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The Key Role of the Dimensions of Supply Chain Management on the Success of the Project Completion Process

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Abstract
From studies, reports, and information, we can see that the Supply Chain Management System (SCMS) has a major impact on project success. The Supply Chain Management (SCM) plays an important role in achieving potential cross-company success because the SCMS allows us to control the development, design, management and identification of the most effective and efficient inputs, information and other resources required to complete the project. An effective SCMS is of essential importance for the strength of the competition and for the success of the entire organization. Therefore, the competitive advantage in this new environment no longer depends on the company's performance, but also on the entire supply chain partners, including competitors.

The main objective of this research is to conduct the relationship between the supply chain management system, project success, project performance, to identify, and to determine the potential impact of SCM on project completion and success. In this study, a random sample was drawn from a population made up exclusively of construction companies, and project departments from other companies in Amman, the capital of Jordan. As a tool for data collection, we chose a questionnaire. Based

on this, many statistical analyzes were carried out and the hypotheses of this study were tested.

As a result of this test, we found out that in general there is a clear and positive relationship between supply chain management and project completion. The dimensions of supply chain management (knowledge, skills, and tools) have different effects on the project closure process. The knowledge dimension has the strongest effect.

Keywords: Supply Chain Management System, Supply Chain System, Success and Completion of Projects, Project Management.

1. INTRODUCTION

Timely and inexpensive delivery of materials, equipment and other requirements is the most important element for the success of any project. If the required project resources are not available, it would be very difficult to achieve project success. The availability of resources should meet certain requirements (time, quantity, quality, location, price, etc.). Also, frequent, and rapid economic, social, and technological shifts have increased uncertainty and at times had a significant impact on supply chains. [Pettit et al. 2010; Trkman et al. 2016; Chowdhury et al. 2021]. To demonstrate the importance of logistical services, we will take up the emergency measures taken during Hurricane Katrina in due course, which suffered badly from lack of needed resources at the required location. This situation and weakness in logistical services led the Mayor of Kenner, LA., Phil Capitano to say: "The Red Cross and FEMA (Federal Emergency Management Agency) have to learn a lot from Wall-Mart about logistics". Inman (2006).

In this context, supply chain management is considered the key factor in ensuring that project resources and requirements arrive and are met on time. These project operations (just in time delivery), in which the right resource is delivered to the right place at the right time, help project management in mitigating catastrophic events like Hurricane Katrina. In addition to the fundamental role of the project supply chain management, in all project implementation processes, updated project globalization landscape increases the need for effective procurement management with the aim of providing all project resources and requirements in a timely manner [Johnston 1995; Hollis 1996; Ganeshan, Harrison 1997; Ahmed et al. 2002; Teeikangas 2002].

This globalization landscape of projects and their competition across domestic borders is always connected to the shared and common environment. At the international level of the economy, local and international companies compete against each other for their survival.

For local companies, to maintain their competitive strength in this international competitive environment, they use foreign production facilities, labour, and joint venture agreements economically, so that they develop new products and / or natural resources and include it in their main task of offering products and services at national and international markets.

For global survival, competing organizations in the field of SCM should increase their competitiveness through cheaper, faster, and better introduction of required products [Christopher 1992; Bushnell 1999; Wong, Fung 1999; Sennara 2002]. We can recognize project management for its ability as a discipline. It improves survival skills and experience as a primary target for business organizations; Kerzner (1998), but it does not guarantee that the company will be successful worldwide [Iles, Hayers 1997; La Londe 1998; Helms et al. 2000]. Therefore, supply chain management is considered as important means for efficient and effective project operation.

[Houlihan 1985; Cooper et al. 1997; Tan, Kannan 1998; La Londe 1998; Hazier, Render 2006, 2014] agree on the definition of SCM. They agree on defining supply chain management and see it as an activities-integration that provide materials and services and converts them into half-finished and finished products that are delivered to customers. Essentially, the supply chain management converts total needs of a project (materials, supplies and services) into finished products, to satisfy projects and customers. This transformation process basically requires a wide set of techniques and skills for supply chain management.

1.1 Project definition

In 2013 the Project Management Institute defined a project as a temporary unit with fixed start and end times as well as a fixed scope and certain resources ". Erik & Clifford (2014) defined a project as a temporary endeavour and a unique product with the aim of creating services or results.

In 2017 the Project Management Institute provided several definitions of supply

chain management as follows: A project is any new task that is performed to achieve a reasonable and useful goal, and it is not a routine activity. It is a special unit that performs a certain set of operations and is designed to achieve a specific target. Therefore, a project-team usually consists of people who normally do not work together beforehand and are sometimes composed of different sectors and organizations. To clarify the definitions of projects, Project Management-Institute (2017), used various examples:

- The development of special software with the aim of improving business processes.
- The construction of a building or a bridge as an example of a project.

Each project is unique and should be carried out in a tailor-made manner. This allows the specially planned results of the punctual execution of activities to be achieved more effectively and within the specified budget. In general, the main characteristics of a project include:

- clearly defined goals,
- certain endpoints,
- it involves different departments and specialists,
- is considered a unique and non-routine process,
- it has a fixed completion time and a fixed budget [Cohen, Graham 2001; Project Management Institute 2006, 2013; Jonas 2010].

1.2 Definition of a Supply Chain

We can define the term "Supply Chain Management" as the monitoring of finances, materials, and information if this activity goes through a clearly defined process from the first supplier to the end-user. Supply chain management comprises the coordination and integration of all steps in this process both within and between companies with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers [Zijm et al. 2019].

Efficiency is the ultimate target of an efficient and effective supply chain management system: to flatten inventory levels if the required products are available when needed [Stevens 1986; Ganeshan, Harrison 1997; Tan, Kannan 1998; La Londe 1998; TechTarget 2017].

1.3 Challenges in a Supply Chain

SCM faces many challenges and risks. Many problems arise along the supply chain such as lack of attention from suppliers, late orders, hindered internal procurement processes, material damaged by shipping and changes made by the supplier. One of the most common problems in this context is the lack of attention from suppliers. This problem is mentioned in the first place, which many projects suffer from. For example, the National Aeronautics and Space Administration (NASA) has suffered many problems of this type, even though NASA has invested a lot of money to keep this problem under control. Ivory and Alderman [Ivory and Alderman 2005], believe that the main cause of this delivery problem and poor supply chain service in NASA environment is due to the unique nature of the work. This environment does not facilitate a long-term workflow from these suppliers, so the whole task was not as valuable to the suppliers and therefore they didn't pay their best attention [Hollis 1996; Johnston 1995; Helms et al. 2000].

The main drawback of this view can be traced through few practices. For example, suppliers give high-quality orders the highest priority, which has a negative impact on competing little-important orders, and their timely compliance. In this situation, the project manager usually recognizes that his/her order, compared with orders from other companies, is given a degree of importance. The supplier treats the order according to size and frequency and therefore treats large or repetitive customers better than one-off customers in terms of prices and level of service. Another example is the supplier's lack of attention. Examples are the failure to respond to calls or e-mails in a timely manner, steady response to make an update of orders, and the permanent shifting of procurement inquiries between the various salespeople. In contrast to the fact that weak supplier attention is a risk to the project. The project team could also create risks and challenges for supply chain management. Therefore, the supplier problems just mentioned can be caused by late orders, which in turn are caused by contradicting goals and conflicting priorities of the project team. Therefore, and according to the "theory of contradicting goals", a project team must first reconcile these competing goals and then approve the correct and unambiguous order.

The project management team is responsible for the correct management of the objectives. This team is supposed to ensure the contradicting goals such as the management of the project cash flow, the availability of the necessary resources, and bring them into balance. In many cases, these goals are in conflict. The reason

is that part of cash flow management procedures is focused on ensuring that materials are procured when needed and within the specified quantities. By planning the material purchase and delivery dates, priority is given to the general cash flow target, which may miss out on obtaining better prices and services from the suppliers. If the project team can achieve a better price with early delivery dates, the project team must then provide additional storage space and finance the costs ahead of time. The procurement of a project, in which contradicting goals and specifications are in conflict, is also the guarantee of a supply only when necessary. Backorders, late deliveries, and incorrect deliveries are other examples of potential difficulties that encourage the project team to set orders earlier than normal to manage these potential risks and difficulties. If project management procures the necessary materials early, it can minimize the number of risks, but on the contrary, this can lead to additional costs for breakage, storage, and shrinkage. Supply chain management is also subject to some internal problems when it comes to purchasing. In this context, a project manager has stated that the process of contract purchase "would go into this black hole called the buying office and they will probably take the cheapest purchase regardless of what you get…We have suffered heavily for that" [Brugess 1998; Tan, Kannan 1998; Wong, Fung 1998; Ivory, Alderman 2005].

Let us name other interior challenges such as restricted or conflicting guidelines and procedures in the company that are intended to regulate the purchasing process. Most of the limitations in supply chain management include restrictions on authorized levels of management, requirements for competitive offerings, and the limitation on the kind of equipment offered that can be used. Other examples of the restrictions include company policies. These guidelines are bureaucratic in nature; therefore, the contractual requirements about warranties and insurance are very strict. These problems and limitations severely limit the ability of project team to maintain the delivery process of the required materials and supplies within the specified timeframe and affordably. There can also be risk in the supply chain if deliveries arrive damaged. An example of this is the provision of a turbine power plant, which upon receipt was found to have been partially damaged and must be returned to the manufacturer. It gets worse when it comes to special technology systems. Here the changes caused by suppliers can lead to an additional area of supply chain risks. It would also be possible for the supplier to make changes to the design of the requested part: examples of this could be the replacement of the metric screws according to the English standard or the delivery of an intensive software-controlled system. Such incidents can lead to several problems which, in the worst-case scenario, can have catastrophic effects on the system. These in turn

lead to additional costs and time to address the changes caused by the supplier. These in turn lead to additional costs and time to address the changes caused by the supplier.

1.4 Assessment of the Supply Chain Process

Knowledge, skills and tools given in the field of supply chain management play an important role in supporting project management performance. Improving the performance of project teams in delivering the required materials or services cost-effectively, at the required location, and at the required time depends directly on an effective application of these skills and tools. The following requirements are important in global supply chains:

1. A supply chain should be elastic and react quickly to abrupt changes (availability of parts, shipping channels or distribution, import duties and exchange rates).
2. A supply chain should use the newest technology (transmission technologies and computer) to better plan the entire delivery process.
3. A supply chain should devote an importance to build a relationship network. This network should connect the employees of the supply chain with the local specialist. These specialists can provide help with specific issues such as customs, freight, and bureaucracy issues [Stevens 1986; Johnston 1995; Bruges 1998; Tan, Kannan 1998; Bushnell 1999; Wong, Fung 1999; Heizer, Render 2006, 2014; Chopra, Meindl 2007; Bowerso, Cooper 2002; Bozarth, Hanfield 2008; Wisner et al. 2012]. Working with specialists and experts is an important task and improves the manageability of a supply chain. The best case is, if the team of project management has a direct affect in these supply chain specialists because the team then can ensure that the best available skills and knowledge are used to support project operations.

Based on the available related literature and some previous studies, the authors have developed the model of this study. The model focuses on the impacts of three main dimensions of supply chain management (knowledge, skills, and tools) on meeting project's completion datelines and its success. The selection of these dimensions (characteristics or measures) was relied upon the outcomes of many pervious field studies [Vrijhoef, Koskela 1999, 2000; Akintoye et al. 2000; Barker et al. 2000; Dainty et al. 2001; Ahmed et al. 2002; Saad et al. 2002; Khalfan et al. 2004; Love et al. 2004; Sweeney 2007; Tennant, Fernie et al. 2010; Jadid et al. 2013; Balwani, Mukesh et al. 2015; Mulla et al. 2015; Vignesh et al. 2016; Sahu et al. 2016].

The three selected supply chain management dimensions (characteristics) were considered as the main independent variables against the project completion process datelines as dependent variable.

The study model is shown below, where you can see the dependent and independent variables:

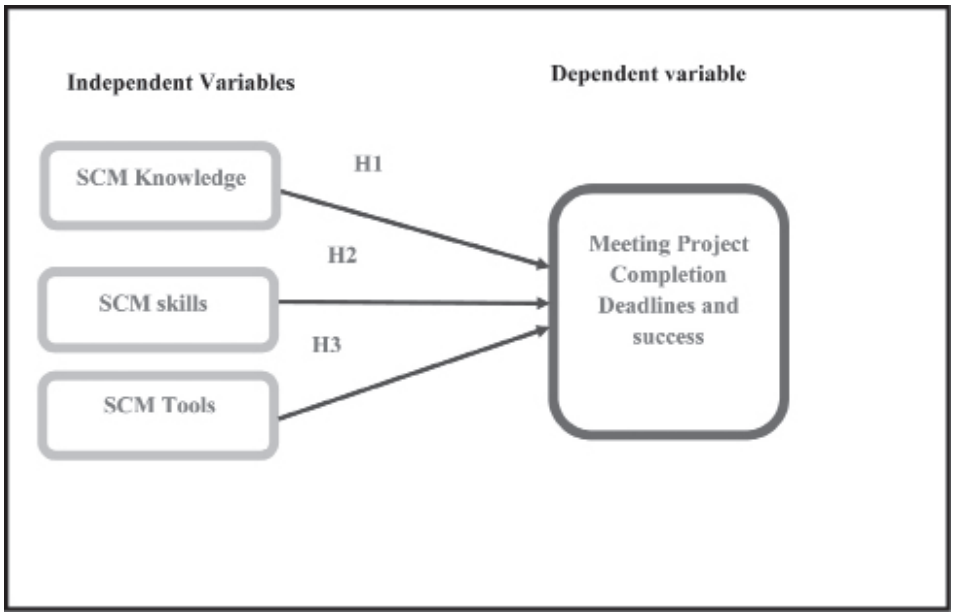

Fig. 1 The Study Model (made by authors)

2. METHODS

2.1 Data Gathering:

The data required to conduct the statistical analysis represented by the descriptive and inferential measures of the study sample data was collected. The researchers developed a questionnaire consisting of 4 sections. Twenty statements were assigned in the study tool to measure the four main variables of the study (i.e., the three independent variables and one dependent variable).

2.2 Selecting the Sample

The population of this study consists of all employees of the main contracting companies and project management personnel in other business enterprises in the Amman area (the capital of Jordan), including the project department employees at Al-Zaytoonah University of Jordan. The researchers selected 140 samples by simple random sampling method and took them from the population. The questionnaires were distributed directly and using electronic means to the sample members by the study team. 133 questionnaires were returned, and 126 questionnaires were used out of the total questionnaires, which were meeting the treatment conditions correctly and were used in the analysis.

2.3 Participants Identification:

As it is illustrated by table (1) below, the gender of the respondents was (71.4 %) males and (28.6%) females, while their ages were varied between less than 20 to over 50 years old. It is interesting to mention that the large percentage of the sample respondents were within the youth category (i.e., between less than 30 to 39 years old). In term of Managerial Position, it was found that 44.4 % of the respondents were employees, 6.3% consultants, 35.7% engineers and 11.1% managers. Regarding the respondents' educational level table (1) indicates that 79.4% of the respondents were bachelor's degree holders, 14.3% had MSc degrees, and 2.4% were PhD holders. The respondents' working experience was varied from less than 5 years to more than 15 years, and about 47.6% of the respondents' tenures were more than 10 years.

Table 1: Participants Description

Variable		**number**	**%**
Gender	Male	90	71.4
	Female	36	28.6
Total		**126**	**100.0**
Variable		**number**	**%**
Age	below 20	6	4.8
	between 20 – 29	47	37.3
	between 30 – 39	51	40.5
	between 40 – 49	18	14.3
	50 years old or more	4	3.2
Total		**126**	**100.0**

Variable		number	%
Managerial Position	Managers	14	11.1
	Consultants	8	6.3
	Engineers	45	35.7
	Employees	56	44.4
	Other	3	2.4
Total		**126**	**100.0**
Variable		**number**	**%**
Educational level	PhD/DBA	3	2.4
	Masters	18	14.3
	Bachelors	100	79.4
	Other Educational Levels	5	4.0
Total		**126**	**100.0**
Variable		**number**	**%**
Working Experience	less than 5 years	21	16.7
	5 – 10 years	60	47.6
	11 – 15 years	34	27.0
	16 – 20 years	8	6.3
	More than 20 years	3	2.4
Total		**126**	**100.0**

Sources of Table 1: All figures and information shown in the above table (no. 1) have been taken from the completed and returned survey forms.

2.4 Questionnaire Validity Testing

To ensure the internal consistency and reliability of the data for the study instrument (questionnaire), the Cronbach alpha test was performed. The results of this test are shown in Table (2). The value of Cronbach's alpha for all paragraphs of the resolution was equal to (0.924%). In addition, every paragraph of the study tool had a Cronbach Alpha value greater than (75%), this indicates the consistency and reliability of the paragraphs of the questionnaire for use in further statistical analysis.

Table 2: Reliability Statistics

Variables		Cronbach's Alpha
Independent Variables	SCM Knowledge (SCM-K) (X1)	0.819
	SCM Skills (SCM-S) (X2)	0.758
	SCM Tools (SCN-T) (X3)	0.761
Dependent Variable	Meeting Project Completion Deadlines and Success (MPCD-S) (Y)	0.786

Sources of Table 2: All figures and information shown in the above table (no. 2) have been taken from the completed SPSS analysis made for the data collected.

3. DEVELOPING HYPOTHESES

Based on previous studies and literature related to the subject of the study, and according to the objectives of the current study, the study model was developed, and its variables defined. The null hypotheses of the current study were formulated based on its variables, and as shown in the following:
Ho.1: knowledge of SCM has a negative significant impact on project completion deadlines and success.
Ho.2: Skills of SCM have a negative significant impact on project completion deadlines and success.
Ho.3: Tools of SCM have a negative significant impact on project completion deadlines and success.

3.1 Hypotheses Testing

To test the hypotheses of this study, relevant statistical analysis such as correlation, regression and ANOVA were performed. The results of this analysis are shown in Tables (3, 4 and 5). Regression analysis is one of the statistical measures of great importance to be used in examining and investigating the effect of independent variables on the dependent variable in the study.

Based on the results shown in Table (3), it was found that there is a strong positive relationship between the elements of the supply chain and the deadlines for completion of the project and success, as the values of R, R, and the modified R square were (0.880), (0.77) and (0.770), respectively, at (0.000) level Significant for F = 125.650. The results of the regression analysis shown in Tables (4 and 5) confirm that SCM knowledge has the most positive effect on project completion and success deadlines (Bata value = 0.517), and the next best effect was supplying chain management tools (Bata value = 0.270) and less Impact of supply chain management skills (PATA value = 0.184). These results clearly indicate that the three elements of supply chain management, in general, have varying positive impacts on the project completion process at 0.001 critical levels. Based on these results, it would be logical to conclude that the three null hypotheses must be rejected, and alternative hypotheses accepted.

It would be valuable to state that there are three dimensions of the supply chain and as the results indicated, there is a strong positive relationship between the process of completing the project and its success, where the value of the correlation

coefficient was approximately equal to (0.89), the value of R squared is equal to (0.77) and the value of the adjusted squared is equal to (0.77) with a value of F equal to (125.650) at the (0.000) significant level. This result statistically means that the change is in the dimensions of supply chain management, that interprets more than 70% of any change in the dependent variable (the *project completion deadlines and success*). In other words, any improvement in the operations and performance a project supply chain management will lead to direct improvement in the project completion deadlines and its success.

Sources of Table 3, 4 and 5: All figures and information shown in the below tables (no. 3, 4 and 5) have been taken from the completed SPSS analysis made for the data collected.

Table 3: Correlation

R	R Square	Adjusted R Square
0.89[a]	0.77	0.77

a. Predictors: (Constant), SCM-T, SCM-S, SCM-K
b. Dependent Variable: MPD

Table 4: ANOVA Analysis

	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.564	3	2.855	125.650
	Residual	2.499	110	.023	
	Total	11.063	113		

a. Predictors: (Constant), SCM-T, SCM-S, SCM-K
b. Dependent Variable: MPD

Table 5: Regression

		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	- 0.199	0.291		-0.683	0.496
	SCM-K	0.556	0.092	0.517	6.016	0.000
	SCM-S	0.235	0.074	0.184	3.191	0.002
	SCM-T	0.240	0.071	0.270	3.396	0.001

$$Y = -0.199 + 0.556X1 + 0.235X2 + 0.240X3 \quad (1)$$

Finally, the regression analysis and statistical testing outcomes illustrated in tables 3, 4 and 5, have clearly indicated that the three supply chain management dimensions (knowledge, skills, and tools) are collectively and individually positively and significantly correlated with the completion process of construction project as R value was 0.880 and beta values varied between 0.184 and 0.517 at 0.001 level of significant.

4. GENERAL CONCLUSION AND PRACTICAL RECOMMENDATIONS

Some of the previous studies had an effective impact in adopting practical proposals for managing supply chains because of their positive impact in supporting the activities and implementation of construction projects and providing practical instructions for various procedures.

These dimensions are the strongest link in the construction project industry, to reduce the total project cost and time, and thus enhance profit. Where the supply chain plays a major role in the success of the project as a critical means of transporting materials and supplies from the manufactures to the related construction project site. To improve supply chain management in construction industry, it would be necessary to build a strong relationship with all participants of the chain who are providing project requirements. This action will help project management to improve its decision-making process and enhances its general performance.

In conclusion, supply chain management is an economic and commercial process that extends to the concept of business intelligence at all local and global levels. Where it plays an active role in providing it with the necessary characteristics for the success of projects. Therefore, all parties, including managers and working teams, must integrate to search for the best methods, tools, and techniques that affect these processes in an efficient and effective manner.

5. CONCLUSION AND RECOMMENDATIONS

Supply Chain Management plays an active role in maintaining the project wheel and the main tasks to meet the desired goals. So that there is an ideal, effective, and

real scheduling of the project's supply flow and requirements, and a good follow-up of the project's supply chain and it's timely and perfect delivery.

Based on the results discussed, it was found that the overall SCM dimensions have a significant and positive correlation with the deadlines for project completion and success. In Addition, the results of the regression analysis also confirmed SCM knowledge, SCM skills, and SCM tools have a positive effect on the completion process and the success of the project. The results show that the supply chain management teams, with their expertise, specialization, and professionalism, greatly and directly affect the success and completion of projects, and this enables the supply chain management teams to choose effective team members of the supply chain links from suppliers and others in a more accurate and wise comparison to ensure timely delivery for all required supplies. If the application of the knowledge base, experience, skills, and tools for supply chain management is sufficiently applied to provide the required materials and services for a project, the project team will seriously assist in obtaining the required product or service at the required time with the lowest costs and most effectiveness.

When we want to gain a high level of performance for our supply chain, we must manage it more efficiently and effectively. This requires providing and strengthening employees with skills and a high level of professionalism in performing work and carrying out tasks, which also gives them extensive experience and specialization in performing tasks and effectively tracking needs, requirements, materials, services, and components for the entire project. Therefore, project managers in all sectors need to be fully aware of the role of supply chain management in the success or failure of a project.

Through the results, it was clearly indicated that the competencies and experiences of the supply chain management team will directly affect the process of completing the project. This result should encourage the project management team to deliberately and accurately select their suppliers to ensure the timely delivery of all required supplies. If the knowledge base, experience, skills, and tools of supply chain management are applied sufficiently to provide the required materials and services for a project, then the project team will assist in getting the required product or service on time at a lower cost. To achieve a high level of performance, efficiency, and effectiveness of supply chain management, it needs to employ highly skilled and experienced employees who can effectively track the needs, requirements, materials, services, and components of the entire project. Therefore, project managers in all sectors need to be fully aware of the role of supply chain management in the

success or failure of a project. It might be relevant to mention that the results of this study are compatible with many previous studies such as [Ahmed et al. 2002; Khalfan et al. 2004; Tennant et al. 2010; Jadid et al. 2013; Balwani et al. 2015; Mulla et al. 2015; Sahu et al. 2016; Vignesh et al. 2016].

6. SOME PRACTICAL RECOMMENDATIONS

Based on the above explained and discussed results, it would be reasonable and beneficial to suggest the following recommendations:

1. It is imperative that there are training courses for project managers represented in supply chain management before starting the tasks and functions of their projects to be fully aware of the impact of the supply chain process on the deadlines for the completion of their projects.
2. Project managers must hold official meetings with their main suppliers and supply chain members before starting any activity on their project, to be fully aware about their capacities, skills, experiences, policies, procedures, and practices which they must take it into their account in developing the project action plan.
3. It would be beneficial for Jordanian construction companies to build partnership relations with their suppliers (supply chain companies) to facilitate and accelerate implementation processes to successfully meet their projects deadlines.
4. Projects managers should be keen to hold regularly scheduled meetings with their supply chain counterpart managers during project executing phases.

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