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Original Research Article

A comparative study of supply chain management in building construction projects within Kathmandu valley

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ABSTRACT

The supply chain plays a vital role in the successful completion of a construction project. Lack of proper supply chain management in any construction project results in cost overrun, time overrun, claims, disputes, and low productivity, which may ultimately lead to failure of the project. The overall objective of this study is to perform a comparative analysis of the need and importance of supply chain management based on stakeholders' perceptions of the selected building construction projects in Kathmandu valley. A total of thirty-four projects were taken for the study. Among these, 16 projects were executed by DUDBC and NRA, and 18 projects from private developers. The primary data collection tool used for the study was a questionnaire survey based on the Likert scale. A key informant interview along with a desk study was also conducted. The responses of questionnaires were ranked using the Relative Importance Index (RII). The findings were based on the comparison of views of public and private stakeholders on factors influencing the importance, challenges, and solutions of the problems of supply chain management. The findings show that both the public and private stakeholders agree on the high importance of proper supply chain management in the construction industry, but their perceptions differ on factors contributing to and benefits obtained from an efficient supply chain. Additionally, public and private stakeholders have differing opinions on the most pressing challenges facing supply chain management, its efficiency, and material management. Public stakeholders focused more on quality and delayed delivery of materials, while private stakeholders focused more on cost and efficiency issues. On the solutions and approaches for improvement of supply chain management, both the public and private sectors agree that improved integrated management between the supply chain and project site is essential to maintain a reliable and efficient supply chain. However, both stakeholders differ slightly on the approaches needed to improve supply chain management. Finally, the study shows that public and private stakeholders in building construction projects in Kathmandu agree that while major challenges exist in supply chain management, solving these problems through proper integration and communication will lead to an efficient and qualitative supply chain vital for a project's completion.

1. Introduction

Supply Chain Management (SCM) is the main factor in manufacturing industry to control the business process in a systematic and defined way to save time, improve quality and increase profit. (Wisner, et al., 2012) In major industrial

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construction projects, one of the main disrupting causes is the late delivery of components and construction materials. In order to meet the completion date of activities in the construction project, the delivery of the material should be on time (Kebede, 2017) In context of Nepal, it is very difficult to develop an efficient and effective low-cost network of relations between the suppliers and customers. Customers in Nepal are prone to the whim of the market drive, lacking critical judgement, which at times results in the backfire of economy like the real estate crash of USA once. The cost of production theory never worked which says that the price of the products should be less for the country where it is produced or manufactured. For example, apples that are produced in mustang are transported in India after being bought by some agents (Kharel, 2017). Mustang apples are sold at a higher price in Nepal itself than its imported counterparts. The demand and supply gap, quality, price, and timely supply are the four major issues related to the supply chain of construction materials. An effective supply chain management strategy should devise appropriate measures to address the issues.[1–12] (Practical Action, 2016-2017).

There is a steep competition in the global market nowadays. Each day various new products are being released into the market. Due to the rise in customer's expectations, the producers and suppliers are forced to introduce new products to win their affiliation. The evolution of techniques and supply chain is very important for the effective management of the project along with the advancement of transportation and communication technology (internet, mobile, overnight delivery) (Kebede, 2017).

There is a great importance of supply chain management in the construction industry for the completion of the project at the right time with the required cost and quality. Therefore, across the entire system, it is very important to obtain a cost-effective and efficient supply chain (Kebede, 2017).

In context of Nepal, construction industry, due to lack of application of supply chain management, results in delay in completion of majority of projects resulting in increment of incurring cost. Proper supply chain management plays a significant role in the success of the project by acquiring information, people, material, and equipment at the right time to the worksite. Construction is a large industry in which a huge number of different materials are used. This study helps to identify the problems that are hampering the effective supply of the materials. The inefficient supply of the materials is causing the causing construction projects and the construction industry as a whole to fail.

The study will be significant for the analysis of the supply chain system of the construction industries of Nepal. This study can help to resolve the issues, challenges, and solutions related to the supply chain management process of the construction industry. Therefore, this thesis will help the researchers and construction parties for future reference.

2. Related Works

2.1. Emergence of supply chain management

The origination and growth of the supply chain management (SCM) concept was done in the manufacturing industry. In, just in time delivery system which was the part of the Toyota production system, there were first visible signs of SCM. Regulation of supplies to the Toyota Motor factory just at the right time and the right small amount was the main aim of this system. However, effective regulation of suppliers' interaction with the production line and drastic reduction in inventories was the main goal of this system. The concept of supply chain management was also found in the quality control field. In 1950, to address Japanese industrial leaders it was also suggested by Deming that, to decrease production and improve the quality, a supplier could be worked as a partner in a long-term relationship of trust and loyalty (Vrijhoef & Koskela, 1999).

A group of organizations that are connected through upstream and downstream, in distinct activities and processes which generate value in the form of service and products to the final customer is termed as supply chain (Christopher, 1998). The general configuration of the supply chain is shown in the figure below (Vrijhoef & Koskela, 1999).

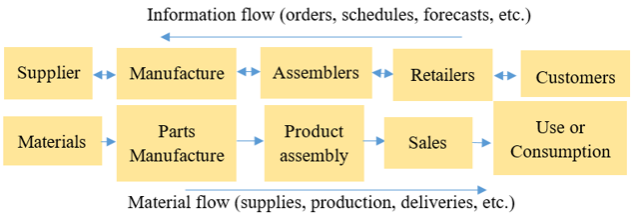

Fig. 1: General configuration of supply chain

In order to sustain and survive the objectives of growth, many organizations are imposed to add their global market share. Meanwhile, those organizations' domestic share market should also defend themselves from international competitors. However, the expansion of distribution and global logistic network is very challenging, for proper shipment of the products to the consumers who demand in rapidly and dynamically changing set of channels.[13–19]

The supply chain needs to be effective and efficient (Domenica, 2002). Efficient, in this case, refers to the minimization of resources that are used to accomplish specific outcomes wherein, effectively refers to the design of distribution channels. Service needs and service quality can be measured by effectiveness, wherein product quality, backorders, delivery performance, and inventory level can

Table 1: Variation between traditional way of management and supply chain management (Adopted from: Cooper & Ellram,1993)

Element	Traditional Management	Supply Chain Management
Inventory management approach	Independent efforts	Joint reduction of channel inventories
Time cost approach	Minimize firm costs	Channel-wide cost efficiencies
Time Horizon	Short term	Long term
Amount of information sharing and monitoring	Limited to needs of the current transaction	As required for planning and monitoring for planning process
Amount of coordination of multiple levels in the channel	Single contract for the transaction between channel pairs	Multiple contract between levels in firms and levels of channel
Joint planning	Transaction –based	Ongoing
Compatibility of corporate philosophies	Not relevant	Compatibility at least for key relationships
Channel leadership	Not needed	Needed for coordination focus
Amount of Sharing risks and rewards	Each on its own	Risk and rewards shared over the long term
Speed of operation information and inventory levels	"warehouse" orientation (storage, safety stock) interrupted by barrers to flow; localized to channel pairs	"Distribution centre " orientation (inventory) interconnecting flows; JIT, quick response across the channel

be measured by efficiency (Klemencic, 2006). 2.2 Four Roles of Supply Chain Management in Construction:

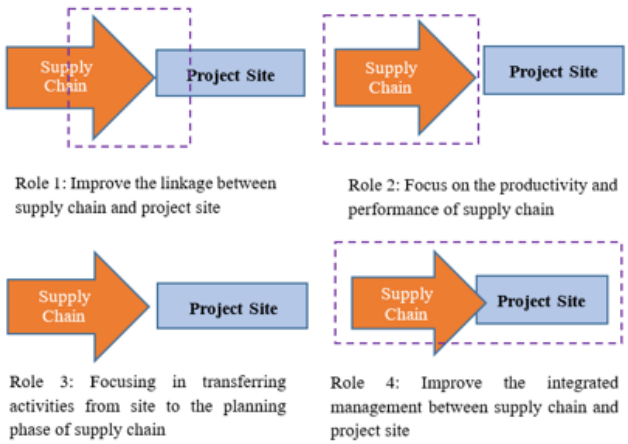

Fig. 2: Four roles of supply chain management in construction (Adopted from: Vrijhoef & Koskela, 2000)

In the first case, the main concern will be the influence of the supply chain on the activities at the site. The main aim here is to reduce the duration and the cost of the site activities. The main concern is to make sure that the dependent labor flow and materials do not disrupt the flow of the work. In order to achieve this, the focus should be given to maintain the relationship between the site and direct suppliers (Vrijhoef & Koskela, 2000).

In the second case, the main focus is on the supply chain and the aim is to reduce the cost mainly on those that are related to lead-time, logistics, and inventory. This focus can also be taken by component and material suppliers (Vrijhoef & Koskela, 2000).

In the third case, the activities are transferred to the initial stages of the supply chain from the site. This can be adopted for wider concurrency within activities or to avoid the inferior conditions that are generally not feasible due to technical dependency on the construction site. This focus can be initiated by contractors or suppliers with the main aim to decrease total duration and cost.[20–25]

In the fourth case, improvement in site condition, supply chain, and integration of management can be the major focus. This can be initiated by suppliers, clients, and contractors (Vrijhoef & Koskela, 2000).

3. Objectives

The overall objective of this study was to analyze a Comparative Study of Supply Chain Management in Building Construction Projects within Kathmandu Valley. And the specific objectives are:

1. To find out the differences and mutual grounds in the implementation of supply chain management between public and private sector building construction projects.
2. To find out the existing challenges in the supply chain management process of the construction industry.
3. To explore appropriate approaches and solutions for an efficient supply chain system in the construction of building projects in Nepal.

4. Materials and Methods

This chapter describes the methods and procedures that are adopted to complete the research study. From the beginning of the statement of the problem to the conclusion and recommendations, this chapter provides the systematic process of describing the research question, research

objectives, methods of data collection, data analysis, and defining results and discussions along with the process of literature review and supervisors' recommendations.[26–32]

4.1. Research design

Research design is a guideline to specify the methods and procedures for collecting and analyzing the data to produce the best outcome which can address the research problem. To make a comparative study of supply chain management in building construction projects, various literature and articles on supply chain (published as well as unpublished) were reviewed. The primary and secondary data were collected through the methods of observation and questionnaire. The questionnaire survey obtained from the concerned stakeholders was then analyzed and interpreted to achieve the research objective. This basic research methodology was carried out for obtaining research objectives as the flow chart is shown below.

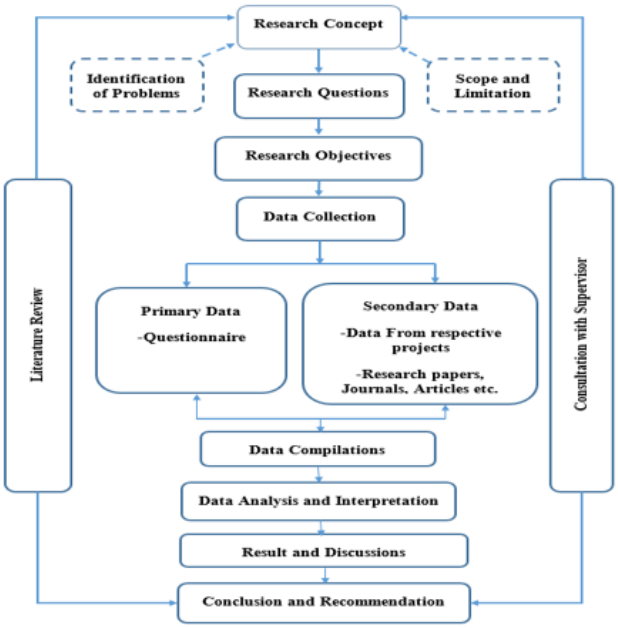

Fig. 3: Research methodology process

4.2. Research approach

The approaches that were used in this study is qualitative research approaches as the collected data were presented and analyzed with proportion. In order to, measure the degree of agreement between the public sector respondents and private sector respondents regarding the importance of the supply chain management, its existing challenges and best approaches and solutions for the supply chain management qualitative approach was used.

4.3. Study population

The study population is the public building projects that are in commercial operation and are at the construction stage. However, the study purposively selected sixteen projects from two clients, Department of Urban Development and Building Construction (DUDBC) and the National Reconstruction Authority (NRA). Among sixteen projects, seven projects were under DUDBC and rest nine projects were under NRA. Another eighteen projects from private builders/real estate were selected for the study.

4.4. Sample size

From those sixteen public building projects, three members from each project, i.e., client, contractor, and consultant were considered. In the case of private builders/real estate, one member from each project was considered. All the respondents who were considered for the purpose of the study are here taken as sample population.

4.5. Data analysis

This analysis was used for ranking the criteria concerning their relative importance. The relative importance index (RII) has been calculated as follows:

$$RII = \sum \frac{W}{A\ x\ N}$$

Here, w = weight as assigned by each respondent on the scale of 1 to 5 where 1 implies the least and 5 implies the highest. A= highest weight and N is the total number of samples.

Akadiri (2011), stated that from RI values, we can transform five levels: High (H) (0.8 ≤RI≤1), High-medium(H-M) (0.6≤RI≤0.8), Medium (M) (0.4≤RI≤0.6), Medium-low(M-L) (0.2≤RI≤0.4) and Low (L) (0≤RI≤0.2). (Rooshdi, 2018)

Also, for further statistical analysis, 16 questionnaires were analyzed by using MS Excel.

The degree of agreement between the public sector respondents and private sector respondents was determined by using Kendall's coefficient of concordance. The degree of agreement can be determined by using the following equation. (Shaban, 2008)

$W = \frac{12U}{m^2 N*(N-1)}$

Where, W = Kendall's coefficient of concordance

$U = \sum (R - \frac{R}{N})^2$

m = Number of Judges

N = Number of Problems

5. Validity and Reliability of Data

5.1. Validity

The constructed validity index was computed to ensure the appropriateness of the research instrument. The construct

validity index computed using SPSS shown in the table below:

Here, r = critical value for the Pearson correlation coefficient

Df = degree of freedom = n-2 = 66-2 = 64

Table 2: Pearson correlation coefficient

Pearson's Coefficient (r_{xy})	r = 0.25 for df 61	Significance value (a_{xy})	if r_{xy}>r & a_{xy} < a, valid
0.458	0.250	0.000	Valid
0.495	0.250	0.000	Valid
0.511	0.250	0.000	Valid
0.364	0.250	0.003	Valid
0.418	0.250	0.001	Valid
0.445	0.250	0.000	Valid
0.585	0.250	0.000	Valid
0.578	0.250	0.000	Valid
0.360	0.250	0.004	Valid
0.572	0.250	0.000	Valid
0.704	0.250	0.000	Valid
0.655	0.250	0.000	Valid
0.683	0.250	0.000	Valid
0.441	0.250	0.000	Valid
0.534	0.250	0.000	Valid
0.518	0.250	0.000	Valid
0.368	0.250	0.003	Valid
0.389	0.250	0.002	Valid
0.437	0.250	0.000	Valid
0.376	0.250	0.002	Valid
0.339	0.250	0.007	Valid
0.389	0.250	0.002	Valid
0.525	0.250	0.000	Valid
0.455	0.250	0.000	Valid
0.529	0.250	0.000	Valid
0.667	0.250	0.000	Valid
0.623	0.250	0.000	Valid
0.473	0.250	0.000	Valid
0.533	0.250	0.000	Valid
0.549	0.250	0.000	Valid
0.638	0.250	0.000	Valid
0.267	0.250	0.035	Valid
0.261	0.250	0.041	Valid
0.599	0.250	0.000	Valid
0.428	0.250	0.000	Valid
0.268	0.250	0.034	Valid
0.686	0.250	0.000	Valid
0.491	0.250	0.000	Valid
0.649	0.250	0.000	Valid
0.602	0.250	0.000	Valid
0.638	0.250	0.000	Valid
0.392	0.250	0.001	Valid
0.540	0.250	0.000	Valid
1.000	0.250	0.000	Valid
0.459	0.250	0.000	Valid
0.612	0.250	0.000	Valid
0.523	0.250	0.000	Valid

In this study, the assessment of supply chain management in building construction projects was obtained from the literature review. A pilot survey was conducted before the questionnaire was distributed to the respondents.

5.2. Reliability

The most common measure of internal consistency ("reliability") is Cronbach's equation. Researchers mostly use this equation to determine the reliability of the Likert scale used in survey questions/questionnaires. The formula for the standardized Cronbach's alpha is given by,

$$\alpha = \frac{N.\bar{c}}{\bar{v} + (N-1).\bar{c}}$$

Where N is equal to the number of items, c-bar is the average inter-item covariance among the items and v-bar equals the average variance.

In this study, Cronbach's alpha was calculated by using SPSS and found to be 0.926 which is more than acceptable for a social science survey.

The summary of the research methodology followed in this study is presented in table below:

6. Results and Discussion

6.1. Factors that enhance supply chain in the organization

According to the relative importance index (RII), it was found that the public body puts a high emphasis on improved quality assurance with the value of 0.840 to enhance the supply chain in the organization. Whereas, private builders emphasized on satisfaction to the client with the RII value of 0.882. Thus, it has been found that improved quality assurance along with satisfaction to the client is more important to enhance the supply chain in any construction industry. However, the above-listed common factors cannot be neglected for the growth of supply chain management in the construction industry.

6.2. Factors that affect successful growth of supply chain relationship between clients and suppliers

The factors affecting the successful growth of the supply chain relationship between clients and suppliers have been assessed through RII. It has been found that four of the factors are common to both sectors. Whereas, the public sector stressed a factor related to simplifying the bidding process as the fifth important factor to maintain the successful growth of the supply chain relationship. In contrast, private-sector advocates on a factor related to ease in the construction process as the fifth important factor.

Table 3: Cronbach'salpha table

Case Processing Summary			
		N	%
	Valid	66	100
Cases	Excluded	0	0
	Total	66	100
a. List-wise deletion based on all variables in the procedure.			
Reliability Statistics			
Questionnaire Section	Cronbach's Alpha	N of Items	
Section II	0.871	19	
Section III	0.823	19	
Section IV	0.856	26	

Table 4: Research matrix

S.N.	Objectives	Data Required	Data Collection Methods	Analysis	Results
1.	To find out the differences and mutual grounds in the implementation of supply chain management between public and private sector building construction projects.	View of Client, Contractor, Consultant Representative's	Questionnaire Survey and Hypothesis Testing	Relative Importance Index (RII)	Perception/Knowledge about importance of supply chain management system
2.	To find out the existing challenges in the supply chain management process of the building construction projects.	View of Client, Contractor, Consultant Representative's	Questionnaire Survey and Hypothesis Testing	Relative Importance Index (RII)	Existing challenges faced by construction stakeholders for better supply chain management
3.	To explore appropriate approaches and solutions for an efficient supply chain system in the construction of building projects in Nepal.	View of Client, Contractor, Consultant Representative's	Questionnaire Survey and Hypothesis Testing	Relative Importance Index (RII)	Appropriate approaches and solutions for efficient supply chain system in the construction

Table 5: RIIanalysis of the factors that enhance supply chain in the organization

Factors	Public Body, Consultants and Contractor Combined Response		Private Builders/Real Estate Combined Response	
	RII	Rank	RII	Rank
Cost minimization within your organization	0.692	8	0.647	8
Reducing Vertical line of work/ paperwork	0.633	9	0.624	9
Enhanced customer service	0.758	4	0.765	4
Increased Profitability	0.713	7	0.718	6
Satisfaction to client	0.804	3	0.882	1
Satisfaction to Supplier	0.725	6	0.729	6
Improved quality assurance	0.840	1	0.812	3
Accomplishment of firm goals and objectives	0.825	2	0.812	2
Market competitiveness	0.729	5	0.753	5

6.3. Factors that create a barrier in supply chain management

Among the factors listed above, the public body emphasis more on factor related to delay in delivery, delivery of inferior quality of materials as the main barrier for the integration of the supply chain. Whereas private builders emphasized more on delay in payment as the main barrier for the integration of the supply chain. Hence, it has been found that these two factors should be focused on great importance to create good supply chain integration. However, the above-mentioned common factors are to be considered while planning supply chain management.[19,33–37]

According to the relative importance index (RII), it was found that the cost of the material with RII value 0.750 affects the efficiency of supply chain management most in the case of the public body. Whereas cash to cash cycle with

Table 6: RII snalysis of the factors that lead to the successful growth of supply chain relationship with clients and supplier

Factors	Public Body, Consultants and Contractor Combined Response		Private Builders/Real Estate Combined Response	
	RII	Rank	RII	Rank
Relation between demand and supply	0.763	1	0.800	1
Efficient supply	0.754	2	0.700	4
Enhanced customer service	0.738	3	0.711	3
Efficient Communication	0.708	4	0.744	2
Simplifying the bidding process	0.704	5	0.678	6
Ease in the construction process	0.704	5	0.689	5
Government support	0.679	6	0.633	7
Trust	0.679	6	0.589	9
Inappropriate organizational structure	0.617	7	0.622	8

Table 7: RIIanalysis of the factors that creates a barrier in supply chain management

Factors	Public Body, Consultants and Contractor Combined Response		Private Builders/Real Estate Combined Response	
	RII	Rank	RII	Rank
Delay in Payment	0.742	3	0.822	1
Problems due to inferior quality	0.713	4	0.689	4
Change in design, delay in approval, inappropriate drawings or drawings that do not fit in use and incorrect documents	0.754	2	0.767	2
Bidding Process	0.683	6	0.578	6
Delay in delivery/delivery of inferior quality materials,	0.767	1	0.722	3
Large number of substitute products and approval delay	0.692	5	0.678	5

Table 8: Factors thataffect the efficiency of supply chain management

Factors	Public Body, Consultants and Contractor Combined Response		Private Builders/Real Estate Combined Response	
	RII	Rank	RII	Rank
Poor road condition and shortage of transporting means	0.638	9	0.700	5
Lead time	0.675	6	0.744	2
Perfect order/inventory fit in use and incorrect documents	0.688	4	0.722	3
Blocked and Natural disasters	0.683	5	0.678	7
Procurement Process	0.696	3	0.656	8
Lack of conflict resolution skills	0.675	6	0.633	9
Distance between supplier depots and construction sites	0.667	8	0.700	5
Fill rate	0.625	10	0.622	10
Cost of material	0.750	1	0.711	4
Cash to cash cycle	0.729	2	0.767	1

RII value 0.767 affects most in the case of private builders. However, other common factors also affect the efficiency of supply chain management.

7. Challenges Faced During Material ManagementFigure 4

Figure above shows the distribution of different problems encountered during the material management or material delivery process. According to the figure above, it was found that the main challenge for material delivery in the case of the public body is associated with the changes made in design during the construction progress and lack of proper drawing.

However, from the analysis of private builders, it was found that the most affecting factors are the designer's lack of knowledge about available sizes and alternative products in the market as well as changes made in design during

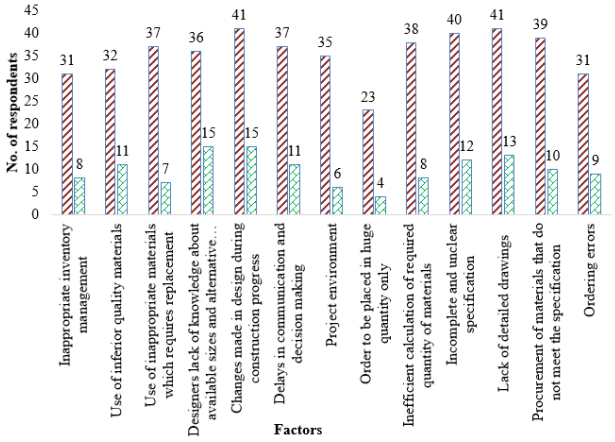

Fig. 4: Frequency of challenges faced during material management

construction progress.

8. Approach for Supply Chain System

It can be observed from figure 4.5 below, that according to the respondents the major factor that will fit best at the construction site is the improvement of integrated management between the project site and supply chain. In this role, the inclusion of the activities is done in the supply chain that has to be performed in the site which helps to handle the problems easily with no disturbance in the work. The main purpose is to eliminate the temporary supply chain with the permanent supply chain.

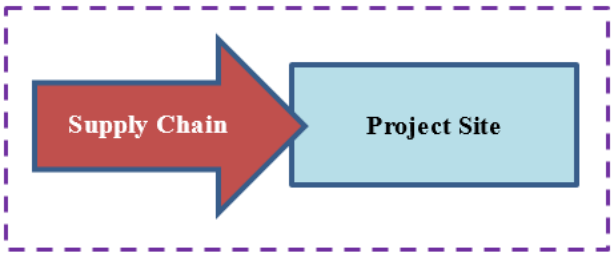

Fig. 5: Role 4: Improve the integrated management between supply chain and project site

8.1. Solutions for the challenges encountered in the supply of materials

According to figure 4.7 below, it was found that the public body puts a high emphasis on a factor good communication system as a solution to eliminated the problems of supply of materials. Whereas, private builders have emphasized both factors good communication system and ordering at the right time to maintain the inventory as a solution to eliminated the problems of supply of materials.

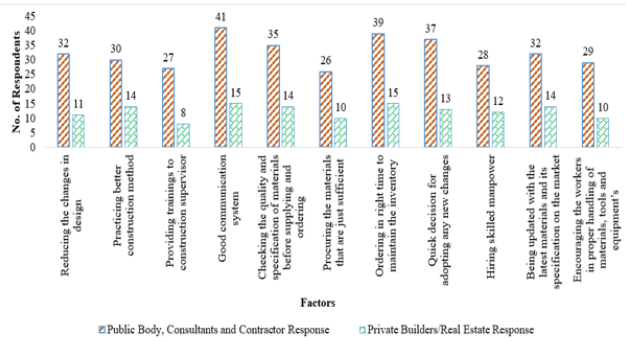

Fig. 6: Frequency of solutions for the challenges encountered in the supply of materials

8.2. Measures to be adopted for better supply chain managementTable 9

According to the relative importance index (RII), it was found that the public body puts a high emphasis on identifying alternative suppliers with a value of 0.558 for better supply chain management. Whereas, private builders have emphasized identifying the wastages and elimination of non-value activities as well as terracing the performance of the project for better supply management with both the factors having an RII value of 0.656. However, identifying the capacity of suppliers, proper resource planning, and developing good relations with suppliers and sub-contractors were other important factors considered by both the public and private sectors.

1. *Null Hypothesis: H0:* Role 4 i.e., Improve the integrated management between supply chain and project site is not the suitable approach and measures for the supply chain management.
2. *Alternative Hypothesis: H1:* Role 4 i.e., Improve the integrated management between supply chain and project site is not the suitable approach and measures for the supply chain management.
   The p-value (Sig.) is less than a = 0.05, (a is the level of significance) the null hypothesis, H0, is rejected and the alternative hypothesis, H1, is accepted. Thus, it can be said that there is relatively significant degree of agreement between public respondents and private respondents regarding Role 4 i.e., Improve the integrated management between supply chain and project site, identifying alternative suppliers & identifying the wastages and elimination of non-value activities are not the suitable approach and measures for the supply chain management.
3. *Null Hypothesis: H0:* Good communication and ordering at the right time to maintain the inventory

Table 9: RII Analysis of the Measures to be adopted for Better Supply Chain Management

Factors	Public Body, Consultants and Contractor Combined Response		Private Builders/Real Estate Combined Response	
	RII	Rank	RII	Rank
Identifying the wastages and elimination of non-value activities	0.558	6	0.656	1
Provide training to the employees	0.546	7	0.567	8
Develop good relation with suppliers and subcontractors	0.579	2	0.633	3
Terracing the performance of the project	0.546	7	0.656	1
Perfect cash to cash cycle	0.542	9	0.556	9
Perfect order and inventory management	0.563	5	0.589	7
Identify the capacity of suppliers	0.571	3	0.611	5
Identifying alternative suppliers	0.588	1	0.533	10
Proper resource planning	0.571	3	0.600	6
Proper relation between main office and site office	0.542	9	0.622	4

Table 10: Hypothesis testing for research questions

Field	w	Chi-Square	P-value	Decision
Role 4: Improve the integrated management between supply chain and project site	0.938	5.625	0.0177	Reject: H0
Good Communication and Ordering at the right time to maintain the inventory	0.286	5.727	0.0167	Reject: H0
Identifying alternative suppliers, identifying the wastages and elimination of non-value activities and terracing the performance of the project	0.432	7.767	0.0053	Reject: H0

is not the best solution for an efficient supply chain system in the construction of building projects.

4. *Alternative Hypothesis: H1:* Good communication and ordering at the right time to maintain the inventory is the best solution for an efficient supply chain system in the construction of building projects.
   The p-value (Sig.) is less than a = 0.05, (a is the level of significance) the null hypothesis, H0, is rejected and the alternative hypothesis, H1, is accepted. Thus, it can be said that there is a moderate degree of agreement between public respondents and private respondents regarding good communication and ordering at the right time to maintain the inventory is the best solution for an efficient supply chain system in the construction of building projects.
5. *Null Hypothesis: H0:* Identifying alternative suppliers, terracing the performance of the project and identifying the wastages and elimination of non-value activities do not enhance the supply chain management system.
6. *Alternative Hypothesis: H1:* Identifying alternative suppliers, terracing the performance of the project and identifying the wastages and elimination of non-value activities will enhance the supply chain management system.
   The p-value (Sig.) is less than a = 0.05, (a is the level of significance) the null hypothesis, H0, is rejected and the alternative hypothesis, H1, is accepted. Thus, it can be said that there is a significant degree of agreement between public respondents and private respondents regarding that identifying alternative suppliers, terracing the performance of the project and identifying the wastages and elimination of non-value activities will enhance the supply chain management system.

9. Conclusion

The main objective of the study is to make a comparative study of supply chain management in building construction projects in Nepal. In this chapter, the conclusion and respective recommendations from this study were based on a critical review of the literature, questionnaire survey, and the analysis of the data collected through the checklist. Following conclusions are made from this study:

9.1. Differences and mutual grounds in the implementation of supply chain management between public and private sector building construction projects

For the public sector, the most important factor to enhance the supply chain in the organization is improved quality assurance. Whereas, to private builders, the most important factor is satisfaction of the client.

For both public and private sectors, the most affecting factor for the successful growth of supply chain relationship

with client and supplier is relation between demand and supply.

Hypothesis testing shows that there is a significant degree of agreement between public and private respondents regarding the high importance of supply chain management in the construction industry. However, there is a varying degree of perceptions in relation to the priority of contributing factors.

9.2. Existing challenges in the supply chain management process

For the public sector, the most contributing factor that creates a barrier in SCM is 'delay in delivery/delivery of inferior quality of materials.' Whereas, for private builders, the most contributing factor is 'delay in payment'.

For the public sector, the efficiency of SCM depends on the cost of materials. Whereas, for private builders' efficiency of SCM depends on the cash-to-cash cycle.

For the public sector, the main challenge for material management are associated with the changes made in design during the construction process. Whereas, for private builders, the most challenging factor for material management are 'designer's lack of knowledge about the availability of sizes and alternative products in the market, and, changes made in design during construction the process'.

Hypothesis testing shows that there is a significant degree of agreement between public respondents and private respondents regarding the factors such as delay in delivery, delay in payment, changes made in design and drawings, delay in approval and delivery of inferior quality of materials as the existing challenges or barriers in supply chain management process in building construction projects.

This also shows that there is a moderate degree of agreement between public respondents and private respondents regarding the factors such as cost of materials, procurement process, cash to cash cycle, perfect order, poor road condition and shortage of transporting means are the existing challenges for inefficient supply chain management process in the building construction projects.

Similarly, this also shows that there is relatively significant degree of agreement between both public and private respondents that material management is one major existing challenge facing supply chain management process in the building construction projects.

9.3. Approach and solution for supply chain system

The approaches and solutions for supply chain systems in the construction industry have been assessed using three different questions related to roles of SCM, measures taken to mitigate the problems of supply of materials and then to be adopted for better SCM.

For both the public and private sectors, the best method of SCM to be implemented in the construction site is to improve integrated management between the supply chain and project site.

The public sector felt that existing challenges in SCM could be overcome by establishing a good communication system within the organization or between related parties. Whereas, the private sector thought that existing challenges in SCM could be overcome by establishing a good communication system and ordering at the right time to maintain the inventory.

While public sector viewed 'Identifying the alternative suppliers' as a prime measure for better supply chain management, the private-sector considered 'Identifying the wastages and elimination of non-value activities' and 'Tracing the performance of the project' as more impactful measures.

Hypothesis testing showed that there is a significant degree of agreement between public and private respondents that improved integrated management between supply chain and project site is the proper approach in implementing supply chain management in building construction projects

10. Recommandations

The study raised the number of implications that have to be addressed to enhance the approach and solutions for an effective supply chain system. It stressed the following recommendations.

1. The study recommends that the best approach for the successful growth of supply chain management is to improve the integrated management between supply chain and the project site.
2. The study recommends the solutions for the challenges that are encountered in the materials supply could be overcome by establishing a good communication system. It has been recommended to initiate the process of ordering construction materials at the right time to maintain inventory and make quick decisions for adopting new changes. In addition, it also recommends to check the quality and specifications of materials before ordering, practicing better construction methods, and updating with the latest materials and its specification available in the market.
3. The study recommends the measures to be adopted for better supply chain management are- identifying alternative suppliers, proper resource planning, identifying the capacity of suppliers. Furthermore, the study also recommends to identify the wastages and elimination of non-value activities along with tracing the performance of the project regularly for the better supply chain management. The study also recommends developing a good relationship with the

supplier and sub-contractor for the better supply chain management.

10.1. Recommendation for further study

This study has explored the knowledge related to the problems of supply chain management on a limited scale. There is a lot of fields for further study and research.

1. Similar studies on supply chain management of the construction workforce, construction equipment can be done.
2. Study-related to logistic management in the construction industry.
3. Study related to cost-effective material and its inventory management.
4. Study related to developing the network system of procuring and delivering the materials to the site.
5. A Similar study can be done on other projects related to roads, bridges, etc.

11. Source of Funding

None.

12. Conflict of Interest

None.

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