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SCOR Based Performance Analysis of Supply Chain Management in Construction Projects

I Dewa Ayu Winda Ari Pramesti[1], Gusti Ayu Putu Candra Dharmayanti[2], Anak Agung Diah Parami Dewi[3]

apramestiwinda@gmail.com[1], candra_dharmayanti@unud.ac.id[2], anakagungdewi@unud.ac.id[3]
Department of Master Civil Engineering, Udayana University, Bali, Indonesia

ABSTRACT

The construction industry heavily relies on highly efficient supply chain management (SCM) to ensure project success, minimize costs, and guarantee timely delivery. This study evaluates the supply chain performance of a construction project at PT. Bingkai Langit Construction, which experienced material procurement constraints. The objective is to measure performance using the SCOR 12.0 framework and formulate improvement strategies. Using a descriptive analysis method, this study evaluates five SCOR indicators: Reliability, Responsiveness, Agility, Cost, and Asset Management. Data were collected through observations and questionnaires from 37 respondents, analyzed using the Frequency Index method, and finalized via a Focus Group Discussion (FGD) with the strategic management team. The results show an overall "Good" performance score of 76.8%. Individual indicators scored: Reliability (79.73%), Cost (77.70%), Responsiveness (76.13%), Agility (75.45%), and Asset Management (75.00%). To address weaknesses in asset management and agility, priority strategies include implementing Just-In-Time (JIT) delivery for structural materials, optimizing heavy equipment utilization, reducing material waste, and aligning logistics schedules.

Keywords: Supply Chain Management; SCOR; Performance Evaluation; Construction Project.

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Correspondence Author:

Gusti Ayu Putu Candra Dharmayanti
Civil Engineering, Faculty of Engineering,
Udayana University,
Jl. P. B. Sudirman, Denpasar 80232
Email: candra_dharmayanti@unud.ac.id

1. INTRODUCTION

The construction industry is characterized by high complexity, involving numerous stakeholders, tight schedules, and extensive material flows [1]. Effective Supply Chain Management (SCM) is critical for overcoming these challenges and achieving optimal project performance [2]. Inefficient SCM often leads to project delays, cost overruns, and quality issues, particularly concerning structural construction technicalities such as reinforcement bar calculations and technical drawing interpretations [3]. Therefore, measuring and analyzing supply chain performance is essential for identifying bottlenecks and implementing continuous improvement strategies [3]. This research focuses on evaluating the supply chain performance of PT. Bingkai Langit Construction, a firm actively engaged in various building projects. Preliminary observations have indicated potential inefficiencies within the company's operations, specifically regarding material procurement, inventory management, and project execution timelines [4].

To address these issues systematically, a robust performance measurement framework is required. The Supply Chain Operations Reference (SCOR) model is globally recognized as a standard diagnostic tool

for SCM, integrating business processes, metrics, benchmarking, and organizational design into a comprehensive, cross-functional framework [5]. However, while numerous studies have successfully applied the SCOR framework within the manufacturing sector, its application in the construction industry remains limited. This presents a significant research gap, particularly regarding the adaptation of SCOR to the specific operational variables of construction contractors. This study aims to bridge this gap by utilizing SCOR variables to analyze the SCM performance of PT. Bingkai Langit Construction. The primary objective is to map existing supply chain processes, measure performance using established SCOR indicators, and formulate actionable SCM improvement strategies. The novelty of this research lies in delivering a customized, data-driven performance baseline tailored specifically to the operational dynamics of PT. Bingkai Langit Construction, providing the company with a practical tool to optimize its construction supply chain operations.

2. RESEARCH METHOD

This research employs a quantitative descriptive research design to analyze SCM performance. To provide a clear and systematic overview of the methodology, the step-by-step execution of this study is illustrated in the research flowchart presented in Figure 1. The research procedures are chronologically divided into three phases: conceptual mapping using the SCOR framework, data acquisition, and data analysis. The SCOR model was utilized to define the SCM processes into five core management processes: Plan, Source, Make, Deliver, and Return [6]. Data acquisition involved primary data collection through structured questionnaires designed based on the identified SCOR performance measurement indicators as shown in Table 1, which were measured using a four-point Likert scale.

A purposive sampling technique was used to select 37 respondents, targeting stakeholders who are directly involved in the supply chain processes at PT. Bingkai Langit Construction. The participants encompass a wide range of roles critical to supply chain operations. This includes 13 respondents involved in procurement and logistics (comprising a Logistics Manager, Site Logistics staff, and Suppliers); 10 respondents handling strategic project and supply-chain decision-making (such as the Technical Director, Construction Managers, Site Managers, and Planning/Control Managers); and 14 respondents focused on project execution and technical monitoring (including Site Supervisors, Schedule Monitoring Engineers, a Quantity Surveyor, and project administrators). This diverse composition ensures that the collected data accurately reflects a comprehensive understanding of the supply chain dynamics, encompassing strategic planning, material procurement, and on-site execution.

Data testing and analysis were performed using Microsoft Excel as the primary processing tool. The responses from the participants were tabulated and calculated to produce the Frequency Index (FI) percentages, which serve as the core metric for evaluating performance levels across different supply chain variables.

Table 1. SCOR Performance measurement indicators

Code	Dimension	Operational Definition
X1	Reliability	The Supply chain ability to fulfill project requirements on time, in the correct quantity and with the required quality.
X2	Responsiveness	The speed of the supply chain in responding to material/project requests.
X3	Agility	The supply chain ability to adopt to changes in demand or disruptions.
X4	Cost	Cost efficiency in supply chain activities.
X5	Asset Management	The effectiveness of asset and inventory management.

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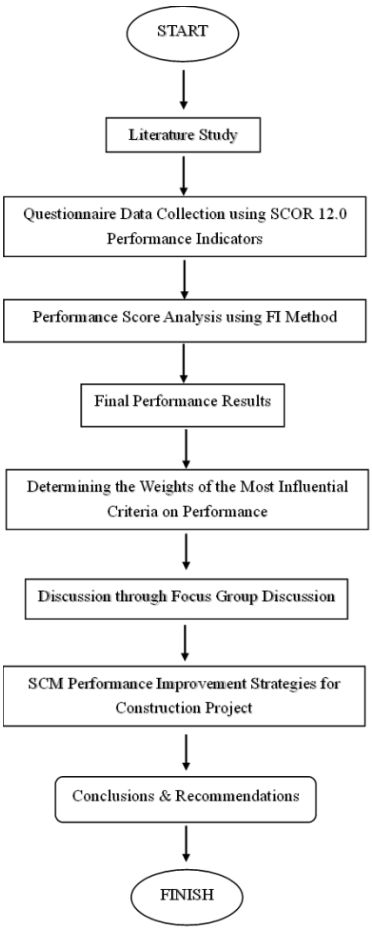

Figure 1. Research Flowchart

2.1. Research Instrument Testing

2.1.1. Instrument Validity Testing

The validity test in this study utilized construct validity testing. With a degree of freedom (df = N - 2) of 35 (37 respondents minus 2) and a significance level (α) of 5%, the critical r-table value is 0.334 [17]. Following the evaluation of all items, the validity test results are summarized in Table 2.

Table 2. Questionnaire Validity Test Results

Reliability			
Dimension/Item	**Calculated r**	**Critical r**	**Status**
X1a	0.808	0.334	VALID
X1b	0.793	0.334	VALID
X1c	0.813	0.334	VALID
X1d	0.844	0.334	VALID
Responsiveness			
Dimension/Item	**Calculated r**	**Critical r**	**Status**
X2a	0.761	0.334	VALID
X2b	0.766	0.334	VALID
X2c	0.721	0.334	VALID
Agility			
Dimension/Item	**Calculated r**	**Critical r**	**Status**
X3a	0.843	0.334	VALID
X3b	0.743	0.334	VALID
X3c	0.819	0.334	VALID
Cost			
Dimension/Item	**Calculated r**	**Critical r**	**Status**
X4a	0.799	0.334	VALID
X4b	0.696	0.334	VALID
X4c	0.640	0.334	VALID

Asset Management			
Dimension/Item	**Calculated r**	**Critical r**	**Status**
X5a	0.840	0.334	VALID
X5b	0.841	0.334	VALID
X5c	0.758	0.334	VALID

Based on the validity test results, all questionnaire items distributed to the 37 respondents were declared valid.

2.1.2. Instrument Reliability Testing

The reliability of the questionnaire was evaluated using a one-shot measurement method, which assesses internal consistency by measuring the correlations among all survey items. Statistical testing was conducted using Cronbach's alpha (α). A construct or variable is considered reliable if it yields a Cronbach's alpha coefficient exceeding 0.70 (α > 0.70). The reliability test results are summarized in Table 3.

Table 3. Questionnaire Reliability Test Results

Cronbach's Alpha	N of items
0.956	16

The reliability test across all 16 valid items yielded a Cronbach's alpha coefficient of 0.956. Because this value exceeds the threshold of 0.70 (α > 0.70), the questionnaire instrument is confirmed to be highly reliable.

2.2. Research Instrumentation

Frequency Index (FI) represents one of the most widely used descriptive statistical methods within construction management, civil engineering, and supply chain management research. The objective of this method is to quantify the frequency rate or "how often" a particular event or factor arises, based on the respondents' perceptions [7]. Within quantitative studies, FI is applied to rank distinct factors such as delay causes, risks, or supply chain constraints allowing researchers to identify the most prevalent factors in the field [8]. The operational steps for calculating the Frequency Index (FI) are outlined below:

$$FI = \frac{a1.x1+a2.x2+a3.x3+a4.x4}{4(x1+x2+x3+x4)} x100\% \quad (1)$$

Where:

a = constant rating from one to four
xi = respondent's rating

With the following Likert scale: 1 = "bad", 2 = "fair, 3 = "good", 4 = "excellent".
The classification scale for the Frequency Index (FI) results is categorized as follows:

0% ≤ FI ≤ 20% = "Poor"
20% ≤ FI ≤ 40% = "Bad"
40% ≤ FI ≤ 70% = "Fair"
70% ≤ FI ≤ 90% = "Good"
90% ≤ FI ≤ 100% = "Excellent"

Following the analysis of the questionnaire survey data to determine the mode values and identify the most influential relationships among the variables, Supply Chain Management (SCM) improvement strategies were formulated through a structured Focus Group Discussion (FGD). Representing the strategic management team, the FGD involved eight key personnel: the Technical Director, Project Planning Manager, Project Control Manager, Construction Manager, Logistics Manager, Site Manager, Site Supervisor, and Site Logistics personnel. The session was conducted over a 90-minute duration, guided by open-ended questions addressing strategies to enhance the five Supply Chain Operations Reference (SCOR) indicators. A consensus-building process through brainstorming and open discussion was utilized until a unanimous agreement was reached. The detailed outcomes and formulated strategies from the FGD are presented in Subsection 3.2.

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3. RESULTS AND DISCUSSION

3.1. SCOR Performance Measurement Results

The data that collected from quisioner survey is presented in Table 4, encompassing the five variable items: reliability, responsiveness, agility, cost, and asset management. These results were obtained by applying equiation number (1). The recapitulation of the questionnaire results, based on the FI calculations for all respondents, is as follows:

Table 4. Recapitulation of FI Percentage Results from all respondents

No	Respondents ID	Variable Item				
		Reliability	Responsiveness	Agility	Cost	Asset Management
1.	Respondent 1	100%	100%	100%	100%	100%
2.	Respondent 2	68.75%	75%	75%	75%	75%
3.	Respondent 3	81.25%	83.33%	75%	91.67%	75%
4.	Respondent 4	68.75%	66.67%	66.67%	58.33%	66.67%
5.	Respondent 5	50%	58.33%	66.67%	66.67%	58.33%
6.	Respondent 6	100%	100%	100%	100%	100%
7.	Respondent 7	100%	83.33%	83.33%	83.33%	100%
8.	Respondent 8	81.25%	83.33%	91.67%	91.67%	100%
9.	Respondent 9	75%	66.67%	66.67%	91.67%	91.67%
10.	Respondent 10	81.25%	75%	91.67%	75%	83.33%
11.	Respondent 11	68.75%	66.67%	66.67%	75%	75%
12.	Respondent 12	87.5%	58.33%	75%	75%	75%
13.	Respondent 13	100%	100%	83.33%	58.33%	75%
14.	Respondent 14	87.5%	83.33%	100%	75%	75%
15.	Respondent 15	25%	50%	33.33%	66.67%	33.33%
16.	Respondent 16	100%	75%	66.67%	83.33%	50%
17.	Respondent 17	62.5%	50%	75%	75%	66.67%
18.	Respondent 18	50%	41.67%	50%	33.33%	33.33%
19.	Respondent 19	100%	100%	83.33%	83.33%	91.67%
20.	Respondent 20	81.25%	75%	75%	75%	75%
21.	Respondent 21	50%	58.33%	50%	66.67%	75%
22.	Respondent 22	100%	91.67%	91.67%	100%	100%
23.	Respondent 23	75%	83.33%	75%	83.33%	83.33%
24.	Respondent 24	31.25%	58.33%	41.67%	41.67%	58.33%
25.	Respondent 25	75%	83.33%	75%	75%	58.33%
26.	Respondent 26	62.5%	50%	66.67%	58.33%	50%
27.	Respondent 27	75%	66.67%	75%	75%	75%
28.	Respondent 28	75%	66.67%	50%	58.33%	58.33%
29.	Respondent 29	93.75%	83.33%	91.67%	83.33%	91.67%
30.	Respondent 30	93.75%	58.33%	66.67%	83.33%	66.67%
31.	Respondent 31	81.25%	100%	100%	100%	100%
32.	Respondent 32	93.75%	100%	58.33%	66.67%	66.67%
33.	Respondent 33	87.5%	83.33%	75%	83.33%	83.33%
34.	Respondent 34	93.75%	91.67%	91.67%	100%	75%
35.	Respondent 35	100%	100%	100%	100%	83.33%
36.	Respondent 36	93.75%	75%	75%	83.33%	83.33%
37.	Respondent 37	100%	75%	83.33%	83.33%	66.67%
Average (%)		79.73%	76.13%	75.45%	77.7%	75%

Overall, the performance of the five variables falls within a relatively stable range, spanning from 75% to 79.73%. The ranking from highest to lowest is as follows:

a. Reliability: Holds the highest rank with an average of 79.73%, indicating that the reliability aspect is perceived as the strongest point by the respondents.
b. Cost: Ranks second with an average of 77.7%.
c. Responsiveness: Obtains an average score of 76.13%.
d. Agility: Records an average of 75.45%.
e. Asset Management: Registers the lowest average value at 75%, indicating that the asset management aspect requires more attention for further improvement.

Generally, the evaluation results fall into the 'Good' category, as all scores are above the 70% threshold. However, PT. Bingkai Langit Construction needs to prioritize improvements in Asset Management, which has the lowest score compared to the other indicators, in order to achieve a balanced performance across all FI dimensions.

3.2. SCM Performance Improvement Strategies

Based on the SCM performance evaluation results explained in Subsection 3.1, it can be seen that, in general, the Supply Chain Management (SCM) performance falls into the "Good" category (average > 70%). However, there are performance improvement opportunities that can be formulated into the following strategies:

1. Top Priority: Improving Asset Management (75%)
   This sector demands capital turnover efficiency and physical material management in the field to prevent assets from becoming a project liability.
   a. Just-In-Time (JIT) Implementation for Structural Materials: The delivery of high-volume materials, such as reinforcement bars (rebar) and cement for foundation work, should be precisely aligned with the daily schedule. This prevents on-site accumulation, which risks weather damage and strains the cash-to-cash cycle.
   b. Material Waste Reduction: Establish clear SOPs regarding the collection of usable steel rebar offcuts, scrap cables, or formwork timber. These materials can be resold to scrap collectors or recycled for small-scale internal projects (salvage value), thereby turning a waste burden into a cash flow inflow.
   c. Equipment Utilization Optimization: Strictly monitor the operational hours of heavy equipment. If utilization is low, utilizing a daily rental option is more recommended than bearing the depreciation and maintenance costs of self-owned assets.

2. Strengthening Agility (75.45%)
   Agility ensures that the project does not stall and can instantly maneuver when external disruptions occur.
   a. Supplier Network Diversification: Prepare pre-qualified second-tier vendors and subcontractors. If the primary supplier experiences production constraints, the project can immediately shift orders without sacrificing the scheduling critical path.
   b. Procurement Contract Flexibility: Utilize contract schemes that allow for rapid adjustments in material volume if there are changes in shop drawings or unexpected site conditions.

3. Enhancing Responsiveness (76.13%)
   The speed of responding to urgent needs and technical constraints determines the smoothness of daily operations.
   a. Integrated Procurement Approval Flow: Streamline the internal bureaucracy among the field execution team, warehouse, and purchasing division. Platform-based communication will shorten the lead time for urgent material orders.
   b. Logistics Schedule Synchronization: Build proactive communication with suppliers regarding the estimated time of arrival (ETA) of materials, ensuring the field team is ready for unloading without disrupting worker productivity in other areas.

4. Maintaining Cost (77.7%) and Reliability (79.73%)
   The highly appreciated performance in these two indicators must be strictly safeguarded to prevent any decline while the company implements efficiency measures in other sectors.
   a. Strategic Sourcing / Long-Term Partnerships: Secure efficient material pricing (Cost) and delivery schedule certainty (Reliability) by locking in strategic collaborations with suppliers who have a proven track record.
   b. Consistent Quality Inspections: Continue strict quality control protocols upon material receipt. Ensuring that the accepted goods comply with technical specifications will prevent unexpected cost overruns caused by rework.

Aligning these five SCOR dimensions will shift the company's supply chain management orientation from a mere procurement function into an operational advantage. Effectively controlled Asset Management will directly provide wider financial and operational room to maneuver, allowing the project to be completed effectively.

4. CONCLUSION

This study concludes that the supply-chain performance of PT. Bingkai Langit Construction is generally categorized as Good. The overall performance achieved an average score of 76.8%, driven by strong reliability (79.73%) and efficient cost management (77.70%). However, agility (75.45%) and asset

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management (75.00%) emerged as the lowest-performing indicators, reflecting constraints in adapting to changing field conditions and inefficiencies in on-site material inventory management.

To address these operational bottlenecks, several practical implications and improvement strategies are recommended. The company should implement Just-In-Time (JIT) delivery for high-volume structural materials, such as reinforcement bars and cement, to prevent site accumulation and alleviate cash-to-cash cycle burdens. Furthermore, establishing Standard Operating Procedures (SOPs) to monetize or recycle usable construction scrap alongside optimizing heavy equipment utilization through targeted rentals rather than bearing owned-asset depreciation will significantly enhance asset efficiency and overall supply chain flexibility.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

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BIOGRAPHIES OF AUTHORS

I Dewa Ayu Winda Ari Pramesti was born in Denpasar on December 08 1998, she received the Bachelor's degree in Civil Engineering from Udayana University, Indonesia. Her research interests are deeply rooted in advanced construction management methodologies. She is deeply passionate about the strategic aspects of construction management. Her research actively explores key project lifecycle elements, including innovative scheduling techniques, comprehensive cost control, and the broader supply chain dynamics required to maximize operational performance.
She can be contacted at email: apramestiwinda@gmail.com

Gusti Ayu Putu Candra Dharmayanti was born in Surabaya on 15 July 1973. She obtained a bachelor's degree in civil engineering in 1999 from the Department of Civil Engineering at Udayana University. She received her MSc in 2002 in project management from the UMIST (University of Manchester Institute of Science and Technology), UK, and a Ph.D. in 2013 in project management from QUT (Queensland University of Technology), Brisbane, Australia. She has written many papers concerning investment evaluation, quality, human resources, and risks of supply chain flow in building construction projects using Bali as the case study area. She is also interested in the research of logistics and supply chain.
Dr. Dharmayanti is a member of the Indonesian Engineers Association.
She can be contacted at email: candra_dharmayanti@unud.ac.id

Anak Agung Diah Parami Dewi is a lecturer in the Department of Civil Engineering, Faculty of Engineering, Udayana University, Indonesia. She received her Ph.D. in Civil Engineering with a specialization in Construction Project Management. Her research interests include construction project management, design-build procurement, risk management, sustainable construction, and lean construction. She has published articles in national and international peer-reviewed journals and has been actively involved in research and community engagement projects related to construction management and public infrastructure. In addition to her research activities, she teaches undergraduate and graduate courses in construction management, contract management, cost estimation, and project procurement. Her current research focuses on risk management frameworks for design-build project delivery systems and sustainable procurement strategies in infrastructure projects.
She can be contacted at email: anakagungdewi@unud.ac.id