



Impact of covid-19 on supply chain management in construction industry in Kashmir

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Abstract

The building industry has become a critical economic sector for country's development. Due to covid-19, world's most industrialised countries saw significant declines in their GDP. An effective supply chain system ensures higher efficiency rates, better customer relationship and service, reduced production costs and an overall improvement in the financial performance of a construction company. The entry of covid-19 in Kashmir has adversely impacted the supply chain of construction industry and the economy. So, there is a need to mitigate the impact of covid-19 pandemic on the supply chain management for the better future of construction industry. The aim of this paper is to capture the issues, challenges and implications of the covid-19 pandemic on supply-chain activities in Kashmir, India. This also provides strategies and insights on mitigating the risks and impact of the pandemic on supply chain management. Based on the issues identified, a questionnaire survey was conducted to assess the impact of these factors on supply chain management. Exploratory factor analysis and structural equation modelling was used to analyse the factors. The problematic causes include reduction in supply chain flexibility and difficulties in supply chain collaboration. There is a need to diversify the supply chains and avoid the single source of supply.

Keywords Supply-chain · Covid-19 · Construction industry · Kashmir · Management

Introduction

Covid-19 is a deadly infectious disease which is caused by coronavirus. This disease has affected millions of people all around the world causing mass destruction and desolation, one of the worst affected sectors is the construction industry. In virtually all countries, there has been a financial slump in the construction business, which has resulted in job losses. Overall, the construction industry is concerned, apprehensive, and uneasy about the situation. The building industry is a critical economic sector for a country's development and due to this pandemic, world's most industrialised countries saw significant declines in their GDP. The construction sector must reinvent itself by defending construction enterprises and collaborating to recover from this pandemic (Husien et al. 2021). The supply chain management is important for the continuation of a project and owners and contractors are responsible for the identification and management of risks

due to this pandemic. Construction companies are placing a greater emphasis on operations in their supply chain at this time. A variety of issues have arisen in the management of supply chains because of this pandemic. At present, this pandemic does not make projects completely difficult to accomplish, it is slowing them down and causing delays and disruptions. To enhance procedures and raise profit margins, the construction industry must understand the value of supply chain management (Gamil and Alhagar 2020).

Supply chain extends from the end customer to the key suppliers and is referred as combination of operations related to enterprises, beneficial to clients and associates in process, like goods, assistance, along with documentation and data (ERKESİM 2021). The topics covered are buying, securing, transformation, planning and shipment, inventory management, manufacturing, deploying, trading, organisational behaviour and relationship management, agreements, blueprints, efficacy regulation, and so on. The pandemic has not caused any new difficulties in the management of supply chains but has put forth the weaknesses which were previously present but unknown in a few areas, and also employee shortages and losses are the issues faced by many organisations. However, this pandemic has highlighted the issues that

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were previously present in the supply chain (Pamidimukkala and Kermanshachi 2021). From manufacturers to consumers, the supply chain encompasses all procedures involved in the production of goods and services and supply chain should include all functions such as development of product, marketing, operations, distribution, finance, and customer service (ERKESİM 2021). The main objective of this paper is to highlight the elements that contributed to the supply chain being disrupted because of this pandemic.

Literature review

(Indhu and Yogeswari 2021), identified lack of skilled labour, frequent staff changes and poor site management all contribute to delays in payments to contractors and delays in construction. Other significant factors include the weather and shortage of material in construction. (Paul et al. 2021), observed that lack of raw materials, disruption in production and transit operations, and social distancing because of current pandemic has exposed risk of world supply networks. For management of supply chain, its recovery is important. The major challenges were decrease in appeal for extended time, inability to make a recovery decision within a short period of time, escalation in debts of partners involved in supply chain and reduction in supply chain facilities. (Esa et al. 2020), studied for the housing projects, government enforcements led to the limited availability of resources, increase of cost, lack of workforce and time delays. (Osui-zugbo 2020), observed the disturbance of supply chain in the form of cost overruns, rise of material cost, shortage of labour, inability of clients to release money. Lockdowns also caused the transportation problems and closure of projects. (Sierra 2021), studied that supply chain was severely disrupted due to pandemic. In the early stage, even basic and necessary materials were difficult to obtain because of high demand from industries which eventually led to delays and increase of price. Lockdowns have created disturbances in the logistics and construction industry as all parties were not involved in the supply chain such as raw material distributors, intermediate builders, fabricators or carriers which consequently led to the suspension of work. (Timilsina et al. 2021), examined the government budget reduction has caused financial problems to contractors which caused disruptions to supply chain and difficulties in workforce management. Based on observed occurrences, the construction industry had breakage in supplies along with lack of labours post lockdown. The fundamental source of the market's labour and material shortages is the ceasing of Indo-Nepal borders.

(Demissew 2020), found covid-19 is rather retarding the projects, producing lags instead of making them completely unattainable or non-viable, even if, only supply chains get muddled on multiple occasions. Unavailability

and increasing costs of building materials, deficiency of hard currency, decreased productivity, labour shortages, project lag, and increased expenses are found as the main effects of pandemic on Ethiopian construction industry. (Husien et al. 2021) reported the pandemic resulted in a host of issues at work, including decreased or reduced output, elevated production time and expenses, and disagreements about construction contract terms. Supply-chain networks should be diversified instead of being satisfied with a single supplier source. (Ogunnusi et al. 2020), collected participant responses and identified the daily labourer endured hardships, a delay that impacts budget, and a well-planned project was disrupted, all while the lockdown was never addressed during the tendering or contracting process. (Akmam et al. 2021), identified time lags, inadequate supply, lack of manpower, contract postponements, and financial consequences as some of the challenges associated with the covid-19 pandemic. To tackle the problem posed by this disease outbreak, there is a need to employ creative construction technologies. (Bou Hatoum et al. 2021), stated that projects have been halted due to supply shortages and transit restrictions. Labour shortage was observed due to termination of projects and transmission of virus in gatherings. There is a pressing need to raise efficiency, improve project performance, manage labour shortages, minimise fragmentation, introduce standardisation, and increase collaboration.

(ERKESİM, 2021), identified Information technology, raw material supply, corporate relationships, strategy, and cultural formation all play a role in supply chain management and Coronavirus outbreak has put a huge pressure and deteriorating influence on world economy through these networks. (Pamidimukkala and Kermanshachi 2021), observed Covid-19 has disrupted contract worker scheduling as well as the delivery of commodities and supplies, and it is likely to continue to do so. When supply chain involved commodities/raw materials from foreign countries, the delays were very noticeable. To minimise the impact, longer term should be given for project delivery, contractor assessment and risk analysis should be conducted to enhance productivity, and also an end-end supply chain should be mapped. (Alsharaf et al. 2021), reported negative repercussions of the Covid-19 pandemic including considerable project material procurement delays, decreased production, increased prices. Supply-chain interruptions increased the ingredient prices, with most interference being caused by termination as well as depletion in processing and production units of supply chain. (Hansen 2020), observed to stop the spread of coronavirus disease, Indian government enforced a nationwide lockdown, restricting people's movement and congregations. This led to delay in meeting the timelines and all the construction activity halted. The most evident impacts were reverse migration and interruptions in supply chains. (Butt

2021), examined the steps or counter measures adopted by buying and distributing enterprises to address supply chain interruptions due to the ongoing Covid-19 pandemic. To mollify the repercussions on supply chain disruptions from buyers', distributors' perspective, strategies have been formulated, these are production rescheduling, active communication, formulating alternate plans, examine supplier's shipment status, examine supplier's production schedule, work with secondary suppliers, and modifying inventory policies. (Biswas et al. 2021), concluded that, the supply chain is broken through several means, around the world. The financial dip can be mitigated, provided the continuation of the construction tasks. (Veselovská 2020), found the most successful measure was the formation of a new supply chain alliance. It was noted that the supply chain disruptions due to Covid-19 outbreak, had a beneficial impact on revenue in some situations. This event has brought to light the vulnerability and crucial points of supply networks, many of which were not designed to withstand such massive disruptions. Decrease in the number of suppliers was identified the most prominent change in the supply chain of construction industry. (Tilaoui 2021), found several causes have led to the construction sector's downturn, namely the lack of ingredients because of closing of numerous manufacturing areas, insufficient funding.

Goal of this study is to establish the validity of many origins in finance, as well as envision of the future building sector. Travel ban between cities makes it impossible to transport employees willing to occupy construction sites in the midst of a health crisis. (Uchehara et al. 2020), revealed that both socioeconomic and macroeconomic difficulties have affected the tenant and real estate supply chains as a result of covid-19. This research sheds light on a risk mitigation method that makes use of contractual provisions as a capable way to reduce the pandemic's unforeseeable future consequences.

Theoretical framework

Based on an in-depth review of the relevant literature, the various factors that influence supply chain management as a result of covid-19 can be broadly classified into four categories, namely, resource, budget, management, and lockdown. These categories serve as the theoretical foundation for the construction of the research model in this paper, which is presented in the following section in Table 1

Hypothetical structural model depicted in Fig. 1 shows arrows indicating the direction of effect in the postulated model of this work.

Table 1 Factors affecting supply chain management

Factor	Sub-factor	Statement
Resource	R1	Shortage of construction material
	R2	Unavailability of machinery
	R3	Lack of transportation facilities
	R4	Shortages in availability of contractors and subcontractors
	R5	Lack of manpower
Budget	B1	Material price escalation
	B2	Government budget reduction
	B3	Increase in cost of construction operations
	B4	Economic slowdown
	B5	Increase of bankruptcy of supply chain partners
	B6	Hard currency shortage
Management	M1	Sharp fall of demand for a longer period
	M2	Long time to make a recovery decision
	M3	Postponement of contracts
	M4	Reduction in supply chain flexibility
	M5	Difficulties in supply chain collaboration
	M6	Lack of guidance
	M7	Lack of technology
Lockdown	L1	Requirement to suspend site operations
	L2	Remaining defective equipment at sites
	L3	Quarantines
	L4	Closure of manufacturing and processing facilities
	L5	Closure of state borders
	L6	Work from home

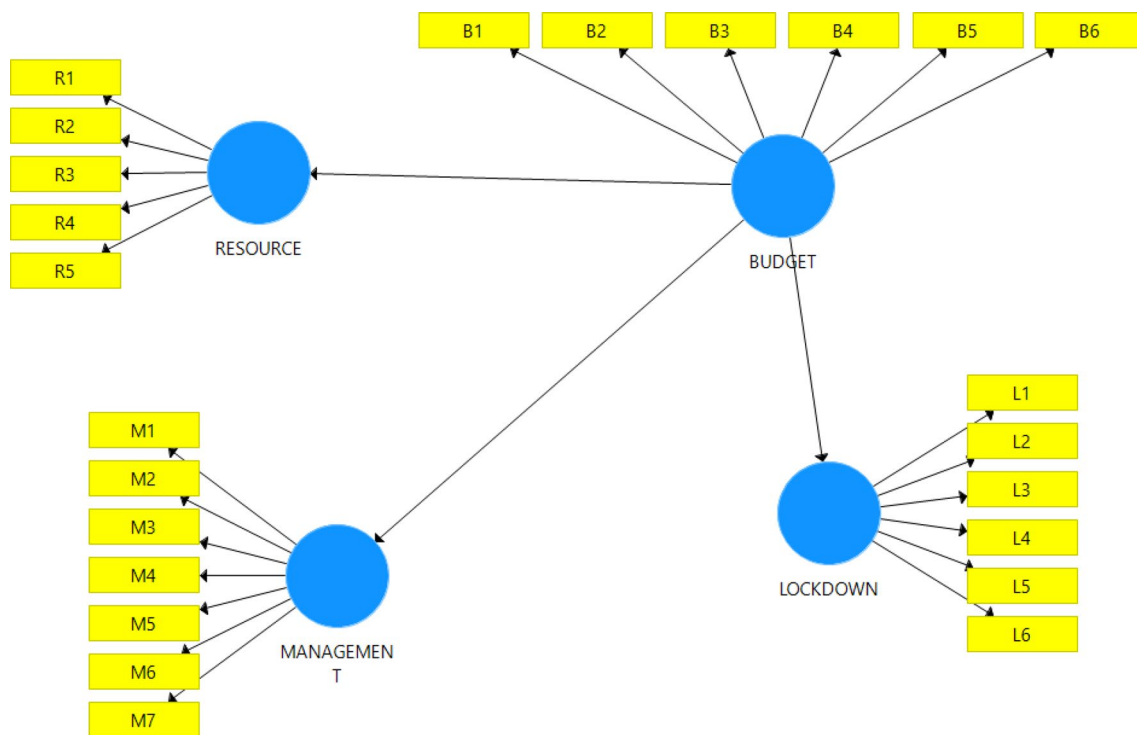


Fig. 1 Hypothetical model of the factors influencing supply chain management

Research methodology

To fulfil the goals of this study, a stepwise research methodology is adopted. The first step involves a detailed literature review to collect information from related journals of supply chain. A list of factors has been identified which affect the supply chain management as a result of disruption caused by covid-19. This study uses a questionnaire survey method to examine the theoretical model of the factors affecting Kashmir's construction industry's supply chain management. A five-point Likert scale from "1 = strongly disagree" to "5 = strongly agree" was used to guide the respondents in providing input about varying levels of impact. Preliminary surveys were undertaken to ensure the questionnaire's practicality and validity before it was made public (Cronbach's alpha and KMO). A total of 101 responses were collected and exploratory factor analysis and SEM were used for the purpose of analysis. Based on the findings, recommendations are made to address the factors that impact supply chain management. The research design is shown in Fig. 2

Data demographics

The questionnaire survey has been completed by several private and government organisations in Kashmir division. The

Department of Roads and Buildings has made a significant contribution to this project's success. The questionnaires were disseminated by email, Google Forms, and hardcopies at the building sites and offices to gather data. There were 72 valid responses (71% of the total disseminated) out of 101 distributed questionnaires; 29% of the responses were either invalid or missing. The experience and designation of respondents is shown in Fig. 3 and Fig. 4 respectively. The sample size requirement for this research is satisfied according to (Doloi et al. 2011).

Data analysis

The evaluation of the questionnaire data by exploratory factor analysis (EFA) and structural equation modelling (SEM) were utilised to empirically assess a hypothetical model of supply chain management components.

Exploratory factor analysis

EFA was used to investigate the relationship between correlated variables and to condense the data, which aided in confirming the supply chain management factor model's structure. The principal component matrix is frequently rotated to better comprehend the factors, and SPSS provides numerous techniques for accomplishing this. Because it is

Fig. 2 Research design

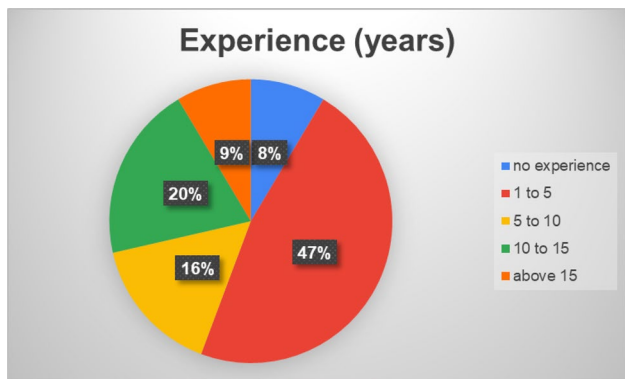
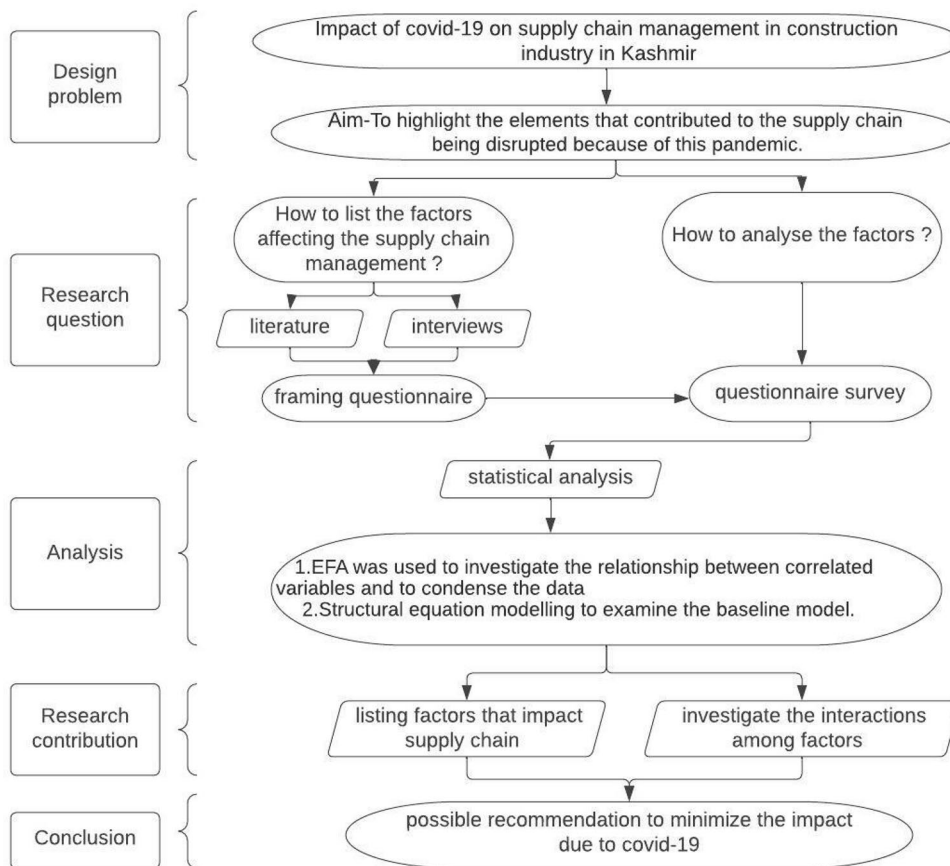


Fig. 3 Experience of respondents

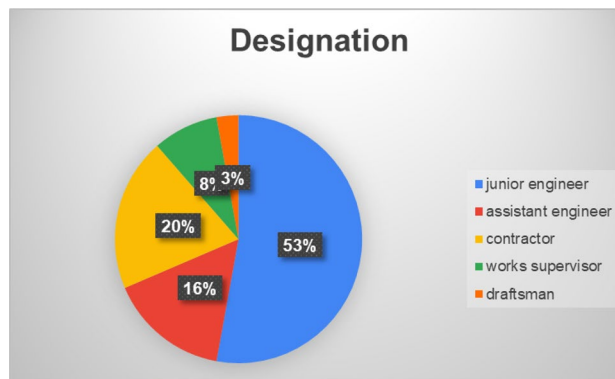


Fig. 4 Designation of respondents

so widely used, varimax is selected for rotation (Fellows and Liu 2008). Small coefficients were suppressed whose absolute value was below 0.4 (Cho et al. 2009). The initial eigenvalues for each component are shown in Table 2. The original data set contained 25 components. Eigenvalues are the variance explained by a given component in the data set. As a first step, only those components with an eigenvalue more than 1 were retrieved and those with an eigenvalue less than 1 were eliminated.

A total of 24 elements were used to identify the four underlying factors, which are depicted in Table 3 resource, budget, management, and lockdown. Cronbach's alpha coefficient was determined to ensure that the items in each component were internally consistent after they had been categorised and entitled. It is considered internally consistent when the Cronbach's alpha coefficient is greater than 0.7 at the broad category level (Jang et al. 2011). Kaiser–Meyer–Olkin (KMO) test is used to determine whether the data samples to be used for Factor Analysis are enough. A KMO score

Table 2 Total variance

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.617	30.467	30.467	3.963	15.853	15.853
2	2.809	11.237	41.704	3.140	12.559	28.412
3	2.014	8.058	49.762	2.555	10.220	38.632
4	1.739	6.955	56.716	2.340	9.361	47.993
25	.088	.352	100.000	-	-	-

Table 3 Factors and factor loadings extracted from EFA

Factor	Item	Factor loading	KMO
Resource	Shortage of construction material	0.646	.694
	Unavailability of machinery	0.522	
	Lack of transportation facilities	0.862	
	Shortages in availability of contractors and subcontractors	0.737	
	Lack of manpower	0.731	
Budget	Material price escalation	0.746	.725
	Government budget reduction	0.644	
	Increase in cost of construction operations	0.773	
	Economic slowdown	0.730	
	Increase of bankruptcy of supply chain partners	0.733	
Management	Hard currency shortage	0.751	.679
	Sharp fall of demand for a longer period	0.630	
	Long time to make a recovery decision	0.706	
	Postponement of contracts	0.673	
	Reduction in supply chain flexibility	0.853	
	Difficulties in supply chain collaboration	0.752	
	Lack of guidance	0.782	
Lockdown	Lack of technology	0.703	.810
	Requirement to suspend site operations	0.834	
	Remaining defective equipment at sites	0.642	
	Quarantines	0.805	
	Closure of manufacturing and processing facilities	0.727	
	Closure of state borders	0.727	
	Work from home	0.630	

greater than 0.5 indicates that the data are highly correlated (Ahmad et al. 2016).

Structural equation modelling

As shown in Fig. 5, Smart PLS was used to examine the baseline model. As a result of the model update, four of the observed attributes, Lack of manpower(R5), Hard currency shortage(B6), Lack of guidance(M6), and Lack of technology(M7), were eliminated since they had low path coefficients. As a result of these changes, the final SEM depicted in Fig. 5 was created. Standardised path coefficients (all positive and statistically significant at 0.05) and square multiple correlation (R^2) of the final SEM are summarised in Table 4 for the elements influencing supply chain

management in Kashmir's construction industry because of covid-19.

Also, construct reliability and validity of the final SEM is given in Table 4 and Table 5.

Results and discussion

A path coefficient of 0.714 associated with budget has an effect on supply chain management in the construction industry in Kashmir, as seen in the final SEM (Fig. 6). The lockdown has the greatest effect because of requirement to suspend site operations, remaining defective equipment at sites, quarantines, closure of manufacturing and processing facilities, closure of state borders, and work from home.

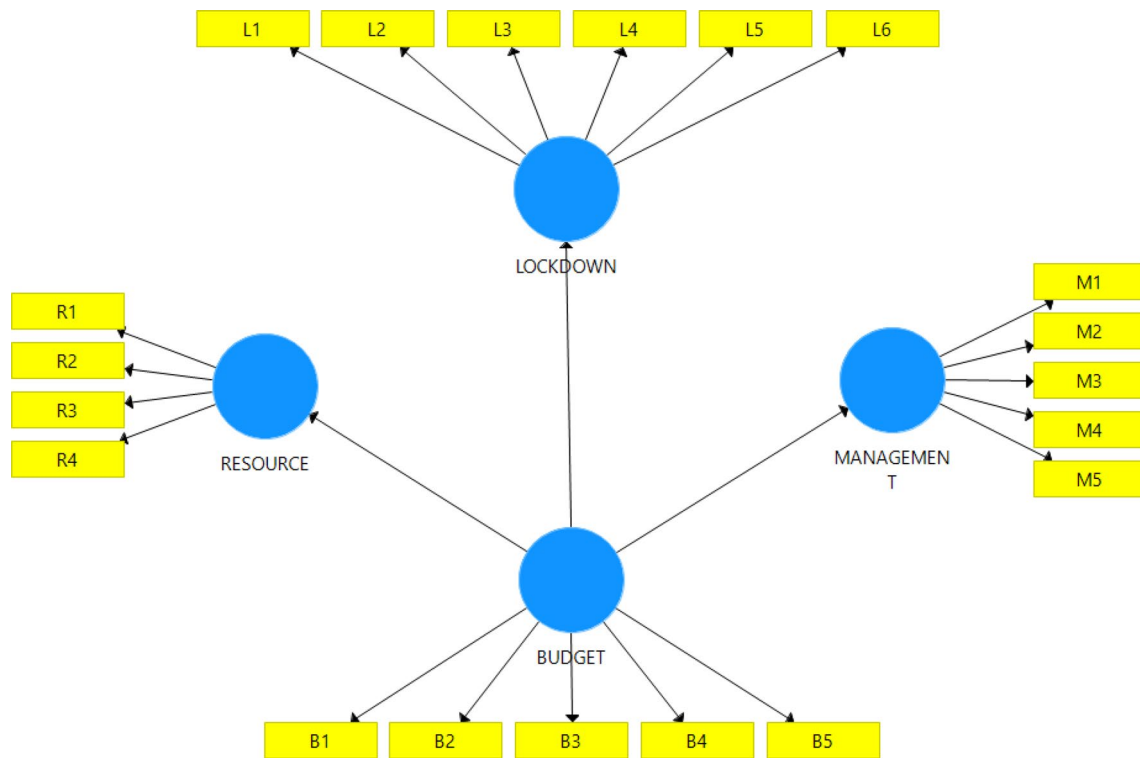


Fig. 5 Modified model of the factors influencing supply chain management

Table 4 Standardised path coefficients and square multiple correlations of the observed variables

Path	Standardised path coefficient ^a	R ²
R1 Resource	0.698	0.487
R2 Resource	0.740	0.547
R3 Resource	0.830	0.689
R4 Resource	0.598	0.357
L1 Lockdown	0.851	0.724
L2 Lockdown	0.700	0.490
L3 Lockdown	0.751	0.564
L4 Lockdown	0.683	0.466
L5 Lockdown	0.743	0.552
L6 Lockdown	0.551	0.304
M1 Management	0.634	0.402
M2 Management	0.621	0.386
M3 Management	0.755	0.570
M4 Management	0.874	0.764
M5 Management	0.747	0.558
B1 Budget	0.714	0.509
B2 Budget	0.636	0.404
B3 Budget	0.771	0.594
B4 Budget	0.767	0.588
B5 Budget	0.762	0.581

^aSignificant at the 0.05 probability level (Doloi et al. 2011)

Table 5 Construct reliability and validity

	Cronbach's alpha	rho_A	Composite reliability	Average variance extracted
Budget	0.786	0.802	0.852	0.535
Lockdown	0.815	0.835	0.863	0.517
Management	0.781	0.801	0.850	0.536
Resource	0.696	0.721	0.811	0.520

The most important component related to lockdown is the requirement to suspend site operations with a loading of 0.851.

The second significant factor with a path coefficient of 0.588 is the resource. It plays a vital role in the management of supply chain. Greater the resources, greater will be the management of supply chain. Among shortage of construction material, unavailability of machinery, lack of transportation facilities and shortages in availability of contractors and subcontractors, lack of transportation facilities having a loading of 0.830 is the most important one.

The path coefficient related to management was found to be 0.504 because of sharp fall of demand for a longer period, long time to make a recovery decision, postponement of contracts, reduction in supply chain flexibility (with a highest loading of 0.874) and difficulties in supply chain collaboration. Among the budget related components

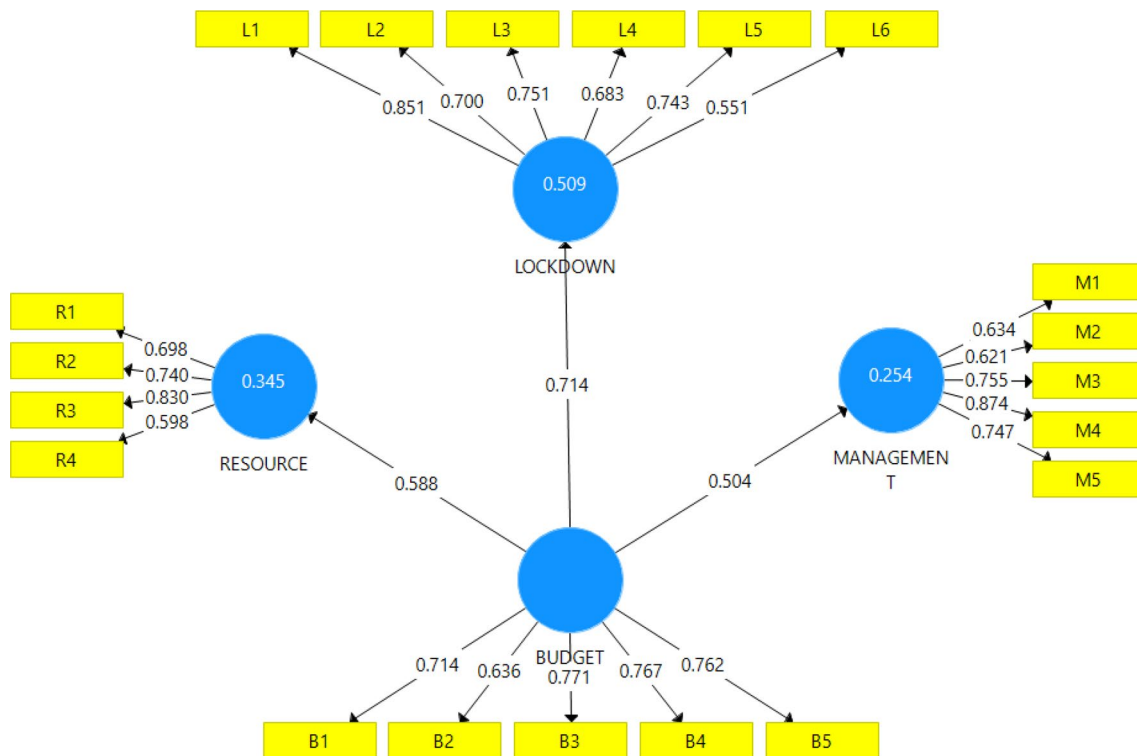


Fig. 6 Final structural equation model of the factors influencing supply chain management

such as material price escalation, government budget reduction, increase in cost of construction operations, economic slowdown and increase of bankruptcy of supply chain partners; increase in cost of construction operations affected the supply chain most with a loading of 0.771.

In order for a measurement model to be considered valid, all of the items in it must be statistically significant. AVE must have a value greater than or equal to 0.5 to be considered valid and Cronbach's alpha should be greater than or equal to 0.6 (Ahmad et al. 2016).

Recommendations

Although not all the factors affecting supply chain management can be completely eliminated, but actions can be taken to reduce the impact by considering the following recommendations.

- The transparency in multi-tier supply chains should be established, with a list of essential components, the source of supply determined and alternative sources identified.
- Estimates of available inventory should be made along the value chain so that it can be used as a bridge between production and distribution to clients.

- Production and distribution capacity should be maximised to ensure employee safety and participation in communication teams and work-from-home possibilities.
- It is important to have a plan in place for logistics, and to be able to switch between modes of transportation when necessary.
- Managing cash and net working capital should be done by conducting stress tests to determine when supply-chain difficulties begin to have a financial impact.

Conclusion

Supply-chain management in the construction industry has received very little attention from researchers. It was the primary objective of this paper to examine the impact of resources, budget, lockdown and management on the supply chain because of covid-19. The four dimensions of construction supply chain management were explained in relevant literature through the design of a questionnaire. Only 72 valid responses (out of a total of 101 distributed) were received from Kashmir's construction professionals. Likert scale was used to express quantitative data gathered from survey participants using terms such as strongly disagree, disagree, neutral, agree, and strongly agree for attributes affecting supply chain management. The reliability and validity of the factor structure of supply chain management

in the construction industry were evaluated using exploratory factor analysis. The structural equation model (SEM) was utilised to investigate the interactions among supply chain management components, and the final structural model was created. The lockdown had the greatest effect on the supply chain management because of covid-19. The most important component related to lockdown is the requirement to suspend site operations with a loading of 0.851. Reduction in supply chain flexibility with a loading of 0.874 affected the supply chain most among all factor components. Lean inventory tools can be implemented for the supply chain management. There is a need to diversify the supply chains and avoid the single source of supply and there should be a provision in the future contracts for the pandemic like situation.

Future scope

This topic has a wide range of future scope as very less work has been done on it because the covid-19 is not completely eradicated yet. The sample size can also be increased by covering a large section of population.

Limitations

- The research is limited to Kashmir only.
- Only the residential projects were taken into consideration.
- Only supply chain management was considered for research.

Author contributions The authors confirm contribution to the paper as follows: study conception and design: sofi adnan farooq; data collection: sofi adnan farooq; analysis and interpretation of results: sofi adnan farooq, B. Indhu; draft manuscript preparation: sofi adnan farooq. All authors reviewed the results and approved the final version of the manuscript.

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Declarations

Competing interests The authors declare no competing interests.

Conflict of interest The authors have not disclosed any competing interests.

References

- Ahmad, S., Zulkurnain, N., & Khairushalimi, F. (2016). Assessing the validity and reliability of a measurement model in structural equation modeling (SEM). *British Journal of Mathematics & Computer Science*, 15(3), 1–8. <https://doi.org/10.9734/bjmcs/2016/25183>
- Akmam, S., Zakaria, S., Kaur, A., & Singh, M. (2021). Impacts of Covid-19 outbreak on civil engineering activities in the Malaysian construction industry. *A Review.*, 33(3), 477–75.
- Alsharaf, A., Banerjee, S., Uddin, S. M. J., Albert, A., & Jaselskis, E. (2021). Early impacts of the COVID-19 pandemic on the United States construction industry. *International Journal of Environmental Research and Public Health*, 18(4), 1–21. <https://doi.org/10.3390/ijerph18041559>
- Biswas, A., Ghosh, A., Kar, A., Mondal, T., Ghosh, B., & Bardhan, P. K. (2021). The impact of COVID-19 in the construction sector and its remedial measures. *Journal of Physics: Conference Series*. <https://doi.org/10.1088/1742-6596/1797/1/012054>
- Bou Hatoum, M., Faisal, A., Nassereddine, H., & Sarvari, H. (2021). Analysis of COVID-19 concerns raised by the construction workforce and development of mitigation practices. *Frontiers in Built Environment*, 7(May), 1–15. <https://doi.org/10.3389/fbuil.2021.688495>
- Butt, A. S. (2021). Strategies to mitigate the impact of COVID-19 on supply chain disruptions: a multiple case analysis of buyers and distributors. *International Journal of Logistics Management*, December. <https://doi.org/10.1108/IJLM-11-2020-0455>
- Cho, K. M., Hong, T. H., & Hyun, C. T. (2009). Effect of project characteristics on project performance in construction projects based on structural equation model. *Expert Systems with Applications*, 36(7), 10461–10470. <https://doi.org/10.1016/j.eswa.2009.01.032>
- Demissew, A. (2020). Assessment on Impact of Covid-19 on Ethiopian Construction Industry. *Ijesc*, 10(7), 26889–26894.
- Doloi, H., Iyer, K. C., & Sawhney, A. (2011). Structural equation model for assessing impacts of contractor's performance on project success. *International Journal of Project Management*, 29(6), 687–695. <https://doi.org/10.1016/j.ijproman.2010.05.007>
- ERKESİM, D. U. (2021). IMPACT OF COVID-19 ON SUPPLY CHAIN MANAGEMENT Dilek ULUCAN ERKESİM International Journal of Commerce and Finance 2 Literature Review. *International Journal of Commerce and Finance*, 7(1), 72–76.
- Esa, M. B., Ibrahim, F. S. B., & Kamal, E. B. M. (2020). Covid-19 pandemic lockdown: The consequences towards project success in Malaysian construction industry. *Advances in Science, Technology and Engineering Systems*, 5(5), 973–983.
- Fellows, R., & Liu, A. (2008). Impact of participants' values on construction sustainability. *Proceedings of the Institution of Civil Engineers: Engineering Sustainability*, 161(4), 219–227. <https://doi.org/10.1680/ensu.2008.161.4.219>
- Gamil, D. Y., & Alhagar, A. (2020). The impact of pandemic crisis on the survival of construction industry : A case of COVID-19 Dr. Yaser Gamil Abdulsalam Alhagar. *Mediterranean Journal of Social Sciences*, 11(4), 122–128.
- Hansen, S. (2020). Does the COVID-19 Outbreak Constitute a Force Majeure Event? A Pandemic Impact on Construction Contracts. *Journal of the Civil Engineering Forum.*, 6(1), 201.
- Husien, I. A., Borisovich, Z., & Naji, A. A. (2021). COVID-19: Key global impacts on the construction industry and proposed coping strategies. *E3S Web of Conferences*, 263. <https://doi.org/10.1051/e3sconf/202126305056>
- Indhu, B., & Yogeswari, K. (2021). Structural equation modelling (Sem) approach on inappropriate construction equipment delay factors. *Civil Engineering Journal (Iran)*, 7(7), 1156–1168.

- Jang, H., Kim, K., Kim, J., & Kim, J. (2011). Labour productivity model for reinforced concrete construction projects. *Construction Innovation, 11*(1), 92–113. <https://doi.org/10.1108/1471417111104655>
- Ogunnusi, M., Hamma-adama, M., Salman, H., & Kouider, T. (2020). COVID-19 Pandemic : The Effects and Prospects in the Construction Industry. *International Journal of Real Estate Studies, 2*(2), 120–128.
- Osuizugbo, I. C. (2020). Disruptions and Responses within Nigeria Construction Industry amid COVID-19 Threat. *Covenant Journal in Research & Built Environment (CJRBE), 8*(2), 37–48.
- Pamidimukkala, A., & Kermanshachi, S. (2021). Impact of Covid-19 on field and office workforce in construction industry. *Project Leadership and Society, 2*, 100018. <https://doi.org/10.1016/j.plas.2021.100018>
- Paul, S. K., Chowdhury, P., Moktadir, M. A., & Lau, K. H. (2021). Supply chain recovery challenges in the wake of COVID-19 pandemic. *Journal of Business Research, 136*(August), 316–329. <https://doi.org/10.1016/j.jbusres.2021.07.056>
- Sierra, F. (2021). COVID-19: Main challenges during construction stage. *Engineering, Construction and Architectural Management. https://doi.org/10.1108/ECAM-09-2020-0719*
- Tilaoui, N. (2021). The Impact of COVID-19 Pandemic on the Civil Engineering sector VS The various economic and financial measures : Moroccan case. 29–32.
- Timilsina, S. P., Ojha, S. K., & Dhungana, B. R. (2021). Impact of Covid-19 on construction industry of Nepal. *Modern Economy, 12*(08), 1232–1244. <https://doi.org/10.4236/me.2021.128064>
- Uchehara, I., Hamma-Adama, M., Obiri, K. A., Jafarifar, N., & Moore, D. (2020). Impacts and risk management of COVID-19 pandemic on real estate supply chain. *International Journal of Real Estate Studies, 14*, 41–53.
- Veselovská, L. (2020). Supply chain disruptions in the context of early stages of the global COVID-19 outbreak. *Problems and Perspectives in Management, 18*(2), 490–500.

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