Supply Chain Perfomance in Expedition Services Using The Supply Chain Operations Reference (SCOR) and Analytical Hierarchy Process (AHP) Methods

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ABSTRACT

The internet continues to evolve alongside the rapid advancements in information technology, which is one of the characteristics of the Fourth Industrial Revolution (Industry 4.0) that influences the transformation of business processes from conventional methods to e-commerce. Expedition services are a key player in the Supply Chain Management (SCM) process, making a significant contribution to e-commerce as providers of goods delivery services. Currently, the expedition service industry is growing rapidly, largely driven by the expansion of online business or e-commerce. This paper discusses the supply chain (SC) performance in the expedition service sector, considering that the topic of SC performance in this sector still requires further development. The research uses the SCOR model to measure SC performance based on five key processes: plan, source, deliver, return, and enable. Performance indicator weighting is conducted using the AHP method. Based on the data analysis, it was found that the SC performance value is 82.53%, which falls within the "average" category. The highest weight was found in the "deliver" performance metric at 50.44%, while the lowest performance value was observed in the "enable" metric at 6.33%.

1. INTRODUCTION

The Internet continues to evolve alongside the rapid advancement of information technology, which is one of the main characteristics of the Fourth Industrial Revolution. This development also impacts the transformation of business processes, which have shifted from conventional methods to e-commerce. Transactions in e-commerce are conducted indirectly, where consumers and companies interact and transact through virtual platforms [1] [2]. [1] argue that a company's success, including in e-commerce, is highly influenced by the presence of an effective and efficient Supply Chain Management (SCM) system. SCM encompasses all parties involved in meeting consumer demands, both directly and indirectly. This aligns with the view of [1], who state that e-commerce can expand its business through an effective SCM network. The parties involved in SCM include suppliers, manufacturers, distributors, retailers, and supporting companies such as logistics service providers [3].

Expedition services, which are a part of logistics services, play a crucial role in [3] by making significant contributions to e-commerce as providers of goods delivery services. According to [4] [5], the demand for expedition services is currently growing rapidly, driven in part by the expansion of online businesses and e-commerce. Logistics processes are increasingly being outsourced to logistics service providers to handle various aspects such as warehousing, product delivery, and packaging [6].

Despite this growth, expedition services still face practical challenges that impact supply chain performance. These challenges include delivery delays due to traffic congestion and insufficient route optimization, inaccurate demand forecasting leading to overstocking or stockouts in sorting centers, and fluctuating operational costs. These practical issues underline the need for systematic supply chain performance measurement in the expedition sector to identify bottlenecks and areas for improvement.

Discussions on supply chain (SC) performance measurement have been extensively conducted by researchers across various fields using different methodologies. Performance measurement can be defined as the act of assessing the effectiveness and efficiency of a process [15] [16] [17]. According to [7], performance measurement involves evaluating various activities within a company's value chain. The complexity of the SC structure, with the involvement of multiple parties, can become a challenge when a company is unable to assess the SC performance of its business [18] [19] state that performance evaluation in SC should be conducted to achieve efficiency. Meanwhile, [7] emphasize that performance measurement serves as an approach for optimizing the SC network.

Supply chain (SC) performance measurement serves as a foundation for evaluating overall SC performance [20]. The results of SC performance measurement can provide information regarding the effectiveness of plan execution and facilitate adjustments to planning and control activities [7]. The primary objectives of SC performance measurement are to reduce costs, meet customer demands, increase company profitability, and achieve optimal SC performance [18].However, studies specifically focusing on SC performance in the expedition service sector remain limited. [7] measured SC performance in an electronics company using the Supply Chain Operation References (SCOR), Analytical Hierarchy Process (AHP), and Objectives Matrix (OMAX) methodss, focusing on the upstream SC aspect, particularly transportation and raw material storage. [8] conducted a literature review to identify supply chain performance indicators in e-commerce. [1] measured e-commerce performance from a logistics perspective. [9] examined SC performance measurement in e-commerce by considering financial dimensions, logistics capabilities, and information technology while validating the identified Key Performance Indicators (KPIs). [10] integrated the Balanced Scorecard (BSC) and SCOR methods in SC performance measurement, focusing on innovative product entrepreneurs as internal factors and government as an external factor. [11] identified aspects involved in SC using the Food Supply Chain Network (FSCN) method and measured SC performance in the coffee industry using the SCOR and AHP methods.

Kumar et al. [12] conducted a review highlighting the importance of sustainable supply chain management, utilizing digital technology to enhance supply chain performance, particularly in the Industry 4.0 era. This study proposed a framework for measuring sustainable performance, emphasizing the use of technologies such as the Internet of Things (IoT) and data analytics for operational efficiency. [13] researched relevant performance metrics for lean and agile supply chain strategies and validated a framework for performance measurement. These findings are particularly relevant for expedition services seeking to integrate lean and agile strategies to improve service efficiency and flexibility. [14] conducted a study utilizing machine learning in logistics and inventory management, demonstrating how machine learning techniques can be applied to enhance logistics efficiency. Their findings include a 15% improvement in demand forecasting accuracy, a 10% reduction in overstock, and 95% accuracy in delivery time prediction. These insights can be applied in the expedition sector to optimize SCM efficiency.

This study addresses the research gap in supply chain performance measurement within the expedition service sector, which still requires in-depth exploration. Furthermore, this paper investigates the performance scores of the SC in the expedition service sector to establish performance benchmarks that can serve as a basis for stakeholders in determining policies for SC performance improvement. This study employs the SCOR method to assess SC performance based on five key processes: plan, source, deliver, return, and enable. The weighting of performance indicators is conducted using the AHP method.

2. METHOD

This study was conducted at a branch of an expedition service company that operates with the following supply chain structure:

a. Shiper: individulas, small and medium entreprises (SMEs), corporations, and others.
b. Drop point/agnt: the point where goods are reveived and initial processes are performed, including data entry, labeling, and preliminary sorting.
c. Sorting center: goods are consolidated and sorted based on their destinations.
d. Intercity transportation: the main transportation mode that moves goods across regions.

e. Final sorting facility: goods are re-sorted according to delivery zones within the destination area.
f. Courier/las-mile delivery: final delivery of goods to the recipeint's address.
g. Receiver: The end customer who receives the goods.
h. Supporting systems: including tracking systems, support services, and other logistical infrastructure.

The research consists of three main stages: preliminary stage, data collection and processing stage, and analysis and conclusion stage. In the preliminary stage, a literature review, observations, problem formulation, and determination of research objectives were carried out.

The data was collected directly through observations, interviews, and questionnaire distribution. The questionnaires were distributed to two respondents, namely the inbound/outbound supervisor and the warehouse manager, considering that these positions have a deep understanding of the proposed SC performance indicators. To process the data, this study utilize the SCOR framework and AHP technique.

SCOR was developed in 1996 by the Supply Chain Council (SCC) and is defined as a technique used by companies to communicate effectively within the supply chain by describing, measuring, and evaluating SC configurations [21] [7]. From an operational perspective, SCOR focuses on SCM functions, including consumer interactions, market interactions, and physical transactions [22].

SCOR defines supply chain processes into five integrated processes: Planning (Plan), Procurement (Source), Production (Make), Distribution (Deliver), and Returns (Return) [7]. Additionally, SCOR includes general performance dimensions, namely Reliability, Responsiveness, Agility, Cost, and Asset Management Efficiency [20].

The process began by determining the SCOR matrix (Table 1) to be used, followed by calculating performance indicators for each attribute: Plan, Source, Deliver, Return, and Enable. The weighting of each level and performance score was calculated using the AHP method. AHP is a decision-making method [23] and a measurement theory used to determine ratio scales from paired comparisons, applicable to both discrete and continuous data [7]. AHP decomposes multi-criteria problems into a hierarchical structure [23]. By using a hierarchy, complex problems can be categorized into groups, forming a systematic and structured framework [4] [7]. Subsequently, the relative importance of elements is compared using a scale ranging from 1 to 9 [23].

Subsequently, the analysis and discussion stage was carried out based on the data processing results. Finally, conclusions were drawn to address the research problem formulation and objectives.

Table 1. SCOR Performance Metrics

No	SCOR Classification (Level 1)	Attribute (Level 2)	Metric (Level 3)
1	Plan	Responsiveness	Order fulfillment cycle time
		Reliability	Delivery planning
			Warehouse utilization
2	Source	Responsiveness	Package verification cycle time
		Reliability	Package receipt inspection
			% of packages received with complete shipping data
			Package cross-docking
		Agility	Customer collaboration
3	Deliver	Responsiveness	Package loading process
			On-time delivery
		Reliability	Delivery accuracy
			Undamaged packages
		Agility	Ease of access to package status information
4	Return	Responsiveness	Returned package handling
		Reliability	Average number of returned packages
5	Enable	Responsiveness	Delivery performance assessment
		Reliability	Shipping and document management information system

Table 2. Performance Value Standard

Performance Value	Criteria
95% – 100%	*Excellent*
90% – 94%	*Above Average*
80% – 89%	*Average*
70% – 79%	*Below Average*
60% – 69%	*Poor*
< 60%	*Unacceptable*

Source: Monczka et al. in [24].

3. RESULTS AND DISCUSSIONS

3.1 AHP Weighting

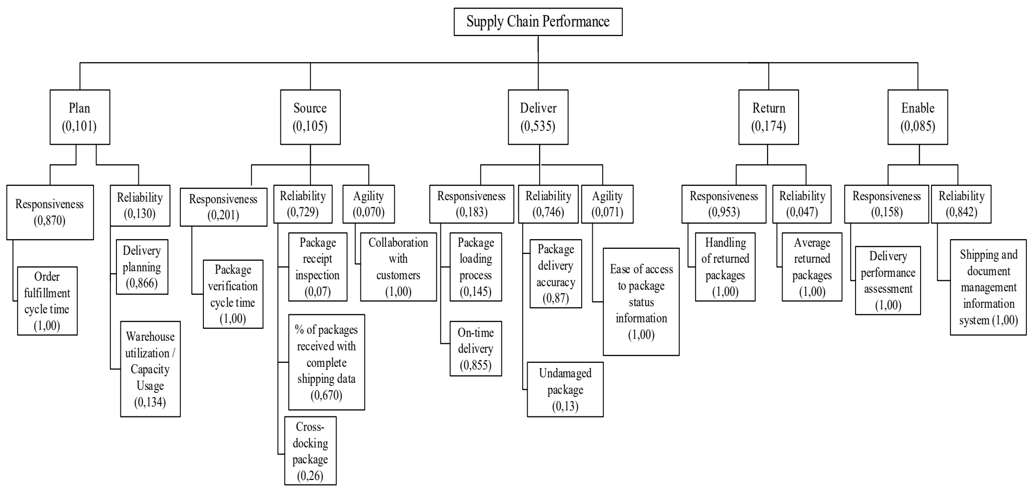

Figure 2. Hierarchy Structure of Supply Chain Performance Measurement in Expedition Services

AHP weighting is used to determine the importance level of each performance criterion. The data was obtained through questionnaire distribution to two respondents: the warehouse manager and the outbound/inbound supervisor at a logistics service company. Based on data processing results, the weighting for all levels of performance metrics was determined, as shown in Figure 1.

3.2 Performance Measurement

Supply chain performance measurement involves the actual, minimum, and maximum scores, which are used to calculate the Snorm value. Table 3 presents the results of supply chain performance measurement based on the previously established SCOR performance metrics. Furthermore, to determine the level of supply chain performance, it is necessary to calculate the supply chain performance score, which is presented in table 4.

Table 3. Supply Chain Performance Measurement

No	Process	Performance Attribute	Attribute Weight	Performance Indicator	Indicator Weight	Actual Value	Min Value	Maks Value	SNORM	Performance Matrix Value	Total Performance Attribute Value
1	Plan	Responsiveness	0.87	Order fulfillment cycle time	1	89	0	100	89.00	89.00	89.00
2		Reliability	0.13	Delivery planning	0.866	0.75	0.5	1	50.0	43.30	50.00
3				Warehouse utilization (Capacity Usage)	0.134	3	1	5	50	6.70	
4	Source	Responsiveness	0.201	Package verification cycle time	1	45	10	60	30	30.00	30.00
5		Reliability	0.729	Package receipt inspection	0.07	94	0	100	94	6.58	99.58

6				% of packages received with complete shipping data	0.67	100	0	100	100	67.00	
7				Cross-docking package	0.26	100	0	100	100	26.00	
8		Agility	0.07	Collaboration with customers	1	44.35	0	100	44.35	44.35	44.35
9	Deliver	Responsiveness	0.183	Package loading process	0.145	1.5	0.5	2	33	4.79	90.29
10				On-time delivery	0.855	100	0	100	100	85.50	
11		Reliability	0.746	Package delivery accuracy	0.87	100	0	100	100	87.00	97.16
12				Undamaged package	0.13	78.16	0	100	78.16	10.16	
13		Agility	0.071	Ease of access to package status information	1	4	1	5	75	75.00	75.00
14	Return	Responsiveness	0.953	Handling of returned packages	1	3	1	5	50	50.00	50.00
15		Reliability	0.047	Average returned packages	1	8	0	100	92	92.00	92.00
16	Enable	Responsiveness	0.158	Delivery performance assessment	1	30	0	100	70	70.00	70.00
17		Reliability	0.842	Shipping and document management information system	1	4	1	5	75	75.00	75.00

Table 4. Supply Chain Performance Measurement

Process	Performance Attribute	Total Attribute Score	Attribute Weight	Attribute Score	Total Business Process Score	Business rocess Weight	Supply Chain Performance Score
Plan	Responsiveness	89	0.87	77.43	83.93	0.101	8.45
	Reliability	50	0.13	6.5			
Source	Responsiveness	30	0.201	6.03	78.62	0.105	8.26
	Reliability	99.58	0.729	72.59382			
	Agility	44.35	0.07	3.1045			
Deliver	Responsiveness	90.29	0.183	16.52216	94.33	0.535	50.44
	Reliability	97.16	0.746	72.48196			
	Agility	75	0.071	5.325			
Return	Responsiveness	50	0.953	47.65	51.97	0.174	9.06
	Reliability	92	0.047	4.324			
Enable	Responsiveness	70	0.158	11.06	74.21	0.085	6.33
	Reliability	75	0.842	63.15			
Total Performance Score							82,53

Based on Table 8, the Supply Chain Performance Score is 82.53%. This score indicates that the supply chain performance of the logistics service company falls within the Average category (Monczka et al, in [24]. The findings suggest that, overall, the company has been able to functionally execute its core supply chain process, although opportunities for improvement remain in several areas of its business operations.

One of the business process classifications that contributes the least to overall performance is the enable process, with a performance score of 6.33%. The low score in the enable process indicates the presence of improvement gaps in supporting supply chain functions such as integrated management of information and resources. Enhancing understanding of the enable process can be facilitated through collaborative approaches, such as end to end supply chain processmapping based on SCOR model [25]. Previous research by [26], demonstrated a positive influence of digital

transformation on information sharing, integration activities, and the competitive performance of the supply chain. Therefore, improving the enable process is crucial as a strategic step to enhance the overall effectiveness of the supply chain.

There are certain business process classifications that can be improved to achieve a better performance rating. One of the key areas for improvement is the Enable business process classification, as it has the lowest Supply Chain Performance score at 6.33%**.**

4. CONCLUSION

Based on the results of the supply chain performance assessment conducted at a logistics service company using the SCOR model and AHP to determine the weight of priority among five business process classifications: Plan, Source, Deliver, Return, and Enable, the overall supply chain performance score was 82.53%**,** which falls into Average category. The highest weight in the SCOR Level 1 performance metric was found in the Deliver process, accounting for 50.44%**,** indicating that delivery operations play a dominant role in overall supply chain performance. Conversely, the lowest performance score was observed in the enable process at 6.33%, suggesting significant opportunities for improvement in supporting functions such as information systems, human resource training, and digital process integration.

Thus, this study not only provides a quantitative overview of supply chain performance in the expedition service sector, but also presents an initial baseline that can serve as a reference for stakeholders in formulating strategies and policies for future supply chain performance improvement.

For future research, a more comprehensive supply chain performance evaluation model could be develop by integrating the SCOR framework with Balanced Scorecard (BSC) approach, particularly in the expedition service sector. This integration would allow performance to be assessed not only from an operational standpoint, but also from the perspectives of customers, finance, internal business processes, and organizational learning. Such integration is essential, as the dynamics of expedition services are strongly influenced by customer experience, service speed, technological adaptation, and human resource capabilities.

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