Design of Conceptual Framework for Measuring Operational Performance of Third-Party Logistics

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Abstract—The logistics business is expected to soar significantly, for which will reach 30 percent by 2020, driven by the growth of transaction of e-commerce. This growth, indeed, requires an apparent concern from the transporter logistics to continuously enhance their performance. On the other hand, the performance of logistics transporters will provide a positive contribution to the increase of LPI (Logistics Performance Index) score of Indonesia. Thus, the development of performance measurement systems is necessary to maintain the competitiveness level of logistic actors. This study provides a comprehensive overview of performance measurement systems in regard to the 3PL (third party logistics) companies. The goal of this study is to develop such a conceptual framework that portrays the essential elements necessary to take into account when implementing performance monitoring system to the 3PL companies. The conceptual framework is established using grounded-theory approach which comprises of four main steps: collecting and mapping data sources, categorizing the data, identifying and naming concepts, and establishing a conceptual model. The framework itself, is constructed into two main stages: 1) developing KPIs, 2) measuring the performance. To exhibit the applicability of the proposed approach, a numerical experiment is provided. This research has two main contributions. First, the study fills the theoretical gap pertaining to the concept of performance assessment systems in case of 3PL companies. Second, in practical view the proposed conceptual framework contributes to the academia by describing the basis of establishing performance monitoring as well as to the practitioners who wish to better measure performance in the transporter logistics.

Keywords—performance measurement, 3PL (Third Party Logistics), conceptual framework

I. INTRODUCTION

Logistic sector is a potential and influential industry in Indonesia. As the digital business is soaring, the logistic sector is received an increase in market as well. According to the Statistic Bureau of Indonesia, the logistic sector contributes 5.37% to the GDP of Indonesia by which about 14.837,36 trillion rupiahs [1]. It is expected that logistic will keep growing about 11.56% in 2019 and the growth of GDP contribution will be expected to rise to 5.56% (cite 2). The growth of logistics business constitutes an effect of e-commerce transaction which is expected to reach 30% increase by 2020. The Gross Merchandise Value (GMV) has been increasing to reach $21 billion by 2019 with an outlook to achieve about $82 billion by 2025 [2]. In addition, the valuation of formal and informal e-commerce sector in Indonesia has reached $5 billion and $3 billion, respectively [3]. Accordingly, the increase of goods distribution will be expected to rise to 1.6 billion packets distribution.

In addition, the growth of logistics performance will also contribute to the score of Logistic Performance Index (LPI) for which its value ranges from 1 (very low) to 5 (very high). Figure 1 shows the LPI score of Indonesia since 2010 which tends to increase every year, despite the fall in 2016. Then, in 2018 the LPI score increased significantly to 3.15 which lead Indonesia to the rank of 46 [4]. The LPI is measured by six dimensions i.e. 1) Customs, 2) Infrastructure, 3) Ease of arranging shipments, 4) Quality of logistics services, 5) Tracking and tracing, and 6) Timeliness [4]. Among the sixth dimensions, the last remaining three are closely related to the performance of the logistics company in running their operational business. In terms of score, the last three components have the following score 3.10, 3.30, and 3.67, respectively which relatively is higher than the remaining measurement components.
It is obvious that the improvement of logistics performance will significantly influence in positive manner to the pillar of competitiveness index in particular to the market size [5]. Third party logistics (3PL) provider has an essential role in driven the LPI score, therefore its performance and efficiency must be assessed periodically. Aside from the delivery fee, 3PL performance is considered as an important factor by customer while deciding the distributor service. The 3PL performance might influence indirectly to the expansion of market share and the growth of logistic business [6].

On the other hand, operational performance of 3PL services may lead to the customer trust and satisfaction [7]. To assess the performance, it is common that the 3PL company makes use of certain Key Performance Indicator (KPI) that measure and benchmark the target or historical record with the recent achievement. Company decision makers must thoroughly select an appropriate KPI that not only suitable to their operational model, but also at the same time can be used to measure their performance relatively to their competitors.

All the more, to develop such a comprehensive performance measurement framework is considerably challenging, in particular for new 3PL companies. As the business of 3PL providers is getting more competitive, the development of assessment tools, by which may assist the practitioners to appropriately measure the company performance, is obviously required. This situation, therefore, raises research questions (RQs):

RQ 1: “What are the factors that influence the performance measurement of 3PL companies?”

RQ 2: “How to build a conceptual framework to measure and monitor the performance of 3PL companies?”

Accordingly, this study aims to propose a conceptual framework of operational performance measurement system in leveraging the performance of 3PL provider. The paper structures as follows. The subsequence section II provides briefly relevant literature review. Meanwhile, section III discusses the research methodology. Section IV constructs the main part of proposed framework. Finally, section V draws a conclusion of the study.

II. LITERATURE REVIEW

Zhang & Okoroafo argued that the increase of 3PL performance will indirectly contribute to the increase of Logistic Performance Index (LPI) score of the country [8]. Moreover, the competition rate among the businesses is getting more intense gradually, thereby the company is imposed to increase their performance as well. Quantifying the effectiveness and efficiency of activities based on a set of indicators is known as performance measurement [9]. In case of 3PL providers, the operational performance has a significant impact to the customer satisfaction and trust to the company [6], [7]. Thus, it is prevalent found in the online shopping that the customer is allowed to rate and give a review of the transporter’s performance. In addition, the operational performance will impact to their financial as they increase the performance and efficiency the financial growth will increase as well [10].

The measurement is intended to drive the organization in comprehend the current situation which lead them to set a proper strategy. Thus, throughout the organization unit know that how they perform the work is always has to be linked with the defined strategy [11]. There are several popular tools to be used as performance measurement system (PMS) such as, BSC (Balanced Score Card), performance prism, KB-PMS (Knowledge-Based Performance Measurement System), SCOR (Supply Chain Operation References), and lean six sigma [9], [11]–[13]. All those aforementioned frameworks cannot used straightforward to the context of 3PL companies for which in most cases required some adjustments.

Domingues et al. proposed 25 set of performance indicators of performance measurement which structured into three dimensions i.e. decision level, activities, and actors. They used a 3PL firm as a case study to validate the proposed framework [14]. Another study carried out by Irfani et al. develop a framework in particular for companies with multiple roles by which generally they encounter a conflicting goals between to achieve commercial and social profitability [9]. The framework was then improved by incorporating system dynamics which offers decision makers to identify the relationship among indicators in such a way it enables them to understand logistics performance in holistic view [12]. However, the framework possesses a limitation for its highly complexity and requires a sufficient period, data, capabilities to develop and interpreting the overall system performances. A SC (Supply Chain) performance framework based on KB-PMS, proposed by Khan, et al., integrated short-term and long-term decision criteria. The framework utilized the fuzzy AHP (Analytic Hierarchy Process) to incorporate the vagueness normalization while the experts performing a pairwise comparison to identify the importance weight of decision criteria [13].

In case of Indonesia, there have been several studies regarding the performance of 3PL providers in Indonesia comprising the customer service quality, measuring the performance, and marketing strategic. A study carried out by Najib pada 2012 discusses about the service quality of 3PL providers to their customer using a model Logistic Service Quality. The model results some variables considered as important factor by the customer, i.e. tangible and empathy variable. The tangibility is indicated by the VIP services and
track and trace facility. The empathy variable is measured by the service of employee to the customer [15].

On the other hand, Astuti and Fatma stated that while considering the courier service, the customer will sequentially consider the reliability, cost, convenience, and service [16]. The reliability describes the ability to deliver the product to the designated destination precisely and on time with an intact condition. The cost variable describes the amount of fee paid by the customer to deliver their package. The convenience variable describes the convenience of customer to obtain the delivery services. Meanwhile, the service variable account for the type of services given by logistic providers (cite 11).

Another research conducted by Wulan and Setyawati reported that the implementation of marketing strategic comprehensively will have a positive contribution to the performance of company and its employee [17]. By increasing the marketing strategy, especially pertaining the responsibility and the implementation of standard operating procedure (SOP), improving the communication between the provider and customer, and also putting the flexibility in the bargaining process, it is expected to increase the performance of 3PL provider. The competition will become a moderation variable in modelling the relationship between the implementation of strategic marketing and the performance of 3PL providers. The competitive environment may amplify and drive the company to improve their capacity and performance [17]. To increase the flexibility and expand the collaboration opportunity, information sharing (IS) is one of keys which plays an important role to make the collaboration run subtly. A study by Kirono et al., tried to seek how the collaboration, capability, and IS support on logistic performance in positive way [18]. The study engaged the registered company in Gafeksi of East Java region to validate the propose theoretical framework. They found that capability, which is the mediation of IS in building business process, has a positive impact on logistic performance. Meanwhile, the collaboration has no direct impact to the increase of logistic performance [18].

The capability does not constitute only on IS capability in sharing resources effectively among partners. Sudrajat stated that the dynamic capability which comprises adaptive, absorptive, and innovative capability can also contribute to the 3PL provider performance [19]. In addition, capability to build internal integration and customer integration (relationship management, information sharing, customer communication) also enhance the service performance. This evidence was revealed in the study carried out by Liu and Lee which focus on the relationships between different types of integration, SCR (Supply Chain Resilience), and service performance towards the 3PL’s perspective [20].

Most of those studies, however, yet no study discusses specifically about the how to build such a 3PL performance monitoring framework owing to the fact of complexity and perplexity of selecting appropriate indicators as well as to implement the measurement system. There is still no generic framework or model to assess and evaluate how the 3PL providers in Indonesia perform their business. This framework, which consist set of indicators, is required to aid the company in understanding their capability and performance, so that they will be able to use the assessment result to improve their performance or even expand the business [21]. Add a closing sentence

III. METHODOLOGY

This study adopts the definition of conceptual framework from Jabareen, which is an interlinked of concepts into such a network that provide a comprehensive understanding of particular phenomenon rather than to predict the outcome [22]. The purpose of conceptual framework is to build a foundation by using previous works in the way to demonstrate associations while providing an overview of the concept [23]. On this basis, we then design a framework of performance monitoring to the use in 3PL companies. To design such a framework, we employ a grounded theory with its adequacy and primary characteristics for building conceptual framework. The grounded theory namely “Conceptual Framework Analysis” intends to generate, identify, and trace key concepts each of which possess own attributes, characteristics, assumptions, limitations, distinct perspectives, and specific function within the conceptual framework [22]. The development of conceptual framework is built upon the data acquired from relevant literatures as well.

The procedure to develop a conceptual framework based on the grounded-theory consists of four main steps:

1) Data collection and mapping

This step aims to collect relevant literature and map them in the context of performance measurement system particularly related to the 3PL providers. The literature covers the article from journal and conferences within the last 8 years.

2) Categorizing the data

In this step, the collected data will be classified into several categories. Thus, it enables us to probe the PMS issues effectively as the literature may emanate from a vary discipline.

3) Identifying and naming concepts

The aim of this step is to perform in depth literature review or usually known as systematic review which to identify all empirical evidence that fits the pre-specified research question [24]. This step allows a new concept to emerge from the literature [22].

4) Establishing a conceptual model

The final step aims to integrate a number of concepts and synthesize them into a theoretical framework. Clearly, this step is critical as it aims to integrate the identified concepts from the previous step.

IV. DEVELOPMENT OF CONCEPTUAL FRAMEWORK

This section elucidates the development of conceptual framework regarding to the 3PL performance measurement monitoring. There are four phases followed to develop the
conceptual model: 1) Mapping the selected data sources, 2) Reading and categorizing of the selected data, 3) Identifying and naming the concept, 4) Synthesizing and integrating into a new conceptual framework.

A. Mapping the selected data sources

In this phase, several relevant data sources such as peer-reviewed articles, books, and other documents related to 3PL performance measurement systems are identified. From this phase, we identified there are 17 articles and 3 report documents that relevant to the topics.

B. Reading and categorizing of the selected data

In this phase, we read the selected data sources and categorize them into type of framework. The literature review is carried out in a way of systematic review. This approach aims to identify empirical evidence that fits the development of 3PL performance measurement framework. The advantage of systematic review is that we may minimize the bias, able to determine the effect across the studies and discover the future studies [24]. TABLE I shows the summary of the literature review and category of data sources that relevant to this study. Herein, we categorized the data source into four cohorts i.e. supply chain, logistics, 3PL, and LPI. Each category consists of 3, 8, 4, and 3 articles, respectively.

C. Identifying and naming the concepts

From the prior step, we then identify the concepts pertaining to the 3PL performance measurement as well as to respond the first research question. TABLE II summarizes the factors that influence towards the 3PL performance. The observations with regard of performance indicators (PI) yield three concepts of 1) decision scope, 2) internal PI, and 3) external PI. The design of PI can be derived from the decision scope which may result different indicators [14]. The sets of PI, then, can be classified into two i.e. internal PI, which mostly correlated to the internal 3PL infrastructure and capabilities, and external PI, which in a broad view measure the ability of 3PL in building collaboration and integration with external parties or stakeholders.

Using those three concepts, we are allowed to design a more rigorous set of KPI. The following construct is collecting data of the 3PL providers. In this way, we can perform further analysis and verification from the experts. Hence, we can build a generic PMS which enables other 3PL to use the system in monitoring their performance.

D. Synthesizing and integrating into a new conceptual framework

In this phase, the identified attributes and concepts were grouped and integrated into a conceptual model. To build so-called performance monitoring of 3PL providers, we developed two stages of main concept. The first stage as depicted in Figure 2 encompasses six entities: 1) Performance Indicators (PI), 2) Decision Scope, 3) Internal PI, 4) External PI, 5) Ranking Variables, 6) Set of Key Performance Indicators (KPIs).

The first entity, PI, is built both from literature review of relevant PMS and decision scope. Herein, the decision level proposed by Domingues et al. is used by which is defined into three dimensions i.e. strategic, tactical and operational level [14]. By incorporating those two aspects, it is expected that the PI appropriately represent the best practice and the requirement of the 3PL company itself.
The following entities are derived from the collected PIs which categorized into two i.e. internal and external PI. The internal PI comprises six attributes by which PI can be classified into. Those attributes are reliability, responsiveness, flexibility, assets and resources management, cost, and safety each of which may has different PIs [9]. The adjacent entity is the external PI which also essential to be considered as it may influence the satisfaction of stakeholders. The external PIs consist of four attributes i.e. Customer integration, Rules, Policies, and Regulation. TABLE III describes in detail the indicators used both inside internal and external PI.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Indicators</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability</td>
<td>This indicator describes the ability of 3PL to deliver the product to the designated destination precisely and on time with an intact condition [6], [12], [13]</td>
<td></td>
</tr>
<tr>
<td>Responsiveness</td>
<td>This indicator measures how quick the company performing the task [12], [14]</td>
<td></td>
</tr>
<tr>
<td>Flexibility</td>
<td>The flexibility is set of indicators that quantify to what extend the company adapts to the change of regulation, demand, customer behavior, etc. [12], [13]</td>
<td></td>
</tr>
<tr>
<td>Assets and Resources Management</td>
<td>This indicator describes the amount of resources, capacity, utilization, inventory level, travel distance, and frequency of delivery [12]–[14]</td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>This indicator encompasses all cost variables incurred by the carrier during the operation [6], [12]–[14].</td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>This indicator measures the contingency of incident (loss, damage, accident) and threat to the transport</td>
<td></td>
</tr>
</tbody>
</table>
The subsequent step is to rank the variables using questionnaire survey. It is possible that a particular variable is critical in case of Indonesia rather than other countries, and vice-versa. Thus, the ranking variables will take into account which variable most important compare to the others by putting a level or weight of importance. Afterwards, we may construct set of KPIs according to the ranking variables.

The framework is, then, proceeded to the stage 2 as illustrated in Figure 3. This stage consists of five entities: 1) Questionnaire, 2) Collected data, 3) Analysis, 4) Performance Measurement Systems, 5) Performance Monitoring. The questionnaire is built from the set of KPIs obtained from the prior stage. This questionnaire is then fill out by the 3PL providers and the survey data is collected. By using statistical test and inference to the data, it enables further analysis (descriptive, predictive). Afterwards, the analysis result is verified by the experts with thoroughly inspection of the instruments to check their relevance with most of the 3PL’s business. In addition, by the assent and insight from them, a generic performance measurement system can be established. Thus, 3PL companies may make use of a rigorous PMS to assess their performance. This performance is projected to such a dashboard to aid the manager in monitoring the performance periodically by providing analytics capability, such as descriptive, predictive, and prescriptive analytics, so that the decision-makers allowed to take a prompt and accurate decision.

To calculate the operational performance, the weighting procedure is employed. The rationale is that by means of weighting will enable the 3PL provider to take into account which indicator has the relative importance compare to other indicators. Let \( W_i \) denotes the weight of \( i \)-th key performance indicator (KPI), where \( n \) is the number of KPI. Each KPI may consists of a set of performance indicator (PI) such that \( U_{ij} \) denotes the weight of the \( j \)-th PI which belongs to the \( i \)-th KPI, where \( m \) is the number of PI towards a particular KPI. The weight value ranges from 0-1, such that \( \sum_i W_i = 1 \) and \( \sum_j U_{ij} = 1 \), \( \forall i \in W_i \). Thereafter, \( A_i, T_i, \) and \( Y_i \) represent the value of actual, target, and performance, respectively, of a particular PI. Meanwhile, the calculation of \( Y_i \) refers to the equation (1). To aggregate the performance value, denoted by \( P_i \), the weighting and value and the performance are incorporated based on the equation (2). Accordingly, the following TABLE IV shows the illustration of performance weighting.

\[
Y_i = \frac{A_i - T_i}{T_i} \times 100\% \tag{1}
\]

\[
P_i = W_i \times U_{ij} \times Y_i \tag{2}
\]

### TABLE IV
**PERFORMANCE CRITERIA WEIGHTING ILLUSTRATION**

<table>
<thead>
<tr>
<th>KPI</th>
<th>PI</th>
<th>Actual</th>
<th>Target</th>
<th>Performance</th>
<th>Aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td>( W_i )</td>
<td>( U_{ij} )</td>
<td>( A_i )</td>
<td>( T_i )</td>
<td>( Y_i )</td>
<td>( P_i )</td>
</tr>
<tr>
<td>( \ldots )</td>
<td>( \ldots )</td>
<td>( \ldots )</td>
<td>( \ldots )</td>
<td>( \ldots )</td>
<td>( \ldots )</td>
</tr>
<tr>
<td>( W_{n} )</td>
<td>( U_{nm} )</td>
<td>( A_m )</td>
<td>( T_m )</td>
<td>( Y_m )</td>
<td>( P_m )</td>
</tr>
</tbody>
</table>

### V. NUMERICAL EXPERIMENT

This section provides a numerical experiment to exemplify the application of 3PL performance measurement. In this example, we assumed there are six KPIs (i.e. reliability, responsiveness, flexibility, assets and resources management, cost, and safety) which represent the internal indicator. Each KPI has a different weight value i.e. 0.23; 0.25; 0.07; 0.1; 0.2; 0.15; respectively. The weight shows the degree of importance of each KPI. In addition, each KPI also has a different number of indicators such that the sum of indicator’s weight is equal to 1. The actual and target data is generated randomly according normal distribution shown in equation (3), where \( x, \mu, \sigma \) denote the value of random variable, mean, and standard deviation, respectively [25]. Meanwhile, \( \pi \) denotes the constant value for phi i.e. 3.14.

\[
f(x) = \frac{1}{\sigma \sqrt{2\pi}} \exp \left(\frac{- (x-\mu)^2}{2\sigma^2}\right), \sigma > 0 \tag{3}
\]

### TABLE V
**NUMERICAL EXPERIMENT RESULT**

<table>
<thead>
<tr>
<th>KPI</th>
<th>PI</th>
<th>Actual</th>
<th>Target</th>
<th>Performance</th>
<th>Aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 0.23 )</td>
<td>0.4</td>
<td>45.73</td>
<td>43.59</td>
<td>5%</td>
<td>0.0045</td>
</tr>
<tr>
<td>( 0.2 )</td>
<td>0.25</td>
<td>50.95</td>
<td>49.99</td>
<td>24%</td>
<td>0.0112</td>
</tr>
<tr>
<td>( 0.15 )</td>
<td>0.45</td>
<td>49.95</td>
<td>43.44</td>
<td>15%</td>
<td>0.0052</td>
</tr>
<tr>
<td>( 0.25 )</td>
<td>0.25</td>
<td>43.72</td>
<td>49.17</td>
<td>-11%</td>
<td>-0.0064</td>
</tr>
<tr>
<td>( 0.25 )</td>
<td>0.25</td>
<td>47.89</td>
<td>49.39</td>
<td>-3%</td>
<td>-0.0019</td>
</tr>
<tr>
<td>( 0.1 )</td>
<td>0.25</td>
<td>50.18</td>
<td>43.92</td>
<td>14%</td>
<td>0.0036</td>
</tr>
<tr>
<td>( 0.15 )</td>
<td>0.25</td>
<td>43.96</td>
<td>50.17</td>
<td>12%</td>
<td>-0.0046</td>
</tr>
<tr>
<td>( 0.5 )</td>
<td>0.25</td>
<td>46.65</td>
<td>54.10</td>
<td>-14%</td>
<td>-0.0172</td>
</tr>
<tr>
<td>( 0.07 )</td>
<td>0.3</td>
<td>47.47</td>
<td>45.60</td>
<td>4%</td>
<td>0.0009</td>
</tr>
<tr>
<td>( 0.2 )</td>
<td>0.25</td>
<td>48.67</td>
<td>41.80</td>
<td>16%</td>
<td>0.0023</td>
</tr>
<tr>
<td>( 0.15 )</td>
<td>0.25</td>
<td>48.13</td>
<td>55.39</td>
<td>-13%</td>
<td>-0.0014</td>
</tr>
<tr>
<td>( 0.25 )</td>
<td>0.25</td>
<td>56.55</td>
<td>53.31</td>
<td>6%</td>
<td>0.0011</td>
</tr>
<tr>
<td>( 0.1 )</td>
<td>0.25</td>
<td>52.13</td>
<td>54.17</td>
<td>-4%</td>
<td>-0.0003</td>
</tr>
<tr>
<td>( 0.35 )</td>
<td>0.25</td>
<td>50.97</td>
<td>43.81</td>
<td>16%</td>
<td>0.0057</td>
</tr>
<tr>
<td>( 0.25 )</td>
<td>0.25</td>
<td>48.56</td>
<td>55.15</td>
<td>-12%</td>
<td>-0.0030</td>
</tr>
</tbody>
</table>
The experiment, herein, sets the parameter of random number generator by mean value to 50 and standard deviation to 5. Table V shows the experiment result. By means of the proposed approach, the average of aggregate performance is 0.0021 while the total performance value is found to be 0.494.

VI. CONCLUSION

This paper presents a development of conceptual framework towards the 3PL performance monitoring system. The study is accomplished through a qualitative study which reviews related works that has a relevancy to the performance measurement. A grounded-theory method is adopted to establish the conceptual framework. The study has revealed that there are six factors that influence the performance measurement towards the logistics provider as described in Table II. The proposed conceptual model consists of two consecutive stages i.e. building set of KPIs and measuring the performance. In addition, the numerical experiment shows the practical use of the proposed framework.

This research has two main contributions. First, the study fills the theoretical gap regarding to the concept of performance assessment systems specifically in case of 3PL companies. Second, the proposed conceptual framework contributes to the academia by describing the basis of establishing performance monitoring as well as to the practitioners who wish to better measure performance in the logistics transporter. Therefore, practically this framework offers an operative approach that can serve 3PL operation manager to plan, organize, execute, and evaluate their operational performance.

The study has a limitation owing to the fact that the study was still in conceptualization with more theoretical and using a qualitative approach, therefore, further research is required to prove the conceptual model, apply, and test empirically.

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