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Measurement of Supply chain Performance for Medium Construction Qualification Projects Using the AHP-SCOR Method Version 12

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Abstract

Construction industry competition is not only limited to individual companies, but also competition between supply chain networks. Supply chain is a problem that constantly faced in construction. Supply chain players who contribute efficiently and productively can help the construction industr experience fierce competition. Good supply chain performance can improve quality efficiency, time, and cost to increase construction productivity. According to previous research, poor supply chain design can increased production costs by up to 10%. Each construction project has its own uniqueness that makes a difference in managing the supply chain from one another, including building construction. Building construction has a complicated construction process and involves many workers so good supply chain performance is needed so the construction process can run optimally and efficiently. According to the importance of the role of the supply chain in construction, a framework is needed to assess the performance of the supply chain on the project. This is in accordance with instructions from the Ministry of Public Works and Spatial Planning (PUPR) which states that supply chain performance activities must be measured to be efficient. There are many studies of supply chain performance measurement analysis, especially in construction, but there are no studies that measure medium construction projects in the Special Region of Yogyakarta (DIY). This study used qualitative research methods to assessed supply chain performance. The research was carried out in May 2022 with samples in the study, namely the construction of the Tipe I MAN Yogyakarta Dormitory Building which is a medium-scale construction building project. The data was taken using questionnaires that were distributed to the staff of project workers. The core process variables / supply chain criteria that used are plan, source, make, deliver, and return with work attributes of reliability, responsiveness, and agility. The resulting data is processed by the AHP method. Based on calculations using the AHP method and the SCOR matrix, a performance score from the supply chain obtained 85.6 which is included in the good category. The lowest score value is return responsiveness with a score of 0.77041 and the highest score value is source reliability with a value of 10.96349. Based on supply chain measurements of the MAN Yogyakarta Type I Dormitory Building Project, a score of 85.6 with a good category was produced.

Keywords: *supply chain, SCOR method, medium construction project.*

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Introduction

According to reported data by the Lean Construction Institute, construction industry waste reaches 57%, while only 10% of other activities provide added value. This is inversely proportional to the manufacturing industry which records data waste of 26% and other activities by 62% that provide added value (Abduh, 2011). Many design changes, poor coordination, lack of worker expertise, poor construction planning and construction control, very slow decision making, and slow material delivery can cause waste problems in the construction industry. A supply chain is an organization/company that is involved in a series of material change activities ranging from natural materials to final products such as buildings or roads (Maddeppungeng et al., 2015). Supply chain design is very influential on the performance of construction projects. Supply chain actors who contribute efficiently and productively can help the construction industry which is experiencing intense competition (Nurwega et al., 2014). The construction industry with good supply chain performance can improve quality, time, and cost efficiency so as to increase construction productivity. Poor supply chain design can increase costs by up to 10% (Maddeppungeng et al, 2015).

Given the important role of the supply chain in construction, especially medium-scale construction, a framework is needed to assess supply chain performance in projects. The Ministry of Public Works and Spatial Planning (PUPR) has instructed that supply chain performance activities must be measured in order to be efficient. This is certainly a challenge for all contractors and suppliers for this policy (Sholeh et al, 2020). There are many analysis studies of supply chain performance measurement, but there is no study that measures supply chain performance of medium construction qualification projects in the Special Region of Yogyakarta (DIY). This condition encourages researchers to measure the supply chain performance of building construction projects in Yogyakarta.

Research Method

Variable and Attribute

This section will explain the definition of each variable used in this study. According to Pujawan and Mahendrawati (2017: 281-282) the variables to be used are Plan Source, make, deliver, and return. While the attributes used in this study are reliability, responsiveness, agility.

Supply Chain Performance Measurement

Measurement begins with selecting performance objectives such as speed, quality, reliability, and so on. The performance is then given a weight or value (Sumiati, 2012). The supply chain strategy can be applied to the relationship according to the equation below:Measurement begins with selecting performance objectives such as speed, quality, reliability, and so on. The performance is then given a weight or value (Sumiati, 2012). The supply chain strategy can be applied to the relationship according to the equation below:

$$\text{Pi} = \sum_{j=i}^{n} \text{Sij Wj}$$

P_i = total supply chain performance variant i

n = number of performance objectives

S_{ij} = Supply chain score to 1 in performance objective j

M_j = the weight of the performance objectInformation:

The results of the determined indicators have different weights with different size scales so that parameter equations are needed. Equalization of parameters is by means of normalization (Sumiati, 2012). Normalization plays an important role in determining the final value of the performance measurement. This study uses the Snorm De Boer normalization formula with the following formula:

$$\mathrm{Snorm} = \frac{\mathrm{Si} - \mathrm{Smin}}{\mathrm{Smax} - \mathrm{Smin}} \mathrm{x} 100$$

Information:

Si = The actual indicator value that successfully achieved

Smin = The value of the worst performance achievement of the performance indicators

Smax = Performance achievement score best of performance indicators

Analytical Hierarchical Process (AHP)

Analytical Hierarchy Process (AHP) is the most effective way of making decisions to answer complex problems by simplifying and accelerating the creation of solutions to the problems experienced (Saaty, 1993). The process of hierarchical analysis produces decision outputs by considering the value aspects taken logically. The steps that must be taken to use the AHP method according to Aurachman (2019) are as follows:

a. Define the problem and determine the knowledge sought.

b. Create a hierarchical structure so that complex problems can be reviewed from a detailed perspective.

c. Create a pairwise comparison matrix. Elements at a higher level are used to compare the elements below it.

d. Prioritize each issue at the hierarchical level.

A_1	A_{11}	A_{21}	A_{31}	....	A_{1n}
A_2	A_{21}	A_{22}	A_{22}	....	A_{2n}
A_3	A_{31}	A_{32}	A_{33}	....	A_{3n}
.	.	.	.		.
.	.	.	.		.
A_n	A_{n1}	A_{n2}	A_{n3}		A_{nn}

Tabel 1 Analytical Hierarki Proses (AHP)

(Source: Pengambilan Keputusan, Thomas L Saaty, 1993)

e. Perform normalization so that the weight of each is found Information

f. Calculate the maximum eigen value on the criteria

g. Test the consistency of each generated hierarchy. If the consistency ratio is smaller than the specified limit, then the data can be accepted. On the other hand, if the CR is found to be greater than the standard that has been determined, it is necessary to reconsider.

Results and Discussion of Questionnaire Data

This questionnaire was prepared by considering theory, construction parties, and previous research. Questionnaires were distributed to eight respondents from the staff of the construction project for the Type 1 Dormitory Building of MAN 1 Yogyakarta. Staff who are respondents to this questionnaire are staff who handle the material section.

Consistency Ratio Hierarchy (CRH)

Filling in the data from respondents may be inconsistent in making judgments because the assessment carried out is a preference comparison assessment.

Hierarchical consistency analysis aims to determine the consistency of the priority values obtained (Aurachman, 2019). Calculation of the consistency ratio of the core process/criteria, work attributes, and sub-criteria can be seen in the table below:

Tabel 5 Consistency Ratio Hierarchy core process/criteria

No	Criteria	Weight	CI	CIH	RI	RIH
1	Plan	0,278		0,00018		0,31148
2	Source	0,242		0,00016		0,27145
3	Make	0,241	0,001	0,00016	1,120	0,26981
4	Deliver	0,158		0,00010		0,17679
5	Return	0,101		0,00007		0,11343
		Total		0,00066	Total	1,14297
		Consistency Ratio Hierarchy			0,00058	OK

Table 5 is the result of the calculation of the Consistency Ratio Hierarchy for the core process/criteria which is worth 0.00058 or 0.058%, which means based on the standard if the result of the Consistency Ratio Hierarchy value 0.1 or 10% = consistent.

Tabel 6 Consistency Ratio Hierarchy atribut kerja

No	Atribut	Weight	CI	CIH	RI	RIH
1	PRL	0,476	0,000	0,00000	0,000	0,00000
2	PRS	0,205		0,00000		0,00000
3	SRL	0,476		0,00024		0,27617
4	SRS	0,205	0,000	0,00010	0,580	0,11893
5	SAG	0,319		0,00016		0,18514
6	MRL	0,555		0,00046		0,32202
7	MRS	0,123	0,001	0,00010	0,580	0,07140
8	MAG	0,246		0,00021		0,14291

9	DRL	0,559	0,000	0,00000	0,000	0,00000
10	DRS	0,441		0,00000		0,00000
11	RRL	0,759	0,000	0,00000	0,000	0,00000
12	RRS	0,241		0,00000		0,00000
		Total		0,00127	Total	1,11657
		Consistency Ratio Hierarchy			0,00114	OK

Tabel 6 merupakan hasil dari perhitungan Consistency Ratio Hierarchy atribut kerja yang bernilai 0,00114 atau 0,114% yang berarti berdasarkan standart jika hasil nilai Consistency Ratio Hierarchy ≤ 0,1 atau ≤ 10% = konsisten.

Tabel 7 Consistency Ratio Hierarchy sub criteria

No	Atribut	Weight	CI	CIH	RI	RIH
1	PRL-1	0,305	0	0	0,9	0,2749
2	PRL-2	0,272		0		0,2446
3	PRL-3	0,317		0		0,2852
4	PRL-4	0,131		0		0,1176
5	PRS	1	0	0	0	0
6	SRL	1	0	0	0	0
7	SRS-1	0,61	0	0	0	0
8	SRS-2	0,39		0		0
9	SAG	1	0	0	0	0
10	MRL-1	0,368	0	0	0,58	0,2132
11	MRL-2	0,253		0		0,1465
12	MRL-3	0,411		0		0,2383
13	MRS	1	0	0	0	0
14	MAG	1	0	0	0	0
15	DRL	1	0	0	0	0
16	DRS-1	0,451	0	0,0004	0,58	0,2618
17	DRS-2	0,242		0,0002		0,1403
18	DRS-3	0,308		0,0003		0,1789
19	RRL-1	0,478	0	0	0	0
20	RRL-2	0,522		0		0
21	RRS-1	0,684	0	0	0	0
22	RRS-2	0,316	0	0	0	0
		Total		0,0008	Total	2,1013
		Consistency Ratio Hierarchy			4E-04	OK

Table 7 is the result of the calculation of the Consistency Ratio Hierarchy sub-criteria which is worth 0.0004 or 0.04%, which means based on the standard if the result of the Consistency Ratio Hierarchy value 0.1 or 10% = consistent.

So from the table of the Consistency Ratio Hierarchy calculation in the table above, it can be concluded that the value of the core process hierarchy/criteria, work attributes, sub-criteria are consistent and acceptable.

Supply Chain Performance Assessment

Supply chain performance measurement requires a process of equalizing parameters because the scale value for each sub-criteria is different. parameter equations have an important effect on the final results of performance measurements with the same weight. Parameters are equalized by using the Snorm De Boer normalization process. The calculation of normalization of work assessment can be seen in table 9.

Tabel 9 Recap normalization of performance assessment

Criteria	Atribute	Value Matrix (%)	Score (%)	Best	Actual	Unit
Plan	Reliability	Planning of material arrival schedule	100	11	11	Freq
		Relationships between suppliers that can affect	100	9	9	Amount
		The accuracy of the planning results with the method used	100	10	10	Freq
		Need briefing for construction plan	100	150	150	Day
	Responsiveness	It takes a certain amount of time to revise the schedule	100	1	1	Day
Source	Reliability	The suitability of the condition of the material sent by the supplier	95	100	95	%
	Responsiveness	The suitability of the condition of the material sent by the supplier	80	4	5	Day
		It takes a certain time in the inspection process	100	22	22	Freq
	Agility	The supplier's ability to meet the needs	100	100	100	%
Make	Reliability	The suitability of the material in the initial design with the results	100	100	100	%
		The amount of material damage generated during	100	0	0	Freq
		Conformity of the final construction result with the request	100	100	100	%
	Responsiveness	There is a certain time to store materials	71,4	5	7	Day
	Agility	There is a request for a change in material specifications	100	0	0	Freq

	Reliability	The amount of material that the supplier can meet from the total	100	100	100	%
Deliver	Responsiveness	Supplier response speed in responding if there is material delay	80	20	16	Freq
		It takes a certain time in material arrival	100	1	1	Day
		The distance of the supplier location affects the delivery time schedule	100	5	5	Km
Return	Reliability	Number of material complaints to suppliers	50	1	2	Freq
		The number of defective materials returned to the supplier	50	1	2	Freq
	Responsiveness	It takes a certain time for the contractor replace the material that the client complains about	100	0	0	Day
		It takes a certain time for the supplier to replace the defective material	100	1	1	Day

Performance measurement process several indicators obtained total assessment 85.6. Performance appraisal score score the lowest is return responsiveness with a value of 0.77041 and the highest score is source reliability with a value of 10,96349. The results of this measurement are influenced by the value of the criteria, weights, and global weights of several indicators such as plan, source, make, deliver, and return.

Discussion

Based on the calculation of the final value of supply chain performance carried out on The SCOR matrix obtained a performance score from the supply chain of the Type 1 Dormitory Building Project of MAN 1 Yogyakarta of 85.6. The lowest score of performance assessment is return responsiveness with a value of 0.77041 and the highest score is source reliability with a value of 10,96349. According to Trienekens and Hvolby (2000), the score of 85.6 is in the good category.

The good supply chain results in this study can be caused because the project being carried out is a medium project so that the project has relatively fewer workers. This can facilitate management and coordination between workers.

Conclusion

The purpose of the research conducted by the researcher is to measure the supply chain performance of a medium construction qualification project located in Yogyakarta. This study resulted in the following conclusions:

a. The final value of supply chain performance from this calculation is obtained from the calculation results as follows:

1) Measurement of the weighting of pairwise comparisons using the analytical hierarchy process (AHP) method.

2) The calculation result of supply chain performance is obtained by multiplying the global weight with the performance value.

b. Through research that has been carried out, the results of this research show that the performance score of the project supply chain is 85.6 in the good category.

References

Abduh, M. (2007). Konstruksi Ramping: Memaksimalkan Value dan Meminimalkan Waste. Fakultas Teknik Sipil dan Lingkungan, Institut Teknologi Bandung.

Aurachman, R. (2019). Proses Pengambilan Data Pada AHP (Analytical Hierarchy Process) Menggunakan Prinsip Closed Loop Control System. JISI: Jurnal Integrasi Sistem Industri, 6(1), 55-64.

Badan Pusat Pengembangan dan pembinaan Bahasa (n.d). Konstruksi (Def. 1). Dalam Kamus Besar Bahasa Indonesia (KBBI) Online. Diakses 30 Maret 2022. Melalui https://kbbi.web.id/.

Badan Pusat Statistik Daerah Istimewa Yogyakarta. (2020). Statistik Konstruksi Daerah Istimewa Yogyakarta 2020. Yogyakarta: Badan Pusat Statistik Daerah Istimewa Yogyakarta.

Liputra, D. T., Santoso, S., & Susanto, N. A. (2018). Pengukuran kinerja rantai pasok dengan model supply chain operations reference (SCOR) dan metode perbandingan berpasangan. Jurnal Rekayasa Sistem Industri, 7(2), 119-125. Maddeppungeng, A., Suryani, I., & Yuliatin,

R. (2015). Analisis Kinerja Supply chain Pada Proyek Konstruksi Bangunan Gedung. Journal Industrial Servicess, 1(1).

Nurwega, M. A., & Meddeppungeng, A. (2014). Analisis Pola dan Kinerja Supply chain Pada Proyek Konstruksi Bangunan Perumahan. Konstruksia, 5(2).

Saaty, T. L. (1993). Pengambilan Keputusan Bagi Para Pemimpin. PT. Pustaka Bianaman Pressindo. Jakarta.

Sholeh, M. N., Wibowo, M. A., & Handayani, N. U. (2020). Supply chain Performance Measurement Framework for Construction Materials: Micro Meso Macro. management, 8, 7.

Sholeh, M. N., Wibowo, M. A., & Sari, U. C. (2020). Pengukuran Kinerja Rantai Pasok Konstruksi Berkelanjutan dengan Pendekatan Model Supply chain Operations Reference (SCOR) 12.0. Jurnal Vokasi Indonesia, 8(2).

Sumiati, M. (2012). Pengukuran Performansi Suplly Chain Perusahaan Dengan Pendekatan Supply Chain Operation Reference (Scor) Di PT Madura Guano Industri (Kamal-madura). Tekmapro: Journal of Industrial Engineering and Management, 2(2).