Designing Key Indicators for Measuring E-Commerce Supply Chain Performance

Wahyu Oktri Widyarto, Mohamad Jihan Shofa, Nugraheni Djamal

Abstract: *E-commerce usage grew up rapidly in the business sectors. Its interaction run virtually which is from upstream to downstream or reverse process. This interaction is a description of SCM. SC performance measurement was employed to determine the level of performance that can be considered in determining strategic policy. This research aims to propose KPIs' model for finance, information system and logistics capability dimensions in the e-commerce. The collecting of data was carried out by distributing questionnaires to respondents with amount of 100 questionnaires. In this research, the data was analyzed with the structural equation modeling (SEM) to test validity of KPI and hypotheses. As results in supply chain performance, 25 indicators are valid, involving 4 indicators on financial dimension, 9 indicators on logistic capability dimension, and 12 indicators on technology information dimension. Furthermore, this research finding is the logistic capabilities have significant effect on the financial aspect and information technology has a significant effect on logistics capabilities. This research finding may contribute on the development model of SC performance measurement.*

Keywords: *e-commerce, KPIs, Supply Chain Performance Measurement..*

I. INTRODUCTION

Industrial revolution era 4.0 as result of the internet of things (IoT) impact on the business process development [1] such as e-commerce. As consequence, many companies around the word adopt the e-commerce concept to create competitive advantage in the global market [1], while, the e-commerce interactions from upstream to downstream or reverse process run in virtual world [2].

Supply chain management (SCM) is an effective way for deliver products with speed, reliable and low cost [3]. It comes up with integrating upstream and downstream involved directly and indirectly parties [4]. In recent years, some world companies have been using SCM in managing they daily activities [5]. The success of SCM depends on planning and implementation in minimizing the gap between planing and implementation [6]. It makes fast process, low cost, and quality product [7]. In addition, good SCM promotes the companies of e-commerce to grow up the business [2].

To measure supply chain (SC) network, it is needed SC performance measurement [8]. SC performance is as a set of metrics and process in evaluating the accuracy of panning and implementation [6]. Performance improvement requires measurement of performance in advance which is used as a reference for supply chain performance [8]. It will make alignment the whole SC process in the way of communication and strategy of company in order to improve operations [9].

SC performance measurement need Key Performance Indicators (KPIs) [10]. While the recognition of metrics and operations in KPIs is an important step in achieving company management goals among the processes involved [11]. [11] In e - commerce, to manage supply chain effectively needs performance measurement and consequently the necessity to identify KPIs for measuring e-commerce supply chain performance.

Some research shows about SC performance measurement (e.g. [6], [8]). A few literature discuss about the indicator of measurement in e-commerce in partial dimension, such as information systems [12], logistic capabilities [2], [13] and finance [14]. In addition, [15] integrate the key indicators for measuring SC performance.

The measurement of SC performance in e-commerce remains challenging due to the partial dimension of KPIs generally conducted in the non-e-commerce company. Thus, this research fills this gap by validating the KPIs for measuring SC performance in e-commerce based on financial status, logistic capability and technology dimension.

II. LITERATURE REVIEW

A. E-Commerce

E-commerce refers to online services for selling and purchasing. The goal is to create and modify business relationships in order to make business transactions simpler and more efficient [14]. In general, e-commerce is an activity between sell and purchase that includes information, products and services over the internet [14]. According to [12], E-commerce is a business activity that facilitates, manages and performs online business transactions.

E-Commerce provides benefits for companies in increasing efficiency, reducing inventory cost, enhancing customers, penetrating new markets, and financial returns [16].

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E-commerce helps the company to understand consumer needs and creates faster and more accurate services the consumers. With the internet, e-commerce is more powerful to develop and enhance cooperation with suppliers [17].

E-Commerce calls for a new approach to logistics. Logistic operations are generally small order sizes, increased average order volume, limited packet distribution and day delivery. Nevertheless, it is such a complex task to deliver the goods from the supplier to the consumer on time. And the company's goal in e-commerce is the distribution network's efficiency [2]. At the e-commerce, there is information exchanges across elcetronic network of supply chain. Evans 2002.

E-commerce consist of two types that are business to consumer (B2C) and business to business (B2B) [18]. In detail, e-commerce could be classified in five types. They are Customer to Customer (C2C), Business to Customer (B2C), Business in Business (BIB), and Business to Business (B2B). B2B is the most popular than the others [19].

B. Measuring SC Performance

Involving many parties on a complex SC structure both internal and external can be a problems when the company does not find out SC performance has been achieved. [20]. The selecting of measuring SC is important because managers should evaluate on various aspects. The right SC strategy may not be generalized because it needs syncronize between SC strategy and product characteristics [21]. Meanwhile, reference [5] states that an important things in measuring SC is synchronization of strategy between competitive performance and SC strategy. So that the alignment between competitive performance with market strategies and the position of actors needs to be done to achieve effective performance.

Measurement of SC performance for companies need to be carry out to reduce costs, accomplish customer satisfaction, increase company profit, and to find out achievement of SC performance [20]. Perfomance measurement evaluation in all of SC should be done to realize eficient SC [3]. Monitoring to ensure accordance of implementation with plan is an important in operational performance and SCM success [6]. Performance measurement is very important for successfull SCM. Ineffective on measurement of performance will be never show the conformity needed in the SC [8].

III. METHODOLOGY

This research concerned on designing key performance indicators in e-commerce. The initial stage of this research is identify the variables and KPI's to measure SC performance in e-commerce. And then, the relationship of each variable is sought. The second stage is designing of the questionnaires based on the variables and KPI's. We used three variables in this research. As shown in Table 1, the variables involved financial (four indicators), logistics capability (nine indicators), and information technology (twelve indicators). Reference [15] conducted literature review for KPIs on the e-commerce SC performance measurement. And the KPIs as shown in table 1.

The third stage is data collection which is conducted by distributing questionnaires to e-commerce entrepreneurs. In this research, 135 questionnaires were distributed and 100 questionnaires were successfully obtained. The last stage is data processing in which performed by conducting statistical tests that include validity, reliability, and structural model assessments using the smartPLS application.

Table I. KPIs for Measuring E-Commerce SC Performance that Developed from [15]

Dimension	Indicator	Code
Finance	Increasing in profitability	F1
	Profit in sales	F2
	Return on investment	F3
	Reduction of operational costs	F4
Logistic capability	Pre-Sale Customer service	K 1
	After-sales service	K 2
	Delivery speed	K 3
	Delivery reliability	K 4
	Responsive to target market	K 5
	Low distribution costs	K 6
	Inventory management	K 7
	Payment process	K 8
	Order tracking status	K 9
Information - technology	Ability to share information with externals users	T 1
	Booking system	T 2
	Information Technology Infrastructure	T 3
	Ease of use of web site	T 4
	Web site design	T 5
	Electronic Data Interchange	T 6
	Data Consistency	T 7
	Human Resource Skills on IT	T 8
	Information system security	T 9
	Internet service provider	T 10
	Information technology investment	T 11
	Ability to share information with internal users	T 12

IV. RESULT

The distribution of questionnaires was carried out in order to collect data to support this research. Respondents are business actors who use e-commerce in their business.

130 questionnaires have been distributed, and 100 respondents were successfully obtained who filled out the questionnaire and then the data will be processed. The Initial model is developed as depicted in Fig. 1.
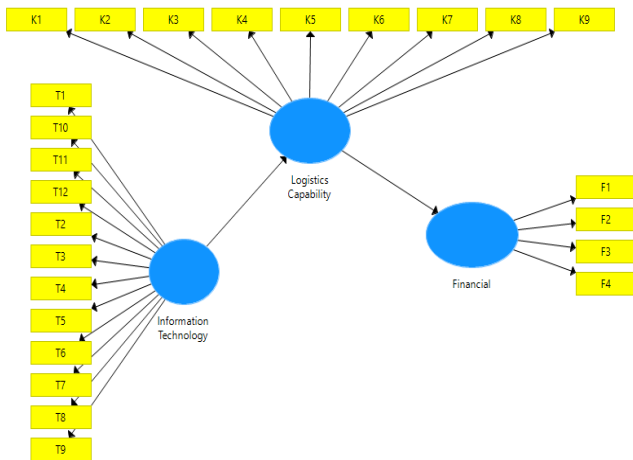

Figure 1. Initial Model of relationship among variables and indicators

Based on the initial model, we create hypotesis formulation, as follow:

H1 : logistic capabilities has significant effect on financial

H2 : information technology has significant effect on logistic capabilities.

Model evaluation of this study is conducted by evaluating the outer and inner model. An outer model evaluation is performed to evaluate the construct of validity and reliability. Validity is done with convergent and discriminant validity. In this paper, we use convergent validity in term of the factor loading parameters, Average Variance Extracted (AVE), and communality. Whereas discriminant validity uses the cross loading parameter or compares the squares roof of AVE value with the correlation of latent variables [22]. For reliability testing, it is carried out with composite reliability. And evaluation of the inner model is performed with the parameters R-square and Q-square [23].

The parameters used for convergent validity are loading factor and AVE. According to [24], an indicator is valid, if the loading factor value is higher than 0.7 but the indicator with a loading factor value of 0.5 to 0.6 is still acceptable. For AVE, the indicator is valid if the AVE value is higher than 0.5 [23]. As shown in Table 2, all indicators (SC performance, logistic capabilities) are valid.

Then, discriminant validity is conducted by comparing the AVE root value with the correlation of latent variables. If the AVE root value is greater than the correlation variable, a variable is valid. The findings of discriminate validity are shown in Table 3.

The criteria used in the performance analysis are the alpha and composite reliability of cronbach. A build is reliable if the alpha value of the cronbach and the composite quality exceed 0.6 [22]. As shown in Table 4, Cronbach's alfa and composite reliability for three variables are reliable respectively financial (0.91; 0.94), logistic capabilities (0.96; 0.97), and information technology (0.93; 0.93).

4.1 Goodness of fit Measurement Model

Table II. Convergent Validity

Variable	AVE	Indicator	Load. Factor	Variable	AVE	Indicator	Load. Factor
Financial	0.79	F1	0.94	Information technology	0.52	T 1	0.59
		F2	0.96			T 2	0.84
		F3	0.85			T 3	0.80
		F4	0.78			T 4	0.56
Logistic capability	0.77	K 1	0.94			T 5	0.78
		K 2	0.89			T 6	0.69
		K 3	0.85			T 7	058
		K 4	0.89			T 8	0.72
		K 5	0.90			T 9	0.76
		K 6	0.74			T 10	0.60
		K 7	0.89			T 11	0.88
		K 8	0.88			T 12	0.73
		K 9	0.92				

Table III. Discriminant validity

Variable	AVE root value	Corr.
Financial	0.88	0.75
Logistic capability	0.88	0.86
Information technology	0.72	0.63

Tabel IV. Reliability

Variable	Cronbach's Alpha	Composite Reliability
Financial	0.91	0.94
Kapabilitas Logistik	0.96	0.97
Information technology	0.93	0.93

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Additionally, this research uses inner evaluation model. The determination coefficient is intended to measure the severity of the ability of the model to explain the variance of the dependent variable. The value of the coefficient of determination is between 0 and 1. [24].

As a result, the coefficient of determination of the financial is 74% which means that 74% the financial influenced by the construct of logistics capabilities. The coefficient of determination of the logistical capability is 57%, it means that 57 % the logistic capability is influenced by information technology.

4.2 Hypothesis of Research

SmartPLS uses a non-parametric test to determine the significant path coefficient level, where the value generated by t (t-test) is used to determine whether or not the hypothesis is accepted. The level of significance (α) indicates the probability or chance of error set by the researcher in making a decision to reject or support the hypothesis null. a significance level of 5 percent is used in this study, with a degree of freedom (df) 97, t table value 1.660 can be obtained. If t-statistic >1.660, the result is that the independent variable has a significant effect on the dependent variable. And if t-Statistic <1.660 then the independent variable has no significant effect on the dependent variable [24].

Based on the results of this hypothesis (Table V), H1 can be accepted which means that the logistical capabilities significant effect on the improvement of financial aspects in supply chain performance. Hypothesis (H2) is accepted which means that information technology has a significant effect on improving aspects of logistics capabilities.

Table V. T-test

Item	t-statistics	t-table	Result
H1	33.76	1.660	Accepted
H2	19.50		Accepted

The results of data processing with helping of smartPLS depict in figure 2.
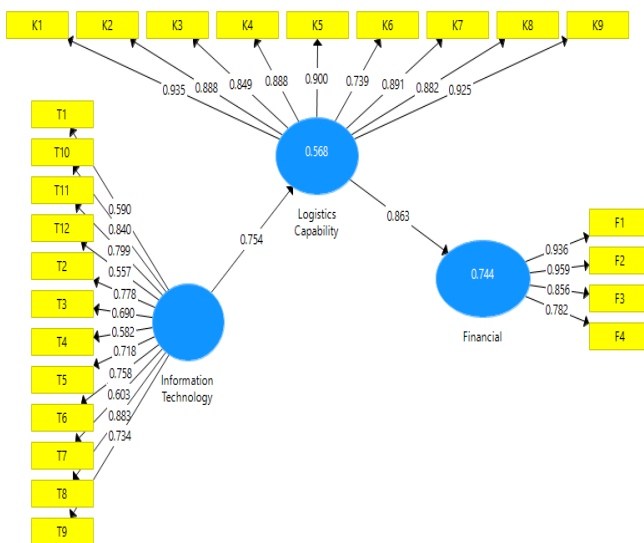

Figure 2. Result Model with PLS

V. CONCLUSION

E-commerce must be attention in business process evaluation, namely KPIs of supply chain performance measurement. The KPIs of Supply chain performance measurement in e-commerce could be done with dimension of financial, logistic capabilities and information technology. These dimensions have been validated by this research using SEM. This research concludes that in supply chain performance measurement, the dimension logistic capabilities have significant effect on the financial, and also information technology has a significant effect on logistics capabilities. Based on the validity test obtain that 25 indicators are valid (4 indicators in financial, 9 indicators in logistic capability, and 12 indicators in technology information).

The result of the hypothesis and KPI's validity are expected to be an approach in the measurment of SC in e-commerce as the development of SC performance measurement. For further research project is needed to conduct a measurement of supply chain performance on e-commerce with various dimension.

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