CONSTRUCTION OF COLLABORATION MODEL OF SUPPLY CHAIN MANAGEMENT ON BUSINESS PERFORMANCE AND SUSTAINABLE COMPETITIVE ADVANTAGE USING STRUCTURAL EQUATION MODELING (SEM) METHOD

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Abstract. Supply chain management strategies can be used to collaborate between members of the supply chain through supply chain collaboration (SCC). Supply chain collaboration can be made using Structural Equation Modeling (SEM). SEM is a statistical modeling technique to test the relationship between complex variables to obtain a comprehensive picture of the overall model. The method in this study is included in the type of causal research, where the population involves all ICON + employees from the group leader level to managers and employees who have and know the process of procurement of goods and services. The size of the sample is based on the maximum likelihood, which is greater than or equal to 100. The results of this study show 6 hypotheses proposed by the researchers. The result is 1 non-significant variable as a factor affecting supply chain collaboration, namely the Trust variable, while Communication, Commitment and Dependency have a significant influence on collaboration supply chain, the results of this study also answer research gaps previously carried out by (Stefany et al., 2014) which state that dependence has no significant effect on supply chain collaboration.

Keywords: Supply Chain Collaboration, Structural Equation Modeling

I. Introduction

In this era of globalization, it is undeniable that the need for access to digital information is very important for human life, especially for a company agency. The development of the information and communication technology industry needs to take advantage of this opportunity to innovate and create product infrastructure and broadband-based services to support the government’s plan towards the digital economy era. The presence of PT. Indonesia Comnet Plus (or hereinafter referred to as ICON +) as a subsidiary of PT. PLN (Persero) has a mission to fulfill the needs and expectations of providing the best IT service solutions. This mission is in the form of project planning, telecommunications network providers, providers of telecommunications equipment and services, providers of software and hardware, computer systems and data processing facilities related to technology, transmission, contact services, power stations, and distribution.

Stefany et al. (2014), Mamad et al. (2013), Y. Gusti (2018), Hudnurkar, M et al. (2014), and Munizu, M (2015) explain that supply chain collaboration is built through trust, commitment, dependency, long-term relationships, open information sharing, discussing processes and systems, and harmonizing incentives. Currently ICON + builds collaboration only based on the lowest price. Even if the company in collaborating with its supply chain members does not pay attention to the above factors can lead to short-term cooperative relationships, the difficulty of solving problems together due to the lack of relational relationships and several other impacts that can reduce company performance.
Through an effective and appropriate supply chain management strategy, the service process for consumers will be smoother and ultimately increase ICON+'s competitiveness as a result of sustainable competitive advantage. The supply chain management strategy that can be used to realize this is by collaborating between members of the supply chain through supply chain collaboration (SCC). The formation of this collaboration was designed through the concentration of SCC factors between the company and its suppliers from the Buyer’s point of view so that later it can be found out which factors are not significant and which factors are significant.

Based on this background, the authors are interested in making the construction structure model of the influence and relationship of supply chain collaboration factors using Structural Equation Modeling (SEM), so that the company is expected to begin to pay attention to factors that significantly influence supply chain collaboration to determine the strategy cooperation with suppliers. In addition, it can benefit companies in improving business performance oriented towards sustainable competitive advantage in maintaining 2,200 customers that have spread throughout Indonesia and strengthen collaborative relationships between members of the upstream supply chain.

II. Theory

2.1. Supply Chain Collaboration

Partnership relations, in the context of the supply chain, have a long-term orientation born of the relational approach. If seen based on the type of relationship that exists, this partnership relationship is divided into contractual, cooperative, collaborative and alliance relationships. Ferrer et al. (2013) view the type of collaboration relationship as a more lasting relationship where each party seeks to bring the organization to a new structure with full commitment, the same vision and mission and a higher level of trust. Simatupang & Sridharan (2015) describe the concept of SCC measured from three interrelated dimensions, namely information sharing, decision synchronization and incentive alignment. Information sharing refers to the extent to which supply chain members share personal information about operational activities from time to time. The main point of information sharing is how the information obtained must be used to make better decisions (Frankel et al., 2015). Decision synchronization refers to joint decision making in the context of planning and operational level. While the incentive alignment shows the extent to which supply chain members share losses, risks and benefits.

2.2. Structural Equation Modeling (SEM)

Structural Equation Model (SEM) is a statistical modeling technique to test the relationship between complex variables to obtain a comprehensive picture of the overall model. SEM is known by various terms, including covariance structure analysis, latent variable analysis, LISREL models and AMOS models. SEM testing is actually not only using Amos software, there are other software that can be used, namely PLS software, but the drawback is the maximum amount of data used is 30 respondents so the results are not necessarily good enough to represent the population.

2.3. Data Analysis Techniques

The data analysis technique used to discuss the problems in this study is the Structural Equation Model (SEM). A Structural Equation Model is a statistical technique that allows testing of a relatively complex set of relationships simultaneously. Complex relationships can be established between one or several dependent variables with one or several independent variables. There may also be a variable that plays a
dual role, namely as an independent variable in a relationship, but becomes a dependent variable on another relationship given a tiered causality relationship. Each dependent and independent variable can take the form of a factor or construct that is constructed from several indicator variables. Likewise, among these variables can be a single variable observed or measured directly in a research process. Such a Structural Equation model has been widely known in social studies through various names including: causal modeling, causal analysis, simultaneous equation modeling or analysis of covariance structure. Often SEM is also called Path Analysis or Confirmatory Factor Analysis, because actually these two names are special types of SEM. Examples of flow diagrams or path diagrams in which diagrams are very fundamental in SEM, because these diagrams allow researchers to describe relationships. hypothesized relationship that is called the model. These diagrams are very important for a researcher because visually the diagrams explain the flow of research ideas regarding the relationship between variables, then they are directly translated into the equations needed to test the hypothesis.

2.4. Model Testing
To make a complete modeling the following steps need to be done, as follows:
- Theory-Based Model Development
  The first step in developing a SEM model is search or development of a model that has strong theoretical justifications. After that the model is validated empirically through SEM. Therefore, in developing the theoretical model, a researcher must carry out a series of scientific explorations through intense literature to obtain justification for the theoretical model he developed.
- Compilation of Path Diagrams
  The theoretical model that has been built will be depicted in a path diagram that will make it easier for researchers to see the causal relationships that they want to test. We know that causal relationships are usually expressed in terms of equations but in SEM the causality relationship is sufficiently illustrated in a path diagram and then the program language will convert the image into equations and equations into estimates. In building a path diagram, the relationship between constructs is shown by a line of arrows that shows a regression relationship from one construct to another. A line with two arrows shows a correlation between constructs.

III. Research Methods
This research is included in the type of causal research which is a study designed to measure a causal relationship between research variables, and identify and show the direction of relations between these variables, where this relationship will later be described using structural equation modeling. This alleged model was formed through the study of international journal literature along with other literature studies, later this model will be confirmed to the respondents to see the significance of the model. The size of the sample is based on the maximum likelihood which is greater than or equal to 100. The data collection technique used in this study is using a questionnaire. Where questions are arranged in tables using a Likert scale.

The preparation begins with drafting a construction model of the Supply chain collaboration in structural equation modeling (SEM). The SEM model in this study was built on the theoretical framework proposed by several researchers such as Stefany et al. (2014), Mamad et al. (2013), Y. Gusti (2018), Hudnurkar, M et al. (2014), and Munizu, M (2015) which explain that supply chain collaboration is built on trust, commitment, dependence, long-term relationships, sharing information and openly discussing processes and systems, and incentive alignment. Based on the framework of supply chain collaboration
factors above, the following is the SEM model that was prepared for PT. ICON + is based on the results of the literature study and interviews with the experts at the company:

IV. RESULTS AND DISCUSSION
A. Development of a Measurement Model Flow Chart

The theoretical model that has been built in the operational definition section of the variable is depicted in a path diagram that will make it easier for researchers to see the causal relationship that they want to test. We know that a causal relationship is usually expressed in terms of equations but in SEM the causality relationship is sufficiently illustrated in a path diagram and then the program language will convert the image into equations and equations into estimates.

![Figure 4.1 Output Measurement Model](Source: Data Processing, 2018)

Goodness of Fit Measurement Test Model

The results of the Good of Fit and Cut Off Value values, show the model reflects the latent variables analyzed. Tests are carried out using critical indigo parameters where the summary results of the test results can be seen in Table 4.26 below

| Criteria          | Model Test Results | Critical Value | Conclusion |
|-------------------|--------------------|----------------|------------|
| $\chi^2$ (Chi square) | 215,989            | Small, $\chi^2$ with df = 209 $\leq 0.05$ equal 243.7272 | Marginal   |
| Probability       | 0.355              | $\geq 0.05$    | Good       |
| Cmin/DF           | 1.033              | $\geq 2.00$    | Good       |
| RMSEA             | 0.018              | $\geq 0.08$    | Good       |
| GFI               | 0.852              | $\geq 0.90$    | Marginal   |
| AGFI              | 0.805              | $\geq 0.90$    | Marginal   |
| CFI               | 0.993              | $\geq 0.95$    | Good       |
| TLI               | 0.992              | $\geq 0.95$    | Good       |

(Source: Data Processing, 2018)
From Table 4.26, it can be seen that all the goodness of fit parameters produced by the model have met the standards set by SEM, that is, at least having marginal information to good, so it can be concluded that the indicators used in this model are significantly dimensions of latent variables formed.

To see the relationship between variables whether positive or negative can be seen in the Standardize Reg column. Weight (\(\beta\)). If there is no "-" sign then the relationship between these variables is positive. The required lambda value is \(\lambda\) ≥ 0.40, if the lambda value or loading factor is less than 0.40 then the variable is not dimensioned equal to other variables to explain a latent variable.

**Validity Test of the Measurement Model**

Validity testing is assessed from the measurement model developed in this study by determining whether each estimated indicator validly measures the dimensions of the concept being tested. If each indicator has CR > 2.SE, this shows that the indicator validly measures what is actually measured in the model presented.

**Table 4.2. Regression Weights Measurement Model**

|        | Estimate | S.E. | C.R. | P  | Standardized Reg. Weight (\(\beta\)) |
|--------|----------|------|------|----|-------------------------------------|
| Y1.1   | \(<---\) Y1 | 1,000 |      |    | .803                                |
| Y1.2   | \(<---\) Y1 | .936  | .120 | 7.824 | *** | .733                                |
| Y1.3   | \(<---\) Y1 | .905  | .126 | 7.171 | *** | .699                                |
| X1.3   | \(<---\) X1 | .967  | .168 | 5.764 | *** | .639                                |
| X1.2   | \(<---\) X1 | .946  | .174 | 5.438 | *** | .663                                |
| X1.1   | \(<---\) X1 | 1,000 |      |    | .735                                |
| X2.3   | \(<---\) X2 | 1,049 | .143 | 7.308 | *** | .804                                |
| X2.2   | \(<---\) X2 | 1,047 | .146 | 7.181 | *** | .819                                |
| X2.1   | \(<---\) X2 | 1,000 |      |    | .738                                |
| X3.3   | \(<---\) X3 | .899  | .098 | 9.183 | *** | .803                                |
| X3.2   | \(<---\) X3 | .747  | .103 | 7.264 | *** | .689                                |
| X3.1   | \(<---\) X3 | 1,000 |      |    | .891                                |
| X1.4   | \(<---\) X1 | 1,104 | .166 | 6.655 | *** | .799                                |
| X4.2   | \(<---\) X4 | 1,440 | .390 | 3.689 | *** | .850                                |
| X4.1   | \(<---\) X4 | 1,000 |      |    | .643                                |
| Y2.1   | \(<---\) Y2 | 1,000 |      |    | .761                                |
| Y2.2   | \(<---\) Y2 | 1,098 | .157 | 6.980 | *** | .698                                |
| Y2.3   | \(<---\) Y2 | 1,029 | .140 | 7.343 | *** | .730                                |
| Y3.1   | \(<---\) Y3 | 1,000 |      |    | .832                                |
| Y3.2   | \(<---\) Y3 | .956  | .109 | 8.788 | *** | .799                                |
| Y3.3   | \(<---\) Y3 | 1,114 | .112 | 9.958 | *** | .869                                |
| Y2.4   | \(<---\) Y2 | 1,072 | .139 | 7.719 | *** | .770                                |
| Y2.5   | \(<---\) Y2 | 1,143 | .141 | 8.128 | *** | .791                                |

(Source: Data Processing, 2018)

From Table 4.28 above, all indicators have a value of CR > 2.SE which means the estimated indicators validly measure the dimensions of the concept being tested (Anderson & Gerbing, 1988) quoted from (Waluyo, 2016: 92).
Test of Measurement Significance Model

A variable can be used to confirm a latent variable together with other variables using analysis as follows: Weight (Regression Weight)

The strength of the dimensions in forming latent variables can be analyzed using the t-test on regression weight, which can be seen in Table 4.28. From the t-table it can be seen that df = 23 (number of indicators) \( t_{\text{table}} = 0.025 \) obtained \( t_{\text{table}} = 2.0686 \). So that CR > \( t_{\text{table}} \) (2.0686) this means that it can be concluded that these indicators are significantly dimensions of variables latent formed.

B. Structural Equations (Structural Models)

| Tabel 4.3. Standardized Regression Weights Structural Model | Estimate |
|----------------------------------------------------------|----------|
| Y1 \( \leftarrow \) X2                                 | .381     |
| Y1 \( \leftarrow \) X3                                 | .255     |
| Y1 \( \leftarrow \) X4                                 | .307     |
| Y1 \( \leftarrow \) X1                                 | .101     |
| Y2 \( \leftarrow \) Y1                                 | .969     |
| Y3 \( \leftarrow \) Y2                                 | .599     |

(Source: Data Processing, 2018)

Select the Input Matrix and Estimation Technique

After the model is specified in full as in the previous chapters, the next step is to choose the appropriate type of input namely covariance or correlation. If the causal relationship is tested, the type of input used is covariance (Waluyo, 2016) because in this study we will test the causality relationship, then covariance is used as input for SEM operations. The estimation technique used is the maximum likelihood estimation method which has become the default of the AMOS 24 program.

Figure 4.2. Output Structural Model
(Source: Data Processing, 2018)
After the measurement model is analyzed through confirmatory factor analysis and results in convergent validity and discriminant validity, a full SEM model can be analyzed. This analysis is used to determine the effect of the relationship of Trust, Communication, Commitment, Dependence on Supply Chain Collaboration and Business Performance oriented towards Sustainable Competitive Advantages. This analysis was indeed created to solve problems or complicated models solved by other analyzes, as well as in confirmatory factor analysis structural equation modeling testing. This technique is intended to estimate measurement models to test the undimensionality of exogenous constructs and endogenous constructs.

**Goodness Of Fit Structural Model Test**

Testing is done by using parameters at critical values, where the results of the goodness of fit can be summarized as in Table 4.4 below:

| Criteria     | Model test results | Critical Value | Conclusion |
|--------------|--------------------|----------------|------------|
| $\chi^2$ (Chi square) | 412,641            | Small, $\chi^2$ with df = 218, $\chi^2$ = 0.05, equal 253.4445 | Good |
| Probability  | 0.097              | $p > 0.05$     | Good       |
| Cmin/DF      | 1.126              | $0.00 < 2.00$  | Good       |
| RMSEA        | 0.036              | $0.08 > 0.00$  | Good       |
| GFI          | 0.838              | $0.90 > 0.00$  | Marginal   |
| AGFI         | 0.794              | $0.90 > 0.00$  | Marginal   |
| CFI          | 0.974              | $0.95 > 0.00$  | Good       |
| TLI          | 0.970              | $0.95 > 0.00$  | Good       |

(Source: Data Processing, 2018)

**V. Conclusion**

The results of this study show that the 6 hypotheses proposed by the researcher are 1 non-significant variable as a factor that influences supply chain collaboration, namely the Trust variable, whereas Communication, Commitment and Dependency have a significant influence on supply chain collaboration, the results of this study also answer the research gaps previously carried out by (Stefany et al., 2014) which states that dependence does not have a significant effect on supply chain collaboration.

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