Critical Success Factors for Adopting Supply Chain Management in Tanzanian Construction Projects

Geraldine J. Kikwasi[1], *Nyamagere Gladys Sospeter[1,2] and Pantaleo D. Rwelamila[2]

Abstract: Supply chain management (SCM) has been effective in several industries, such as the manufacturing industry and agriculture. SCM is the active management of supply chain activities to maximise customer value and achieve a sustainable competitive advantage. Therefore, the adoption of SCM by construction businesses can help reduce delays, thereby improving their competitive advantage. The purpose of this study is to discover which critical success factors (CSFs) determine the successful adoption of SCM in the construction projects, with the aim of filling the knowledge gap in the context of a developing country by using a questionnaire. To achieve this, respondents were purposely selected from construction firms registered in Class 1 and 2 by the Contractors Registration Board of Tanzania. Out of 100 questionnaires distributed, 60 were returned filled in fairly well for analysis. The data was analysed using two features of IBM SPSS version 20, which are descriptive statistics-frequencies and compare means-one-sample *t*-test. The findings revealed that the CSFs for adopting SCM by construction projects were providing logistics at a lower cost and on-time delivery to clients, having a centrally coordinated logistics function and top management's commitment and support. It means that clients, contractors, subcontractors, consultants and suppliers/manufacturers will need to rethink what CSFs determine the performance of the construction projects using SCM, as knowing which ones are critical would lead to improved project delivery. This study contributes to the body of knowledge by providing insights into the CSFs that can be adopted by firms to successfully implement SCM in construction projects for sustainable construction businesses in Tanzania, which has not been explored.

Keywords: Construction project, Logistics, Critical success factor, Supply chain management, Tanzania

INTRODUCTION

The concept of supply chain management (SCM) is widely used in the manufacturing industries. The application of SCM, mainly in the manufacturing industry, has been successful and has achieved the expected benefits like reducing costs, maintaining a competitive advantage, improving productivity, adding value and creating better relationships between parties (Sospeter, Rwelamila and Matiku, 2019; Kocoglu et al., 2011). Unlike other industries, construction is a business where a number of fragmented actors, such as the main contractor, consultant, subcontractor and suppliers are given contracts to supply goods and services in order to provide

[1]Department of Building Economics, Ardhi University, Dar es salaam, TANZANIA
[2]Graduate School of Business Leadership, University of South Africa, SOUTH AFRICA
*Corresponding author: nyamagere@yahoo.com

the customer (construction client) with a designated product. Since SCM is an approach to management, it is relevant because the key supply chain participants, comprising clients, consultants, main contractors, subcontractors and suppliers must work collaboratively (i.e., having joint risk management, using collaborative tools for sharing information and being transparent during construction and throughout the project life cycle so as to reduce performance-related problems, thereby giving construction clients value for money). Although Tanzania wants to remain competitive in the world, it is still faced with a number of challenges (Sospeter, Rwelamila and Matiku, 2019; Nguyen et al., 2018), which have led to unreliable time schedules for projects, low productivity, cost and time overruns and disputes resulting in claims and time-consuming litigation in many building projects. Delays in a project have been acknowledged as the major cause of performance-related problems facing building projects in Tanzania. The main reason for delays in the construction projects is because of supply or procurement problems (Kikwasi, 2012), which implies that an improvement in SCM is greatly needed to enhance the performance of the construction industry.

Despite the growing need for SCM in the construction industry, not much is known about the critical success factors (CSFs) for adopting it. The knowledge and practice of SCM vary widely among industries. Therefore, knowing about CSFs for adopting SCM will help to improve the performance of projects in the Tanzanian construction industry and encourage partnership for sustainable development because SCM in construction projects can help to reduce delays. This will give construction firms a competitive advantage, ensure customer satisfaction, reduce cost overrun and improve the delivery of construction projects. The goal of SCM is to synchronise clients' requirements with the flow of materials and information so that a balance is reached between clients' satisfaction and costs, which is necessary for making the project successful (Kocoglu et al., 2011; Jagtap and Kamble, 2019). Unlike other industries, in construction, products are derived from the requirements of the customer who then finds the main contractor who can meet their demands. The main contractor will then find the subcontractors and suppliers to help them complete the project. This process needs effective partnership for sustainable development as it continues to create a construction supply chain by engaging all key participants to create the final product.

With the increasing of global competition, construction firms in Tanzania need to focus on the new ways of improving productivity through adopting SCM to meet global standards. The CSFs for integrating SCM will probably cause the project to be successful. Handfield and Nichols (2003) argued that SCM is becoming recognised as a core competitive strategy. It is aimed at synchronising a set of activities, from designing the construction that a client has demanded, procuring materials and workers and executing and coordinating the work to delivering the project through the flow of information, logistics and cash to form a construction network with architects, subcontractors and suppliers to ensure the value of the end product (Khalfan, McDermott and Kyng, 2006). Although SCM has been existing for over 20 years, its complexity and the difficulties in adopting the concept make it challenging for academicians or practitioners to understand and implement (Ying, Tookey and Seadon, 2018), which is similar to the concept of CSFs, as there is no established framework to determine them. Nevertheless, SCM is the basis of firms' competitive advantage and is an effective strategy, which the implementation of it benefits the firms, in terms of increased customer satisfaction, market share and profitability (Tan, 2001).

A number of studies in other countries have discussed SCM, its role in construction projects, its benefits and challenges and the factors affecting its application and strategies (McDermott and Khalfan, 2012; Tucker et al., 2001; Vrijhoef and Voordijk, 2003; Nguyen et al., 2018). For example, in the Japanese construction industry, an integrated approach to projects is common in establishing a long-term relationship between the contractor and subcontractor (Ireland, 2004). Other authors include Papadopoulos et al. (2016), Jagtap and Kamble (2019), Segerstedt and Olofsson (2010), Hassan (2018) and Ying, Tookey and Seadon (2018) are the majority of whom focused on the developed countries, with only a few focusing on the developing countries. For instance, the available studies are the potential of SCM in building projects in Tanzania (Hassan, 2018) and in the construction projects (Remmy, 2018). Addressing the issue of logistics to balance the cost and the performance will enable the industry to improve its performance. There is a need for specific studies, especially on stakeholders in sub-Saharan Africa, focusing on CSFs as another dimension for adopting SCM to deliver construction projects in Tanzania. However, the few studies available focused on the integrating of the supply chain in other industries such as agriculture and timber production (Ochieng and Price, 2009). This study is relevant to the Tanzanian construction industry because it differs from the other industries in terms of the nature of activities, characteristics of the industry, the business environment, procurement system and products/services.

LITERATURE REVIEW

Although there are different definitions of a supply chain, a typical one comprises the supply of materials, information and services and procuring links that enable the client's demands to be met. In that way, SCM involves integrating all the activities through good relationships along the supply chain to achieve a competitive advantage (Kocoglu et al., 2011). Generally, it means coordinating the activities of everyone involved in the supply chain so that the client is satisfied with the product that has been delivered and the costs of the organisation applying the SCM principles are reduced.

Characteristics of Construction Supply Chain

Unlike the manufacturing industry where multiple products passed through the factory and are distributed to many customers, a construction project has only one client to satisfy. Creating a supply chain for the construction industry is complicated with the result that the construction supply chain is typified by instability and fragmentation, especially when the design and the construction of a building are separated. There are two schools of thought with regard to the SCM in the construction industry. First is the logistics theory concerned with reducing waste through efficient management of the supply of materials to the construction site, whereby suppliers are viewed as clusters of subcontractors around the main contractor (Kocoglu et al., 2011; Asad, Khalfan and McDermott, 2005). In this regard, Bertel, Fenies and Roux (2008) concluded that productivity is increased when building materials needed at the site are delivered on time. The second is promoting and coordinating the supply chain parties in a project (O'Brien, London and Vrijhoef, 2002), as the construction supply chain has been characterised as a

project based (Koskela and Vrijhoef, 2000; Cheng et al., 2010), a network (Aziz and Hafez, 2013; Vrijhoef and Voordijk, 2003) and a forecasting demand (Gosling, Naim and Towill, 2013).

Reasons for Implementing SCM

SCM has been implemented more by private construction firms than the public ones in Tanzania (Remmy, 2018). Hassan (2018) found that SCM practices in Tanzanian construction industry go through bidding, sourcing and procuring materials, constructing and assessing the challenges faced by each phase and the factors that led to its success. SCM is adopted for the contractors, the subcontractors and the suppliers to understand what the client needs and are committed to meeting them, the designers to participate throughout the entire construction process and the contractors to have regular contact with the suppliers, so that all the involved parties in the supply chain pass on information about the project on time. Hassan (2018) stated that contractors are greatly aware of the need to integrate key aspects and members of the supply chain to deal with its fragmented nature, which is why Kocoglu et al. (2011) stressed the need for everyone involved in the supply chain to be quick to share information. Duncan (2001) stated that before starting a project using SCM principles, all members of the senior management team should state their commitment to it. Early in the implementation phase of a project, logistical performance should be measured. Communication is the key driver to success and the information technology system should not be an excuse for not proceeding in other areas.

Fawcett and Magnan (2003) researched on the bridges when implementing advanced supply chain practices. They contended that the most common bridges that can help overcome the barriers and improve SCM are the senior and functional management support, open and honest information sharing, accurate and comprehensive measures, trust, synergistic alliances, aligning and rationalising the supply chain, experienced managers, good measurement and documentation systems, low inventory-driven costs, education and training and effective use of pilot projects (Fawcett and Magnan, 2003; Nguyen et al., 2016). Some reasons for implementing SCM are that there is sharing of information, teamwork, top management support, feedback and partnership with suppliers (Ying, Tookey and Seadon, 2018), who further noted that numerous factors need to be considered by a firm for successful implementation of supply chain principles; from selecting strategies that are aligned with business requirements to defining the critical processes needed to execute the strategy. Nothing can be implemented without the right persons with the competence to support development and execute supply chain processes (Kocoglu et al., 2011).

An effective measurement system is also a prerequisite as it provides good support for monitoring operational performance. Azfar, Khan and Gabriel (2014) identified antecedents to measure the performance of the supply chain, which are inventory level, quality, satisfaction, operational performance in terms of time and cost, environmental cost and cash-to-cash cycle (economic performance) and business waste (environmental performance). Using these antecedents, they proposed a performance measurement conceptual framework for existing supply chain paradigms. Without honest collaboration between the parties in the supply chain, the benefits in terms of lower costs, flexibility and service level are difficult to achieve. Implementing SCM is a complex task as it requires professional

management and a good relationship between partners in the supply chain. To achieve this, using an external consultant may be crucial to overcome all the implementation barriers (Fawcett and Magnan, 2003). Nguyen et al. (2016) stated that logistics play an important role in establishing a supply chain, which will lead to improved business performance. They further noted that outsourcing in SCM is significant for the opportunities and risks involved.

Various studies have been conducted on CSFs for implementing SCM. Kumar, Singh and Shankar (2015) determined CSFs for implementing SCM in Indian small- and medium-size enterprises (SMEs) as top management commitment, development of an effective SCM strategy, resources devoted to the supply chain, logistics synchronisation, using modern technologies, sharing information with supply chain members, forecasting demand based on point-of-sale, developing trust between supply chain partners, just-in-time (JIT) capabilities in the system and reliable suppliers, having a flexible production system, focusing on core strengths and having a long-term vision for survival and growth. Ab Talib, Abdul Hamid and Thoo (2015) revealed that the CSFs for implementing SCM are the use of information technology, top management commitment, partnership/integration, service quality, processes, resource capability, government intervention, skilled employees and trust. Hariharan, Suresh and Sagunthala (2019) stressed the involvement of top management, collaboration with supply chain partners, sharing information, using sophisticated technologies, a less rigid production system, competitive priorities, long-term goals, product differentiation and innovation and inventory management as CSFs for implementing SCM in SMEs. Chau et al. (2021) investigated of the improving management of the supply chain and found that the significant factors were focusing on the customer, the quality of the information technology, increased collaboration among supply chain members, process integration and leadership.

Most of the factors for implementing SCM are generic and some may come from the manufacturing industry. The methodology used for studying these factors are somewhat different from that of this study. For instance, Ab Talib, Abdul Hamid and Thoo (2015), Ying, Tookey and Seadon (2018) and Jagtap and Kamble (2019) used case studies and a literature review. Due to the temporary nature of the construction supply chain, its instability and fragmentation and the fact that each project is unique, a specific study was needed on CSFs for adopting SCM in the construction industry.

METHODOLOGY

SCM is a relatively new approach to delivering projects in the construction industry. This is a descriptive study seeking to reveal the CSFs that can enhance the adoption of SCM in construction projects. The population of this study is 377 of Class 1 and 2 contractors registered by the Contractors Registration Board of Tanzania located in Dar es Salaam at the end of 2019.

A sample size of 100 was estimated using the Yamane Formula (Yamane, 1967) with 10% precision level, and since Class 1 and 2 are a homogenous group (Singh and Masuku, 2014), a small sample size was adequate for this study. Purposive sampling was used to select the respondents for the study, which was deemed appropriate because they were hand-picked due to the researchers' first-hand knowledge of contracting firms (Saunders, Lewis and Thornhill, 2016). Data was

collected using a literature review and questionnaires. The information gathered from the literature review guided the design of the structured questionnaire (Saunders, Lewis and Thornhill, 2016), which was divided into two distinct sections. The first section sought to obtain general background information of the Class 1 and 2 contractors involved in the study and assumed to have been part of SCM practices. The questionnaire had closed questions on CSFs, age, sex and work experience of the respondents and the class of contractor. To enable cross-comparative analysis as part of a robust data protocol, the responses were nominally coded so that they could be entered into one of the categories prepared beforehand. The second section comprised the rating and the ranking of the 48 reasons for implementing SCM, from which CSFs are determined. Reasons for implementing SCM from the literature were included in the questionnaire sent to the respondents.

The questionnaire had mainly closed questions on reasons for adopting SCM and on the respondents' profession, sex and work experience and the class of the contractor. All 48 reasons for implementing SCM extracted from the literature and the CSFs were rated, for which a five-point Likert scale was used. Implementation was rated as 5 = "Most implemented", 4 = "Implemented", 3 = "Implemented on average", 2 = "Rarely implemented" and 1 = "Not implemented"; while CSFs were rated as 5 = "Very critical", 4 = "Critical", 3 = "Average", 2 = "Low" and 1 = "Not at all". Out of 100 questionnaires distributed, 60 were returned fairly filled in for analysis. Data was analysed using two features of IBM SPSS version 20, which are descriptive statistics-frequencies and compare means-one-sample *t*-test.

RESULTS

Respondents' Information

Figures 1 to 4 show the respondents' information, in terms of their professional status, sex, class of contractors and work experience. Majority of the respondents are quantity surveyors (43.3%), followed by engineers (31.7%) and procurement officers (10%), while 15% made up of project planners, project managers and accountants. Females covered 76.7% of the respondents and the rest is males. The study was dominated by contractors registered in Class 1 (86.7%) with the rest in Class 2 (13.3%). The respondents' work experience was remarkable with most of them having experience of 6 years to 10 years (40%), followed by over 10 years of working experience (33.3%).
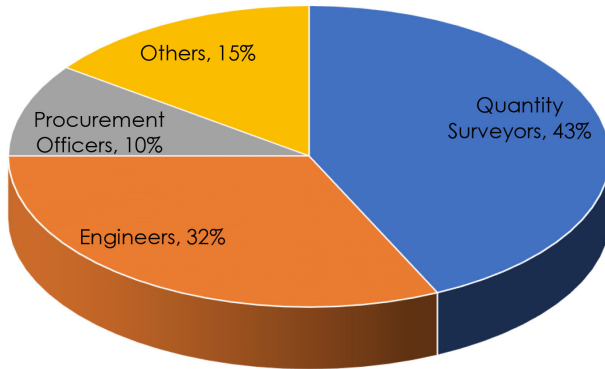
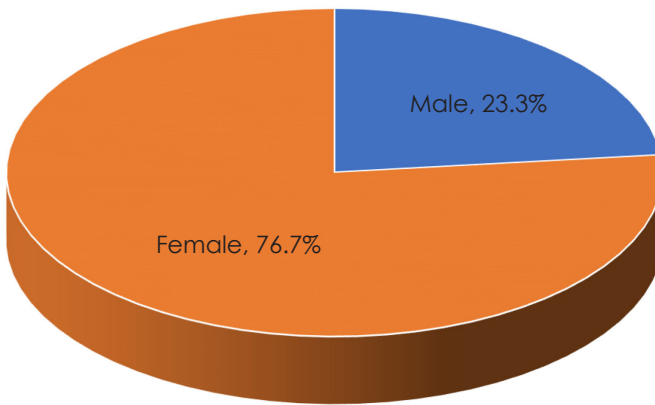Figure 1. Professional status of the respondents

Figure 2. Sex of the respondents
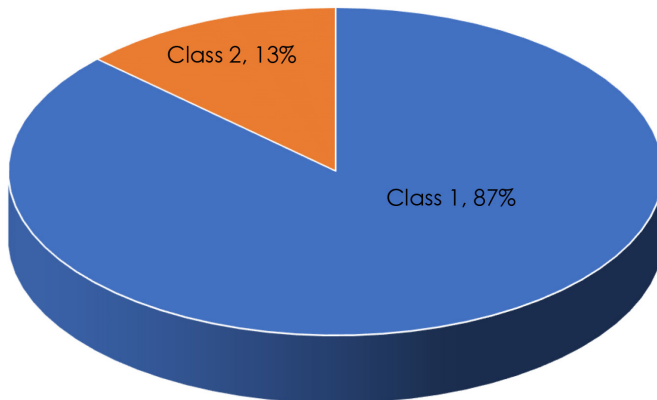
Figure 3. Class of contractors of the respondents
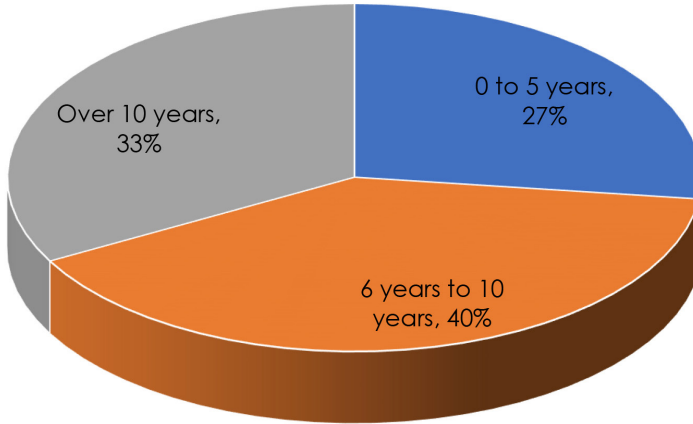
Figure 4. Work experience of the respondents

Implementation of SCM in Construction Projects

Figure 5 shows the implementation of SCM in projects undertaken by the firms that participated in the study, indicating that the majority (98.3%) implement SCM in their firms. This result is important for identifying CSFs for successful adoption of SCM in construction projects. To ascertain the extent of implementation, descriptive analysis of factors was done, as indicated in Table 1.

Figure 5. Implementation of SCM in projects.

Table 1. Descriptive statistics of factors implementing SCM

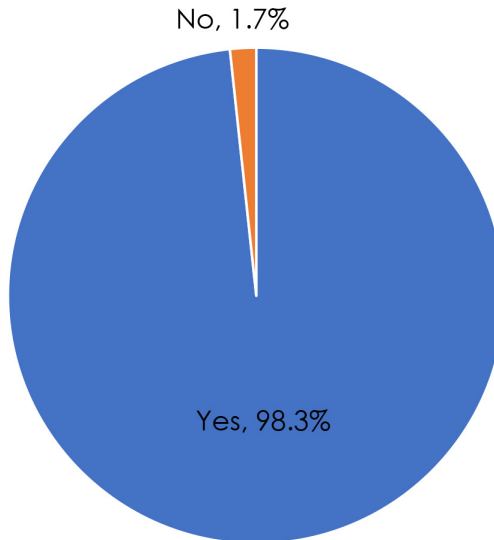| SCM Factors	N	Mean Score (MS)	Std. Deviation	Std. Error Mean	Rank
Most Implemented					
Provide logistics at lower cost	59	4.25	0.733	0.095	1
Provide on-time delivery to customers	59	4.05	0.775	0.101	2
Have a centrally coordinated logistics function	59	4.03	0.718	0.094	3
Top management's commitment and support	59	4.00	0.947	0.123	4
Supply chain performance contributes to cash flow	58	4.24	3.957	0.520	5
Planning and involving customers and stakeholders in demand management	56	4.00	1.062	0.142	6
Implemented					
JIT delivery	58	3.95	0.804	0.106	7
Inter-organisation information systems to coordinate integrate the entire supply chain	57	3.93	0.799	0.106	8
Teamwork and inter-organisational coordination	60	3.88	0.976	0.126	9
Deliveries in full and on time to customers	56	3.86	0.841	0.112	10
Effective use of enterprise resource planning (ERP) and material requirements planning (MRP) systems	58	3.83	1.172	0.154	11
JIT manufacturing	59	3.81	1.008	0.131	12
Responsiveness to meet engineering changes	56	3.77	0.894	0.119	13
Monitoring and measuring customer service level	56	3.73	0.904	0.121	14
Intra-organisational information coordination and sharing	59	3.71	0.852	0.111	15
Company-wide coordination and management of inventory	58	3.71	1.043	0.137	16
Superior quality services compared to competitors	56	3.71	0.909	0.121	17
A 360° view of customer needs and performance	56	3.68	0.897	0.12	18
Vendor managed inventory at production sites	57	3.63	0.938	0.124	19
Partnership with suppliers	60	3.62	0.993	0.128	20
Information sharing with supply chain partners	59	3.61	0.929	0.121	21

(*Continued on next page*)

Table 1. (*Continued*)

SCM Factors	N	Mean Score (MS)	Std. Deviation	Std. Error Mean	Rank
Sell-through information (point-of-sales data) from distributors, partners and retailers	57	3.60	0.961	0.127	22
A process to manage customer dissatisfaction returns	55	3.60	1.011	0.136	23
Low inventory driven costs	54	3.59	1.037	0.141	24
Optimising supply chain via Efficient Customer Response (ECR) System	59	3.58	0.875	0.114	25
Supply chain performance is continuously improving	57	3.58	0.823	0.109	26
Outscoring of non-core manufacturing activities	56	3.57	0.892	0.119	27
Customers are very satisfied with our supply chain capabilities	54	3.54	0.946	0.129	28
There is high employee morale and productivity	57	3.53	0.928	0.123	29
Implemented on Average/Low					
Effective management of customer complaints	57	3.49	0.826	0.109	30
Effective use of internet to manage business to business commerce	59	3.47	0.878	0.114	31
Cycle times from supplier to customer delivery are excellent	57	3.47	0.928	0.123	32
Effective use of internet to manage business to consumer commerce	56	3.45	0.807	0.108	33
Collaboration and bidding for parts and commodities via the internet	56	3.43	0.970	0.130	34
High utilisation of employees' skills and abilities	58	3.38	0.933	0.123	35
Quick resolution of industrial disputes	56	3.38	0.885	0.118	36
Eliminating non-value layers like wholesalers in the supply chain	58	3.36	0.931	0.122	37
Supply chain cost is low compared to competitors	57	3.35	0.876	0.116	38
Company-wide purchasing contracts for best pricing	58	3.34	1.001	0.131	39
Employees are involved in SCM	59	3.32	0.840	0.109	40
Regional distribution centres for product distribution	55	3.31	0.900	0.121	41

Table 1. (*Continued*)

SCM Factors	N	Mean Score (MS)	Std. Deviation	Std. Error Mean	Rank
Product design for environmental and recycling needs	58	3.31	0.940	0.123	42
Product customisation or postponement to meet customer needs	55	3.29	0.875	0.118	43
Employees are trained in supply chain concepts and management	56	3.23	0.953	0.127	44
Employees are empowered to make decisions and changes	58	3.19	0.982	0.129	45
Focus on reducing the number of suppliers	58	3.16	0.834	0.109	46
Automated warehouse management systems (automatic storage and retrieval system)	58	3.12	0.919	0.121	47
Effective use of multiple media to manage customer relationships	56	2.95	1.212	0.162	48

Notes: Mean score of the CSFs where 5 = Most implemented, 4 = Implemented, 3 = Implemented on average, 2 = Rarely implemented, 1 = Not implemented. The higher the mean score, the more critical the SFs.

Table 1 shows 48 factors for implementing SCM. The results indicate that six factors are the most implemented (MS = $4.00 \leq 5.00$), 23 are implemented (MS = $3.5 \leq 3.9$) and 19 are implemented on average (MS = $2.50 \leq 3.4$).

Testing for Normality

Figure 6 and Table 2 show the test for normality on distribution of the 48 factors for implementing SCM in construction projects. The results in Figure 6 indicate the frequency of responses against their mean scores and it shows that 56 out of 57 responses are valid, with a mean score of 3.4 and standard deviation of 0.519 and were normally distributed, while only one outlier was identified as indicated on the normal distribution curve. This implies that SCM is highly implemented in most construction firms. Nonetheless, the outlier means that one firm has not implemented SCM, with a mean score of less than 3.
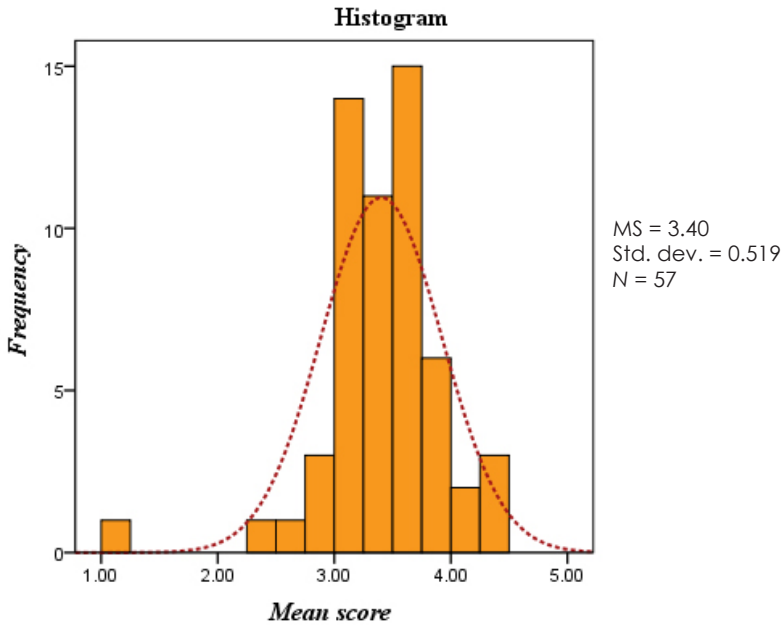
Figure 6. Normal distribution curve of the respondents

Table 2. Testing for normality of factors for SCM implementation

	Tests of Normality					
	Kolmogorov-Smirnov[*]			**Shapiro-Wilk**		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Mean score	0.181	57	0.200	0.925	57	0.077

*Note: *Lilliefors Significance Correction*

The results in Table 2 reveal that 57 responses are valid while 3 are invalid. Since both Shapiro-Wilk and Kolmogorov-Smirnov (sig.) values are greater than 0.05, it implies that the mean score of the responses is normally distributed. Thus, a parametric test (one-sample *t*-test) was employed to test for CSFs for implementing SCM in construction projects.

CSFs for Adopting SCM in Construction Projects

Table 3 shows one-sample *t*-test that reveals the significant factors to be grouped as CSFs for adopting SCM in construction projects. On assessing the critical parameters, out of 48 factors, only 20 were rated on the five-point Likert scale provided. The results indicate that the CSFs for adopting SCM in construction projects are to provide logistics at a lower cost (*t* = 5.282) 0.000 < 0.005, have a centrally coordinated logistics function (*t* = 3.036) 0.004 < 0.005, deliver to clients

on time (*t* = 2.981) 0.004 < 0.005 and top management's commitment and support (*t* = 2.028) 0.0047 < 0.005.

Table 3. One-sample *t*-test

| S/N | Variables | Test Value = 3.75 | | | | | |
| | | *t* | df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference | |
						Lower	Upper
1	Provide logistics at lower cost	5.282	58	0.000	0.504	0.31	0.70
2	Have a centrally coordinated logistics function	3.036	58	0.004	0.284	0.10	0.47
3	Provide on-time delivery to clients	2.981	58	0.004	0.301	0.10	0.50
4	Inter-organisation information systems to coordinate integrate the entire supply chain	1.700	56	0.095	0.180	−0.03	0.39
5	Optimising supply chain via ECR System	−1.525	58	0.133	−0.174	−0.40	0.05
6	Top management's commitment and support	2.028	58	0.0047	0.250	−	0.50
7	Teamwork and inter-organisational coordination	1.058	59	0.294	0.133	−0.12	0.39
8	Deliveries in full and on time to customers	0.954	55	0.344	0.107	−0.12	0.33
9	Supply chain performance is continuously improving	−1.570	56	0.122	−0.171	−0.39	0.05
10	Customers are very satisfied with our supply chain capabilities	−1.654	53	0.104	−0.213	−0.47	0.05
11	Supply chain performance contributes to cash flow	0.946	57	0.348	0.491	−0.55	1.53
12	Open and honest information sharing with supply chain partners	−1.156	58	0.252	−0.140	−0.38	0.10
13	There is high employee morale and productivity	−1.820	56	0.074	−0.224	−0.47	0.02
14	Sell-through information (point-of-sales data) from distributors, partners and retailers	−1.206	56	0.233	−0.154	−0.41	0.10
15	Company-wide coordination and management of inventory	−0.315	57	0.754	−0.043	−0.32	0.23
16	Vendor managed inventory at production sites	−0.953	56	0.345	−0.118	−0.37	0.13
17	Low inventory driven costs	−1.115	53	0.270	−0.157	−0.44	0.13
18	Outscoring of non-core construction activities	−1.499	55	0.140	−0.179	−0.42	0.06
19	JIT construction	0.484	58	0.630	0.064	−0.20	0.33
20	Responsiveness to meet engineering changes	0.149	55	0.882	0.018	−0.22	0.26

DISCUSSION

This study examined various reasons for adopting SCM in construction projects in Tanzania. Looking at the mean scores, the top 10 reasons for implementing SCM are that logistics cost less, the cash flow is better, the delivery to customers is on time, the function is centrally coordinated, top management are committed to support it, customers and stakeholders are involved in planning and managing demand, JIT delivery, the information system is coordinated and integrates the entire supply chain and teamwork ensures that the building project is completed on time to the customer's satisfaction. These findings are similar to those of McDermott and Khalfan (2012), Ying, Tookey and Seadon (2018), Kumar, Singh and Shankar (2015),

Ab Talib, Abdul Hamid and Thoon (2015), Hariharan, Suresh and Sagunthala (2019) and Chau et al. (2021).

Regarding the CSFs for implementing SCM in construction projects, the focus of this study, which are the four factors were statistically significant. They are to provide logistics at lower cost, to have a centrally coordinated logistics function, to provide on-time delivery to customers and top management's commitment and support.

Provide Logistics at Lower Cost and Have Centrally Coordinated Logistics Function

A coordinated logistics function at lower cost was ranked the first of the CSFs for adopting SCM. The finding is supported by the conclusion that construction logistics are thus an essential part of construction SCM in terms of both cost and project management (Ying, Tookey and Seadon, 2018). Logistics form a substantial part of construction projects, particularly in transporting materials, equipment and other goods required for the project. A centrally coordinated function is acknowledged by McDermott and Khalfan (2012), that one of the features of an integrated construction supply chain is that it is centrally coordinated and the relationship between firms is maintained during a specific project period and beyond. Some studies recognised the importance of logistics as part of SCM in the construction industry, supporting this finding. Aneesa, Gupta and Desai (2015) cited a low level of logistical competence as one of the obstacles to adopting SCM in the construction industry while Nguyen et al. (2018) cited the problem of insufficient resources to integrate processes and manage logistics in a one-off project for not adopting SCM. Similarly, Al-Werikat (2017) disclosed poor logistics planning as among the challenges of SCM in the industry. Duncan (2001) proposed that introducing a logistic performance measurement early in the implementation phase of the project influences project delivery. Ying, Tookey and Seadon (2018) stressed the need to provide low-cost logistics by revealing that a small cut in transport costs can have a positive effect on the profits. Vidalakis, Tookey and Sommerville (2011) found that logistics costs are exponentially related to the level of demand for materials and the number of vehicle movements. Koskela and Vrijhoef (2000) established that the extra cost of site logistics in one of the cases studied was due to the extra handling and transport of materials on site. There is a general agreement (Koskela and Vrijhoef, 2000) that cost savings would be realised if contractors and suppliers co-operated to identify joint opportunities to improve logistics.

On-time Delivery to Customers

On-time delivery was ranked second of the CSFs for adopting SCM. Other studies reported that delivery performance provides an indication of the supply chain's potential for providing products and services to the customer (Rao, Rao and Muniswamy, 2011), showing that the timely delivery of materials, equipment or goods to the site of a construction project is vital for its performance. SCM is thought to contribute to an improvement in the performance of construction projects due to the long-term working relationship which is expected to improve delivery. Papadopoulos et al. (2016) stated that the benefits of SCM to the industry are on-time delivery, improved productivity, value creation, repeat business with key clients, greater confidence in long-term planning and better relationships

between parties. The benefits of SCM for end-users and project clients include a more responsive industry that delivers facilities with no defects on time, thus meeting users' needs. Koskela and Vrijhoef (2000) revealed that sub-processes of SCM are slowed down due to delays in the inventory. Gosling, Naim and Towill (2013) revealed that early or late deliveries is one of the sources of uncertainty in the construction supply chain.

Top Management's Commitment and Support

Top management's commitment and support was ranked third of the CSFs for adopting SCM. The finding is consistent with other researchers who asserted that the involvement of top management is seen as an engine in any organisation's undertaking (Sospeter, Rwelamila and Gimbi, 2020), and Kumar, Singh and Shankar (2015), Ab Talib, Abdul Hamid and Thoo (2015), Hariharan, Suresh and Sagunthala (2019) and Chau et al. (2021) stressed the importance of top management's support for the successful implementation of SCM. Other studies (Duncan, 2001; Fawcett and Magnan, 2003; Ying, Tookey and Seadon, 2018) have indicated that top management's commitment is an important component of SCM adopted by the construction industry. Similarly, Nguyen et al. (2016) cited lack of top management's commitment as one of the factors preventing the adoption of SCM by the construction industry. This implies that, if SCM is to be adopted for construction projects, decision makers, consultants and contractors need to be fully committed and obtain the resources needed for them.

CONCLUSION

This article sought to determine the CSFs for adopting SCM in construction projects that will contribute to ensuring that projects are delivered on time. CSFs are essential internal aspects that are influenced by the industry, the firm, the manager and the environment. This study focused on the areas of logistics, on-time delivery to clients, teamwork and the involvement of top management in adopting SCM. Logistics means having an integrated function that involves all partners in the business and ensures low costs on and off the building site. Timely delivery is seen as an important factor in undertaking a project, as materials, components or goods have to be delivered within a specified time frame. Top management's commitment and support is again an important factor as their involvement will ensure that all the resources required for adopting SCM are supplied. This article provides insights into the CSFs that can be adopted by firms for the successful implementation of SCM in construction projects to achieve sustainable construction businesses. The findings also imply that clients, contractors, subcontractors, consultants and suppliers/manufacturers need to rethink what CSFs would improve the performance of the construction projects through adopting SCM. An understanding of which factors are critical would lead to improved project delivery in the future and minimise problems which may arise due to inefficient SCM.

Whilst this research makes significant contributions to academia and practice, limitations in terms of sampling and geographical scope are acknowledged. The respondents were drawn from one geographical location only, namely Tanzania, in sub-Saharan Africa and the sample was limited to Class 1 and 2 contractors. Therefore, the findings may not be generalised to other industries or to organisations

operating in other countries. Furthermore, the research was limited in its scope to the adoption of SCM in Tanzania, focusing on building projects so the results are influenced by the nature of the activities, stakeholders' involvement and the procurement system of the organisations. However, it is the authors' belief that developing countries with similar activities, socio-economic conditions and business set-up could benefit. Future studies should be conducted and extended to other supply chain players in other regions with an emphasis on organisations operating in different industries and countries with the same socio-economic and business environment.

REFERENCES

Ab Talib, M.S., Abdul Hamid, A.B. and Thoo, A.C. (2015). Critical success factors of supply chain management: A literature survey and Pareto analysis. *EuroMed Journal of Business*, 10(2): 234–263. https://doi.org/10.1108/EMJB-09-2014-0028

Al-Werikat, G. (2017). Supply chain management in construction: Revealed. *International Journal of Scientific and Technology Research*, 6(3): 106–110.

Aneesa, M., Gupta, A.K. and Desai, D.B. (2015). Supply chain management: Effective tool in construction industry. *International Journal of Novel Research in Engineering and Science*, 2(1): 35–40.

Asad, S., Khalfan, M.M.A. and McDermott, P. (2005). Managing knowledge across the construction supply chain. Paper presented at the 2nd International Salford Centre for Research and Innovation (SCRI) Research Symposium: In conjunction with the International Built and Human Environment Research Week. University of Salford, United Kingdom, 12–13 April.

Azfar, K.R.W., Khan, N. and Gabriel, H.F. (2014). Performance measurement: A conceptual framework for supply chain practices. *Procedia – Social and Behavioral Sciences*, 150: 803–812. https://doi.org/10.1016/j.sbspro.2014.09.089

Aziz, R.F. and Hafez, S.M. (2013). Applying lean thinking in construction and performance improvement. *Alexandria Engineering Journal*, 52(4): 679–695. https://doi.org/10.1016/j.aej.2013.04.008

Bertel, S., Fenies, P. and Roux, O. (2008). Optimal cash flow and operational planning in a company supply chain. *International Journal of Computer Integrated Manufacturing*, 21(4): 440–454. https://doi.org/10.1080/09511920701574628

Chau, K.Y., Tang, Y.M., Liu, X., Ip, Y.K. and Tao, Y. (2021). Investigation of critical success factors for improving supply chain quality management in manufacturing. *Enterprise Information Systems*, 15(10): 1418–1437. https://doi.org/10.1080/17517575.2021.1880642

Cheng, J.C.P, Law, K.H., Bjornsson, H., Jones, A. and Sriram, R. (2010). A service oriented framework for construction supply chain integration. *Automation in Construction*, 19(2): 245–260. https://doi.org/10.1016/j.autcon.2009.10.003

Duncan, R. (2001). *The Six Rules of Logistic Strategy Implementation*. London: PA Consulting Group.

Fawcett, S.E. and Magnan, G.M. (2003). Supply chain barriers, bridges and benefits: Perspectives from the literature. In *Proceedings: 34th Annual Meeting of the Decision Sciences Institute*. Madison, WI: Omnipress.

Gosling, J., Naim, M. and Towill, D. (2013). Identifying and categorizing the sources of uncertainty in construction supply chains. *Journal of Construction Engineering and Management*, 139(1): 102–110. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000574

Handfield, R.B. and Nichols, E.L. (2003). *Supply Chain Redesign: Transforming Supply Chains into Integrated Value Systems*. New York: Financial Times Prentice Hall.

Hariharan, G., Suresh, P. and Sagunthala, C. (2019). Critical success factors for the implementation of supply chain management in SMEs. *International Journal of Recent Technology and Engineering*, 7(5S3): 540–543.

Hassan, H. (2018). Potentials of supply chain management in building construction projects in Tanzania. Unpublished diss. Ardhi University.

Ireland, P. (2004). Managing appropriately in construction power regimes: Understanding the impact of regularity in the project environment. *Supply Chain Management*, 9(5): 372–382. https://doi.org/10.1108/13598540410560757

Jagtap, M. and Kamble, S. (2019). An empirical assessment of relational contracting model for supply chain of construction projects. *International Journal of Managing Projects in Business*, 13(7): 1537–1560. https://doi.org/10.1108/IJMPB-05-2018-0097

Khalfan, M.M.A, McDermott, P. and Kyng, E. (2006). Procurement impacts on construction supply chains: UK experiences. In *Proceedings of the Symposium on Sustainability and Value through Construction Procurement*. Salford: SCRI University of Salford, 322–331.

Kikwasi, G.J. (2012). Causes and effects of delays and disruptions in construction projects in Tanzania. *Australasian Journal of Construction Economics and Building, Conference Series*, 1(2): 52–59. https://doi.org/10.5130/ajceb-cs.v1i2.3166

Kocoglu, I., Imamoglu S.Z., Ince, H. and Keskina, H. (2011). The effect of supply chain integration on information sharing: Enhancing the supply chain performance. *Procedia – Social and Behavioral Sciences*, 24(3): 1630–1649. https://doi.org/10.1016/j.sbspro.2011.09.016

Koskela, L. and Vrijhoef, R. (2000). The four roles of supply chain management in construction. *European Journal of Purchasing and Supply Chain Management*, 6(3–4): 169–178. https://doi.org/10.1016/S0969-7012(00)00013-7

Kumar, R., Singh, R.K. and Shankar, R. (2015). Critical success factors for implementation of supply chain management in Indian small and medium enterprises and their impact on performance. *IIMB Management Review*, 27(2): 78. https://doi.org/10.1016/j.iimb.2015.04.005

McDermott, P. and Khalfan, M.A. (2012). Achieving supply chain integration within construction industry. *Construction Economics and Building*, 6(2): 44–54. https://doi.org/10.5130/AJCEB.v6i2.2983

Nguyen, P.T., Nguyen, V.N., Pham, L.H., Nguyen, T.A., Nguyen, Q.L.H.T.T. and Huynh, V.D.B. (2018). Application of supply chain management in construction industry. *Advances in Science and Technology Research Journal*, 12(2): 11–19. https://doi.org/10.12913/22998624/92112

Nguyen, V.N., Pham, L.H., Phong, T.A.N., Nguyen, T., Hoang, Q.L., Nguyen, T.T., Huynh, V.D. (2016). Applying supply chain management to construction industry: A case study of Vietnam. *Proceedings of the 3rd International Conference on Finance and Economics*. Zlín, Czech Republic: Tomas Bata University in Zlín.

O'Brien, W., London, K. and Vrijhoef, R. (2002). Construction supply chain modeling: a research review and interdisciplinary research agenda. In *Proceedings: 10th Annual Conference of the International Group for Lean Construction*. Gramado, Brazil: IGLC-10.

Ochieng, E.G. and Price, A.D.F. (2009). Framework for managing multicultural project teams. *Engineering, Construction and Architectural Management*, 16(6): 527–543. https://doi.org/10.1108/09699980911002557

Papadopoulos, G.A., Zamer, N., Gayialis, S.P. and Tatsiopoulos, I.P. (2016). Supply chain improvement in construction industry. *Universal Journal of Management*, 4(10): 528–534. https://doi.org/10.13189/ujm.2016.041002

Rao, C., Rao, K.P. and Muniswamy, V.V. (2011). Delivery performance measurement in an integrated supply chain management: Case study in batteries manufacturing firm. *Serbian Journal of Management*, 6(2): 205–220. https://doi.org/10.5937/sjm1102205M

Remmy, B. (2018). A study of supply chain management in construction industry. Unpublished diss. Ardhi University.

Saunders, M., Lewis, P. and Thornhill, A. (2016). *Research Methods for Business Students*. 7th Ed. Harlow, UK: Pearson.

Segerstedt, A. and Olofsson, T. (2010). Supply chains in the construction industry. *Supply Chain Management*, 15(5): 347–353. https://doi.org/10.1108/13598541011068260

Singh, A.S. and Masuku, M.B. (2014). Sampling techniques and determination of sample size in applied statistics research: An overview. *International Journal of Economics, Commerce and Management*, 2(11): 1–22.

Sospeter, N.G., Rwelamila, P.D. and Gimbi, J. (2020). Project management challenges for post-disaster reconstruction projects in Angola: A public sector perspective. *International Journal of Managing Projects in Business*, 14(3): 767–787. https://doi.org/10.1108/IJMPB-03-2020-0087

Sospeter, N.G., Rwelamila, P.D. and Matiku, J.P. (2019). Challenges for improving integrated construction supply chain in Tanzanian construction projects: The case of competent entities, towards industrialized Africa; Opportunities and challenges. Paper presented at the IAABD Conference. Dar es Salaam, Tanzania, 8–11 May.

Tan, K.C. (2001). A framework of supply chain management literature. *European Journal of Publishing and Supply Management,* 7(1): 39–48. https://doi.org/10.1016/S0969-7012(00)00020-4

Tucker, S.N., Mohamed, S., Johnston, D.R., McFarlan, S.L. and Hampson, K.D. (2001). *Building and Construction Industries Supply Chain Project (Domestic)*. Canberra: Commonwealth Scientific and Industrial Research Organisation (CSIRO).

Vidalakis, C., Tookey, J.C. and Sommerville, J. (2011). The logistics of construction supply chains: The builders' merchant perspective. *Engineering, Construction and Architectural Management*, 18(1): 66–81. https://doi.org/10.1108/09699981111098694

Vrijhoef, R. and Voordijk, H. (2003). Improving supply chain management in construction: What can be learned from the food and grocery sector? Paper presented at the CIB Joint International Symposium on Knowledge Construction. Singapore, 22–24 October.

Yamane, T. (1967). *Statistics: An Introductory Analysis*. 2nd Ed. New York: Harper and Row.

Ying, F., Tookey, J. and Seadon, J. (2018). Measuring the invisible: A key performance indicator for managing construction logistics performance. *Benchmarking. An International Journal,* 25(6): 1921–1934. https://doi.org/10.1108/BIJ-11-2016-0176