor relationship since they help in improving the efficiency

of a supply chain. Managers must understand the importance of supply chain management besides realizing that procurement management has several ripple effects concerning the vendor together with the firm. This study further builds on the Transaction Cost Economics and Resource-Based View theories to the construction industry in a developing-country setting. In doing so, it offers proofs to support the tested mediating function of vendor relationship management in relation to the two variables of interest: the procurement strategy and supply chain efficiency. The results also indicate that there is a need to contextualize most of the advanced management theories as per the existing local conditions. There's a need for practitioners to work on the methods for procurement that will allow them to establish long-term relationships between the organization and the vendors in the context of the specific project being implemented. The result reveals that multiple sourcing has a strong impact on supply chain flexibility and thus practitioners should look at ways of incorporating a diverse supplier base for the SC. Education and training of construction professionals should comprise technical procurement and relationship management competencies. Today, factors such as reduction of waste and cost, as well as supply chain management has played a big role in ensuring constructions of various projects are done in the shortest time possible. This can have further implications in the society such as; better mechanisms for utilization of resources, better infrastructure, and an increased economic growth. In addition, the focus on the relationship management may bring the attitudinal change or culture in the construction industry where relationship management is in tandem with ethicality in the management of relationships.

## 6. Limitations and Future Studies

The limitations of this study are important to note when interpreting the results despite their contribution to the existing literature. The research design used in the study has cross-sectional characteristics, which restrict the possibility of identifying direct causality between analyzed factors. Subsequent research endeavors could use prospective research approaches in order to explicate the evolving forms of procurement strategies, vendor stability, and supply chain performance. Thus, some observations reported in this study are context-specific to the construction industry in Jordan. It would be useful to conduct comparative analysis of different countries or types of activity to obtain a more complete picture of these interactions. Another weakness of the study is that the data used is self-reported and obtained from a single source for each of the organizations, which may cause the common method bias despite the checks used. It would be useful in subsequent research to gather the data from various sources in each company or to incorporate impersonal activity indexes. Also, although the research looked at the moderating role of vendor relationship management, other possible mediators or moderators, including project complexity or environmental uncertainty, were not explored. Further research could examine these other factors to come up with a better model on the subject. This research largely centered on the view from construction firms and managers, therefore, the results may be somewhat skewed. The subsequent works could also involve the objective analysis from suppliers and other supply chain participants to help add another dimension to the future supply chain dynamics. In the same manner, it was agreed that qualitative research may provide a more extended understanding of the processes by which procurement strategies and associated vendors affect supply chain performance. Finally, although the study compares various procurement strategies, it does not look into the possible combination effect or conflict between the strategies. Subsequent studies could explore the ways in which various Delivery-Procurement strategy configurations could help to fine-tune the supply chain configuration in conditions of change.

## 7. Conclusion

The purpose of this research was to assess the effect of project procurement strategies on supply chain responsiveness within the context of the construction industry of Jordan with special reference to vendor relationship management as moderator. Many times, published research studies combine both qualitative and quantitative data collection and analysis; however, the current research restricted the data collection and analysis to only quantitative approach using PLS-SEM on data gathered from 454 construction industry professionals of Jordan. The analysis showed that there is a positive link between Just-In-Time, Multiple Sourcing and Single Sourcing procurement strategies and the nominated supply chain efficiency dimensions of Demand Forecasting, Supply Chain Integration, Collaboration and Communication. Thus, Multiple Sourcing turned out to be the most vital procurement strategy among the lot. Assessment of the research hypotheses yielded that Vendor Relationship Management had significant positive impact on all the dimensions of supply chain efficiency and offered partial mediation in the relationship between procurement strategies and supply chain efficiency. Therefore, this study contributes towards an understanding of the execution of procurement strategies, vendors, and supply chain effectiveness in the Jordanian construction sector. Thus, the research highlights both the choice of the procurement strategy and the management of the supply chain partners as critical for the improvement of construction project outcomes. The partial mediating role of vendor relationship management points not only to the practical value of a procurement approach that adopts an integrated management perspective to crop up appropriate and effective solutions in the light of relationally oriented procurement goals but also to the increased awareness of a relational perspective of contemporary procurement that should take into account the purchasing(-related) projects' requirements and the relational implications of vendors' selection. These findings hold insights for managers and practitioners in construction projects and similarly demanding environments where diverse sourcing is the rule and flexibility of supply sources is paramount. The study also added a theoretical advancement of knowledge concerning these relationships in a developing country environment, given the extension of TCE and RBV perceptions. Further studies need to be based on the longitudinal design, cross-sectional comparisons, and other aspects of mediation and moderation to improve the understanding of these relationships in the construction setting.

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