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Conceptual Model to Manage Supply Chain Performance (Case Study: Pangasius Sp. Agroindustry in Indonesia)

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Abstract

Creating clear and timely performance reports across all components of the pangasius.sp agroindustry supply chain is pressing, particularly in monitoring each stakeholder' KPIs. The information model based on Supply Chain Operation Reference (SCOR) tries to portray the needs of each stakeholder. The essential stakeholders supply chain criteria in the pangasius.sp fish agroindustry was mapped into respectable definitions. The proposed formulation generates associated features into evaluation measures to evaluate specific performance. The performance of each attribute is then compared to industry best practices. An Application Development Framework (ADF) based on Business Process Modeling and Notation (BPMN) connects the model's operations with a cloud-based database. The front-end integrated by JavaScript with database operations based on SCOR is finished and ready for mobile and desktop use. This model enables straightforward interpretation and comprehension of performance measurement through various visualizations such as spider charts, histograms, line charts, and ETL (Extract, Transform, and Load) features. Based on the findings in Figure 8, it is apparent that the fish processing sector is presently performing below expectations. The total performance score of 78.81 signifies this. The scores for reliability, responsiveness, agility, cost, and assets qualities are moderate, indicating room for improvement. The low scores for order fulfillment cycle time (63.60) and cash-to-cash cycle time (51.70) are noteworthy, and improving these performance indicators should be the primary focus to enhance overall performance. The model would efficiently illustrate evaluation functionality by leveraging real-world data obtained from Indonesia's pangasius. sp agroindustry's three main regions, namely the provinces of West Java, East Java and Lampung. Quick geographic comparisons are provided for research at several user levels in the pangasius.sp processing, retail, collector, and aquaculture industries.

Keywords: Conceptual model; Pangasius sp; Supply chain performance; SCOR

1. Introduction

The vast majority of supply chain processes are drive processes. This occurs because the demand for fresh fish must adjust to the fish delivery, which is not always the same, and the harvesting time is indeterminate, so it does not depend on collectors' demand for fish nor on time. The relationship between supply chain actors I and II in business activities is one that brings together suppliers, distributors, retailers, companies, retailers, and final consumers, in the flow of a supply chain in order to produce a fish product and distribute it in the correct quantity and at the appropriate time. A suitable, high-quality, and economical approach to meeting requirements It is critical to relate performance to the activities, processes, and effects of succeeding processes in the chain. Dissanayake and Cross (2018) define the three fundamental concepts in their essay. Those qualities summarize the supply chain performance, namely: objectives that declare the desired performance, relationships that emphasize the company's environmental relationship, and objectives that express the desired performance. The performance dimensions and indicators used to measure supply network aspects which was investigated and analyzed (Divsalar et al., 2022).

The supply chain is a business procedure that involves sellers, wholesalers, manufacturers, and suppliers working enough money (Oktaviani & Asrol, 2022). Information technology plays an important role in helping many parties in the chain and planning and controlling operations, supplying the flow of goods, reducing stock, and reducing total costs. It is hoped that these actions will lead to increased efficiency and fulfillment of client satisfaction (Budiarto et al., 2017; Li et al., 2019).

Incorporating performance appraisal in supply chain operations has garnered much interest from academics and professionals alike. This area must be filled in to make supply chain goals easier to achieve and find solutions to any related challenges (Marimin et al., 2020; Society, 2012). There are many considerations for proposing a model to measure performance. Some of these models include Data Evolved Analysis (DEA), Activity Based Costing (Jaiswal & Samuel, 2023), Balanced Score Card (Marimin et al., 2017; Waaly et al., 2018), and the Supply Chain Operation Reference (SCOR) model, which is among the models that most commonly used (Dissanayake & Cross, 2018; Li et al., 2019; Tutuhatunewa et al., 2023).

Research on supply chain evaluation has resulted in development of various conceptual frameworks. The first is the development of a model for assessing the performance of agricultural operations described in the reference (Mañay et al., 2022). First, they investigate the

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underlying issue of how important supplier performance is to the overall competitive advantage of the supply chain. After that, they determined that the most critical issues in the supply chain were communication and information sharing, in addition to product competition. A literature review on performance appraisal systems in supply chains is presented in Akkawuttiwanich & Yenradee (2017), which is structured as such. A model of a systemic performance monitoring system is required to achieve the objective of increasing supply chain efficiency overall . Although the priority currently placed on performance management systems, a number of deficiencies remain, such as those linked to non-financial indicators behavior of organizational members who fail to ensure the system's correct operation (Ricardianto et al., 2022).

The practices recommended supply chain management metrics is heavily reliant on four critical supply chain procedures involving planning, sourcing, manufacturing, and delivery at strategic, tactical, and operational levels (Budiarto et al., 2017; Li et al., 2019). This metric is considered one of the most critical aspects of information system integration. A comprehensive plan for controlling supply chain performance is presented by the SCOR (Chopra et al., 2022). The five components (reliability, responsiveness, agility, cost, and asset management) make up SCOR's detailed business processes. It is not difficult to implement supply chain performance by leveraging SCOR; all that is needed is to choose the reference value to aim for each metric and characteristic, the maximum realistic value in the same corporate strategy. SCOR's ease of use and comprehensiveness have resulted in broad adoption; examples can be found in (Trueba-Castañeda et al., 2022; Tutuhatunewa et al., 2023).

This paper considers the aims and importance of the supply chain performance measurement process, which has a significant impact on the operations of each actor in the supply chain. This approach to planning can be used with SCOR, which the Supply Chain Council has advocated. The SCOR can be used in all sectors to identify, measure, reorganize, and improve supply chain activities (Asrol & Syahruddin, 2022). The SCOR is divided into four levels: Level 1 offers an enterprise concept incorporating the kinds of preparing, supplying, production, and delivery; Level 2 offers core business procedures; Level 3 gives guidance for achieving supply chain decision - making, and Level 4 tends to focus on important performance indicators in the application. In addition, to quantify supply chain effectiveness, the first step is to identify the business processes involved (Kamble et al., 2023).

The SCOR model suggests different qualities and indicators that can be used to quantify supply chain effectiveness. The SCOR model focuses on the key characteristics of the supply chain namely reliability, responsiveness, agility, cost, and assets (Divsalar et al., 2022; Mañay et al., 2022). Performance indicators are picked based on various viewpoints, dimensions, and criteria measuring the relevance of this metric presents a decision-making challenge that requires considering several factors simultaneously. Analytical Hierarchy Process (AHP) (Saleheen & Habib, 2023) and Analytical Network Process (ANP) (Kamble et al., 2023) are two examples of the many methods that can be used to assess the degree of applicability of supply chain performance metrics.

This system consists of several parts or aspects that work together to ensure that people and products can move safely and effectively. A measuring system that maintains the effectiveness of the business supply chain system is necessary for the organization's success (Marimin et al., 2020). Every company involved in the supply chain must implement a performance measurement for each specific procedure to increase its responsiveness and productivity levels. These instruments guarantee that their goals will be achieved and that their procedures will continue to improve.

The primary function of information systems in the supply chain is to serve strategic objectives, which include improving performance, facilitating the exchange of information among various stakeholders, and, most importantly, developing business strategies that can be used to compete successfully in the marketplace (Budiarto et al., 2017; de Vass et al., 2018; Lhassan et al., 2018). A supply chain architecture should comprise three key operational flexibility: organizational capabilities, information systems (IT), and operations. Companies must demonstrate these skills to monitor and evaluate key performance indicators (Oktaviani & Asrol, 2022).

2. Method

2.1 Research framework

Information systems in the execution of business operations provide considerable benefits, including the capacity to fulfill customers' demands, provide excellent service, and guarantee the longevity of a company (Alshawabkeh et al., 2022). The creation of the mathematical evaluation model of each shareholder performance, the UML (Unified Modelling Language) architecture, and the system's deployment are the first steps in developing performance appraisal information systems. The UML is a standardized language to explain the information systems' implementation framework. To be more explicit, the UML transforms a mathematical performance assessment model and a data processing framework into the needed output.

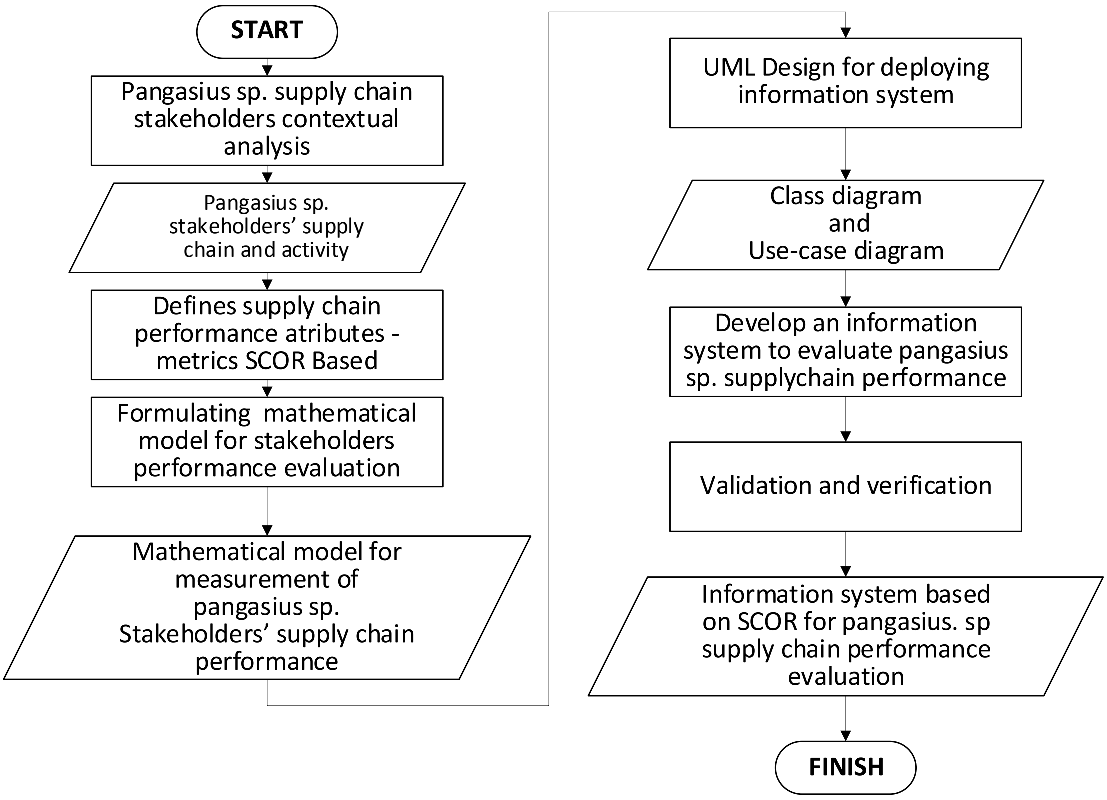


Fig. 1. Research framework

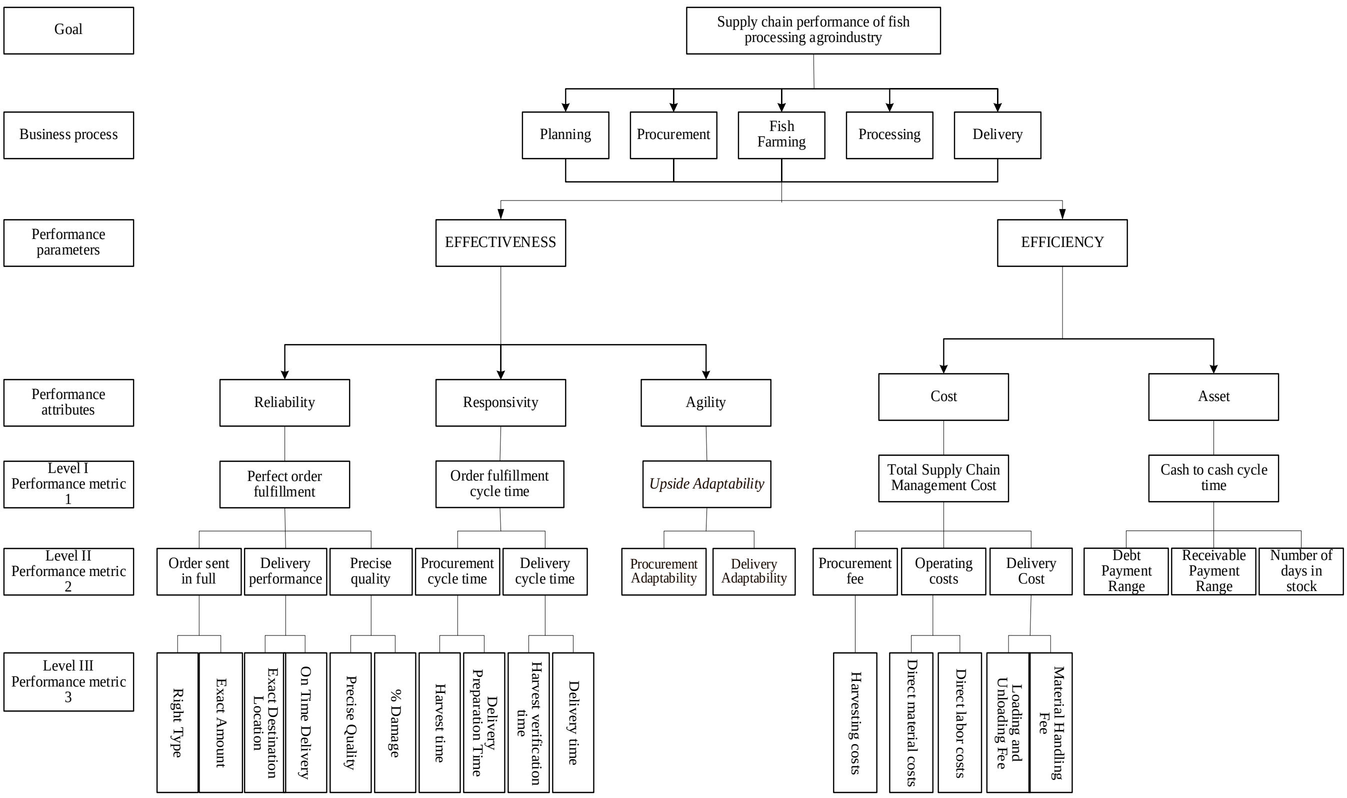


Fig. 2. Hierarchy model for measurement of supply chain performance for the fish processing industry

Class diagrams and use-case diagrams form the UML built for this research. It is necessary to have class diagrams to define the system's structure and simplify the process of implementing the system. Use case diagrams show the links and interactions between system entities and stakeholders, which makes it easy for developers to create information system workflows and the functionality of each page.

Based on the SCOR framework, this study suggests applying an information system for pangasius.sp supply chain management. Verification and validation be done after all mathematical models have been defined and the UML design has been developed.

2.2 Collecting data and information

The data was obtained from the respective actors, such as fish farmers, collectors, and fish processing industries that are located in the provinces of West Java (Purwakarta), East Java (Tulungagung), and Lampung (Pringsewu) in Indonesia. Concurrent field surveys to collect current information are scheduled between August and September 2022. These in-depth interviews and field observations were planned simultaneously according to the need to capture what business operations are the responsibility of each actor along the supply chain. After this, three interview sets containing the content of the model of business processes were disseminated to the participant to assist them in collecting and compiling data and related information. After all data, information, and procedures related to each actor are collected, the resulting data structure is translated into a database so that cloud configuration can take place.

3. Results and Discussion

3.1 Pangasius.sp supply chain issue

The last and most important step is evaluating the current position of the performance of the pangasius.sp agroindustry is to conduct a supply chain scenario study. This study was carried out in West Java, and East Java provinces, considered the most important areas in the supply chain in Indonesia and the most important producers of pangasius.sp fillets.

The two main goals of supply chain management are the fulfillment of consumer demand and profit maximization. To achieve this goal, a group of stakeholders often manages the management of the pangasius.sp supply chain, including fish farmers, collectors, fish processing agroindustry, and retailer.

Each participant in the pangasius.sp supply chain is responsible for managing the coordination needed to fulfill the customer demands or the next participant in the supply chain. For instance, aquaculture farmers are responsible for supplying the fish processing industry with the necessary raw materials. Based on our field observations in West Java and East Java provinces, we identified two types of pangasius.sp cultivators: independent and partnership. The farmer-cultivator partnership has a structural cooperative relationship with pangasius.sp processing factory, which ensures the supply of raw materials at a reasonable price and meets specific quality standards. Fig. 3 illustrates the many stakeholders and mechanisms included in the pangasius sp supply chain agroindustry.

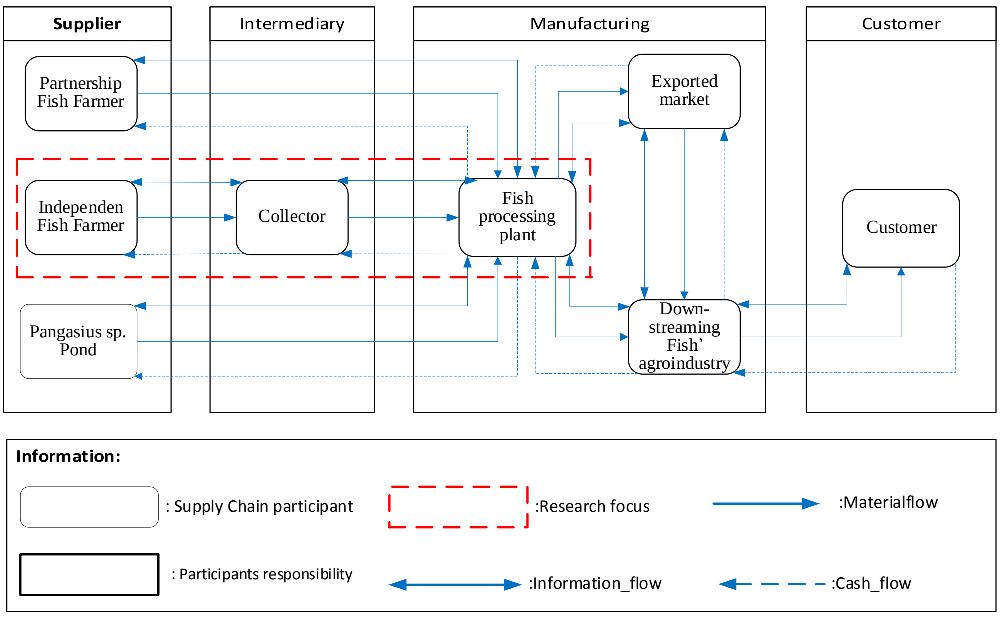


Fig. 3. Stakeholders and mechanisms in the pangasius sp. supply chain

3.2 Mathematical model for performance measurement

To accurately measure supply chain performance, we need to look at the quality and its metrics. This study uses the Supply Chain Operation Reference (SCOR) measurement metric for each farmer, collector, and fish processing factory. At the same time, the quality is broken down into dependability, responsiveness, agility, cost, and assets.

A mathematical model is needed to use supply chain indicators to assess supply chain performance for each stakeholder. The mathematical model can determine how to score stakeholders' performance and make it possible to track underperformance metrics. Mathematical measurements and formulations for each stakeholder in the supply chain are described and defined below.

a) Model for measuring supply chain effectiveness for fish farmers

20 different measures are used to assess whether the fish farmer supply chain is working well or not. The total value of these measures can be broken down into the following components: 6 reliability measures, 4 responsiveness metrics, 2 agility metrics, 5 cost metrics, and 3 asset metrics. Table 1 outlines the notation and definition of each metric, which can be found here.

Table 1

Notation and metrics range for the fish farmer

No	Notations	Description	MetricRange
1	*Rel_*	Reliability	*{1, …., Rel}*
2	*Res_*	Responsiveness	*{1, …., Res}*
3	*Age_*	Agility	*{1, …., Agl}*
4	*Cost_*	Cost	*{1, …., cost}*
5	*Assets_*	Assets	*{1, …, Assets}*
6	*Rel1*	Fish type accuracy	*{1, …., Rel_1}*
7	*Rel2*	Fish weight at harvest	*{1, …., Rel_2}*
8	*Rel3*	Availability of transportation facilities	*{1, …., Rel_3}*
9	*Rel4*	The capacity of transportation facilities	*{1, …., Rel_4}*
10	*Rel5*	% Damage	*{1, …., Rel_5}*
11	*Rel6*	Requirement Quality	*{1, …., Rel_6}*
12	*Res1*	Fish seed stocking time	*{1, …., Res1}*
13	*Res2*	Age of fish at harvest	*{1, …., Res2}*
14	*Res3*	Fish ready to harvest period	*{1, …., Res3}*
15	*Res4*	Fresh fish request	*{1, …., Res4}*
16	*Agl1*	Delivery time	*{1, …., Agl1}*
17	*Agl2*	Number of fish harvested per harvest cycle	*{1, …., Agl2}*
18	*Cost1*	Material Handling Fee	*{1, …., Cost1}*
19	*Cost2*	Loading and Unloading Fee	*{1, …., Cost2}*
20	*Cost3*	Direct Labor cost	*{1, …., Cost3}*
21	*Cost4*	Direct material cost	*{1, …., Cost4}*
22	*Cost5*	Harvesting cost	*{1, …., Cost5}*
23	*Assets1*	Payment contract system	*{1,..., Assets1}*
24	*Assets2*	Payment period	*{1,..., Assets2}*
25	*Assets3*	Production of fish fillet per harvesting cycle	*{1,..., Assets3}*

The following, in order, are formulated as follows to complete the entire mathematical model for self-evaluation of farmer-cultivator performance.

Assume that $Relx_i$ is the value of reliability performance for the i-th fish farmer (x) and that $NRel_1x_i$ is the standardized metric value of $Relx_i$ as a consequence of comparing the benchmark to the target, the fish farmers' performance in terms of their reliability is given by Formula 1.

$$Relx_i = (NRel_1x_i \text{ x } WRel_1x_i) + (NRel_2x_i \text{ x } WRel_2x_i) + (NRel_3x_i \text{ x } WRel_3x_i) + (NRel_4x_i \text{ x } WRel_4x_i) + (NRel_5x_i \text{ x } WRel_5x_i) + (NRel_6x_i \text{ x } WRel_6x_i) \quad (1).$$

Assume that $Resx_i$ is the value of responsiveness performance for the *i-th* fish farmer (x) and that $Nres_1x_i$ is the standardized metric for $Resx_1$ due to benchmark-to-goal comparison. As a result, the fish farmer's responsiveness performance is described in Formula 2.

$$Resx_1 = (NRes_1x_i \text{ x } WRes_1x_i) + (NRes_2x_i \text{ x } WRes_2x_i) + (NRes_3x_i \text{ x } WRes_3x_i) + (NRes_4x_i \text{ x } WRes_4x_i) \quad (2).$$

Assume that $Aglx_i$ is the value of agility performance for the *i-th* fish farmer (x) and that $NAgl_1x_i$ is the standardized metric value of $Aglx_i$ as a consequence of benchmark-to-goal comparison. Therefore, the fish farmer's agility performance may be described by Formula 3.

$$Aglx_1 = (NAgl_1x_i \text{ x } WAgl_1x_i) + (NAgl_2x_i \text{ x } WAgl_2x_i) \quad (3).$$

Assume that $Costx_i$ is the cost performance value for the *i-th* fish farmer (x) and that $NCost_1x_i$ is the standardized metric value of $Costx_i$ due to benchmark-to-goal comparison. Therefore, the fish farmer's cost performance may be described by Formula 4.

$$Costx_1 = (NCost_1x_i \text{ x } WCost_1x_i) + (NCost_2x_i \text{ x } WCost_2x_i) + (NCost_3x_i \text{ x } WCost_3x_i) + (NCost_4x_i \text{ x } WCost_4x_i) + (NCost_5x_i \text{ x } WCost_5x_i) \quad (4).$$

$Assetsx_i$ is the value of assets performance for the *i-th* fish farmer (x), and that $NAssets_1x_i$ is the standardized metric value of $Assets_1x_i$ as a consequence of benchmark to goal comparison. Therefore, the fish farmer's assets performance may be described by Formula 5.

$$Assetsx_1 = (NAssets_1x_i \text{ x } WAssets_1x_i) + (NAssets_2x_i \text{ x } WAssets_2x_i) + (NAssets_3x_i \text{ x } WAssets_3x_i) \quad (5).$$

b) A model for the performance measurement of the collector of the supply chain

Collector's supply chain performance is broken down into 17 metrics. There are nine measures for dependability, two for responsiveness, one for agility, three for cost, and two for assets. Table 2 lists each metric used to gauge collector performance and its definition.

Table 2
Notation and metrics range for the collector

No	Notations	Description	Metric Range
1	*Rel1*	Fulfilling the demands of the fish processing industry	*{1, …., Rel1}*
2	*Rel2*	Fish prices from fish farmers	*{1, …., Rel2}*
3	*Rel3*	The selling price of fish to the fish processing industry	*{1, …., Rel3}*
4	*Rel*	Information on applicable fish prices from the fish processing industry	*{1, …., Rel }*
5	*Rel5*	Delivery period	*{1, …., Rel5}*
6	*Rel6*	Quantity of fish delivery to the fish processing industry	*{1, …., Rel6}*
7	*Rel7*	The capacity of transportation facilities	*{1, …., Rel7}*
8	*Rel8*	Punctuality in fish delivery	*{1, …., Rel8}*
9	*Rel9*	Time to fish harvesting	*{1, …., Rel9}*
10	*Res1*	Frequency of fish delivery to the fish processing industry	*{1, …., Res1}*
11	*Res2*	Duration of fish delivery from collectors to fish processing industry	*{1, …., Res2}*
12	*Agl1*	Fulfillment of extreme demands	*{1, …., Agl1}*
13	*Cost1*	Retribution fee	*{1, …., Cost1}*
14	*Cost*	Delivery costs	*{1, …., cost}*
15	*Cost3*	Return fee	*{1, …., Cost3}*
16	*Assets1*	Payment contract system	*{1, ….,Assets1}*
17	*Assets2*	Payment period	*{1, ….,Assets2}*

A series of mathematical models for evaluating collector performance is suggested in the following section. If $Rely_i$ is assumed to be the *i-th* collector (*y*) value of reliability's performance, then the collector reliability's performance is described in Formula 6.

$$Rely_i\text{ng}=(NRel_1y_i \; x \; WRel_1y_i) + (NRel_2y_i \; x \; WRel_2y_i) + (NRel_3y_i \; x \; WRel_3y_i) + (NRel_4y_i \; x \; WRel_4y_i) + (NRel_5y_i \; x \; WRel_5y_i) + (NRel_6y_i \; x \; WRel_6y_i) + (NRel_7y_i \; x \; WRel_7y_i) + (NRel_8y_i \; x \; WRel_8y_i) + (NRel_9y_i \; x \; WRel_9y_i) \quad (6)$$

Formula 7 defines the responsiveness performance of collector y in the case when the collector's responsiveness is denoted as $Resy_i$.

$$Respy_i = (NResp_1\, y_i \text{ x } WResp_1\, y_i) + (NResp_2\, y_i \text{ x } WResp_2\, y_i) \quad (7)$$

The agility performance's *i-th* collector (y) value is denoted as $Agily_i$. Formula 8 defines the mathematical model for assessing the agility performance of a collector.

$$Agily_i = NAgil_1\, y_i \text{ x } WAgil_1\, y_i \quad (8)$$

Assuming that $Costy$ represents the *i-th* collector's (y) cost performance value, Formula 9 describes the collector y's cost performance.

$$Costy_i = (NCost_1\, y_i \text{ x } WCost_1\, y_i) + (NCost_2\, y_i \text{ x } WCost_2\, y_i) + (NCost_3\, y_i \text{ x } WCost_3\, y_i) \quad (9)$$

Formula 10 defines the asset performance for the collector y, and $Assety$ indicates the *i-th* collector (y) value of asset performance.

$$Assety_i = (NAsset_1\, y_i \text{ x } WAsset_1\, y_i) + (NAsset_2\, y_i \text{ x } WAsset_2\, y_i) \quad (10)$$

c) Model measurement for fishery industry supply chain performance

17 performance metrics define the performance of the fishing industry. These metrics are divided into four reliability metrics, five responsiveness metrics, two agility metrics, three cost metrics, and three asset metrics. Table 3 defines the metrics notation and definition for the fishery industry.

Table 3
Notation and metric range for the fishery industry

No	Notations	Description	Metric Range
1	*Rel1*	Pangasius' Production volume and raw materials	*{1, …., Rel1}*
2	*Rel2*	Pangasius' fillet production capacity	*{1, …., Rel2}*
3	*Rel3*	Pangasius' quality	*{1, …., Rel3}*
4	*Rel4*	Pangasius fillet quality	*{1, …., Rel4}*
5	*Res1*	Pangasius raw material supply cycle	*{1, …., Res1}*
6	*Res2*	Duration for processing	*{1, …., Res2}*
7	*Res3*	Production cycle/day	*{1, …., Res3}*
8	*Res4*	Working hours per day	*{1, …., Res4}*
9	*Res5*	Maintenance cycle	*{1, …., Res5}*
10	*Agl1*	Safety Stock	*{1, …., Agl1}*
11	*Agl2*	Overtime	*{1, …., Agl2}*
12	*Cost1*	Raw Material Cost	*{1, …., Cost1}*
13	*Cost2*	Management and labor costs	*{1, …., Cost3}*
14	*Cost3*	Energy Cost	*{1, …., Cost4}*
15	*Assets1*	Payment Contract System	*{1, …., Assets1}*
16	*Assets2*	Payment System	*{1, …., Assets2}*
17	*Assets3*	Pay-off period	*{1, …., Assets3}*

It is assumed that $Relz_i$ is the *i-th* fishing industry reliability performance value (z). Then the mathematical model that can be developed to measure the reliability performance of the fishing industry is formulated as in Formula 11.

$$Relz_i = (NRel_1\, z_i \text{ x } WRel_1\, z_i) + (NRel_2\, z_i \text{ x } WRel_2\, z_i) + (NRel_3\, z_i \text{ x } WRel_3\, z_i) + (NRel_4\, z_i \text{ x } WRel_4\, z_i) \quad (11)$$

It is assumed that $Resz_i$ is the *i-th* fishing industry responsiveness performance value (z). Then the mathematical model that can be developed to measure the responsiveness performance of the fishery industry is formulated in Formula 12.

$$Resz_i = (NRes_1\, z_i \text{ x } WRes_1\, z_i) + (NRes_2\, z_i \text{ x } WRes_2\, z_i) + (NRes_3\, z_i \text{ x } WRes_3\, z_i) + (NRes_4\, z_i \text{ x } WRes_4\, z_i) + (NRes_5\, z_i \text{ x } WRes_5\, z_i) \quad (12)$$

It is assumed that $Agilz_i$ is the *i-th* fishing industry agility performance value (z). Then the mathematical model that can be developed to measure the agility performance of the fishery industry is formulated in Formula 13.

$$Agilz_i = (NAgil_1\, z_i \text{ x } WAgil_1\, z_i) + (NAgil_2\, z_i \text{ x } WAgil_2\, z_i) \quad (13)$$

It is assumed that $Costz_i$ is the *i-th* fishing industry cost performance value (z). Then the mathematical model that can be developed to measure the cost performance of the fishery industry is formulated in Formula 14.

$$Costz_i = (NCost_1\, z_i \text{ x } WCost_1\, z_i) + (NCost_2\, z_i \text{ x } WCost_2\, z_i) + (NCost_3\, z_i \text{ x } WCost_3\, z_i) \quad (14)$$

It is assumed that $Assetsz_i$ is the *i-th* fishing industry asset's performance value (z). Then the mathematical model that can be developed to measure the asset performance of the fishery industry is formulated in Formula 15.

$$Assetsz_i = (NAssets_1\, z_i \text{ x } WAssets_1\, z_i) + (NAssets_2\, z_i \text{ x } WAssets_2\, z_i) + (NAssets_3\, z_i \text{ x } WAssets_3\, z_i) \quad (15)$$

The next step is to determine the value for each matrix; where to determine the performance value of the stakeholders, it is necessary to normalize and determine the benchmark value specifically for each matrix (N). In determining the benchmark value, it is determined that if the target of Rel_1 is maximum, then the normalization value of $Rel_1x_i(N\,(Rel_1x_i))$, where the mathematical formula is in formula 16.

$$N\,(Rel_1x_i) = \begin{cases} \frac{Rel_1x_i - \min(Rel_1x_i,\ldots,Rel_1x_n)}{B(Rel_1x_i) - \min(Rel_1x_i,\ldots,Rel_1x_n)} \;; if\ Rel_1x_i \le B(Rel_1x_i) \\ 1;\, if\ Rel_1x_i \le B(Rel_1x_i) \end{cases} \quad (16)$$

In determining the benchmark value, it is determined that if the target of Rel_1 is maximum, then the normalization value of $Rel_1x_i(N\,(Rel_1x_i))$, where the mathematical formula is in formula 17. Where Variable $B\,(Rel_1x_i)$is the benchmark value of the metric Rel_1x_i.

$$N\,(Rel_1x_i) = \begin{cases} 1;\, if\ Rel_1x_i \le B(Rel_1x_i) \\ \frac{\max(Rel_1x_i,\ldots,Rel_1x_n) - Rel_1x_i}{\max(Rel_1x_i,\ldots,Rel_1x_n) - B(Rel_1x_i)} \;; if\ Rel_1x_i \ge B(Rel_1x_i) \end{cases} \quad (17)$$

The first objective of the system to be developed is the presence of the overall power of assessment, responsiveness, agility, cost, and assets. The overall performance calculation is carried out by calculating the results of the performance attribute assessment (SC) with a weight (W) on each attribute, where this will result in the performance value of an attribute. For example, the overall value of the reliability attribute on fish farmer performance i(xi) can be obtained by multiplying $Rel_1x_i, Rel_2x_i, Rel_3x_i, Rel_4x_i, Rel_5x_i, Rel_6x_i,$ by the weight of each attribute (W).

The second objective to be achieved is the existence of a performance appraisal for each stakeholder; where the value is calculated by adding the attribute value. The stakeholders' performance's dependability, responsiveness, agility, cost, and asset (xi) attributes will be determined using these requirements.

3.3 System deployment

a) Framework for the information system

An information system is developed to monitor supply chain performance based on SCOR by offering four levels: data, application, collaboration, and presentation. Table 4 provides an in-depth breakdown of the constituent parts of each layer.

Table 4
Layers of the information system

Layer	Layers name	Contents
I	Layer for presentation purposes	• Scorecards for KPIs
		• Reports and Dashboards
		• BI Web Components
II	Integration layer	• Management of content
		• Management of knowledge
		• Collaboration and communication
III	Application layer	• Business data catalog
		• Web service
		• Business process management (BPM)
IV	Data layer	• Data warehousing
		• Data interface frameworks
		• Authentication process

Information system users are managed at 3 levels: participants in the supply chain, institutional users, and administrators. The information system for the user level is illustrated in Fig. 4.

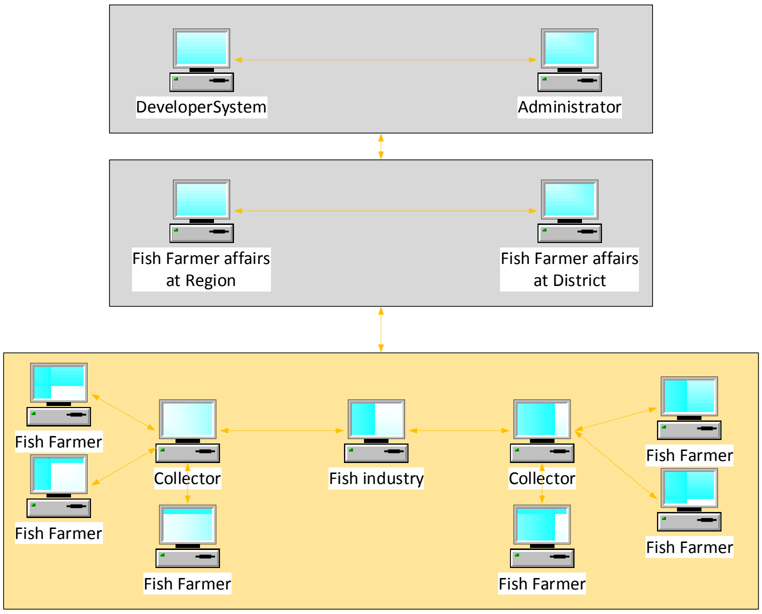


Fig. 4. The administration of users inside the information system

b) Unified Modeling Language (UML)

The Unified Modeling Language (UML) is the primary software engineering method for developing the complete system analysis and design. The suggested model is written in a small framework called Bonita and is built in a completely compatible language like JavaScript for ease of maintenance and portability. This work provides preliminary designs for a use case that helps to show the function and interaction among system entities.

A clear use-case diagram showing how each participant interacts and completes a program based on the real world in the fishery agroindustry was presented as the first prerequisite for system development. In this agroindustry use case, fish farmers, collectors, and the fish processing industry are involved. Fig. 5 shows the use case diagram for the fish farmers as an example.

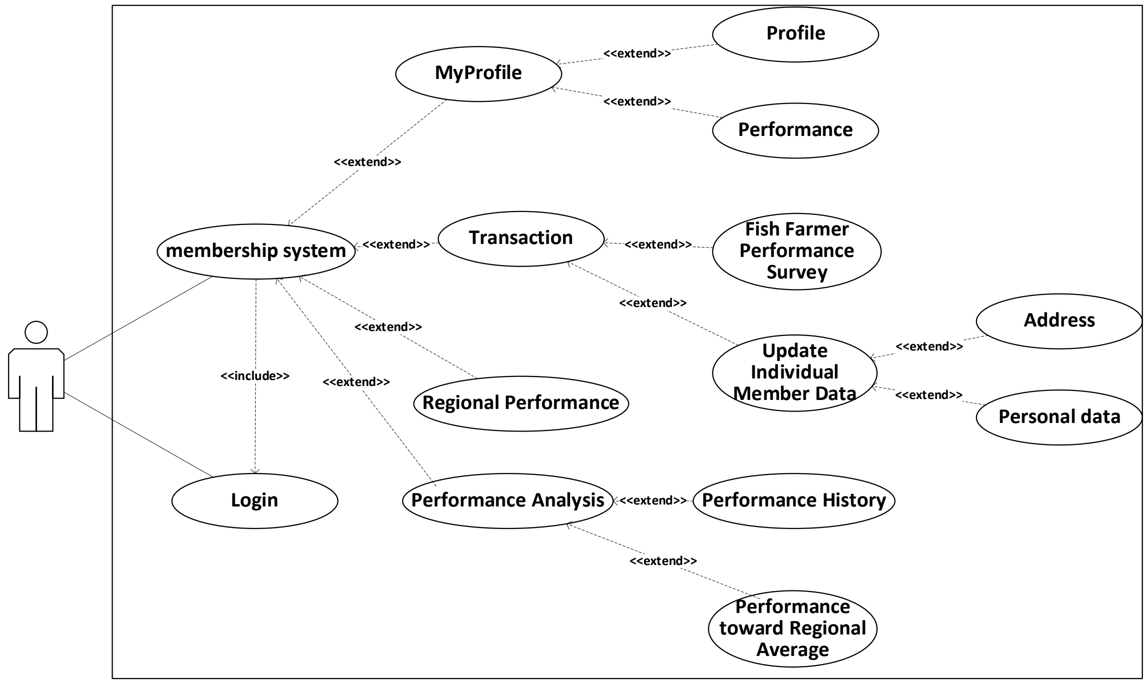


Fig. 5. Use-case diagram monitoring for performance on the fish farmers' level

The object's parameters in the class were established as specified by the UML framework for early software development to guarantee that the SCOR-based model is ready for all necessary data, information, processes, and actors. The composite object comprising classes Date and Product served as the basis for demand. The object's Stock class parameters are similar. Class diagrams represent the static systems' structures as necessary and give developers the knowledge they need to create each information system's features and components. Fig. 6 shows the class diagram for this information system.

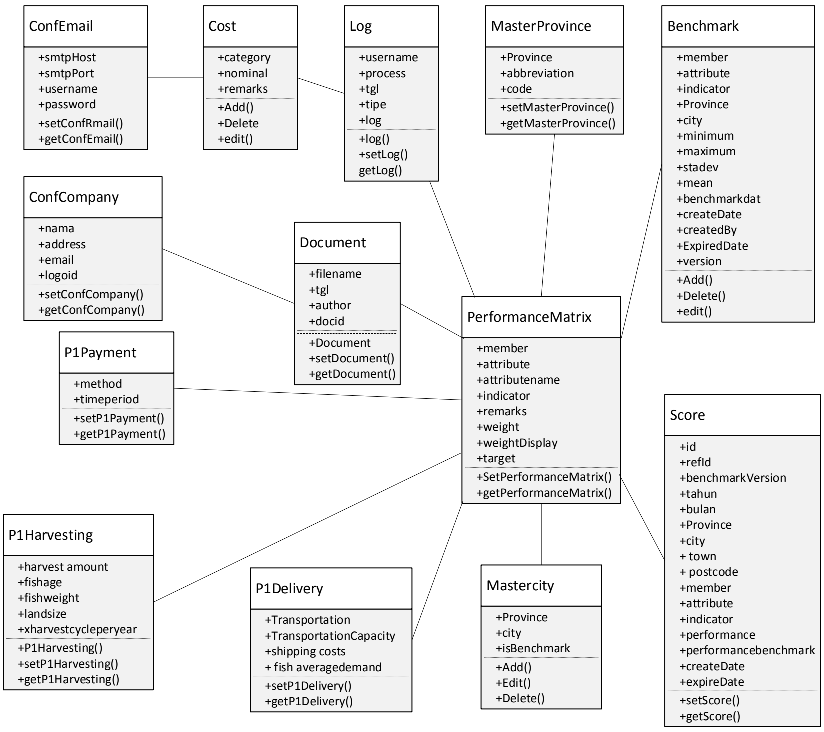


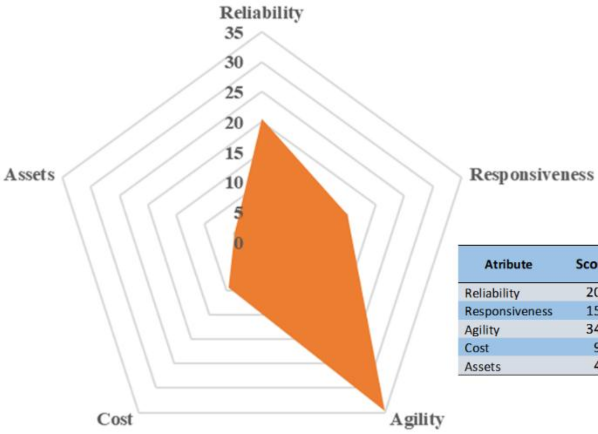
Fig. 6. A class diagram model for business data used for performance measuring

c) Case study involving the use of the newly proposed paradigm

The previously inferred findings from the series mentioned above of mathematical models must be

obtained using the suggested model. The output is described in the paragraphs that follow, in this order:
As the primary real-world actors in the pangasius sp. business, it is of the utmost importance to offer participants, such as fish farmers, collectors, and the fisheries industry, a performance evaluation system based on three distinct types of outputs.

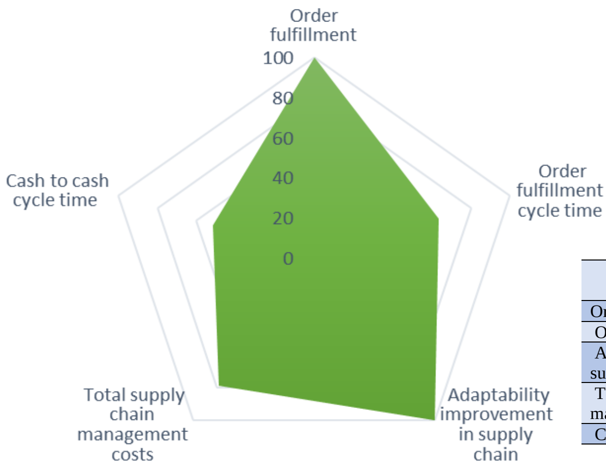
These three stakeholders willingly filled in every field in the system to conduct a performance evaluation of the supply chain. The fish supply chain assessment information system makes recommendations for improving performance value and employs four displays to highlight the significance of each stakeholder's performance. An illustration of supply chain performance measurements is shown in Fig. 7.



Atribute	Score	Performance Index	Performance Criteria
Reliability	20.59	84.46	Good
Responsiveness	15.01		
Agility	34.77		
Cost	9.35		
Assets	4.74		

Fig. 7. Farmers' access to system interfaces that provide information on supply chain performance and value

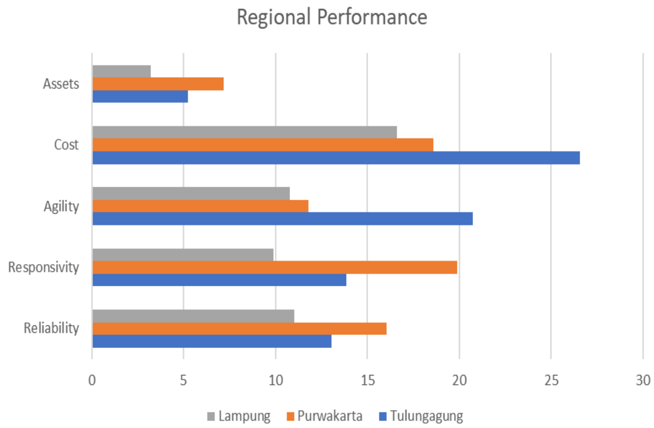
Supply chain performance values are computed utilizing reliability, responsiveness, agility, costs, and assets, as well as the total score. The attributes are low, moderate, medium, good, and excellent performance. The total score are divided on a scale of 1-100 (Quayle, 2006)). It is suggested that the low metric score be increased to improve the supply chain performance.
Figure 8 displays the performance outcomes of a supply chain assessment for the fish processing industry. The results indicate that the fish processing sector is currently underperforming, as evidenced by its total performance score of 78.81. The scores for the reliability, responsiveness, agility, cost, and assets qualities are indicative of moderate performance. To enhance performance, it is advisable to concentrate on the performance indicators with low scores which are order fulfillment cycle time (with score 63.60) and cash to cash cycle time (with score 51.70)



Atribute	Score	Performance Index	Performance Criteria
Order fulfillment	100.00	**78.81**	**Moderate**
Order fulfillment cycle time	63.60		
Adaptability improvement in supply chain	100.00		
Total supply chain management costs	78.77		
Cash to cash cycle time	51.70		

Fig. 8. Interface for fish processing industry performance evaluation

Data on previous performance values can also be shown using the pangasius sp. fish supply chain performance evaluation information system. The data is needed to monitor the average performance value across some geographic regions. Stakeholders are able to do this by comparing their performance score to the average performance score for the region. The system tries to improve supply chain performance for each stakeholder. In Figure 9, a visually appealing comparison is made between the performance scores of stakeholders and the presentation of past performance scores. Additionally, the figure also displays the performance distinction with the overall regional average. This comparison provides a clear understanding of how stakeholders have performed in the past and how their performance compares to the overall regional average. This can be a useful tool for managers and practitioners to identify areas of improvement and set realistic targets for future performance. Overall, Figure 9 provides a useful visualization of performance data that can aid in decision-making and performance management.



Attribute	Score		
	Tulungagung	Purwakarta	Lampung
Reliability	13.05	16.05	11.05
Responsivity	13.88	19.88	9.88
Agility	20.75	11.8	10.8
Cost	26.56	18.6	16.6
Assets	5.23	7.2	3.2
Performance Index	79.48	73.48	51.48
Criteria	**Moderate**	**Moderate**	**Poor**

Fig. 9. The geographical performances of the stakeholders

3.4 Result

As previously described, each mathematical model of goals and limitations was considered for model verification. Refer to Ref. (Marimin et al., 2020) for the information needed to verify and validate this study. Performance evaluations of fish farmers, collectors, and the fish processing industries are verified and validated in Tulungagung (East Java) and Purwakarta (West Java). An exception is made for the Lampung area because there is no fish processing industry in Lampung.

The model's verification and validity indicate that performance evaluation for the fish supply chain can characterize the fish supply chain stakeholders performance in Tulungagung (East Java) and Purwakarta (West Java). Table 5 displays the result of performance information system for measuring the fishery agroindustry supply chain performance in Tulungagung (East Java) and Purwakarta (West Java).

Table 5**.** Verification for performance results in Tulungagung (East Java) and Purwakarta (West Java).

Stakeholders	Tulungagung (%)	Purwakarta (%)
Fish farmers	87.77	72.66
Collector	84.60	75.39
Fish processing industry	89.20	84.11

3.5 Discusion

The proposed solution enables managers to measure the supply chain performance from several viewpoints by detailing the gap between the targeted and actual performance of each SCOR® level indication. Managers can then develop action plans to improve the results of the metrics that show underperformance. Utilizing the suggested system enables managers to assess the success of their plans, making the target organization more proactive in its pursuit of improved performance outcomes. The proposed evaluation system's metrics are subject to change over time by managers.

The suggested system incorporates a wide range of measures linked to many performance aspects, including dependability, agility, responsiveness, cost, and asset management, in contrast to the models put out by (Nathania & Desrianty, 2023). Utilizing the metrics recommended by the Supply Chain Council results in greater performance measure integration, standardization, and alignment across supply chain levels. In keeping with previous works, this one utilizes a mixture of SCOR® metrics and mathematical modelling (Liu & Liu, 2017).

In contrast to the model based to fuzzy inference developed by Ayyildiz & Taskin, (2022), this model does not need manual judgments of specialists. Obtaining adequate information to complete the ANFIS models' learning process is a major weakness of the suggested performance evaluation system. This obstacle has prevented the suggested system from being used in practice so far (Dias & Ierapetritou, 2017; Lima-Junior & Carpinetti, 2017). The number of fuzzy partitions and input variables used in each ANFIS model is another restriction of the system . The number of inference rules will increase in proportion to the number of partitions used, since there will be numerous possible combinations of partitions. In this instance, it may be necessary to increase the number of training samples used to fine-tune the topological parameters. On top of that, it may compromise the reliability of the system's output.

Information models based on SCOR require less frequent iterations to update their adaptive parameters comparing to models that use neural networks system (Jaiswal &

Samuel, 2023; Kamble et al., 2023). The benefit is SCOR models make it possible to determine which decision rules are responsible for producing the observed results, they also improve the clarity and interpretability of the technique used to calculate the performance values of the output variables. Operations managers might have more faith in the decision making procedures that attempt to improve supply chain performance if the information offered by the decision rules is more easily understood. Another advantage is that the mathematical model is a simple stage of use and does not require high technological skills. This makes it easier to use, especially for fish cultivating farmers in the field.

According to Dias & Ierapetritou (2017), most modern businesses employ a suite of IT applications to monitor and control their supply chains. Unfortunately, these programs rarely work together. As a result, information from various stages of decision-making is typically stored in separate departments. Therefore, the various stakeholders in supply chain management lack complete information necessary to make sound choices (Dias & Ierapetritou, 2017).

3.6 Managerial insight

The Conceptual Model to Manage Supply Chain Performance (Case Study: Pangasius.sp Agroindustry in Indonesia) provides several key managerial insights that can help managers and practitioners in the Pangasius.sp agroindustry and other similar industries improve their supply chain performance. Some of these insights include:

- Importance of supply chain strategy: The model emphasizes the importance of developing a clear and effective supply chain strategy that aligns with the organization's overall business strategy. This insight highlights the need for managers to understand the key drivers of supply chain performance and develop a strategy that addresses these drivers.
- Value of supply chain integration: The model emphasizes the importance of integrating various functions and stakeholders in the supply chain to improve performance. This insight highlights the need for managers to foster collaboration and communication among different departments and stakeholders to achieve supply chain integration.
- Critical role of supply chain coordination: The model highlights the critical role of coordination in managing the supply chain performance. This insight emphasizes the importance of managers to develop effective coordination mechanisms such as contracts, incentives, and shared performance metrics to ensure that all parties involved in the supply chain are working towards the same goals.
- Significance of supply chain information technology: The model recognizes the significance of information technology in managing supply chain performance. This insight highlights the importance of managers to invest in appropriate technology solutions to improve supply chain visibility, decision-making, and communication.
- Focus on supply chain performance measurement: The model emphasizes the need for managers to develop and use appropriate performance metrics to monitor and evaluate the performance of the supply chain. This insight highlights the importance of managers to establish clear performance targets, track progress towards these targets, and continuously evaluate and improve the supply chain performance.

Overall, the Conceptual Model to Manage Supply Chain Performance provides managers and practitioners with valuable insights on how to manage supply chain performance effectively in the Pangasius.sp agroindustry and other similar industries. By following these insights, managers can improve their organization's competitiveness, reduce costs, improve quality, and promote sustainability.

The main contribution of the research is the development of a conceptual model to manage supply chain performance in the Pangasius.sp agroindustry in Indonesia. The research proposes a new approach to supply chain management that takes into account the specific challenges faced by the Pangasius.sp agroindustry in Indonesia, such as the need to balance cost, quality, and sustainability.

The conceptual model proposed in the research is based on the integration of several key factors, including supply chain strategy, supply chain integration, supply chain coordination, supply chain information technology, and supply chain performance measurement. By using this model, the researchers argue that the Pangasius.sp agroindustry in Indonesia can improve its supply chain performance, reduce costs, improve quality, and promote sustainability.

The research is significant because it provides a valuable contribution to the field of supply chain management, particularly in the context of the Pangasius.sp agroindustry in Indonesia. It also demonstrates the importance of developing customized supply chain management strategies that take into account the specific challenges faced by different industries and contexts. Overall, the research provides a valuable framework for managing supply chain performance in the Pangasius.sp agroindustry in Indonesia and potentially other similar contexts.

4. Conclusion

The SCOR-based information system model is very useful for evaluating the performance of the fishery agro-industry supply chain quickly and comprehensively. This system has the ability to provide rapid interpretation and understanding of supply chain performance, with unique metric measurements for each partner in the supply chain. Mathematical models and UML designed to evaluate supply chain performance of the fisheries agroindustry show success that they can be integrated to provide supply chain performance evaluations and are able to see historically progress in supply chain performance scores, make comparisons with the average score of supply chain performance at the regional level and determine targets for supply chain performance improvement. This system is comprehensively capable of displaying the aggregated performance score of partners in the supply chain in certain geographic locations. Thus, relevant organizations can take advantage of the availability of these functions to implement policies that improve supply chain efficacy and efficiency.

Internet of Things (IoT) and spatial information integration necessitate further development of the proposed system. Future implementation should include standard operating procedures for system management and provide long-term operational support through data collection activities for each stakeholder.

The main advantages and contributions of this conceptual model are:

- Customization: The model is customized to the specific challenges and needs of the Pangasius.sp agroindustry in Indonesia. This ensures that the model is practical and effective in addressing the unique challenges faced by the industry.
- Holistic approach: The model takes a holistic approach to supply chain management by integrating several key factors, including supply chain strategy, integration, coordination, information technology, and performance measurement. This comprehensive approach helps ensure that all aspects of the supply chain are optimized for performance.
- Improved performance: The model is designed to improve supply chain performance by reducing costs, improving quality, and promoting sustainability. By following the model, organizations in the Pangasius.sp agroindustry in Indonesia can improve their competitiveness and profitability.
- Practical implementation: The model provides practical guidance on how to implement the various factors involved in managing supply chain performance. This helps organizations to apply the model effectively and achieve the desired results.
- Transferability: While the model is customized to the Pangasius.sp agroindustry in Indonesia, its concepts and principles can be applied to other industries and contexts. This makes it a valuable contribution to the broader field of supply chain management.

In summary, the model provides a practical and comprehensive framework for managing supply chain performance in the Pangasius.sp agroindustry in Indonesia. Its holistic approach and practical implementation guidance can help organizations to optimize their supply chain performance, reduce costs, improve quality, and promote sustainability.

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