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Supply chain performance measurement on small medium enterprise garment industry: application of supply chain operation reference

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A B S T R A C T

In 2020, the textile industry contributed nearly 7% of Indonesia's gross domestic product. The garment industry is still dominated by small and medium enterprises (SMEs) among the textile products. Although these SMEs are considered one of the economic pillars in Indonesia, many challenges require strategical scale-up to improve their competitiveness. One of the aspects to be improved is supply chain performance, as the supply chain controls material, information, and financial flow from both supply and demand sides. This study seeks to measure and evaluate supply chain performance in the garment industry, focusing the case on small and medium-scale enterprises. The Supply Chain Operation Reference (SCOR) is used for Key Performance Index (KPI) determinants. Performance measurement starts by determining the criteria based on the performance measurement literature and expert opinion. Then, the weight of each criterion on the performance score is determined using the Analytical Hierarchy Process (AHP). Paired comparison questionnaires for the criteria weighting were distributed to experts, and the answers were analyzed. The final performance value is obtained by multiplying the weight with the normalized performance value using the Snorm-De Boer formula. This study obtained 23 indicators from five processes: plan, make, source, deliver, and return, with the final value of SCM performance classified as good. The result can evaluate the company's current condition and propose a strategy to improve its performance.

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1. INTRODUCTION

As one of Indonesia's most significant Gross Domestic Product (GDP) contributors to the non-oil and gas industries, the textile industry provides more than 3.7 million jobs for Indonesians [1]. Although it is expected that the overall textile industry in 2022 will rebound to the pre-Covid era, many challenges still exist. Indonesia's domestic textile and apparel industry cannot contend globally due to higher selling prices caused by high manufacturing costs [2]. Additionally, the lead-time between manufacturing and garment distribution is extensive. Domestic textile production can take up to 120 days, significantly longer than in other countries, where the lead time is only 60 days (0.5 times faster) [3]. It happened

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mainly in Small and Medium Enterprises (SMEs).

To maintain and improve customer satisfaction, many SMEs require strategical scale-up to improve their competitiveness. One effort can be made to enhance the supply chain (SC) performance. Supply chain management (SCM) can be one of the best solutions to increase competitive advantages [4], [5]. The competitive advantage of SCM is how companies can entirely manage the flow of goods in the supply chain [6]. Based on its business value chain, garment SMEs start with the existence of supply that is processed into the production of semi-finished raw materials, then finished and traded in the distribution channels, and finally for the consumption industry. An exceptional SC performance requires the company to perform well from suppliers to consumers [7], [8]. Performance measurement is required to ascertain the current state. Performance measurement is assessing a business process's effectiveness and efficiency [9]. The objective of SC performance measurement is to evaluate the supply chain network and identify which indicators require improvement, allowing for the formulation and immediate implementation of improvement strategies [10].

Supply chain performance can be assessed using several methodologies, including mathematical programming [11], [12], artificial intelligent [13], statistical [14], [15], fuzzy logic [16], [17], multi-criteria decision making (MCDM) [18], [19], and combination of several methods [20]. While these models have made significant contributions to the literature, they have some limitations and might not be used easily for SMEs' cases.

In this study, the Supply Chain Operations Reference (SCOR) model was used to assess supply chain performance in garment SMEs in Indonesia. As a conceptual model that can facilitate supply chain understanding, SCOR can decompose existing processes into metrics, allowing businesses to quantify process performance in detail and objectively using existing data and identifying areas for improvement [21]. Further, SCOR enables the assessment of reliability, responsiveness, agility, costs, and assets [22], [23]. This methodology has been used and applied in several cases, including in retail service [24], leather industry [25], housing [7], manufacturing [26], poultry [27], footwear industry [22], and automotive industry [28]. According to McCormack [29], the SCOR model generates a "scorecard" that can be used to track performance in the form of measurement metrics, which corresponds with the Analytical Hierarchy Process (AHP) procedure. Thus, this study also incorporated AHP to determine which performance characteristics are most critical to the business.

Compared to various other studies on the garment industry using SCOR, such as those conducted by Kuswandi et al. [30], Karami et al. [31], and Cruz et al. [32], the advantage of this study is the approach developed by the authors. The researchers' findings are based on 23 KPIs from [7], and it is anticipated that this approach can be used by other garment SMEs using the same KPIs and experiencing issues with one or more of these indicators. However, the study has some weaknesses. Since the interview and questionnaire were conducted online, it is conceivable that respondents did not comprehend the researcher's questions. Thus, further studies should consider this and evaluate it to gather the most accurate data possible. It is also vital to establish a plan that considers various aspects.

2. RESEARCH METHODS

The following sections describe the five stages conducted in this study. First, the supply chain structure from 5 processes (plan, source, make, deliver, and return) is plotted. Then, SC performance indicators are identified and designed. Third, indicators weight is being calculated using the AHP method. Fourth, the SC performance index is integrated. The final step is to formulate a strategy for improvement.

2.1. Data collection

This research collected data from garment SME located in Madura, Indonesia. This study has one respondent, the owner of the garment SME, where the study was conducted. Although this study only has one respondent, the knowledge perceived by the respondent as an owner is considered high since the respondent independently operates their business.

The data collected from our respondents is their validation and perceived importance of the indicators that have been selected. The interview process was conducted online. Once the data is collected, each indicator weight is calculated using the AHP method.

2.2. SC performance indicators and normalization calculation

From the five processes of the SC structure, we identified several indicators. These indicators have been validated by the garment SME's owner. Nevertheless, normalization is needed to equalize parameters because each indicator has a different weight and scale. The normalization of these performance indicators defines the level of performance fulfilment. Therefore, normalization is essential in achieving the final performance measurement [33], [34]. This normalization process uses the Snorm De Boer normalization formula as stated in equation (1). The same normalization process has been used in several studies related to SCOR, including Hasibuan et al [35], Yuniaristanto et al. [36], and Kuswandi et al. [30].

$$S_{norm} = \frac{(Si - Smin)}{(Smax - Smin)} \, x \, 100 \qquad (1)$$

In this measurement, the indicator weight is converted into a conversion of a specific value between 0 and 100. Zero (0) means the worst, and one hundred (100) means the best. Thus, the parameters of each indicator are the same [37]. Data collected is arranged to be a performance framework consisting of three levels. The first level is from SCOR metrics: reliability, responsiveness, flexibility, and cost. The second metric consists of several dimensions related to SCOR metrics. The third level indicates the Key Performance Indicator (KPI). The KPIs are adopted from the study of Handayani and Setyatama [7] and changed according to indicators used in the garment industry. Table 1 shows the selected metrics for each level and the indicators used for this study.

2.3. Analytical hierarchy process procedure

The weighting is carried out using the AHP method employing Expert Choice Software 11. The data used in the weighting is obtained from questionnaires distributed to garment SME stakeholders. The questionnaire contains pairwise comparisons between KPIs at level 1, level 2, and level 3 to determine the level of importance between KPIs. Consistency ratios (CR) are acceptable, since CR << 10% [38].

2.4. SC performance index calculation

After weighting using the AHP method, the final value of SCM performance is calculated. The calculation is performed by multiplying each normalization score derived from the Snorm De Boer normalization formula with the weights (W) of each metric listed in all levels ensued from the AHP procedure. The step for the SC performance index calculation is performed using the following equation (2), (3), and (4), respectively.

Table 1. SC performance key performance indicators

Process (Level 1)	Dimension (Level 2)	Key Performance Indicator (KPI) (Level 3)
Plan	Reliability	Meeting with customers (PR)
	Responsiveness	Production scheduling period (Pre-1)
		New product specifications identifying period (Pre-2)
	Asset	Cash to cash cycle time (PA)
Source	Reliability	Raw material defects (SR-1)
		Raw materials fulfilment (SR-2)
		Delivery reliability (SR-3)
	Responsiveness	Lead Time for raw materials (SRe)
	Flexibility	Supplier availability (SF)
	Cost	Order cost (SC)
	Asset	Daily supplies (SA)
Make	Reliability	Number of defective products (MR)
	Responsiveness	Manufacturing time (MRe-1)
		Custom order responsiveness (MRe-2)
	Flexibility	Flexibility in product manufacturing (MF)
	Cost	Production cost (MC)
	Asset	Machine average lifetime (MA)
Deliver	Reliability	Fulfilment rate (DR-1)
		Empty product level (DR-2)
	Responsiveness	Lead Time product (DRe)
Return	Reliability	Complaint level (RR)
	Responsiveness	Time to replace the damaged product (RRe)
	Cost	Cost to replace the product (RC)

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$$DV_j = \sum_i S_{norm}^i x W_i \quad (2)$$

$$PV_k = \sum_j DV_j \, x W_j \quad (3)$$

$$SCPI = \sum_k PV_k x W_k \quad (4)$$

With S_{norm}^i denoted the normalized value of KPI i, DV_j denoted the dimension value for dimension j, PV_k denoted the process value for process k, and $SCPI$ denoted the SC performance index of the study object.

First, the value of each KPI *i* is calculated by multiplying the normalization score with each KPI's weight. Next, each dimension value *j* is computed by summarizing all linked KPIs. Then, each process value *k* is calculated using the dimension *j* weight derived from AHP and multiplied by the dimension value. Last, SC Performance Index is assessed by multiplying the process *k* weight, and the process value *k* gathered from the prior calculation.

3. RESULTS AND DISCUSSION

The normalization calculation, based on Snorm De Boer's formula, is used to equalize the parameters of each key performance indicator (KPI). After obtaining the normalized score, AHP is used to weigh the importance of each level. According to the calculations, the process "deliver" has the highest weight at level one, at 0.452. Then comes "make," which weighs 0.263. The following priority order is "plan" (0.161), "source" (0.048), and "return" (0.077). The performance of each level is calculated by multiplying the normalized score by the weight obtained using AHP. Table 2 summarizes the recapitulation results of SCM performance in garment SMEs. As shown in the table, the total value of SCM performance is 84.521.

Table 2. The SCPI calculation

Process (*k*)	**Dimension (*j*)**	**KPI (*i*)**	**Normalize Score *i***	**Weight KPI (W_i)**	**Weight Dimension (W_j)**	**Weight Process (W_k)**	**SCPI**
Plan	Reliability	PR	94	1	0.101	0.161	
	Responsiveness	Pre-1	100	0.674	0.674		
		Pre-2	60	0.167			
	Asset	PA	67	1	0.226		
Source	Reliability	SR-1	100	0.258		0.048	
		SR-2	40	0.637	0.110		
		SR-3	50	0.105			
	Responsiveness	Sre	50	1	0.075		
	Flexibility	SF	100	1	0.248		
	Cost	SC	60	1	0.128		
	Asset	SA	50	1	0.439		
Make	Reliability	MR	100	1	0.422	0.263	**84.512**
	Responsiveness	Mre-1	80	0.125	0.102		
		Mre-2	75	0.875			
	Flexibility	MF	100	1	0.262		
	Cost	MC	100	1	0.054		
	Asset	MA	100	1	0.160		
Deliver	Reliability	DR-1	80	0.75	0.833	0.452	
		DR-2	60	0.25			
	Responsiveness	Dre	100	1	0.167		
Return	Reliability	RR	100	1	0.297	0.077	
	Responsiveness	Are	100	1	0.086		
	Cost	RC	100	1	0.618		

Table 3. Proposed strategies

Process	Dimension	KPI	Strategy
Plan	Reliability	Meeting with customers (PR)	Improve coordination with customers
	Responsiveness	Production scheduling period (Pre-1)	Understanding market conditions and customer demand
		New product specifications identifying period (Pre-2)	
	Asset	Cash to cash cycle time (PA)	Make a record of payment times regularly
Source	Reliability	Raw material defects (SR-1)	Increase supplier loyalty
		Raw materials fulfilment (SR-2)	
		Delivery reliability (SR-3)	Improve delivery time
	Responsiveness	Lead Time for raw materials (SRe)	
	Flexibility	Supplier availability (SF)	Increase inventory and add product variants
	Cost	Order cost (SC)	
	Asset	Daily supplies (SA)	Enhance payment timeliness
Make	Reliability	Number of defective products (MR)	Establish an efficient production schedule and expand production capacity
	Responsiveness	Manufacturing time (MRe-1)	Improve product quality
		Custom order responsiveness (MRe-2)	
	Flexibility	Flexibility in product manufacturing (MF)	Increase the timeliness of production in accordance with the customer's agreement
	Cost	Production cost (MC)	Increase profits and minimize production costs
	Asset	Machine average lifetime (MA)	Maintain equipment regularly
Deliver	Reliability	Fulfilment rate (DR-1)	Increase the fulfilment of finished products
		Empty product level (DR-2)	Increase finished product stock
	Responsiveness	Lead Time product (DRe)	Shorten the lead time of finished products
Return	Reliability	Complaint level (RR)	Provide customer service
	Responsiveness	Time to replace the damaged product (RRe)	
	Cost	Cost to replace the product (RC)	Provide a budget for product replacement

Based on the result, we could see that the garment SME's current performance is reasonably solid but need improvement. Regrettably, this study concentrated on the SCPI calculation specific to garment SMEs and made no direct comparisons to ascertain the current state of the garment SMEs in general. In a study conducted by Kuswandi et al. [30], different KPIs are used for conducting the reverse logistics system in the leather garment industry. In the case of reverse logistics, the focus of the KPIs is to ensure that the return process can be monitored and recorded. Some of the KPIs from the study can also be used to evaluate the garment SMEs readiness to adopt reverse logistics. Another study by Permadi et al. [39] adopted SCOR to evaluate the performance of the clothing industry.

Nevertheless, their study focused on 14 KPIs and was later integrated with the Balanced Score Card. In their study, according to their make-to-stock production, the attributes used are limited to production reliability, cost, and agility. Although

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similar, these two studies have different KPIs and attributes due to the specific industry needs. Nevertheless, considering several of the KPIs selected for this study, we proposed several strategies for improving the SC's performance. The details of the proposed strategies are presented in Table 3.

According to the results, the KPIs that need to be improved immediately are related to the supplier since the supplier's quality and responsiveness value is relatively low compared with other KPIs. The need to improve their supplier loyalty is high. The owner could consider having multiple suppliers for the steady fulfilment of raw materials with better responsiveness. The selection of suppliers affects whole company performance, such as inventory management, production planning and control, cash flow requirements, and product quality, eventually its commercial value. Internally, the SME must also advance their production system to achieve better product quality and responsiveness.

4. CONCLUSION

This performance measurement enables businesses to evaluate the performance of their SCM performance indicators, requiring continuous improvement. SCOR performance measurement for fashion SMEs is based on five internal processes: plan, source, manufacture, deliver, and return, with 23 Key Performance Indicators (KPI). The final score of 84.512 indicates that, while SMEs still require improvements and strategies for continuous performance improvement, improvements are possible, particularly for indicators with low performance. Indicators that perform poorly can be improved to increase the achievement of the company's SCM targets. Additionally, businesses should monitor key performance indicators (KPIs) that indicate positive performance.

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