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The Impact of Supply Chain Capabilities on Logistic Efficiency for the Construction Projects

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Abstract

Rapid technological advancements force organizations to be more proactive and efficient it operations while previous studies revealed that most of the public sector projects go over in term of time and cost. Although extensive literature is available but only for the private sector, the investigations on the public sector are scarce. After plentiful literature, it has found that timely and sage supply chain is a major hurdle. Various strategies and approaches have been proposed to tackle the situation but after a thorough investigation, it was found that flexibility and collaboration are the topmost influencing factors in improving logistic efficiency. Thus the aim of this study is to empirically verify the positive impact of flexibility and collaboration on logistic efficiency. A questionnaire was adopted and distributed by random sampling to the strategic level of the construction projects in the city of Lahore, Pakistan. Multiple regressions were applied through SPSS. The finding of the study revealed that flexibility contributes 33%, collaboration contributes 35.5% in the logistic efficiency. It can be concluded that construction projects must be flexible and force stakeholders for collaboration. This study added in the frame of knowledge as new findings for public sector projects. This study will help the managers in completing their projects timely and accurately.

Keywords: Flexibility; Collaboration; Logistic Efficiency; Construction Projects; Supply Chain Capabilities.

1. Introduction

The construction sector is considered as the backbone for the economy of every country, in Pakistan, it has gaied the highet attention due to China-Pakistan Econmic Corridor (CPEC). Now it is the largest employment producing sector within the country as well as a vital factor for economic development [1]. The construction sector has registered a growth of 9.05 percent against the last year growth of 14.6 percent [2]. Though the industry is progressing, the quantum and rate of progress are yet not up to the mark [3]. Construction industry of Pakistan, like other countries around the world, has a poor record in terms of completing projects in allotted time and cost [1, 3, 4]. Additionally, it has the issues of quality and meeting other project success factors [5]. Moreover, many projects fail to accomplish their objectives due to time and cost overruns; hence, Pakistan construction industry is unable to deliver as per the government plan of progressive development [6].

To boost up this sector Prime Minister initiate "Hunarmand Pakistan" program for skills development courses up to six months duration with the public and private sector and various more initiatives to augment this sector. Despite all

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this, it has reported several times that construction projects face various problems like delay, high cost and designated requirements [1]. To overcome these problems and mitigating vulnerabilities various strategies and approaches were proposed [3]. Construction is dependent on the smooth flow of material, if any disruption happens it will directly affect the whole project [7]. Thus, to overcome all the issue logistic should be efficient. There are various approaches available to overcome the disruption and enhance the efficiency but it has proposed that flexibility and collaboration are top most effective approaches. Thus, this study limit to two flexibility and collaboration as these approaches have the highest impact on performance even in an uncertain situation [8–10]. The aim of this study is to empirically verification of the structural relationship between flexibility and collaboration with logistic efficiency. The novelty of this lies that these approaches were verified for the private sector only but there is a need to verify this relationship for the public sector.

2. Literature Review

2.1. Logistic Efficiency

Logistics efficiency offers relatively objective measures of organizational performance such as inventory turnover ratio, timeliness of order delivery, order fill rate, and so on. The order fulfillment rate is an important area of logistical efficiency. It signifies the accuracy of demand planning [10]. The order fulfillment rate is used to measure service capacity and order delivery speed in this study. It was used to measure the overall time performance of an organization. Flexibility is a key indicator of a firm's ability to respond to market dynamics. For example, flexibility measures the ability to respond to operating system disruptions. This study used operational flexibility to symbolize the convenience of service and responsiveness. Inventory associated indicators have often been used to measure the effectiveness of SC [11]. Logistics and supply chain management can provide a multitude of ways to increase efficiency and productivity and hence contribute significantly to abridged unit costs [12, 13]. That is why logistics is considered to have a significant impact on a manufacturing organization's performance and it has confirmed "The Importance of Logistics Efficiency to Customer Service and Firm Performance." It is confirmed that logistics influence a manufacturer's ability to satisfy the customer and overall performance [11]. Logistics provide the physical function connecting two different organizations and distributing value added through the SC so, among several indices for evaluating the SC performance, logistics efficiency presents relatively objective and measurable indicators such as order management, inventory management, flexibility, and logistics costs [12]. Additionally, logistics efficiency provides moderately objective measures of organizational performance like timeliness of order delivery, inventory turnover ratio, order fill rate [10, 14]. An important area of logistics efficiency is the order fill rate, which represents the accuracy of demand planning. Order fill rate is used to measure service capability as well as the timeliness of order delivery [10]. Thus, it can be concluded that logistic efficiency should be measured by five items. Table 1 described all these five items with reference.

Table 1. Measurement for logistic efficiency

Variable	Items	Reference
Logistic efficiency	Order fill rate: Percentage of orders completed in full within the planned order lead time.	[11]
	Order fulfillment lead time: The lead time from customer order origination to customer order receipt	
	Operations flexibility: Ability to meet production modification, shortages in inventory, and short-term fluctuation in demand	
	Inventory turnover: How many times a year the average inventory for a firm changes over or is sold	
	Total logistics cost: Overall, costs involving logistics activities	

2.2. Supply Chain Capabilities

2.2.1. Flexibility

Flexibility is defined as "the ability to quickly change inputs/outputs or the mode of receiving inputs/delivering outputs" [15]. Wolf [16] emphasized that product flexibility could also be related to the degree of modularity of projects. Modularity denotes to the possibility of isolating the project into more or less independent subunits. According to Rungtusanatham, Miller and Boyer [17], modularity can enable projects to manage with ambiguity because individual components have no critical role. Large "one-piece" projects such as bridges and tunnels have a low level of modularity, based on the "we do not build a half-bridge" methodology. Moreover, for demand flexibility, the ability of a supply chain to rapidly increase the capacity of storage and distribution services to cope with rising demand without generating overcapacity is extremely cost-effective in the face of increasing demand. Alternative distribution channels are also significant when a supply chain is confronted with transport disruptions or the disruption of an entire network. Table 2 shows the measurement items for flexibility adopted from [15]. The discussion above indicates a number of mutual capability factors that existing researchers agree on. Flexibility is one of the most significant. In construction, flexibility in a project is the capability to adjust the project to the potential consequences of indeterminate situations within the context of the project [18, 19]. In other words, flexibility is the opportunity for construction and technical changes with

minimum cost and disruption. Minis et al., [20] emphasized two main flexibility factors: flexibility in sourcing and flexibility in order fulfillment. This can be assessed by looking at the supply chain members' ability to quickly change inputs or the mode of receiving inputs from the supply side, and their ability to quickly change outputs or the mode of receiving outputs at the demand side [21]. Flexibility can be enhanced by consuming materials or inputs that can be assimilated in multiple finished products. In construction, this could be the application of standardized constituents that can be used in many components of the construction of building design [22, 23]. This would reduce the cost of inventory and the risk of an individual stock out. The use of alternative suppliers is also important in the event of a single or multiple supplier disruption [24]. Based on the literature view below hypothesis has been proposed:

H_1: Flexibility positively enhance the logistic efficiency for construct projects

2.2.2. Collaboration

A commonly accepted definition of collaboration commented by Ross et al. [23], collaboration is "an activity conducted jointly by two or more entities to achieve a common goal. This can range from the exchange of raw data by the most basic means to the periodic sharing of information through technological tools, through the structuring of real-time architectures able to take advantage of highly interdependent infrastructures for the realization of complex and tightly integrated functions ensuring security, planning, execution and synchronization of information" [14]. The rapid growth of the global supply chain requires the interconnection of stakeholders. As a result, a high level of interdependence and complexity develops in the supply chain [25]. Empirical studies have shown that collaboration in the supply chain increases performance. In Chen et al. [26] study found that collaboration in the supply chain reduces the risks of the supply chain. Similarly, another example will add the significance of collaboration [27]. The policy of Dove Chemical Company is to offer a plane to the partners. Like Dow with its logistics service providers in North America, which processes 90% of Dow's shipments, they are developing a road safety network that shares information, discusses best approaches, and creates a common safety plan for safe shipping. Table 2 shows the measurement items for collaboration adopted from [15]. Shahbaz et al. [28] shown, after a comprehensive literature review, that further analysis of supply chain risk management was needed and designates three important gaps. Conferring to him, there is a lack of integration between the internal and external aspects of the SC. Secondly; the internal aspects of the internal and external process of the SC still need to be clarified. Finally, there is a lack of quantitative research in the area of SCRS. In the near past of globalization, IT and the organization of outsourcing forces promote collaboration within their supply network [29]. In this study, collaboration with external partners will be discussed. Shahbaz et al., [30] have revealed in many studies that in the current scenario, it is critical for companies to engage with external partners to address global challenges. The next section focuses on the further development of collaborative indicators after moderating collaborative approaches to sources of risk and performance. Based on the above literature below mentioned hypothesis has developed:

H_2: Collaboration positively increase the logistic efficiency for construct projects

Table 2. Measurement of flexibility and collaboration

Variable	Items	Reference
Flexibility	Our finished products/ designs are flexible to changes.	[15]
	Our supply contracts can be easily modified to change specifications, quantities, and terms.	
	We have many alternative suppliers/sources for key inputs.	
	We can quickly increase the capacity of storage and distribution services when necessary.	
	We can quickly reallocate orders to alternative suppliers & reallocate jobs between different people/ units.	
	We have a sophisticated inventory management system that combines demand projections and current orders.	
	We can quickly change the route and mode of transportation of the materials/products capacity	
Collaboration	Our information flows transparently between supply chain members to facilitate collaborative decision-making.	
	Our clients are willing to delay their orders when our production capacity is hampered by disruptions.	
	We have proactive product life-cycle management programs that strive to reduce both costs and risks.	
	Our firm invests directly in our suppliers' or customers' operations, as well as other actions to share risks	

3. Methodology

This study is an empirical verification of the hypothesis. Figure 1 explains the whole research process. First, after extensive literature review problem of identified. Second, the literature review section was developed to express the previous studies. Thirdly, the methodology was formulated to achieve the aim of this study. A questionnaire was adopted from various studies based on similarity of industry, demographic and problem identified. The items for supply chain capabilities were adapted [15]. Meanwhile, the measurement of logistic efficiency was adopted [11]. The detail of

measurement items was mentioned in Table 1. A questionnaire had distributed to the strategic level of public construction projects in the city of Lahore. The respondents were given seven choices from strongly agreed to strongly disagree. Total 480 questionnaires were sent by random sampling and 268 were received. Data screening was performed to purify the data. Lastly, SPSS was used for validity, reliability and multiple regression analysis.

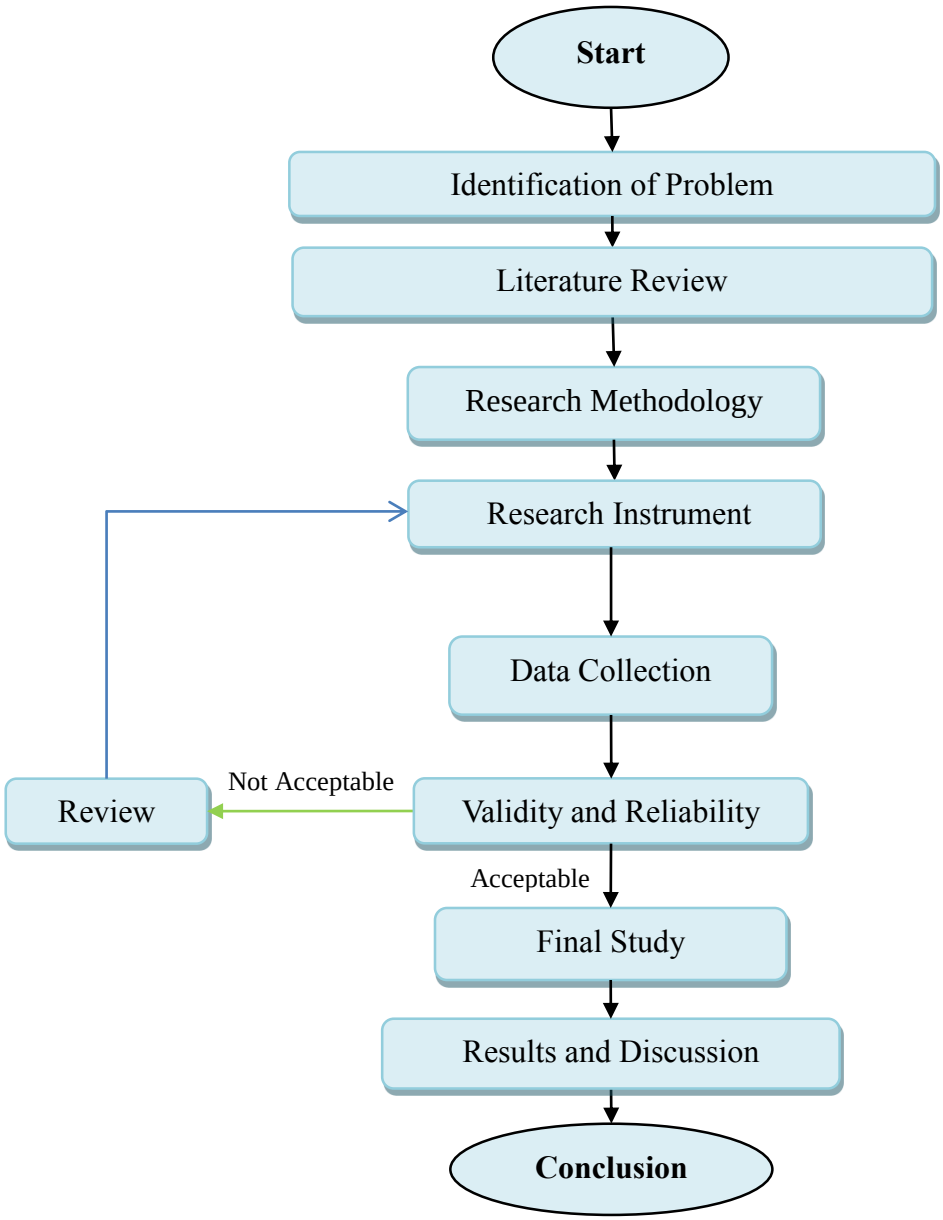

Figure 1. Research flow diagram

4. Results and Discussion

This part consists of two parts descriptive statistics and multiple regressions. SPSS was applied for data analysis. The questionnaires were distributed to two types of projects regular projects like schools, hospitals etc., and mega projects like Metro bus and Orange line train. Figure 2 revealed that 141 responders belong to regular public projects while 110 responders from mega projects. Furthermore, the respondent was asked to mention their working experience and was provided 5 options. Figure 3 shows that for regular projects most of the respondents were belong have more than 20-years' experience while for the mega projects most of the responders have 15 to 19-years' experience. It is because for the mega projects the most of the strategic level management is from China, so they have very less information about Pakistan but for regular projects, most of the respondents were regular government employees.

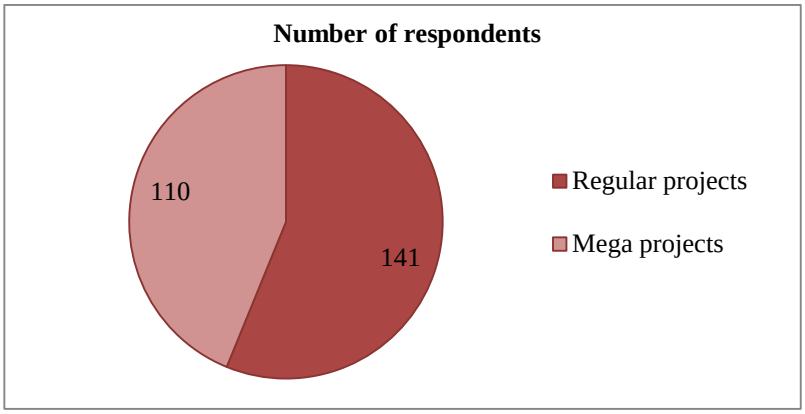

Figure 2. Respondents with types of projects

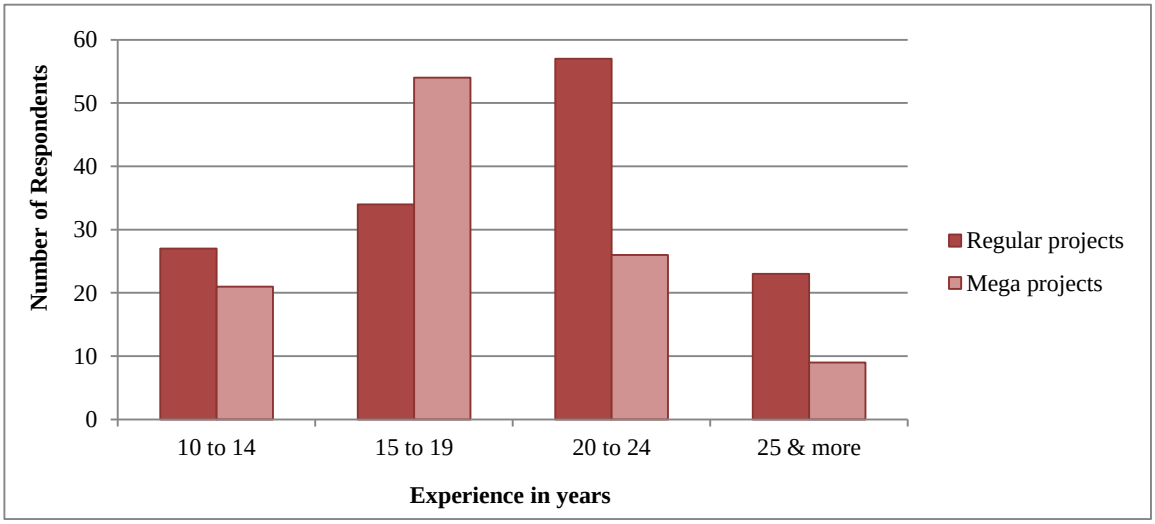

Figure 3. Respondents with experience and projects

The first step of data analysis is manual screening mission values and outliers were identified and resolved during manual screening. Responses with high missing values were deleted. Thus 251 responses have been considered for final data analysis. Additionally, data reliability has been checked through Cronbach's α. Table 3 presents the value of Cronbach's α, mean and standard deviations. For the independent variables, Flexibility has to mean value 3.497 and collaboration has 3.320, while collaboration has 3.214. Meanwhile, all the Cronbach's α values are greater than 0.7, the threshold limit [31].

Table 3. Cronbach's α, means, and standard deviations

Variable	Number of Items	Cronbach's α	Mean	SD
Flexibility	7	0.873	3.497	0.550
Collaboration	5	0.876	3.320	0.636
Logistic efficiency	5	0.803	3.214	0.672

Multiple regression analysis allows for determining the degree of strength and the direction of the linear relationship among research variables [32]. Regression analysis in Table 4 indicates the relationship among independent and dependent variable. Flexibility and collaboration regressed against logistic efficiency and the variance accounted for, R^2 = 35.5%, R^2 = 33% respectively and these statistics show that (35.5%) of Flexibility and 33% of collaboration can be increased logistic efficiency for construction projects of Pakistan. It can be seen in table 4 that the significance of all the independent variable was found $P<0.05$, which is 0.000. Beta coefficient values indicate the contribution of the individual predictor in the model. The beta for flexibility is 0.362. This mean when one unit increases in flexibility the logistic efficiency will increase by 36.2%. The significant was found between collaboration and logistic efficiency and indicates beta value .559 which shows the relationship between them. The beta of electronic data interchange is .334 that mean when one unit increase due to collaboration with members then logistic efficiency will increase by 33%. This study hypothesized that flexibility and collaboration have a positive and significant effect of logistic efficiency and through empirical data, it has been verified. Thus, both H1 and H2 have been accepted.

Table 4. Regression analysis

Coefficients [a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.839	0.199		4.224	0.000
	C	0.334	0.061	0.355	5.499	0.000
	F	0.362	0.071	0.330	5.103	0.000

a. Dependent Variable: L

The analysis results might shed light on the causal relationships between flexibility, collaboration, and logistic efficiency. The result of this study at the individual managers' level support findings from the previous research [10,15]. There is a significant relationship between collaboration, flexibility, and logistics efficiency. Therefore, in order to improve logistics efficiency through collaboration projects must build up a good relationship with their suppliers, government, and other stakeholders. That is, suppliers should assess their buyers' knowledge/expertise and strengthen the partnerships with competent buyers. On the other hand, to maximize the effect of collaboration in information sharing on logistics efficiency, affective trust must be emphasized. If suppliers try to behave openly, honestly, and positively for mutual understanding, buyers might follow and as a result, the effective trust will gradually be fostered. Meanwhile, flexibility has become essential against vulnerability. Rapid technological innovation, continuous fluctuation prices and other uncertainties demand projects must be flexible.

As for internal collaboration, employees may perceive internal collaboration, beyond some undefined point, as being too restrictive, and thereby reducing flexibility. The effect here could be an organization or network where every component performs processes in a very similar manner; a disruption would then influence every component of the highly aligned supply chain in a very similar or identical way [33]. This lack of ability of a particular section of the supply chain network to innovate could be seen as a negative by employees. Flexibility is an essential indicator of a firm's ability to respond to market dynamics. It is suggested that service flexibility, freight damage/loss rate, and claim processing and restitution must be well managed to improve SC performance. We use operational flexibility to represent the convenience of service and responsiveness. Inventory-related indicators have often used to measure the efficiency of the SC. Total logistics cost measures the cost of all logistic activities such as transportation, warehousing, packaging, order processing, customer service, procurement, and inventory management.

5. Conclusion

Normally, construction projects are being forecasted and assumed to fulfil the projected time and cost but due to delay and other disruptions, they fail to achieve their goal. Due to rapid competition construction organization force to be more efficient. They can be efficient only when all aspect of construction projects will be efficient especially logistic side. It can be concluded that construction projects must be flexible and focus on collaboration with other stakeholders to have logistic efficiency. Meanwhile, both flexibility and collaboration are contributing equally to the logistic efficiency. Thus, it is recommended that managers must be flexible in term of cost, time, labor and other decisions to tackle the hurdles and impediments. Moreover, managers must communicate properly with other stakeholders to overcome sudden changes that can disrupt the efficiency and make the process smooth. This study is limited to only two supply chain capabilities future research can verify other capabilities. Meanwhile, this study chose random sampling future studies can choose probability sampling to generalize the findings.

6. Conflicts of Interest

The authors declare no conflict of interest.

7. References

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