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REVIEW OF CONSTRUCTION SUPPLY CHAIN OPTIMIZATION PAPERS FOR PERFORMANCE IMPRVOVEMENT

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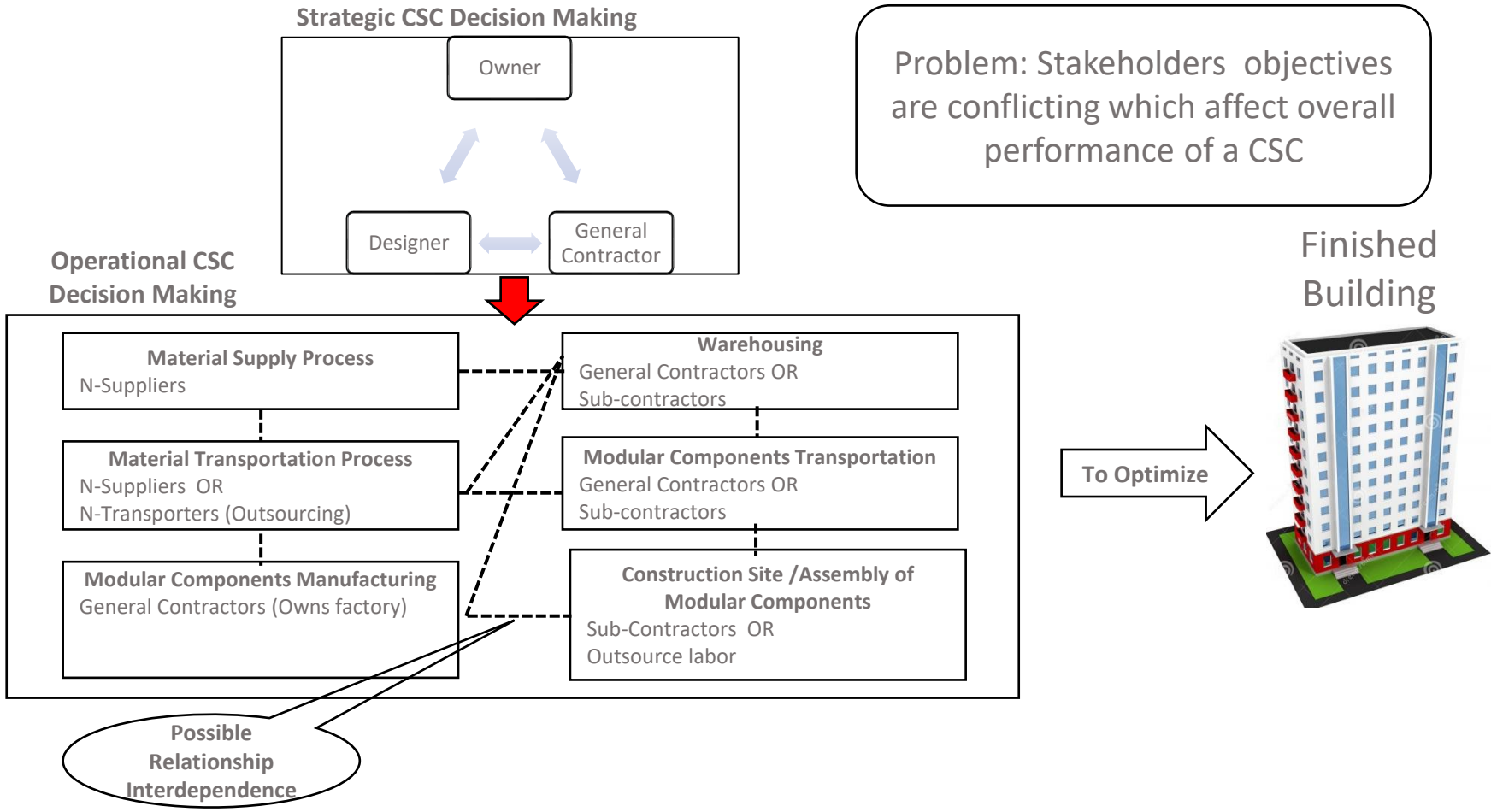
AGENDA

- Overview
- Introduction
- Phases and Processes in Construction Supply Chain (CSC)
- Research Method
- Results
- Discussion
- Conclusion

OVERVIEW

- Construction industry is increasingly getting competitive.
- To provide an overview of the recent developments of optimization techniques on the construction supply chain (CSC) for maximizing performance.
- To highlight the current research gaps in the field.
- The desk methodology has been used in this research.
- The findings of this study shows that there is need of a framework that integrate all CSC processes for its performance improvement.

INTRODUCTION (Problem Context)



PHASES AND PROCESSES IN CSC

Collaboration Level							Execution level			
Design Phase			Procurement Phase				Construction Phase			
CSC Configuration(CC)	Modularity(ML)	Strategic Planning/ Risk Evaluation(SR)	Production/ Prefab components Planning(PP)	Supplier Selection(SS)	Purchasing Decision(PD)	Storage(S)	Building Partnership(BP)	Transportation(T)	Site Layout Planning(SL)	Controlling Information Flow and Other Delay Factors(CD)	Material Handling(MH)

Table 1. Level , Phases and Processes in CSCM (Y. Liu, Dong, & Shen, 2020) and (Phuoc Luong Le et al., 2020)

RESEARCH METHOD

- Step 1: Scopus Database and keywords search approach were used. Unpublished work was neglected.
- Step 2: Criteria: The selected paper should be related with application of Operations Research(OR) on CSC.
- Step 3: Categorization of papers on the basis OR tools and CSC processes.
- Step 4: Evaluation of articles by reading abstracts, methodology and conclusion.

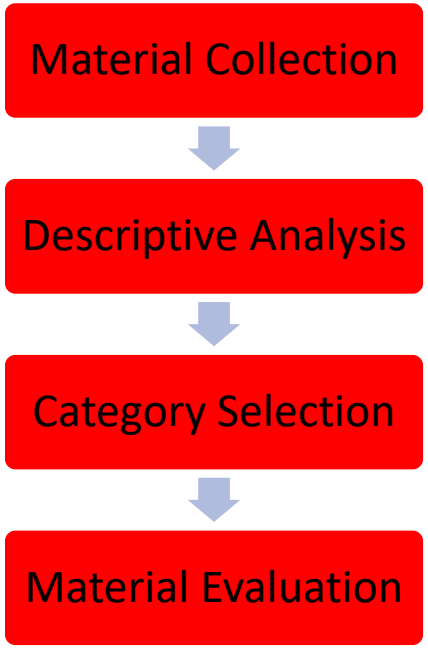


Figure 1. Research Method

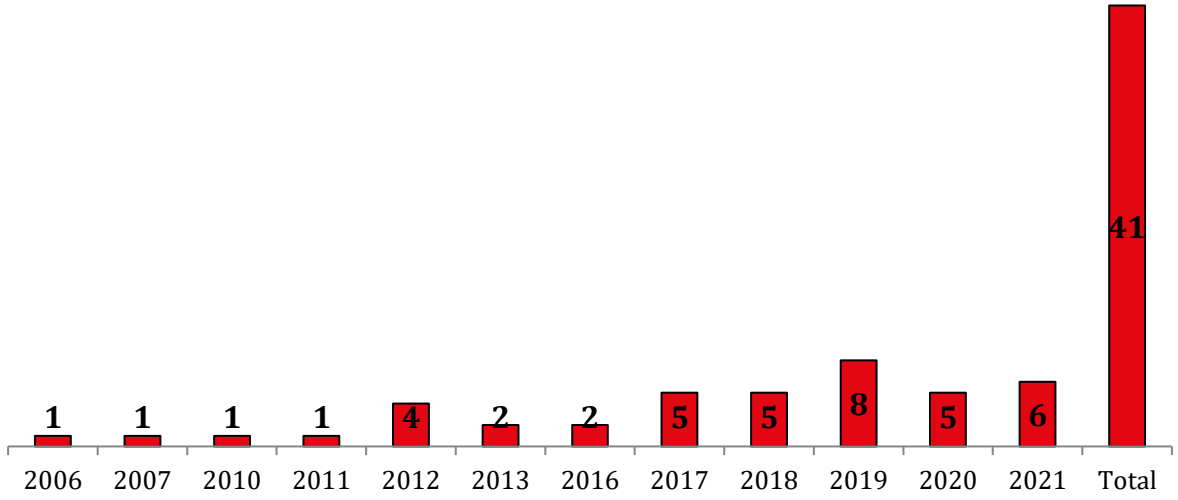
RESEARCH METHOD

Keywords Combination	Search Results
Construction Supply Chain AND Optimization AND Logistics	99
Construction Supply Chain AND Optimization AND Material Planning	31
Construction Industry AND Optimization AND Supply Chain	146
Construction Industry OR Building AND Supply Chain	471
Building AND Optimization AND Supply Chain	536
Construction Supply Chain AND Modular AND Optimization	17
Building AND Optimization AND Logistics	291
Construction AND Supply Chain AND Optimization	516
Construction AND Supply Chain AND Improvement	522
Construction AND Logistics AND Optimization	726
Construction AND Logistics AND Improvement	506
Construction AND Material Planning AND Optimization	647
Construction AND Material Planning AND Improvement	591
Building AND Supply Chain AND Improvement	431

Table 2. Selected Keywords Combination Search Results

RESEARCH METHOD

After analysing the scopus database as per adopted research methodology , 41 papers were identified that have applied optimization techniques on CSCM for performance improvement



Graph 1. Yearwise Breakup of Selected Papers

RESULTS

S:No	Authors	Optimization Tool	CC	ML	SR	PP	SS	PD	S	BP	T	SL	CD	MH
1	(Elimam & Dodin, 2013)	MILP				√	√	√	√		√			
2	(Alayet, Lehoux, & Lebel, 2018)	LP				√			√		√			
3	(Cengiz, Aytekin, Ozdemir, Kusan, & Cabuk, 2017)	MCDM					√			√				
4	(Q. Chen, García de Soto, & Adey, 2021)	NLP						√	√	√	√			
5	(W. W. Chen, Lei, Wang, Teng, & Liu, 2018)	MILP					√	√	√		√			√
6	(Costa, Granja, Fregola, Picchi, & Staudacher, 2019)	MCDM	√		√					√			√	
7	(Deng, Gan, Das, Cheng, & Anumba, 2019)	NLP					√	√	√	√	√	√		√
8	(Hemanth et al., 2017)	MCDM			√					√			√	
9	(Hsieh, 2016)	Hybrid Methods									√	√	√	
10	(P. Y. Hsu, Angeloudis, & Aurisicchio, 2018)	Two-stage Stochastic		√		√	√	√	√		√			
11	(P. Y. Hsu, Aurisicchio, & Angeloudis, 2017)	MILP		√		√	√	√	√	√	√			
12	(P.-Y. Hsu, Aurisicchio, & Angeloudis, 2019)	Hybrid Methods		√			√	√	√		√	√	√	
13	(Jaśkowski, Sobotka, & Czarnigowska, 2018)	MILP					√	√	√					
14	(Karabayir, Botsali, Kose, & Cevikcan, 2020)	MCDM					√							
15	(Kayhan, Cebi, & Kahraman, 2019)	MCDM			√		√	√						
16	(S. Kim, Chang, & Castro-Lacouture, 2020)	Simulation methods											√	
17	(T. Kim, Kim, & Cho, 2020)	Simulation methods			√	√					√	√	√	√
18	(Y. W. Kim, Han, Yi, & Chang, 2016)	Simulation methods	√			√		√	√		√			
19	(Komsiyah, Wongso, & Pratiwi, 2019)	MCDM					√			√				
20	(Kristy & Zagloel, 2020)	MCDM					√			√				

Table 3A. Papers Categorization based on Optimization Techniques and CSC Processes

RESULTS

S:No	Authors	Optimization Tool	CC	ML	SR	PP	SS	PD	S	BP	T	SL	CD	MH
21	(Leontaris, Morales-Nápoles, Dewan, & Wolfert, 2019)	Simulation methods			√			√			√	√	√	√
22	(van der Beek, van Essen, Pruyn, Aardal, & Hopman, 2019)	MILP		√		√		√	√					
23	(J. Liu & Lu, 2017)	LP		√				√			√		√	√
24	(Yazdi, Fini, & Forsythe, 2020)	LP		√		√						√		
25	(Jing Liu & Lu, 2018)	Hybrid Methods		√	√	√		√			√		√	√
26	(Tserng, Yin, & Li, 2006)	Constraint Programming				√		√	√	√	√			
27	(Castro-Lacouture, Medaglia, & Skibniewski, 2007)	LP							√					
28	(Taghaddos, Hermann, AbouRizk, & Mohamed, 2010)	Simulation		√		√		√	√		√	√	√	√
29	(Pan, Lee, & Chen, 2011)	LP	√				√	√	√		√			
30	(Cadena, Ramos, Gómez, & Munoz, 2012)	MILP										√	√	√
31	(D. Liu, 2012)	Genetic Algorithm	√											
32	(Said & El-Rayes, 2012)	Genetic Algorithm						√	√		√	√		√
33	(Xanthopoulos, Aidonis, Vlachos, & Iakovou, 2012)	LP										√	√	√
34	(Said & El-Rayes, 2013)	Hybrid Methods	√					√	√	√	√	√	√	
35	(J. H. Chen, Yan, Tai, & Chang, 2017)	Linear Programming				√					√			
36	(Golkhoo & Moselhi, 2019)	Hybrid Methods						√	√		√		√	√
37	(Jaafar, Elbarkouky, & Kennedy, 2021)	MILP										√	√	√
38	(P. L. Le, Jarroudi, Dao, & Chaabane, 2021)	LP					√	√	√	√	√			
39	(Mirghaderi & Modiri, 2021)	Hybrid Methods	√			√		√	√		√			√
40	(Son, Duy, & Dat, 2021)	Hybrid Methods				√		√	√		√			
41	(Zhu, Dai, Liu, Xu, & Alwisy, 2021)	LP		√		√		√			√		√	√
	Total papers / CSC Process		6	9	6	15	14	24	21	11	25	12	16	14

Table 3B. Papers Categorization based on Optimization Techniques and CSC Processes

RESULTS (Major Points from Table 3)

- MCDM is found to be the most used tool for performance improvement in CSC.
- 25 and 24 articles have focused on CSC transportation and purchasing decision processes. They received the most attention of the previous research.
- CSC configuration and strategic planning have received the least attention as they were studied only 6 times
- **For the Design Phase:** Only 19 papers from 41 have focused at least on one of the process of this phase.
- **For the Procurement Phase:** 36 papers out of 41 have focused at least on one of the process of this phase.
- **For the Construction Phase:** 32 papers out of 41 have focused at least on one of the process of this phase.

DISCUSSION

Research Opportunity 1

"Best Decision-Making Tool for Each Construction Supply Chain Process"

For example, Fuzzy AHP is most recommended for supplier selection as identified from the literature review (Su, 2020)but it is not adequate for other processes such as demand prediction where stochastic models may work well. Therefore, research is needed to find the best decision-making tool for each CSC process.

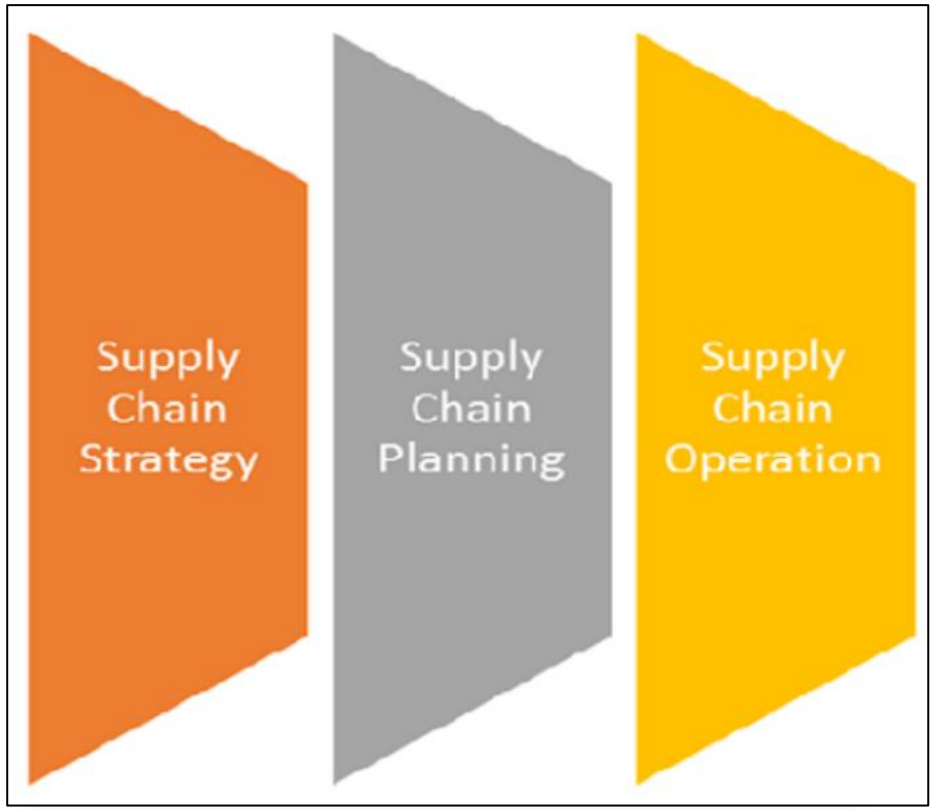


Figure 2. Decsion Making Phases in CSC

DISCUSSION

Research Opportunity 2

"Framework for Optimizing Overall Construction Supply Chain"

There is a need for a framework to identify the best practice to optimize the overall construction supply chain. That framework will also identify how to integrate each process's best results to optimize the overall construction supply chain to produce the most effective results.

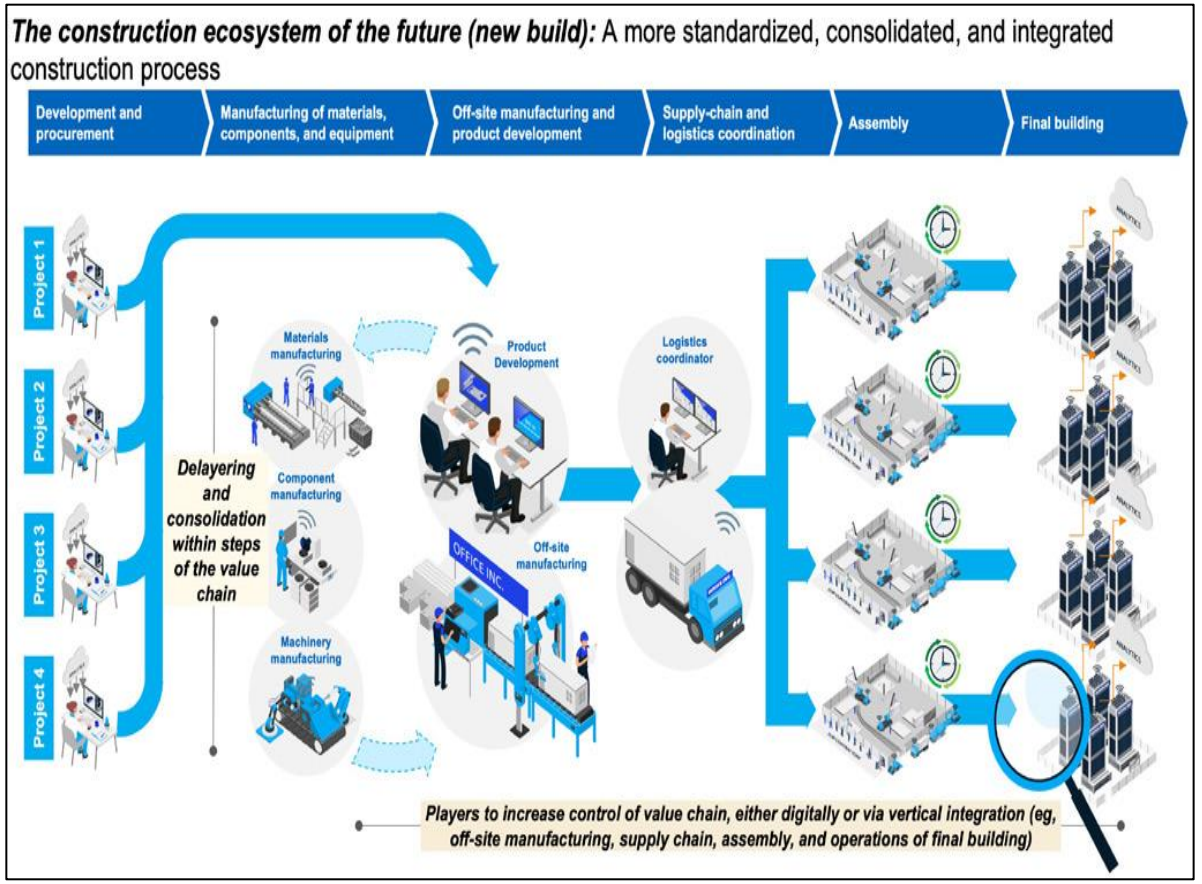


Figure 3. Future Integrated CSC By Mckinsey 2020

DISCUSSION

Research Opportunity 3

"Standardizing Supply Chain processes through Lean Construction."

Recent trend shows that researchers have recommended lean construction. Therefore, research can be done on standardizing construction supply chain processes by lean tools such as VSM.(Dana Broft, 2020).

Figure 4. CSC Wastes

CONCLUSIONS

Research Output

Forty-one papers were analyzed against 12 processes of CSC, and none of them were covering all the processes in their optimization model.

Future Research Directions

RO 1: Best Optimization Tool for each CSC process

RO 2 : An Integrated framework for CSC

RO 3: Standardization through lean tools

Research Limitations

Only Scopus database has been used to carried out this research. Addition of different databases such as web of science will make this research more comprehensive.

THANK YOU!

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