International Journal of Industrial Engineering & Production Research June 2024 Vol. 35, No. 2: 1-18
DOI: 10.22068/ijiepr.35.2.1985

RESEARCH PAPER

Measuring the Supply Chain Performance of a Manufacturing Industry with the Characteristics of a Shift of Role in the Global Supply Chain Using the Scor Model

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Received 21 January 2024; Revised 23 April 2024; Accepted 12 May 2024;

ABSTRACT

Ethiopia has made enormous efforts in the leather industry to gain manufacturing capabilities that can be scaled up to other sectors. Those efforts have resulted in the industry shifting its role from raw material supplier to producer of value-added products for the global supply chain (GSC). However, the industry has faced severe challenges in generating the expected revenue, utilizing capacity, and finally coping with the global competitive environment. Studies reveal that manufacturing firms tackle similar challenges by improving their supply chain performance (SCP). The challenges that appeared in the leather industry of Ethiopia could also be solved by improving its SCP. Nonetheless, there is a lack of study on the basic characteristics and SCP of the industry after it has shifted its role. The main objective of this study is, therefore, to measure the SCP to know where it stands using a bench mark and identify the elements that contribute considerably to the low overall SCP in order to lay the foundation for subsequent improvement. To achieve the research objective, data was collected from primary and secondary sources through a questionnaire, survey, observation, and focus group discussion. The data is analyzed using the supply chain operations reference model (SCOR version 12.0). Accordingly, the overall SCP is found to be 67.33%, suggesting an average rating as per the set benchmark. The source process is identified as the most influential element for the overall low SCP, with a percentage gap of 17.23%. Taking corrective action on the identified elements could help the industry overcome the existing challenges by improving its SCP.

KEYWORDS: *Supply chain performance; Performance measurement; Shift of role in GSC; Manufacturing firms; Leather industry; Developing countries.*

1. Introduction

Supply chain management is a new paradigm in the manufacturing industry, and manufacturing firms are applying it to enhance their supply chain performance [1]. In practice, manufacturing firms that have outperformed their supply chain performances are prevailing in the twenty-first century competition [2]. Subsequently, measuring supply chain performance with appropriate performance measurement systems has enticed the interest of researchers and business practitioners [2, 3], because "you cannot manage what you cannot measure" [4]. Realizing the overall performance of a supply chain is indispensable for a variety of reasons [5]. Primarily, performance measurement is the stage at which gaps are identified. To put it another way, evaluating the performance of a supply chain identifies the discrepancy between the expected and actual performance [3]. It assists in assessing the current state of company conditions and identifying the components that require attention and those with a high potential for business development [6]. According to Ref. [7], evaluating the performance of the entire supply chain is crucial since it allows for the "tracking and tracing" of efficacy and efficiency failures, resulting in better supply chain design decisions. Ref. [8] states that measurements

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serve three primary purposes: improvement, control, and communication. Control refers to the ability of managers and employees to assess and manage resource performance through measurements. When referring to communication, measurements are used to communicate performance to stakeholders both inside and outside the firm. Measurements that are clearly created and communicated will give the user the impression that they will know what has to be done. Whereas improvement is the ability to use measurements to find gaps between performance and expectations, that is how development should begin. Finally, overall performance measurement shall aid in the planning, design, implementation, and monitoring of proposed solutions [9].

However, measuring supply chain performance is not a straightforward process, and there are no readily available practical guidelines for companies and SCM practitioners [10]. Moreover, despite the fact that the basic principles of a supply chain are applicable to all businesses of varying sizes, the characteristics of a supply chain can vary from one another primarily depending on the kind of product, number of participants in the network, location of suppliers, technology, and operating environment [11]. Furthermore, a variety of circumstances lead the supply chains of manufacturing firms to be dynamic [12]. For instance, the supply chains of manufacturing firms in developing countries are dynamic in response to the constant pressure to manufacture more value-added products, as they have been involved in supplying raw materials or semi-processed products for a long time [13]. In some industries, they have succeeded in producing a significant volume of value-added products for the global supply chain [14]. The leather industry is a prime example of this kind [15].

The leather industry is one of the manufacturing industries that produces the most traded goods, such as footwear, clothes, gloves, bags, and other articles, for millions of consumers worldwide [16]. The reports of Grand View Research (GVR) indicate that the worldwide leather goods market was worth USD 404 billion in 2017 and is anticipated to reach USD 610 billion by 2025 [17]. Unlike other industries, the industry generates substantial economic value for the world by using meat processing byproducts such as skins and hides as major raw materials [18]. Moreover, the industry has assisted many countries in their transition to high-tech industries and industrialization, in spite of its low-tech characteristics [17]. For a variety of reasons, the industry's concentration has been shifted toward developing countries since the 1970s [19]. Gradually, the industry in developing countries has reached the capacity of producing around 60% of world leather demand [20]. Even the leather industries in countries known for supplying raw materials, like Ethiopia, Bangladesh, and Pakistan, have emerged as producers of value-added leather products for the global leather supply chain [18].

The development seen in the Ethiopian leather industry is connected to the government's perspective and subsequent implementation of new manufacturing strategies from the early 2000s, most notably in the 2010s [17]. It is perceived as one of the most important industries for Ethiopia's manufacturing development. Considering this perspective, an enormous amount of work has been carried out in the industry to develop manufacturing capabilities that can be scaled up to other manufacturing sectors [17]. The following evidence can help demonstrate the dynamics witnessed following the implementation of the manufacturing strategy: (i) Following the relaxation of restrictions on the tanning sub-sector, foreign firms have also engaged in the production of value-added products in the primary stage, before which it was secured only for the local firms [15]. (ii) The arrival of renowned leather and leather products manufacturing firms from around the world, owing mostly to the establishment of cutting-edge "plug and play" industrial parks, a first for Ethiopia [21]. (iii) About 83% of the large and medium-size tanneries with local ownership have moved to the next stage of value addition through the implementation of new business models and innovative approaches in response to the restriction of semi-processed product export [22]. The leather industry eventually succeeded in selling completed leather and consumer products such as footwear, leather garments, and high-quality gloves in the global market, switching over from raw materials and semi-processed products.

Although the Ethiopian leather industry has reached a turning point in its history, it has also faced unprecedented challenges. It has faced severe challenges in generating the expected revenue, utilizing the established capacity, and finally coping with the existing global competitive environment. As reviewed above, supply chain performance (the efficiency and effectiveness) of supply chains is the state-of-the-art weapon to ensure, increase, and enhance the competitiveness of manufacturing in the present manufacturing environment. The challenges observed in the leather industry of Ethiopia could also be tackled by improving the efficiency of the supply chain of the industry. Unfortunately, there is a lack of study on the basic characteristics and performance of the supply chain of the industry after it has made a shift in its role in the global supply chain. These circumstances have prompted us to pose a research question: how well the supply chain of Ethiopia's leather industry is currently operating in comparison to standard system metrics? The research question has helped to define the study's specific objectives, which include (i) measuring the industry's overall supply chain performance and (ii) identifying the elements that will have the most detrimental effect on the overall supply chain performance of the industry.

To achieve the objective of the research, both primary and secondary data are collected using different methods, including a survey, observation, questionnaire, and focus group discussion. The data is analyzed using the supply chain operations reference (SCOR) model and the analytical hierarchical process (AHP) in combination. The choice of the SCOR model over other models is for the following reasons: It allows for objective measurement of supply chain performance and can identify areas requiring improvement [23]. In doing so, the model first breaks down the entire supply chain into processes such as plan, source, make, delivery, and return [24, 25]. In addition, the model provides standard performance attributes like responsiveness, agility, reliability, and cost and key performance indicators (KPI) for each performance attribute [25]. However, the SCOR model has the limitation of making a pair-wise comparison among the supply chain processes and performance standards [26]. To overcome this limitation, this research employs the Analytical Hierarchal Process (AHP), a popular multi-criteria decision-making (MCDM) method [27], which is generally used to make subjective and objective decisions [28] using the decision-makers intuition, knowledge, and experience [29]. Precisely, the AHP is employed in this research to determine the relative relevance (weights) of the SCOR processes and performance attributes, which is a necessary condition to determine the contribution of each indicator to the overall performance of the supply chain. In the end, a benchmark is chosen to compare the overall supply chain performance in the leather industry of Ethiopia with respect to the best-performing supply chain systems.

This paper will immensely contribute to the body of knowledge by providing a perspective on the supply chain characteristics and SCP in the setup of the manufacturing environment of a developing country like Ethiopia with the characteristics of a shift in role in the GSC. More importantly, it will provide valuable insights for industrial practitioners on how to measure supply chain performance and identify the components that require the most attention. Finally, the paper's next sections are organized as follows: Section 2 provides an overview of theoretical concepts applied to measure supply chain performance. Section 3 describes the study methodology developed for this research, while Section 4 presents the results of the research. Finally, Section 4 provides the conclusions and recommendations.

2. Theoretical Concept on Performance measurement

The scientific studies [30-34] are among the early attempts that laid the groundwork for supply chain performance measurement. Precisely, the performance measurement approaches developed over time can be categorized into process-based, perspective-based, hierarchical-based, and others based on their shared characteristics. Process-based performance measurement approaches are concerned with determining the degree of integration of processes and activities from the supplier to the end customer [30, 33, 35]. The supply chain operations reference (SCOR) model, which aids in measuring performance across the five major supply chain processes: plan, source, make, deliver, and return [24], is the best example in this category [36-39]. On the other hand, the perspective-based measurement approaches take into account six possible supply chain perspectives, including operations research, systems dynamics, logistics, marketing, organization, and strategy. They also provide measures and metrics to assess each perspective [40]. Furthermore, there may be a trade-off among supply chain perspectives [41]. The most well-known model in this category is the balanced scorecard (BSC) model [24, 39, 40]. The third category of measurement approach is the hierarchical-based approach (HBA), in which the measurements are used to assess supply chain performance at three decision-making levels: strategic, tactical, and operational [39, 42, 43]. Additionally, the HBA measures the organizations' aims precisely. However, with such an approach, there is no clear direction to place the measures at multiple levels in order to reduce friction among the parties involved in the supply chain. Other performance measurement approaches are: dimension-based systems [44], interface-based systems [45], function-based systems [44], efficiency-based systems [46-52], generic performance systems [50-52] and any other approach that cannot be placed in the aforementioned categories.

The Balanced Scorecard (BSC) and the SCOR model are the two most widely used performance measurement models [42, 53], which are categorized under perspective-based and process-based approaches, respectively. The popularity of the BSC model can be attributed to its utilization of performance metrics from various perspectives: financial (such as manufacturing and warehousing costs), customer (such as order fill rates and on-time delivery), business process (such as manufacturing adherence to plan), and innovation and technology (such as new product development cycle time) [54]. By incorporating these various perspectives, the balanced scorecard assists companies in understanding the interrelationships and trade-offs of alternative performance metrics, resulting in better decision-making [54]. The Balanced Scorecard (BSC) does, however, have several limitations. It cannot evaluate overall performance and highlight under-performed KPI requirements [42, 55]. Furthermore, it is not an improvement tool; rather, it is designed as a monitoring tool to emphasize strategic level direction rather than functional or operational level [5, 24].

The SCOR model is the most often used paradigm for measurement as well as for improving supply chain performance when compared to the BSC model [54, 56]. Although the SCOR model has large applications in a variety of fields, it is mostly used in the manufacturing sector [57]. Its popularity and greater applicability could be attributed to its distinguishing characteristics over other models. It not only provides firms with the advantage of measuring supply chain performance objectively and in-depth based on existing data but also identifies the areas for improvement [23] with the following benefits [58]: (i) standard descriptions of management processes that comprise a supply chain; (ii) a framework of relationships among the standard processes; (iii) standard metrics to measure process performance; (iv) best-in-class management practices; and finally (v) standard alignment to software features and functionality that enable best practices.

Furthermore, the SCOR model has been constantly updated to keep pace with rapidly developing companies [59, 60] since the release of the original version in 1996 [23, 60]. The SCOR model 12.0, available under APICS membership, is one of the recent versions of the reference model, which was released in 2017 [61]. This latest model [25] describes the supply chains of different companies as plan, source, make, delivery, return, and enable, whether they are simple or complex. After simplifying the supply chains of companies into defined processes, the SCOR model facilitates performance measurement with standard performance attributes and key performance indicators. However, the basic performance attributes and key performance indicators have shown updates following constant changes to the model over time. The details of SCOR version 12.0 are presented in Table 1.

Tab. 1. The SCOR version 12.0 Performance attributes

Performance attribute	Description	Level 1 Strategic metric
Reliability	The ability to perform tasks as expected. Reliability focuses on the predictability of the outcome of a process. Typical metrics for the reliability attribute include: On-time, the right quantity, the right quality.	▪ Perfect Order Fulfillment (RL.1.1)
Responsiveness	The speed at which tasks are performed. The speed at which a supply chain provides products to the customer. Examples include cycle-time metrics.	▪ Order Fulfillment Cycle Time (RS.1.1)
Agility	The ability to respond to external influences, the ability to respond to marketplace changes to gain or maintain competitive advantage. SCOR Agility metrics include Adaptability and Overall Value at Risk	▪ Upside Supply Chain Adaptability (AG.1.1) ▪ Downside Supply Chain Adaptability (AG.1.2) ▪ Overall Value at Risk (AG.1.3)
Costs	The cost of operating the supply chain processes. This includes labor costs, material costs, and management and transportation costs. A typical cost metric is Cost of Goods Sold.	▪ Total Supply Chain Management Costs (CO.1.1) ▪ Cost of Goods Sold (COGS) (CO.1.2)
Asset Management	The ability to efficiently utilize assets. Asset management strategies in a supply chain include	▪ Cash-to-Cash Cycle Time (AM.1.1)

Efficiency (Assets)	inventory reduction and in-sourcing vs. outsourcing. Metrics include: Inventory days of supply and capacity utilization.	▪ Return on Supply Chain Fixed Assets (AM.1.2) ▪ Return on Working Capital (AM.1.3)

(Source: Ref. [25])With reference to Table 1, it is possible to notice how the SCOR model performance attributes and the key performance indicators have been updated. The attribute 'flexibility', which was used as a performance measure in previous SCOR versions, has been replaced by 'agility'. Subsequently, the performance indicators used to measure flexibility, such as upside supply chain flexibility (USCF) and downside supply chain flexibility (DSCF), have been replaced with upside supply chain adaptability and downside supply chain adaptability, respectively. Supply chain adaptability is defined as an increase in the maximum amount from the amount that is usually served in a sustainable way that can be done within 30 days [25]. Precisely, the metric addresses a company's ability to respond to an unplanned increase or decrease in demand. In contrast, upside supply chain flexibility or downside supply chain flexibility is defined as the number of days it takes to respond to a 20% increase or decrease in unanticipated product requests with no additional cost or service.

Despite being the most popular model for measuring supply chain performance, the SCOR model has limitations and cannot be used alone [54]. Some of its limitations are minimized by using it in combination with other decision-making tools like the analytical hierarchal process (AHP) [26]. The AHP is a widely used multi-criteria decision-making (MCDM) method [27] to make subjective and objective decisions [28] by taking into account the decision-makers' intuition, knowledge, and experience [29, 62]. In other words, the AHP is a method that allows for making decisions [63]. To apply the AHP for its intended purpose, a number of procedures are required, including defining criteria, creating a decision matrix, calculating priority vectors, running consistency tests, and calculating the final priority vectors. [64]. After the criteria are identified, the decision matrix is created by the pairwise comparison technique of the criteria with a predefined scale. The 1–9 ratio scale developed by Saaty is widely used in pair-wise comparison, as explained in Table 2 [65].

Tab. 2. Comparison scales

Importance	Definition	Explanation
1	Equally important	Compared alternatives contribute equally to the defined criteria.
3	Moderately important	The first factor is moderately important compared to the other to achieve the goal.
5	Quite important	The first factor is quite important compared to the other to achieve the goal.
7	Much more important	Factor 1 is very strongly important over the other.
9	Extremely important	The first factor is extremely important compared to the other.
2,4,6,8	Intermediate values	Used when compromise is needed.
Mutual Values	If the value of "x" is compared with the value of "i" and "j"; j will be (1/x) when comparing with i.	

(Source: Refs. [28, 66])

The decision matrix, or square matrix, created using the scale factors is then normalized. This is done by calculating the sum of a column's cell values and then dividing each cell value of that column by that sum. The next step is to determine the priority vector, which shows the importance levels of the factors. After doing this, the most important step is to conduct a consistency test. In real life, it is never possible for the decision-maker to make perfect judgments. Therefore, there are cases when some inconsistency may appear. The inconsistency problem is minimized by conducting a consistency test and adjusting the level of inconsistency. To be more specific, the consistency ratio (CR), which is the ratio of the consistency index (CI) to the random index (RI), is used to measure the decision consistency. The CR is determined step-by-step using the following formulas [27].

$$CR = \frac{CI}{RI} \quad \text{Eq. (1)}$$

$$CI = \frac{(\lambda_{max} - n)}{(n-1)} \quad \text{Eq. (2)}$$

$$\lambda_{max} = \frac{summation\ of\ EI\ values}{n} \quad \text{Eq. (3)}$$

$Where,\ \lambda_{max}:$ $is\ the\ largest\ eigenvalue\ of\ a\ decision\ matrix$

n: is the size of the decision matrix

RI: is the mean value of randomly derived pairwise comparison matrices based on n number

The eigen values (EI) are calculated by dividing the D column vector by the corresponding priority vector. The column vector D, in turn, is obtained from the matrix multiplication of the comparison matrix and the priority vector. Finally, the consistency ratio (CR) of having values of 10% or less is acceptable[27]. If it is not less than 10%, the decision-making process lacks consistency, and therefore the judgments should be revised [27].

3. Research Methodology

The study makes several assumptions and uses a number of steps to achieve the study's objectives. The methodology employed for this research is explained with the help of Figure 1 below.

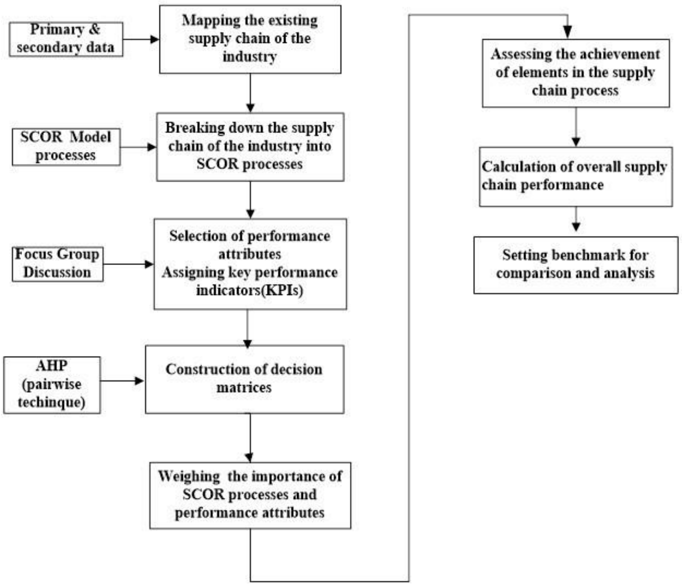

Fig. 1. Flow chart used to elaborate the research methodology

3.1. Mapping the supply chain of the industry

The first step involves mapping the supply chain of the leather industry based on empirical data from large and medium-sized firms in Ethiopia's leather industry after the industry has moved from providing raw materials to the production of value-added products. To do this, the country's large and medium-scale manufacturing firms were considered, including 34 tanneries, 24 shoe manufacturers, 22 garment producers, and 5 glove producers. This was accomplished through the use of a survey and questionnaires (Annex-1, Annex-2). In addition to this, secondary data (Annex-3, Annex-4, and Annex-5) were taken. The questionnaire analysis has helped identify six different types of supply chains in the leather industry in Ethiopia. Out of the six supply chains, the one depicted in Figure 2 has been identified as the predominately practiced supply chain in the industry. As a result, it is assumed to represent the nature of the Ethiopian leather industry's supply chain, which has changed its position in the global supply chain. The characteristics of this supply chain are detailed below.

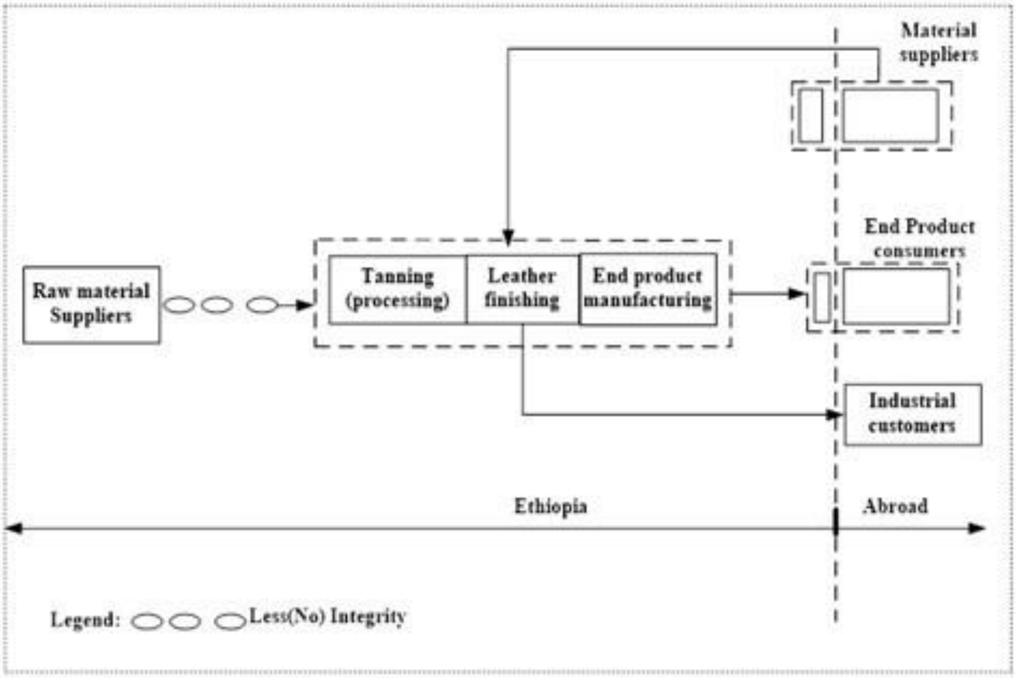

Fig. 2. The supply chain of the leather industry in Ethiopia after the shift in its roleIn the existing supply chain

Value-added products are produced in the following proportions: Completed leather accounts for 70% of the goods produced by the industry, while finished goods such as leather shoes, clothes, gloves, and other items account for the remaining 30%. Almost all of the finished leather is delivered to industrial customers in other countries for further processing. A large portion of the finished product is also sold to global consumers via world-class distributors. Only about 5% of the final product is consumed locally, as indicated by the smaller rectangle of consumers. The industry transforms the locally produced raw materials into the above products using different input materials, including varieties of basic and special chemicals and accessories and components. When measured in terms of material types, approximately 90% of the total input materials necessary for value addition, as represented by the large rectangle on the right side of the vertical line, are sourced from overseas supplier sources. Only 10% of the input material is sourced from local manufacturing industries. As depicted in Figure 2 above, the manufacturing firms in the leather industry of Ethiopia carry out all major operations, including tanning (processing), leather finishing, and end-product manufacture, without outsourcing. Such practice has been represented by coupling the major activities to show that they are operated by individual firms.

3.2. Breaking down the supply chain of the industry into SCOR processes

The purpose of this step is to represent the supply chain depicted in Figure 2 above in the SCOR processes, such as source, make, delivery, and return [24, 25] to facilitate supply chain performance measurement. The plan process has been disregarded since firms have a clear supply chain plan, despite the fact that their plan is being challenged by various circumstances. The SCOR processes are illustrated in Figure 3 below. The SCOR processes are illustrated in Figure 3 below. Details on the processes and assumptions are provided below.

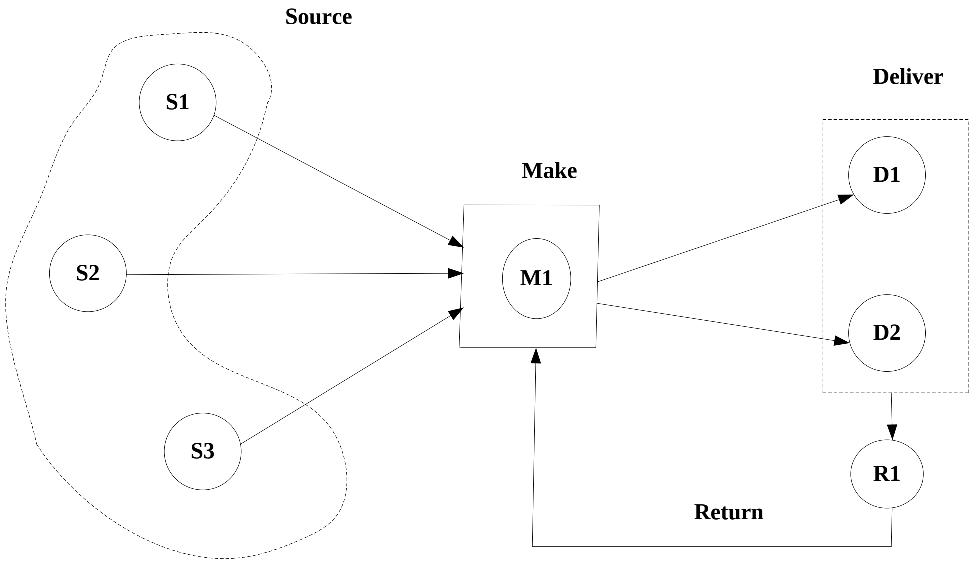

Fig. 3. The SCOR processes of the supply chain of the leather industry in Ethiopia

Source: Based on the results of the analysis of various questionnaires, the suppliers are divided into three categories: suppliers of raw materials (skin and hide) from the local market, designated by S1; suppliers of basic and specialty chemicals from both foreign and local markets in a 90:10% proportion, designated by S2; and suppliers of components, accessories, and packaging materials for end-product manufacturers such as footwear, garment, and glove manufacturers, designated by S3. It is sourced from both the international and domestic markets in a 95:5% proportion.

Make/manufacture: he make process is the conversion of raw material by carrying out value-adding procedures, such as tanning, leather finishing, and end product manufacturing, without using outsourcing, and it is assumed to be a single process as designated by M1. It can be considered a single process since the firms possess all the facilities needed for the complete value-adding process.

Delivery: The results of the survey revealed that the products are delivered to customers in two ways. One is by the Ethiopian airlines' cargo system, designated by D1, and the other is by land and sea shipment, designated by D2. The choice of airline cargo system has several justifying factors. Firstly, Ethiopian Airlines is the largest and leading cargo carrier in Africa. Secondly, the Ethiopian government encourages the cargo system with subsidies to compensate for the challenges that the conventional shipping systems face as a result of the country's landlocked location. Thirdly, Ethiopia is roughly located in the center of the G7 as well as BRICS countries, which gives manufacturing companies an edge over other countries when it comes to supply chains and marketing expenses. Finally, the products are lightweight and seasonal.

Return: The return process is designated as R1, which is equally significant as the other processes. Seasonal effects make leather goods, shoes, gloves, and clothing more sensitive. In addition, certain products are fashionable. Therefore, returns occur when the product is not delivered on schedule. Furthermore, a product return happens when the sample and the actual product do not match.

3.3. Selection of performance attributes and key performance indicators (KPIs)

After defining the industry's supply chain processes as above, the next step is selecting performance attributes from the SCOR model version 12.0 that are highly relevant in the Ethiopian context. This is accomplished with the focus group discussion (FGD) method. Seven experts from the Ethiopian Leather Industry Development Institute (LIDI), who have both theoretical understanding and real-world expertise, are used in the method. The performance attributes and corresponding key performance indicators (KPIs) selected by this method are provided in Table 3.

Tab. 3. The performance attributes and KPIs assigned by the FGD method

	Responsiveness	Agility	Reliability	Cost
Source	% on-time delivery	USCA	% scrap and rework	CGS
	average time of delivery	DSCA	% orders accepted	SCC
Make	% on-time delivery	USCA	% scrap and rework	CGS
	average time of delivery	DSCA	% orders accepted	SCC
Delivery	% on-time delivery	USCA	% scrap and rework	CGS
	average time of delivery	DSCA	% orders accepted	SCC
Return	% on-time delivery average time of delivery	USCA	% scrap and rework	CGS
				SCC

Note: USCA: Upside supply chain adaptability; DSCA: Downside supply chain adaptability; CGS: Cost of goods sold; SCC: Supply chain cost

Each cell represents the performance indicator. For example, if we take the cells in the first raw corresponding to the (source, responsiveness), (source, agility), (source, reliability), and (source, cost), it will indicate the following:
(i) The contribution of the source process to the responsiveness of the entire supply chain is measured by on-time delivery and average time of delivery;
(ii) The contribution of the source process to the agility of the entire supply chain is measured by upside supply chain adaptability and downside supply chain adaptability;
(iii) The contribution of the source process to the reliability of the entire supply chain is measured by scrap, rework, and orders accepted; and
(iv) The contribution of the source process to the total supply chain cost is measured by the cost of goods sold and the total supply cost.
The remaining cells are interpreted in the same way. After the performance indicators have been selected, the next step is to construct decision matrices for the SCOR processes and performance standards (metrics). The process is explained in the next step.

3.4. Constructing decision matrices

The same experts who participated in the prior step (Section 3.3) are used to construct the 4x4 decision matrix for the SCOR processes and SCOR performance standards. The 1–9 ratio scale developed by Saaty, which is the most widely used scale in pair-wise comparison as explained in Section 2, is used to construct the square matrices. The decision matrices generated this way are provided in Tables 4 and 5.

Tab. 4 . Decision matrix for the SCOR processes

	Source	Make	Delivery	Return
Source	1	5/2	7/2	9/2
Make	2/5	1	5/2	7/2
Delivery	2/7	2/5	1	5/2
Return	2/9	2/7	2/5	1

Tab. 5. Decision matrix for the SCOR performance standards

	Responsiveness	Agility	Cost	Reliability
Responsiveness	1	2	3	4
Agility	1/2	1	5/2	7/2
Cost	1/3	2/5	1	2
Reliability	1/4	2/7	1/2	1

3.5. Weighing the importance of the SCOR processes and performance attributes

In this step, the weights for the selected SCOR processes and SCOR performance attributes are calculated using the eigenvalue method. The consistency of decision analysis carried out using the Eq. 1, explained in Section 2 for the SCOR processes and SCOR performance attributes is 2.01% and 2.02%, respectively. It is known that consistency ratios (CR) of less than 10% are considered acceptable [27]. The consistency ratios obtained in our analysis are much less than 10%. This implies that the decisions made by the FGD method are consistent. Therefore, the weights displayed in Table 6 are taken as final values. Thus, it is possible to proceed to the next steps.

Tab. 6 . Final weights of the SCOR processes and performance standards

Process	Weight (%)	Performance standard	Weight (%)
Source	45.8	Responsiveness	49.7
Make	15.1	Agility	26.1
Delivery	30	Cost	16.3
Return	9.1	Reliability	7.9
CR	2.01%	CR	2.02%

3.6. Assessing the achievement of elements in the supply chain process

The purpose of this step is to find the actual achievements for each element of the supply chain in the leather industry as input for the next steps. This was accomplished by conducting rigorous evaluations in three rounds during the year 2019. The performance of three consecutive years, from 2016 to 2018, was used in the evaluation. The evaluation was supported by professionals from the Ethiopian Leather Industry Development Institute (LIDI), the Ethiopian Kaizen Institute, and the Ethiopian Leather Industry Association (ELIA). Table 7 provides a summary of the accomplishments.

Tab. 7. Achievements of the supply chain elements

	Responsiveness		Agility		Cost		Reliability	
Processes	On time delivery	Average delivery	USCA	DSCA	CGS	SCC	Rework	Orders accepted
S1	65	72	72	75	55	72	62.5	75
S2	35	48	40	43	78	70	73	80
S3	65	72	65	65	65	63	87.5	90
M1	73	78	78	86	88	83	87.5	85
D1	80	90	90	85	80	45	90	10
D2	65	72	75	55	68	65	75	62
R1	45	55	55	-	40	70	55	-

Note: USCA: Upside Supply Chain Adaptability; DSCA: Downside Supply Chain Adaptability SCMC: Supply Chain Cost; CGS: Cost of Goods Sold

3.7. Calculating the overall supply chain performance

In this step, the importance of 54 KPIs is first calculated using the following formula:

$$Importance\ of\ an\ indicator = \frac{Weight\ of\ a\ process * wieght\ of\ performance\ attribute}{number\ of\ indicators\ in\ a\ process * number\ of\ elements\ in\ a\ process}$$

Remember that the indicators allocated to the same performance attribute have the same importance[26]. This helps to save time on calculations. Next to this, the percentage contributions of each individual indicator are then determined using the following formula:

$$\%\ of\ contribution = improrance\ of\ an\ indicator \text{ x } achievements$$

Where the achievements are the actual achievements detailed in Table 7 in Section 3.6

The total supply chain is then obtained by adding the % contribution of all the KPIs.

Setting a bench mark for comparison and analysis

The final step in this methodology is to choose a benchmark that can assist in comparing the industry's overall supply chain performance. As a result, the metrics developed to assess the performance of systems are chosen as a benchmark. The performance metrics are shown in Table 8 below.

Tab. 8. Performance indicator

System Indicator	Performance indicator
<40	Poor
40-50	Marginal
50-70	Average
70-90	Good
>90	Excellent

(Source: Ref. [67])

Finally, the sum of all metric contributions determines the SC's overall performance. Therefore, the outcomes of implementing the aforementioned steps are presented in Results and Discussion.

4. Results and Discussion

Table 9 presents the industry's overall supply chain performance measurement using the prescribed research methodology. It includes the processes, performance priorities, and indicators for each supply chain element, along with their corresponding percentage of importance. As explained in Section 3, the sum of all metric contributions determines the SC's overall performance. Accordingly, the summing up of the percentage contributions of each performance indicator results in 67.33%.

Tab. 9. Result of the total supply chain performance measurement

Process	Performance	Element of SC	Indicator	Importance (%)	Measured (%)	%contribution of indicators(pp.)
Source	Responsiveness	S1	% on-time delivery	3.79	65	2.46
45.80%	49.70%		% average delivery time	3.79	72	2.73
	Agility		USCA	1.99	72	1.43
	26.10%		DSCA	1.99	75	1.49
	Cost		% CGS	1.24	55	0.68
	16.30%		%SCC	1.24	72	0.89
	Reliability		% scrap and rework	0.61	62.5	0.38
	7.90%		% orders accepted	0.61	75	0.46
	Responsiveness	S2	% on-time delivery	3.79	35	1.33
			% average delivery time	3.79	48	1.82
	Agility		USCA	1.99	40	0.80
			DSCA	1.99	43	0.86
	Cost		% CGS	1.24	78	0.97
			% SCC	1.24	70	0.87
	Reliability		% scrap and rework	0.61	73	0.45
			% orders accepted	0.61	80	0.49
	Responsiveness	S3	% on-time delivery	3.79	65	2.46
			% average delivery time	3.79	72	2.73
	Agility		USCA	1.99	65	1.29
			DSCA	1.99	65	1.29
	Cost		% CGS	1.24	65	0.81
			% SCC	1.24	63	0.78
	Reliability		% scrap and rework	0.61	87.5	0.53
			% orders accepted	0.61	90	0.55
			Total =	**45.78**		**28.55**
Make	Responsiveness	M1	% on-time delivery	3.75	73	2.74
15.10%			% average delivery time	3.75	78	2.93
	Agility		Upside flexibility	1.97	78	1.54
			Adaptability	1.97	86	1.69
	Cost		% product budget	1.23	88	1.08
			Inventory level	1.23	83	1.02
	Reliability		% scrap and rework	0.6	87.5	0.53
			% orders accepted	0.6	85	0.51
			Total =	**15.1**		**12.03**
Delivery	Responsiveness	D1	% on-time delivery	3.73	80	2.98

Process	Performance	Element of SC	Indicator	Importance (%)	Measured (%)	%contribution of indicators(pp.)
30.00%			% average time of delivery	3.73	90	3.36
	Agility		USCA	1.96	90	1.76
			DSCA	1.96	85	1.67
	Cost		% SCC	1.22	80	0.98
			% CGS	1.22	45	0.55
	Reliability		% scrap and rework	0.59	90	0.53
			% orders accepted	0.59	10	0.06
	Responsiveness	D2	% on-time delivery	3.73	65	2.42
			% average time of delivery	3.73	72	2.69
	Agility		USCA	1.96	75	1.47
			DSCA	1.96	55	1.08
	Cost		% SCC	1.22	68	0.83
			% CGS	1.22	65	0.79
	Reliability		% scrap and rework	0.59	75	0.44
			% orders accepted	0.59	62	0.37
			Total =	**30**		**21.98**
Return	Responsiveness	R1	% on-time delivery	2.26	45	1.02
9.10%			% average time of delivery	2.26	55	1.24
	Agility		USCA	2.37	55	1.30
	Cost		% SCC	0.74	40	0.30
			% CGS	0.74	70	0.52
	Reliability		% scrap and rework	0.72	55	0.40
			Total =	9.09		4.77
			Over all	**100**		**67.33%**

The performance metrics system selected for benchmarking divides the achievements of systems into five categories: poor, marginal, average, good, and excellent [67]. Therefore, the measured overall supply chain performance of the industry, 67.33%, is rated as an average compared to the benchmark system metrics. This result can be considered a significant milestone for the industry transitioning from a raw material supplier to a value-added product producer in the global market. Furthermore, the possibility of meeting the bottom limit for the "good" rating, which is 70%, is very high. The industry's real performance is only 2.67% lower than the lower limit of the performance interval classified as good in the system metrics. However, this result falls short of the upper limit of a good (90%) and an excellent (>90%) rating based on system performance metrics. As a result, the most crucial step before taking any action is to examine the gaps by comparing the importance of factors to actual performance, as this reveals insights into how well the resources are allocated or not allocated [68]. Higher gaps indicate which processes and priorities need to be re-examined [26]. Because of this advantage, a gap analysis is conducted for the case industry. This is accomplished by calculating the disparities between the relevance of the elements and the actual achievements. The process performances are calculated by adding the individual performances of all indicators within the same process. The same argument holds true for the performance factors. Table 10 presents the process and performance gaps in the industry

Tab. 10. Performance gaps in the processes and performance attributes

Process	Relevance (%)	Achieved (%)	Gap	Performance	Relevance (%)	Achieved (%)	Gap
Source	45.78	28.55	17.23	Responsiveness	49.68	32.90	16.78
Make	15.10	12.03	3.07	Agility	26.09	17.68	8.41
Delivery	30.00	21.98	8.03	Cost	16.26	11.06	5.20
Return	9.09	4.77	4.32	Reliability	7.96	5.70	2.76

From the above Table 10, we can understand the following points: Of the four processes chosen to analyze the supply chain performance of the leather industry in Ethiopia, the source and delivery processes are found to have the highest gaps, with values of 17.23% and 8.03%, respectively. Similarly, among the selected performance standards, responsiveness, the speed with which the supply chain delivers the products to customers, and agility, the degree of adaptability of the supply chain, are found to have the highest gaps, with values of 16.78% and 8.41%, respectively. This means that putting effort into the source and delivery processes could increase the responsiveness and agility of the leather industry's supply chain. Thus, it is critical to determine the percentage of gaps in individual contributions. This is derived by dividing each absolute gap by the sum of all gaps in the respective elements of the processes [26]. The results of the analysis are presented in Table 11, which provides a more detailed picture of what is happening on the ground.

Tab. 11. Gaps and prioritization by elements of processes

Specific element of the case industry's SC	Identified gap	Prioritization
S1	4.73	14.49%
S2	7.69	23.57%
S3	4.81	14.74%
M1	3.07	9.41%
D1	3.11	9.54%
D2	4.91	15.04%
R1	4.32	13.22%
	Total	100%

The highest gap in the source process is caused by the sourcing of basic and specialized chemicals (S2), with a value of 23.57%. Similarly, the highest gap in the delivery process is caused by the delivery of goods via the conventional system (D1), with a gap of 15.04%. The third highest gap is found in the sourcing of parts, components, and packaging materials (S3), at 14.74%. The gap seen in the sourcing of raw materials (S1) is somewhat unexpected. The identified gap is 14.49%, which is the fourth-highest gap. It's unclear as to how this might occur given that the raw material is obtained from the local market. Furthermore, the supply chain's return procedure (R1) has a significant gap of 13.22%. This means that the manufacturing firms in the leather industry in Ethiopia are suffering from product returns due to failure to meet delivery deadlines and other reasons. In general, the sourcing process is regarded as the most challenging aspect of the leather industry's supply chain.

5. Conclusions and Recommendations

This study has applied the latest version of the SCOR model to measure the supply chain performance of the leather industry in Ethiopia, which has made a shift from a raw material supplier to a provider of value-added products in the global supply chain. The measurement has been carried out by breaking up the entire supply chain into SCOR processes (source, make, delivery, and return) and using the SCOR model (version 12.0) performance standards of responsiveness, agility, cost, and reliability as measurement attributes. By taking the percentage contributions of 54 indicators, the overall SCP of the industry is found to be 67.33%. This achievement is rated as average when compared to the system performance metric, which categorizes the system performance into five performance levels: poor, marginal, average, good, and excellent based on the numerical values that must be met for each level. The overall performance of the industry falls just 2.67% short of achieving the system's performance metrics' lower limit of a good rating (70%). This level of achievement is quite encouraging for the industry that shifted from a raw material supplier to a provider of value-added products in this competitive era. However, the current performance position is far from the upper limit of good (90%) and excellent (> 90%) ratings of the system performance metric. This implies that it would be very challenging for the manufacturing firms in the leather industry of Ethiopia to compete with the highly performing companies in the global supply chain. The source process has been identified as contributing to the low overall supply chain performance more than the other aspects of the supply chain, with a percentage gap of 17.23%. Moreover, each element of the source process, namely the source of raw material (S1), source of basic and specialized chemicals (S2), and source of parts and components (S3), has significant gaps, with values of 14.49%, 23.57%, and 14.74%, respectively. The larger gaps in the SCOR performance attributes, such as responsiveness and agility, with values of 16.78% and 8.41%, respectively, could be linked to the source process. Furthermore, larger gaps in other elements of the SCOR processes, such as the significant gap in the return process (13.22%), could be due to the source process. This larger gap implies the risk of product returns from customers due to delays or other factors.

In light of our specific findings, we draw the general conclusion that the source process could be a major limiting factor for supply chain performance when manufacturing firms make a shift in their role in the GSC in countries with similar manufacturing environments, like Ethiopia. Finally, we believe that this study will be very helpful for industry practitioners who seek to apply cutting-edge measurement models like the SCOR to their manufacturing firms in developing countries. By doing so, the practitioners will be able to evaluate the level of achievement of their firms and identify elements that require re-examination.

Finally, further research is essential to provide scientific solutions on how the elements that contribute the most to the low overall supply chain performance of the leather industry in Ethiopia can be alleviated.

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