Asian Journal of Social Science and Management Technology
ISSN: 2313-7410
Volume 7, Issue 1, January-February, 2025
Available at www.ajssmt.com

Evaluation Supply Chain Efficiency and Effectiveness in Cement Freight: A Case Study of Indonesian Railways

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ABSTRACT: Indonesian Railways, Ltd. Co. faces the challenges of an increasingly competitive freight transportation business to achieve customer satisfaction. The relatively easier and cheaper transportation options are a challenge for Indonesian railway facilities. The increasing demand for freight transportation such as cement corporate goods must be balanced with improved supply chain management so that maximum efficiency and effectiveness can be achieved. Indonesian Railways can be evaluated for their effectiveness and efficiency as a means of transporting cement corporate goods. This study aims to determine the efficiency of transportation service operation services of Indonesian Railways, Ltd. Co. Cilacap – Yogyakarta operating area and the effectiveness of services for recipients (distributors) of Dynamix brand cement in Yogyakarta, as well as knowing the influence of the efficiency of Indonesian Railways, Ltd. Co. on the effectiveness of services for recipients or distributors of Dynamix brand cement in Yogyakarta. The analysis of this study uses the Structural equation modelling (SEM) method. The results of the analysis showed that the efficiency of transporting goods had a positive effect on the effectiveness of services to distributors by 0.794. The hypothesis is accepted because it has a p value of 0.000 or < 0.05 and a statistical t value of 12,993 or > 1.96 so that the efficiency of transporting cement corporate goods by Indonesian Railways, Ltd. Co. will increase the effectiveness of services for Dynamix brand cement distributors in Yogyakarta by 79.4%. The highest efficiency of transporting goods is in the indicator of Management reducing logistics administrative costs and Management is trying to increase the level of facility utilization in providing services. Meanwhile, the effectiveness of distributor services is most effective in the indicators of Willingness to help the recipient of goods, and Providing services at the promised time. Thus, it can be concluded that in Indonesian Railways, Ltd. Co. in the Cilacap – Yogyakarta operating area is already relatively efficient in freight transportation services, and has been classified as effective in services for Dynamix brand cement distributors in Yogyakarta in 2024

Keywords - Efficiency of transporting goods, service effectiveness, SEM, Indonesian Railways

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1. INTRODUCTION

Indonesian Railways, Ltd. Co. faces the challenges of an increasingly competitive freight transportation business to achieve customer satisfaction. The main task of Indonesian Railways, Ltd. Co. includes three things, namely passenger transportation, freight transportation and facility management. The advantages of the railway are certainty of time, fast, safe, controlled, monitored, large capacity, flexibility, spacious place, competitive fares, there are storage warehouses, loading-unloading facilities, easy payment systems. The increasing demand for

freight transportation such as cement corporate goods must be balanced with improved supply chain management so that maximum efficiency and effectiveness can be achieved.

Along with the development of the region and the growth of the number of motor vehicles, it has had an effect on the decrease in speed levels, high accidents and highway congestion. The transportation of goods for distribution or delivery outside the city or medium and long distances is very efficient, when transported by train. Based on data from the Central Statistics Agency on freight transportation by rail throughout 2021, it increased by 10.29% to 53.44 million tons from the 2020 achievement of 48.45 million tons. Meanwhile, transportation by sea vessels grew 3.45% to 313.02 million tons [1].

The global cement industry is an integral part of the construction sector, contributing significantly to infrastructure development. As corporations expand their operations internationally, the need for efficient and reliable logistics for cement transportation becomes paramount. This study highlighting the critical aspects that influence the transportation process. The selection of appropriate transportation modes, including maritime, rail, and road transport, is crucial for optimizing the logistics of cement transportation. Each mode presents unique advantages and challenges in terms of cost, speed, and capacity [2]. Adhering to international regulations and standards is essential for ensuring smooth cross-border transportation. This includes compliance with environmental regulations, safety standards, and customs requirements [3]. Effective coordination among various stakeholders, including suppliers, carriers, and receivers, is vital for minimizing delays and maintaining the quality of cement during transit. Advanced supply chain management systems are often employed to achieve this coordination [4].

Strategies for Optimization, the use of advanced technologies, such as GPS tracking and real-time monitoring systems, enhances the visibility and control over the logistics process. This allows for proactive management of potential disruptions and efficient route planning [5]. Implementing just-in-time (JIT) inventory management practices helps in reducing storage costs and minimizing the risk of cement deterioration. This approach requires accurate demand forecasting and reliable transportation schedules [6]. Incorporating sustainable logistics practices, such as optimizing load capacities and reducing carbon emissions, aligns with global environmental goals and enhances corporate social responsibility [7].

Great opportunities are still wide open to increase the volume of cement corporate goods transportation in line with the increasing demand for cement used for the development of the infrastructure and property sectors. Corporate goods are goods produced by the company such as fuel oil, crude palm oils (CPO), fertilizers, cement and so on. Until now, cement transportation using trains is increasing, both in terms of transport volume and the number of train trips. Cement producer companies that have collaborated with Indonesian Railways, Ltd. Co. such as cement factories with the Dynamix brand produced by Solusi Bangun Indonesia, Ltd. Data from the Indonesian Ministry of Industry, national cement production in 2013 is estimated to reach 65 million tons, an increase of about 7% compared to 2012 which was 60.56 million tons. The increase is in line with the increase in production capacity carried out by cement producers in the country and investments made by nine cement producers in the country [8] . Statistical data on the production of goods in the largest group of train transportation in 2015 – 2022, especially freight transportation in the form of cement in units of thousands of tons are as follows [9].

Table 1. Data on the Amount of Cement Transported by Indonesian Railways, Ltd. Year 2015 – 2022

No.	Year	Amount in thousands of tons
1.	2015	4.907
2.	2016	4.173
3.	2017	5.762
4.	2018	5.588
5.	2019	4.515
6.	2020	3.890
7.	2021	3.377
8.	2022	1.668

The Covid-19 pandemic situation had an impact on a decrease in volume in 2020 and even lower in 2022. But data-wise, the capacity to transport the type of railway transportation mode is very large and this is a business opportunity. The high demand for cement corporate freight transportation at Indonesian Railways, Ltd. Co. must be balanced with improved management, especially supply chain management, namely the smooth flow of goods, money and good information so that maximum efficiency and effectiveness can be achieved. Thus, this study was carried out to determine the level of efficiency of freight forwarding operations by Indonesian Railways, Ltd. Co. knowing the effectiveness of services for goods recipients or customers, namely distributors, and knowing the influence of the efficiency of transportation services of Indonesian Railways, Ltd. Co. on the effectiveness of receiving goods by distributors.

2. METHODS OF RESEARCH

2.1. Research location and research design

This research took five places, namely at the Indonesian Railway station specializing in freight transportation in Karangtalun Cilacap, at the Lempuyangan freight station in Yogyakarta, and at three cement distributor companies of Dynamix brand products of Solusi Bangun Indonesia, Ltd. in Yogyakarta. The time for conducting the research is planned to take place from July 1 to August 30, 2024. This study is a survey-type quantitative research and aims to measure the performance of cement corporate goods transportation supply chain management by Indonesian Railways, Ltd. Co. from the cement factory of Solusi Bangun Indonesia, Ltd. Cilacap Central Java through the Karangtalun Cilacap Railway station to the Lempuyangan Railway station Yogyakarta and from Lempuyangan station to the Dynamix brand cement distributor in Yogyakarta through coordination with the receipt warehouse of Solusi Bangun Indonesia, Ltd. at Lempuyangan station, Yogyakarta.

2.2. Research site and research design

The research started from the freight train station in Karangtalun, Cilacap continued at Lempuyangan station in Yogyakarta, and finally the research was carried out on Dynamix brand cement distributor companies for Solusi Bangun Indonesia, Ltd. in Yogyakarta. Research data is primary data, namely data obtained directly by revealing with questionnaires. Data collection was carried out by distributing questionnaires given to respondents who were employees of Indonesian Railways, Ltd. Co both at the Karangtalun Cilacap station and at the Lempuyangan station in Yogyakarta to obtain data on the efficiency of logistics transportation services and to the recipients of goods, in this case Dynamix brand cement distributor companies in Yogyakarta. The target of this research is all Indonesian railways employees of freight transportation at Karangtalun Cilacap station and Indonesian railways employees of freight transportation at Lempuyangan station in Yogyakarta totaling 56 people. Meanwhile, the target for distributor employees is 56 people consisting of three Dynamix brand cement distributor companies in Yogyakarta.

In addition, a model of the company's supply chain structure, company SCM performance data, and SCOR are also needed. The SCOR model is a model of process-based supply chain operations that integrates three main elements in management, namely business process engineering, benchmarking, and business process automation into a cross-functional supply chain framework. SCOR divides supply chain processes into five core processes, namely plan, source, make, deliver and return.

2.3. Research variables and hypotheses

The variables of this study are the efficiency of freight transportation services, and the effectiveness for the recipient of the goods. In a table, the variables and attributes of the study can be described as follows.

Table 2. Variables and attributes of the study

No.	Variable	Attribute
1	The efficiency of the operation of freight transportation services by Indonesian Railways, Ltd.Co.	- Cost - Asset management

2	The effectiveness of the service for the recipient of the goods or the customer, in this case the distributor.	-Reliability - Responsiveness

This study aims to measure the performance of the supply chain in terms of transporting goods or logistics transportation using the SCOR method and SEM analysis. The economic aspects of the supply chain are evaluated using the SCOR method. This study uses the SCOR approach in supply chain measurement as follows.

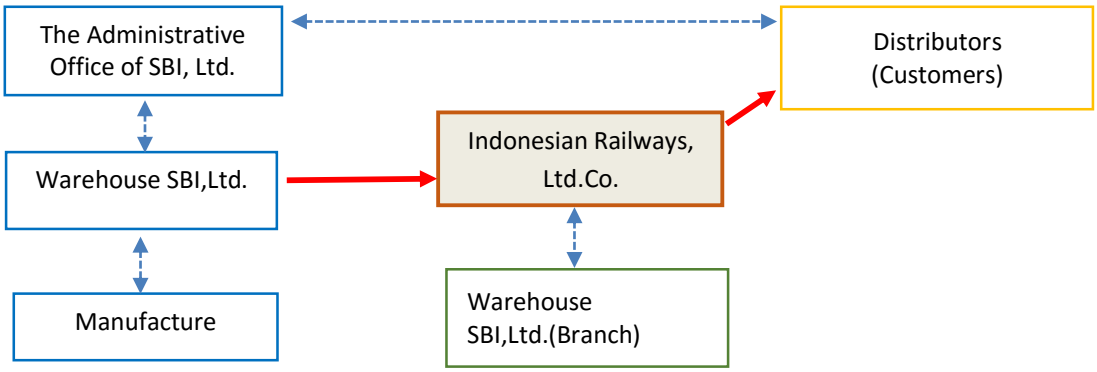

Figure 1. Supply Chain Flow Patterns with the SCOR Approach

At the order acceptance stage, customers can place cement orders through online channels such as the company's website or through direct contact with sales representatives. The order received is then verified by the administration team and confirmed to the customer to ensure a match between the order and the availability of the goods. Once the order is confirmed, the order processing team will pick up the cement from the warehouse and prepare it for delivery. Indonesian Railways, Ltd. Co. has a logistics team that is tasked with determining delivery schedules based on customer location, fleet availability, and other factors. The customer accepts the shipment and checks the condition and quantity of the goods received. If there are no problems, the customer confirms the receipt of the order to Indonesian Railways, Ltd. Co. In addition, the company also conducts reporting and administration related to delivery, receipt, as well as documents and data related to delivery transactions.

Table 3. Reseach Position on Supply Chain Operation Reference (SCOR)

It	Researchers	Heading	Method	Purpose	Year
1	Rizqi Rahmawati Chotimah, Bambang Purwanggono, Aries Susanty [10]	Measurement of Supply Chain Performance Using SCOR and AHP Methods in the Urea Fertilizer Bagging Unit of Dwimatama Multikarsa, Ltd. Semarang.	SCOR	Identifying the appropriate Supply Chain Key Performance Indicators set at DMK, Ltd. in the fields of planning, processing, production, bagging, delivery and returns, measuring indicators of supply chain performance in companies, evaluating indicators in the company chain that need improvement	2018
2	Yuni Aristatnto, N Ikasari, W Sutopo, R Zakaria [11]	Performance Measurement in Supply Chain Using SCOR Model in The Lithium Battery Factory	SCOR	To measure the performance of supply chain in the Sebelas Maret State University lithium battery factory using the SCOR Model in order to determine an improvement plan for the factory.	2020
3	Anas Mutakin, Musa Hubeis [12]	Supply Chain Management Performance	SCORE	1. Examining the structure of the supply chain of cement products of ITP. Ltd.	2016

		Measurement with SCOR Model 9.0 Case Study at Indocement Tunggal Prakarsa, Ltd.		2. Measuring the performance of supply chain management for cement products at ITP. Ltd. with the SCOR 9.0 model. 3. Provide alternative solutions and suggestions for supply chain management.	
4	Dimas Bayu Pamungkas, Anton Mulyono Azis [13]	Optimizing the Performance of the Special Vehicle Supply Chain: A Case Study of Pindad, Ltd. Co. Bandung.	SCORE	To find out the supply chain channels, the flow of goods, money and information and measure the performance of the supply chain using the SCOR method and provide suggestions to improve the performance of the supply chain	2022
5	Rahm Darma, Yunus Moses, Na Teriyawadu, Mahyudin Mahyudin. [14]	Supply Chain Performance of Cayenne papper in Gorontalo, Indonesia.	SCORE	To explain the performance attributes based on reality, responsiveness, agilibility and assets in Gorontalo, Indonesia.	201
6	Abdul Rahman, Sindu Raharjo, Budi Sambaran, Dodi Sugianto, Agung Kwartama [15]	Logistics Business Supply Chain Performance Using the SCOR Model at Tanjung Priok Port, Jakarta.	SCORE	Accurately identify and evaluate the SCM Measurement Process of Tanjung Priok Port Operator, Jakarta.	2022
7	Iphove Kumala Sriwana, Nurul Hijrah S., Arif Suwandi, Roesfiansjah Rasjidin [16]	Supply Chain Performance Measurement Using the SCOR Model at Ananda, Ltd.	SCOR	Determine the performance value and achievement of each company's performance indicators.	2021
8	Roro Hamulian Putri [17]	Measurement of Supply Chain Performance in the Palm Oil Industry Using the SCOR Method. Case Study: Gersindo Minang Plantation (GMP),Ltd. West Pasaman Regency.	SCOR	To find out the performance of the supply chain of quality palm oil procurement at Gersindo Minang Plantation, Ltd.	2022
9	Ki Hung Lai, A.U.T. Nagai, T.C.A. Cheng [18]	Measures for Evaluating Supply Chain Performance in Transport Logistics.	SCOR	To research construction, and develop measurement instruments for supply chain performance (SCP) in logistics transportation	2010

Each process has performance metrics that are obtained through the SCOR approach. Factors affecting the assessment of the performance of logistics transportation of Indonesian Railways, Ltd. Co. can be identified as a performance attribute. These performance attributes are obtained through identified and measured

sub-processes listed in SCOR. Because this research focuses on cement products that have been produced and stored in warehouses (Assemble-to-Order), all sub-processes involved are related to the transportation logistics business process. The logistics transportation SCOR performance measure matrix can be mapped as follows:

Table 4. SCOR Performance Measurement Matrix for Logistics Transportation

Logistics Transportation Process	Measurement Criteria/attributes	Performance Indicators
Internal-facing/Transportation Services (*Variable*: *Efficiency of transportation services*)	Cost	Total logistics management costs Value-added productivity Return processing fee
	Assets/asset management	Cash-to-cash cycle time The length of time lasts with the existing supply of tools/materials. Asset changes
Customer-facing (Recipient of the goods) (*Variable*: *Effectiveness for receipt of goods*)	Receiver Reliability	Admissions performance Acceptance fulfillment performance Fulfillment of perfect/complete admission
	Flexibility & Responsiveness/agility	Supply chain/receipt response time Production/service flexibility

3.6. ***Data Analysis Methods***

The data analysis method used in this study is structural equation model (SEM) analysis with *partial least square* (SEM-PLS) to analyze the influence between variables. The software used for SEM PLS analysis is the SmartPLS 4.0 program [19].

SEM PLS is a multivariate statistical method to test a series of influences between variables that are estimated simultaneously with the aim of prediction, exploration or development of structural models. Evaluation in SEM PLS includes outer model measurement model, inner model, and hypothesis testing. The measurement model or outer model describes [19] indicators that make up latent variables. The tests carried out to evaluate the outer model are Validity and Reliability tests. The Validity Test is carried out to test whether the indicators in a study really measure the construction in question. The Validity Test is carried out by looking at loading factor latent variable constructor. A high loading factor (>0.70) reflects a strong correlation in the items that make up the latent variable. Once all measurement items have loading factor ≥0.70, then a reliability test is carried out with an inspection Composite reability (CR) and Average variance extracted (AVE). Value composite reability acceptable is >0.70, the item is consistent and reliable in measuring a variable. The next evaluation of the research model is the measurement of [20] discriminant validity which can be seen from three criteria, namely Fornell-lacker criterion, Cross loadings and Heteroit Monotrit Ratio (HTMT). Next, the preparation of the inner model if the reliability and validity tests have been completed. *Inner Model* i.e. R- test square (R2). Next, a hypothesis test was carried out using a procedure bootstrapping (resampling) with type *two-tailed* is a statistical technique used to test whether a hypothesis in research can be accepted or rejected based on the data obtained [21]

3. RESULT AND DISCUSSION

The performance of the supply chain management of corporate freight transportation of the Dynamix brand cement and coordinating with the receipt warehouse of Solusi Bangun Indonesia, Ltd. by Indonesian Railways, Ltd. Co. can be measured through descriptive analysis. Based on the results of processing the percentage value of the weight in each indicator used as a benchmark to group performance into two categories, namely efficient and inefficient as follows.

Table 5. Descriptive statistics of the variable efficiency of transporting cement corporate goods by Indonesian Railways, Ltd. Co.

Indicator	n1	n2	n3	N4	ntotal	RII	Weight	Information
X1	1	10	20	25	181	0.808	80.80%	Efficient
X2	1	10	29	16	172	0.768	76.79%	Efficient
X3	0	17	22	17	168	0.750	75.00%	Efficient
X4	2	8	17	29	185	0.826	82.59%	Efficient
X5	2	5	37	12	171	0.763	76.34%	Efficient
X6	2	3	22	29	190	0.848	84.82%	Efficient
X7	1	5	21	29	190	0.848	84.82%	Efficient
X8	1	9	36	10	167	0.746	74.55%	Efficient

Note: X1 = reduce order costs, X2 = reduce facility costs, X3 = reduce warehousing costs, X4 = reduce transportation costs, X5 = reduce logistics administration costs, X6 = increase facility utilization, X7 = increase cash amount, X8 = increase net asset change, RII = relative importance index

Based on the results of statistical analysis, it shows that in the variable of efficiency in transporting cement corporate goods by Indonesian Railway, Ltd. Co. consisting of X1-X8 is relatively efficient. Thus, Seeking to increase the change in net assets (working capital) is classified as efficient by 84.82%.

Table 6. Descriptive statistics of service effectiveness variables for Dynamix brand cement distributors in Yogyakarta

Indicator	n1	n2	n3	N4	ntotal	RII	Weight	Information
Y1	1	3	32	20	183	0.817	81.70%	Effective
Y2	1	3	13	39	202	0.902	90.18%	Effective
Y3	2	5	39	10	169	0.754	75.45%	Effective
Y4	2	3	9	42	203	0.906	90.63%	Effective
Y5	1	4	36	15	177	0.790	79.02%	Effective
Y6	1	5	11	39	200	0.893	89.29%	Effective
Y7	0	5	38	13	176	0.786	78.57%	Effective
Y8	2	4	12	38	198	0.884	88.39%	Effective
Y9	1	6	23	26	186	0.830	83.00%	Effective

Note: Y1 = fulfilling the promise to the consignee, Y2 = solving the consignee's problem, Y3 = performing services for the consignee, Y4 = providing services at the promised time, Y5 = keeping the consignee's record, Y6 = telling the estimated time of arrival, Y7 = providing fast service, Y8 = willingness to help the consignee, Y9 = timely response, RII = relative importance index

Based on the results of statistical analysis, the service effectiveness for Dynamix cement distributors in Yogyakarta, measured by Y1-Y9 indicators, is classified as effective. Thus the timely response to the consignee's request (e.g. transshipment arrangements) is classified as effective at 83.00%.

*3.1. **Model Measurement outer model***

The validity convergen test was used to prove that the statements on each latent variable in this study could be understood by the respondents in the same way as the researcher intended. Convergent Validity is carried out by looking at reliability items (validity indicators) indicated by the value of the loading factor. Loading factor is a number that shows the correlation between the score of a question item and the score of the indicator construct indicator that measures the construct.

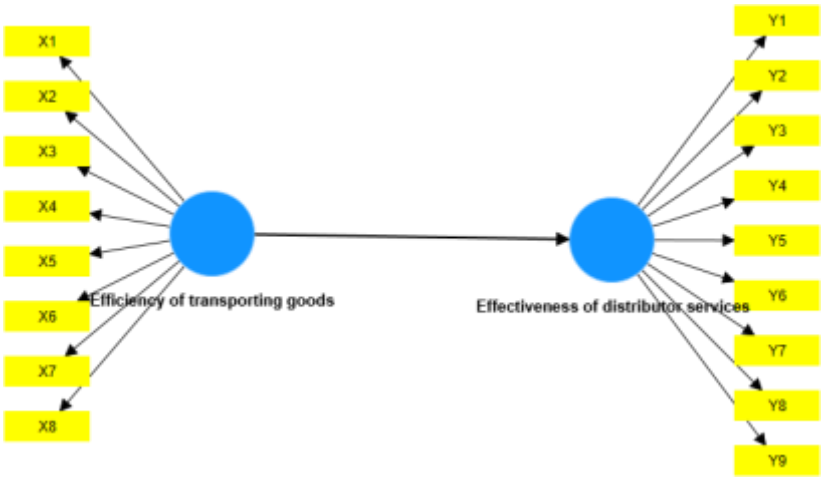

Figure 2. Loading factor results

Based on the results in the figure above, it is known that each of the research variable indicators has an outer loading value of > 0.5. The data above shows that the variable of distributor service effectiveness in the Y1 – Y9 indicator has an outer loading value of > 0.5 so it is considered valid. In the variable of the efficiency of transporting goods on the X1-X8 indicator, the outer loading value > 0.5 so it is classified as valid. According to Hair et al (2014), the indicators that make up the latent variable are classified as valid if they have an outer loading value of more than 0.70. However, the indicators that make up the latent variable that have an outer loading value of 0.4-0.6 can also be grouped into valid items, if the average variance extracted and composite reliability values meet the requirements for the latent variables, namely the average variance extracted is more than 0.50 and *the composite* reliability value is more than 0.70.

3.2. ***Discriminant Validity***

The validity test of discrimination was used to prove that the statements on each latent variable were not confused by respondents who answered the questionnaire based on questions on other latent variables.

Table 7. Average Variance Extracted

	Average variance extracted (AVE)
Effectiveness of distributor services	0.576
Efficiency of transporting goods	0.538

Based on the results of the validity analysis through the average variance extracted indicator on the distributor service effectiveness variable of 0.576, while on the variable of freight transportation efficiency is 0.538. Thus all variables have an AVE value of > 0.50 so that all variables are classified as valid.

Table 8. Discriminant Validity (Fornell-Larcker Criterion) and squareroot Average Variance Extracted

	Effectiveness of distributor services	Efficiency of transporting goods
Effectiveness of distributor services	**0.690**	
Efficiency of transporting goods	0.599	**0.662**

Based on the results of the analysis, it shows that each indicator has the largest FLC value in its own latent construct compared to the FLC value in other constructs. This explains that the indicators used in this study have good discriminant validity in shaping their respective variables. When viewed from the value of the AVE root (*bold*) also has a greater value in the construct compared to the value of other variables. This value shows that the variable is classified as valid and there is no indication of collinearity in the variable.

Table 9. Cross loading values

	Effectiveness of distributor services	Efficiency of transporting goods
X1	0.479	**0.647**
X2	0.387	**0.637**
X3	0.385	**0.534**
X4	0.500	**0.639**
X5	0.524	**0.640**
X6	0.590	**0.747**
X7	0.688	**0.714**
X8	0.549	**0.713**
Y1	**0.566**	0.460
Y2	**0.601**	0.397
Y3	**0.643**	0.549
Y4	**0.798**	0.577
Y5	**0.732**	0.650
Y6	**0.673**	0.560
Y7	**0.608**	0.417
Y8	**0.819**	0.709
Y9	**0.682**	0.466

Based on the data presentation in the table above, it can be seen that each indicator in the research variable has the largest cross loading value in the variable it forms compared to the cross loading value in other variables. Based on the results obtained, it can be stated that the indicators used in this study have good discriminant validity in compiling their respective variables. From the results of cross loadings, all indicators are highly correlated with each of their components. Cross loading describes how strongly the indicators affect each latent variable (construct).

*3.3. **Reliability analysis***

The Reliability Test was carried out with the aim of finding out the research instrument item, in this case the research questionnaire used for the tool in this study. A measuring tool or instrument in the form of a questionnaire is said to be able to provide stable or constant measurement results, if the measuring tool is reliable or reliable. Composite Reliability is an index that shows the extent to which a measuring instrument can be trusted to be reliable. Data that has a composite reliability of > 0.7 has high reliability.

Table 10. Composite reliability

	Composite reliability
Effectiveness of distributor services	0.877
Efficiency of transporting goods	0.861

Based on the results of reliability analysis through the composite reliability indicator on the distributor service effectiveness variable of 0.877, while on the variable of freight transportation efficiency is 0.861. Thus all variables have a CR value of > 0.70 so that all variables are classified as reliable.

The reliability test with the above composite reability can be strengthened by using Cronbach's alpha value. A variable can be declared reliable or meets cronbach's alpha if it has a cronbach's alpha value > 0.7. The classification of reliability categories using Cronbach's alpha indicator is as follows: (1) a scale of 0 – 0.2 is categorized as very unreliable, (2) 0.21-0.41 is categorized as unreliable, (3) 0.42-0.60 is categorized as moderately reliable, (4) 0.61-0.80 is categorized as reliable, and 0.81-1.00 is categorized as highly reliable. The following are Cronbach's alpha values of each variable:

Table 11. Cronbach's alpha values

	Cronbach's alpha
Effectiveness of distributor services	0.839
Efficiency of transporting goods	0.817

Based on the results of reliability analysis through Cronbach's alpha indicator on the distributor service effectiveness variable of 0.839 or categorized as very reliable, while on the variable of freight transportation efficiency of 0.817 or categorized as very reliable. Thus, all variables have a Cronbach's alpha value of > 0.80 so that all variables are classified as very reliable.

*3.4 **Inner model measurement model***

After testing the outer model that has met the requirements, the next test is carried out on the inner model (structural model). The Inner Model defines the relationship between latent constructs by looking at the results of estimating the parameter coefficients and their level of significance [21]

The structural model (inner model) is a pattern of research variable relationships. The evaluation of the structural mode is by looking at the coefficients between variables and the value of the determination coefficient (R2). The value of R2 is close to 1, with the criterion of limiting the value divided into 3 classifications, according to chin the value of the r-square is categorized as strong if it is more than 0.67, moderate if it is more than 0.33 but lower than 0.67, and weak if it is more than 0.19 but lower than 0.33, as well as very low when it is less than 0.19. The R-square value can be seen in the following table: [23]

Table 12. R-Square Values

	R-square	R-square adjusted
Effectiveness of distributor services	0.639	0.632

Based on the table, it can be seen that the R-square value of the endogenous variable of distributor service effectiveness is 0.639 or 63.6% or is relatively strong. Thus, it shows that the efficiency model of transporting goods in influencing the effectiveness of distributor services by 63.6% while the other 36.4% is influenced by other factors that are not observed in the study.

*3.5. **Hypothesis Tests***

After testing *the outer* model and *inner model* that have met the assumptions in the SEM analysis, it is continued to test the hypothesis.

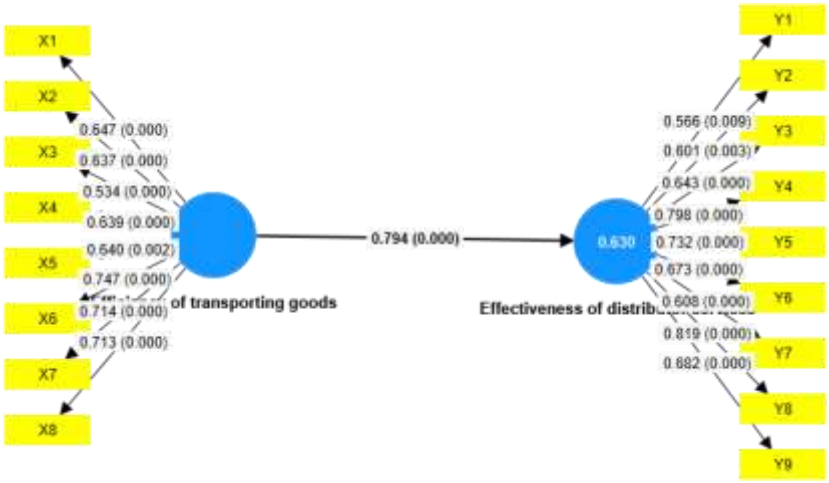

Figure 3. Bootstrapping test results

Table 13. Results of the Direct Influence Hypothesis Test

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Efficiency of transporting goods -> Effectiveness of distributor services	0.794	0.804	0.061	12.993	0.000

Based on the results of the analysis on the hypothesis test, it shows that the efficiency of transporting goods has a positive effect on the effectiveness of distributor services by 0.794. The hypothesis is accepted because it has a p value of 0.000 or < 0.05 and a statistical t value of 12,993 or > 1.96 so that the efficiency of transporting cement corporate goods by Indonesian Railways, Ltd. Co will increase the effectiveness of distributor services at Solusi Bangun Indonesia, Ltd. by 79.4%. The practical implications for stakeholders from the hypothesis result that the efficiency of transporting cement corporate goods by Indonesian Railways, Ltd. Co. will increase the effectiveness of distributor services at Solusi Bangun Indonesia, Ltd. by 79.4%. When viewed as the highest efficiency of transporting goods, namely in the X5 indicator (Management reduces logistics administration costs (for example, building good relations with related organizations, such as customs, commodity inspection bureaus, port authorities) with a coefficient value of 0.747, then X6 (Management seeks to increase the utilization rate of facilities/equipment/labor in providing services) with a coefficient value of 0.714, and X8 (Trying to increase asset changes net (working capital) with a coefficient value of 0.713. While the most effective effectiveness of distributor services is found in the Y8 indicator (Willingness to assist the recipient of goods (e.g. suggesting inland routing) with a coefficient value of 0.81), then Y4 (Providing services at the promised time to the consignee (e.g. cargo availability) with a coefficient value of 0.798, and Y5 (Keeping accurate records of the consignee (e.g., error-free records of the consignee's address) with a coefficient value of 0. 732.

*3.6. **Implications of findings and recommendations***

One of the main advantages of railways in transporting cement is the efficiency of its carrying capacity. Trains are able to transport much larger quantities than other modes of land transportation, such as trucks. This provides a significant advantage especially in meeting large-scale demands in the construction sector, which requires a large and timely supply of materials. In addition, the railway mode is relatively more environmentally friendly because the carbon emissions produced per ton of transported goods are lower than fossil fuel-based land transportation modes. This aspect is becoming increasingly important amid increasing awareness of environmental sustainability in logistics activities. The results of the questionnaire from Karangtalun - Cilacap Station and Lempuyangan Station Yogyakarta show that most of the questionnaire numbers are in the efficient category. This indicates that the entire supply chain performance at this station has met the expectations of respondents.

To maintain performance at Karangtalun Station, strategic steps are needed which include:[24]

1. Strengthening Operational Management: Developing an integrated operational management system to ensure the smooth logistics process.
2. Proactive Customer Approach: Adopt a service strategy that focuses on customer needs to improve their satisfaction.

These steps are expected to maintain the perception of respondents by always being categorized as efficient. One of the identified advantages is performance consistency. A high total score on several numbers indicates that the operational process is running stably and planned.

The effect of efficient performance is customer satisfaction. Respondents gave a positive assessment of the services at Lempuyangan Station and Karangtalun Cilacap Station which included timeliness, coordination effectiveness, and ease of access to services.

Based on the results of the analysis, there are several strategic opportunities that can be implemented to improve service quality, especially in the context of transporting cement by Indonesian Railways, Ltd. Co.

These opportunities include adjusting operating schedules, digitizing monitoring systems, and developing station infrastructure [25].

In addition, scheduling that is more responsive to customer needs can speed up delivery, especially to meet the urgent demands of distributors or large construction projects. These adjustments can also improve customer satisfaction by minimizing unnecessary delays. This step requires a thorough evaluation of demand patterns, resource availability, and coordination with related parties, such as distributors and other logistics operators. With a planned approach, adjustments to the operating schedule can have a significant positive impact on service efficiency and customer perception of the company's performance.

In addition, along with the development of technology, digitalization is one of the main solutions to improve operational efficiency and customer experience. One of the important opportunities is the implementation of a real-time tracking system for the delivery of goods. This system allows distributors to monitor the location and condition of shipments directly through a digital platform. With information transparency, customers will feel more confident in the services provided. They can predict the arrival time of goods more accurately, so that operational planning on their side can be done better. The system can also reduce complaints caused by lack of communication or inaccurate information regarding the status of shipments. The implementation of digitalization requires investment in technological infrastructure, such as tracking sensors, web-based platforms or applications, as well as training the workforce to operate the system. However, its long-term benefits include increased efficiency, reduced operational errors, and increased customer satisfaction and loyalty. Real-time monitoring systems can also assist management in analyzing operational patterns and identifying potential problems before they become major obstacles [26]

3.7. ***Challenges and solutions***

Although the analysis showed a positive relationship between delivery speed and customer satisfaction levels, some respondents expressed a desire for the delivery process to take place more frequently. This challenge needs to be a major concern because the frequency of delivery is one of the main indicators in assessing the quality of logistics services. As a solution, increasing the frequency of goods delivery can be a strategic step to increase the number of goods transported, especially on routes with high transportation volumes. Thus, it is necessary to optimize operational time, such as rescheduling the departure and arrival of freight trains, so as to reduce waiting time. These steps are expected to be able to answer the needs of customers who prioritize punctuality and speed in transportation services [27].

Although most respondents stated that the transportation service was quite effective, there were still respondents who were not satisfied with the consistency of service performance. This variation in effectiveness levels indicates that there is room for improvement, especially when it comes to maintaining consistent service standards across all operational aspects of receiving goods. The solution that can be implemented is to improve the competence of human resources through training and staff development, both on the side of Indonesian Railways, Ltd. Co and distributors. This training can be focused on improving skills in logistics management, communication, and coordination between parties involved in the distribution process. Thus, the effectiveness of the service can be improved overall, which will ultimately increase customer satisfaction and trust in the rail transportation mode.

4. CONCLUSION

Based on the results of the research on the performance of the supply chain management of cement corporate goods transportation at Indonesian Railways, Ltd. Co. Cilacap – Yogyakarta operating area, there are several conclusions that can be drawn as follows: This study shows that the effectiveness of goods receipt services by distributors is reflected in more than 70% of respondents who stated that goods receipt services are classified as effective. The effectiveness of distribution services can be seen through the attributes of reliability as well as from the attributes of responsiveness or agility to customers. Meanwhile, the efficiency of transportation performance by Indonesian Railways, Ltd. Co. has proven to be efficient, both contributed from cost attributes and asset utilization attributes. This study also shows the results of the influence of transportation efficiency

performance on the effectiveness of goods receiving services by cement distributors in Yogyakarta by 0.794 or an effect of 79.4%.

5. REFERENCES

[1] A. M. Arief, katadata.co.id, 14 April 2022, [Online], Available: https://katadata.co.id/tiakomalasari/berita/6257e3d6d3f74/volume-angkutan-barang-kai-naik-14-4-didorong-permintaan-batu-bara?page=2.

[2] A. Brown, Supply Chain Coordination and Quality Management, Journal of Global Logistics, 15(3), 2021, 213-229.

[3] M. Davis, Technology Integration in Logistics, International Journal of Transportation, 22(4), 2018, 189-205.

[4] R. Jones, Regulatory Compliance in International Transport, Global Logistics Review, 18(2), 2020, 154-170

[5] J. Lee, Inventory Management Practices in the Cement Industry, Logistics Today, 10(1), 2017, 78-90.

[6] S. Miller, Sustainability in Corporate Logistics, Environmental Logistics Journal, 25(5), 2022, 301-317.

[7] T. Smith, Transportation Modes in Cement Logistics, Journal of Transport Economics, 14(3), 2019, 97-112

[8] Owo, Neraca, 28 September 2012, [Online], Available: https://www.neraca.co.id/article/19685/investasi-kian-meningkat-produksi-semen-ditargetkan-naik-7-di-2013. di update.

[9] Directorate General of Railways, Railways in Numbers, Central Jakarta: Directorate General of Railways, Ministry of Transportation, 2022.

[10] R. R. Chotimah, B. Purwanggono, and A. Susanty, Measurement of Supply Chain Performance Using SCOR and AHP Methods in the Urea Fertilizer Bagging Unit of PT. Dwimatama Multikarsa Semarang.

[11] Yuniaristanto, N. Ikasari, W. Sutopo, and R. Zakaria, Performance Measurement in Supply Chain Using SCOR Model in the Lithium Battery Factory, in IOP Conference Series: Materials Science and Engineering, IOP Publishing Ltd, Nov. 2020. doi: 10.1088/1757-899X/943/1/012049.

[12] A. Mutakin and M. Hubeis, Performance Measurement of Supply Chain Management, 89, 2011.

[13] D. B. Pamungkas and A. M. Azis, Performance Optimization of Special Vehicle Supply Chain Case Study at PT Pindad (Persero) Bandung, 20(2), 2022, 131-142.

[14] R. Indriani, R. Darma, Y. Musa, and N. Tenriawaru, Supply Chain Performance of Cayenne Pepper in Gorontalo, Indonesia, 2019, [Online], Available: http://excelingtech.co.uk/.

[15] T. Herdian, Marketing Strategy, Competitiveness and Logistics Performance at the Domestic Vehicle Terminal at Patimban Port, Journal of Transportation & Logistics Systems, 2 (2), 2022, Available: https://journal.itltrisakti.ac.id/index.php/jstl.

[16] I. K. Sriwana, N. Hijrah S, A. Suwandi, and R. Rasjidin, measuring supply chain performance using supply chain operations reference (SCOR) in ud. Ananda JISI: Journal of Industrial System Integration, 8(2), 2021, yogurt: 10.24853/GC.8.2.13-24.

[17] K.H. Lai, E. W. T. Ngai, and T. C. E. Cheng, Measures for evaluating supply chain performance in transport logistics, 2002, [Online]. Available: www.elsevier.com/locate/tre.

[18] F. Alamsjah, Howto cite: Wistin, Firdaus Alamsjah, Analysis of Supply Chain Management with the Supply Chain Operation Reference (Scor) Method of PT Fourmi Asha Sejahtera, analysis of supply chain management with the supply chain operation reference (SCOR) method of PT Fourmi Asha Sejahtera, 5(2), 2024, Available: https://fourmi.co.id/.

[19] J.F. Hair, Partial Least Squares Structural Equation Modeling Based Discrete Choice Modeling: An Illustration In Modeling Retailer Choice. Business Research, 12(1), 2019, 115-14.

[20] J.F. Hair, J.J. Risher, M. Sarstedt, C.M. Ringle, when to use and how to report the results of PLS-SEM. European Business Review, 31(1), 2019, 2–24. https://doi.org/10.1108/EBR-11-2018-0203.

[21] J.F. Hair, F. Hult, G. T. M. Ringle, C. M. Sarstedt, M. Danks, N. P. Ray, Partial least squares structural equation modeling (PLS-SEM) using R: A workbooK, In Springer (2021).

[22] I. H. L. Ghozali, Concepts, Techniques, Applications Using Smart PLS 3.0 for Empirical Research. BPFE, 2015.
[23] W. Chin, the partial least squares approach for structural equation modelling, 1998.
[24] B. M. Beamon, Measuring supply chain performance, 1999. doi: 10.1108/01443579910249714.
[25] D. M. Lambert, M. C. Cooper, Issues in Supply Chain Management, 2000, [Online], Available: http://www.CLM1.org.
[26] R. E. Indrajit, R. Djokopranoto, Purchasing and Supply Management Strategy of Chai, 2011.
[27] J. Heizer, J. H. Jones Professor, Operations management. Salemba empat, 2014, [Online]. Available: http://www.penerbitsalemba.com.

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How to cite/reference this article: Musthafa Iqbal Aziz, Eko Pujiyanto, Muhammad Hisjam, Evaluation Supply Chain Efficiency and Effectiveness in Cement Freight: A Case Study of Indonesian Railways, *Asian. Jour. Social. Scie. Mgmt. Tech*. 2025; 7(1): 111-124.