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Supply Chain Management Strategy Research Quantitative Analysis: Comparing of Smart-PLS and SPSS Results

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Abstract. Many researchers are unsure which software to use for quantitative research data analysis because there is no research comparing different software options. This study aims to compare the results of using Smart-PLS and SPSS software for analyzing quantitative data in the field of supply chain management. The study analyzed data from 231 respondents using questionnaires with three variables: lean supply chain strategy, agile supply chain strategy, and sustainable performance. The analysis focused on hypothesis testing and regression analysis, which measures the influence of independent variables on dependent variables. The study found that both Smart-PLS and SPSS software produced significant results in terms of p-value, t-value, determination value, and correlation value. This research is unique because it provides a comparative analysis of Smart-PLS and SPSS software.

Keywords: Lean supply chain strategy, agile supply chain strategy, sustainable performance.

INTRODUCTION

There are many statistical software options available, each with their own unique features. The choice of software depends on factors such as the research question, statistical knowledge, and coding experience. However, the quality of data obtained from the research depends on how well the study is conducted, not just the software used. Data analysis is an important step in the research process, and using the right analytical tools is crucial for accurate conclusions. For researchers in fields like operation management and supply chain management, statistical software tools like Smart-PLS and SPSS are commonly used. It is important for researchers to have a good understanding of different analytical techniques to ensure their research results are meaningful and scientifically justified.

Smart PLS is a statistical software that shares the same purpose as other similar software like LISREL and AMOS, which is to test the relationships between variables, both among latent and indicator variables. It is recommended to use Smart PLS when there is a limited number of samples and the model being built is complex. This is not possible with the other software mentioned, which require a sufficient number of samples. Smart PLS is commonly used in supply chain management research, as evidenced by various studies conducted by different researchers. For example, [1] studied impact of lean and agile strategies on supply chain risk management, while [2] investigated the effects of sustainable practices and managers' leadership competences on sustainability performance of construction firms. [3] examined the effect of lean and agile supply chain strategy on financial performance with mediating of strategic supplier integration and strategic customer integration, and [4] studied pursuing green growth in technology firms through the connections between environmental innovation and sustainable business performance. Other researchers

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have also used Smart PLS to study different aspects of performance, such as the mediating effect of green innovation on the relationship between green supply chain management and environmental performance [5], impact of lean manufacturing practices on firms' sustainable performance [6], and the relationship between internal lean practices and sustainable performance: exploring the mediating role of social performance [7]. Environmental scanning, supply chain integration, responsiveness, and operational performance [8], while others have explored the effect of supply chain agility on export performance [9]. Finally,[10] investigating and analyzing the supply chain practices and performance in agro - food industry.

SPSS, which stands for Statistical Package for the Social Sciences, is a software application that enables researchers to conduct advanced statistical analysis, including data analysis using machine learning algorithms, string analysis, and big data analysis. It is widely recognized as one of the most commonly used programs for quantitative research. In order to produce comprehensive data analysis, it is essential for researchers to be familiar with the capabilities and functions of SPSS. The program was developed to simplify the process of organizing and analyzing data according to established methods. Its latest version, SPSS 25, was released in 2019. In the field of supply chain management, numerous studies have utilized SPSS, such as those conducted by [11] examining The effect of supply chain management practices on supply chain and manufacturing firms' performance; [12] exploring Effects of green supply chain management practices on sustainability performance; [13] investigating the effects of supply chain strategies on supply chain performance of Malaysian manufacturing companies; [14] examining Sustainable supply chain management practices, supply chain dynamic capabilities, and enterprise performance.

METHODS

This study employs a quantitative research method, utilizing Smart-PLS and SPSS software for data analysis to compare the results. The primary focus of this analysis is hypothesis testing and regression analysis, which helps measure the impact of the independent variables on the dependent variable. The study collects quantitative data through questionnaires, with a sample size of 231 respondents, and comprises of three variables, namely lean supply chain strategy, agile supply chain strategy, and sustainable performance, developed from [15], [16], [6], and [3]. The research model used is presented below:

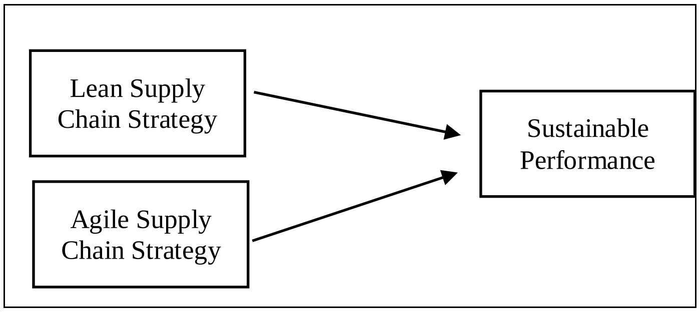

FIGURE 1. Research Model

X1 is Lean Supply Chain Strategy, X2 is Agile Supply Chain Strategy, and Y is sustainable Performance. The relationship models to be analyzed are as follows:

1. The relationship between Lean Supply Chain Strategy (X1) and Sustainable Performance (Y1).
2. The relationship between Agile supply chain Strategy (X2) and Sustainable Performance (Y).

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RESULTS AND DISCUSSION

TESTING THE SIGNIFICANCE OF T-VALUE

The first stage of data analysis is testing the significance of the relationship between the independent variable lean supply chain strategy (X1), agile supply chain strategy (X2) with the dependent variable sustainable performance (Y) by looking for t-Value using Smart-PLS and SPSS, the decision criteria if the t-Value value is greater than 1.96 or > 1.96 then the relationship is significant, if less than 1.96 or < 1.96 then the relationship is not significant. The test results with 2 software for a direct relationship can be seen in Table 1 below:

TABLE 1. Comparison of t-Value Result

Construct	SPSS	Smart-PLS	Results
LSC-SP	3.914	3.346	Significant
ASC-SP	5.952	11.164	Significant

Relationship between lean supply chain strategy (X1) and sustainable performance (Y)

Based on the results of the software analysis, the results of the t-Value using Smart-PLS is 3.346, which is greater than 1.96, so it can be concluded that the relationship between X1 and Y is significant. The result of t-Value using SPSS is 3.914 which is greater than 1.96 so that it can be concluded that the relationship is significant so that it can be concluded that Smart-PLS and SPSS give the same results.

Relationship between agile supply chain strategy (X2) and sustainable performance (Y)

Relationship between agile supply chain strategy (X2) and sustainable performance (Y). The t-Value using Smart-PLS is 11.164, which is greater than 1.96, so it can be concluded that the relationship between X2 and Y is significant. The results of the t-Value using SPSS of 5.952 are greater than1.96 so that it can be concluded that the relationship between X2 and Y is significant, so it can be concluded that Smart-PLS and SPSS give the same results.

Testing the Significance of p-Value

The second stage is data analysis, namely testing the significance of the relationship between the independent variable lean supply chain strategy (X1), agile supply chain strategy (X2) with the dependent variable sustainable performance (Y) by looking for p-value using SPSS, and Smart-PLS software. The decision is that if the p-value is less than 0.050 or <0.050 then the relationship is significant, if it is more than 0.050 or >0.050 then the relationship is not significant. The test results with 4 software for direct connection are as follows:

TABLE 2. Comparison of p-Value

Construct	SPSS	Smart-PLS	Results
LSC-SP	0.000	0.001	Significant
ASC-SP	0.000	0.000	Significant

The relationship between Lean Supply Chain Strategy (X1) and Sustainable Performance (Y)

Relationship between lean supply chain strategy (X1) and sustainable performance (Y) Based on the results of the software analysis, the p-value results using Smart-PLS is 0.001 less than 0.050 so it can be concluded that the relationship between X1 and Y is significant. The p-value using SPSS is 0.000 less than 0.050, so it can be concluded

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that the relationship between X1 and Y is significant, so it can be concluded that Smart-PLS and SPSS give the same results.

The relationship between Agile Supply Chain (X2) and Sustainable Performance (Y)

Based on the results of the software analysis, the p-value results using Smart-PLS is 0.000 which is smaller than 0.050, so it can be concluded that the relationship between X2 and Y is significant. The result of the p-value using SPSS is 0.000 less than 0.050 so it can be concluded that the relationship between X2 and Y is significant t so that it can be concluded that Smart-PLS and SPSS give the same result.

Coefficient of Determination Test

Testing the coefficient of determination to calculate the influence of the independent variable on the dependent variable. In this study, the R Square determination coefficient was calculated for the independent variables of lean supply chain strategy (X1), agile supply chain strategy (X2) and sustainable performance (Y). The results of the R Square test using Smart-PLS and SPSS are as follows:

TABLE 3. Comparison R-Square Result

Construct	SPSS	Smart-PLS	Results
Y	0.658	0.573	Significant

Based on the results in Table 3, the R Square value for sustainable performance (Y) using Smart-PLS is 0.573 or 57.3%, meaning that the sustainable performance variable (Y) is influenced by the lean supply chain strategy variable (X1) and agile supply chain strategy (X2) of 57.3% while the remaining 42.7% is influenced by other variables that are not discussed in this study. The R Square value for sustainable performance (Y) using SPSS is 0.658 or 65.8%, meaning that the sustainable firm performance (Y) is influenced by the lean supply chain strategy variable (X1) and agile supply chain strategy (X2) by 65.8% while the remaining 34.2% is influenced by other variables not discussed in this study.

Correlation Coefficient Test

According to [17] stated the correlation coefficient shows the strength of the linear relationship and the direction of the relationship between variables. If the correlation coefficient is positive, then the two variables have a unidirectional relationship. This means that if the value of the variable X is high, then the value of the variable Y will be high as well. Conversely, if the correlation coefficient is negative, then the two variables have an inverse relationship. This means that if the value of the variable X is high, then the value of the variable Y will be low and vice versa. Meanwhile, [18] to make it easier to interpret the strength of the relationship between two variables, the following criteria are provided:

• 0 means There is no correlation between two variables
• >0.00 – 0.25 means the correlation is very weak
• > 0.25 – 0.50 means enough correlation
• >0.50 – 0.75 means strong correlation
• > 0.75 – 0.99 means the correlation is very strong
• 1.00 means perfect correlation

The results of testing the correlation coefficient for structural equations using Smart-PLS and SPSS software are as follows:

TABLE 4. Comparison of Structural Equation Result

Software	Equation
SPSS	Y=a + 0.287 + 0.526 X1 + 0.637 X2 + e

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Smart-PLS	Y=a + 0.732 X2 + 0.796 X2 + e

The results of the structural equation using SPSS software obtained the equation is Y=0.287 + 0.526X1+ 0.637X2 + e, meaning that the correlation coefficient value of the influence of lean supply chain strategy as variable (X1) on sustainable performance (Y) is 0.526, meaning that there is a strong correlation and indicates that if the value of lean supply chain strategy (X1) increases by 1 unit, while the value of agile supply chain strategy (X2) remains, the sustainable performance value (Y) will increase by 0.637 units plus a constant of 0,287 units. This means that the partial effect of lean supply chain strategy on sustainable performance is 52.6%. The correlation coefficient value of the influence of agile supply chain strategy variable (X2) on sustainable performance (Y) is 0.637, meaning that there is a sufficient correlation and indicates that if the value of agile supply chain strategy (X2) increases by 1 unit, while the value of lean supply chain strategy (X1) remains, the sustainable performance value (Y) will increase by 0.637 units plus the constant 0.287 units. This means that the effect of agile supply chain strategy (X2) on sustainable performance partially is 63.7%.

The results of the structural equation using Smart-PLS software obtained the equation is Y = 0.732X1+0.796X2+e, meaning that the correlation coefficient value of the influence of lean supply chain strategy variable (X1) on sustainable performance (Y) is 0.732, meaning that there is a strong correlation and indicates that if the value of lean supply chain strategy (X1) increases by 1 unit, while the value of agile supply chain strategy (X2) remains, the performance value (Y) will increase by 0.796 units. This means that the partial effect of lean supply chain strategy on sustainable performance is 73.2%. The correlation coefficient value of the influence of agile supply chain strategy (X2) on sustainable performance (Y) is 0.796, meaning that there is a sufficient correlation and shows that if the value of agile supply chain strategy (X2) increases by 1 unit, while the value of lean supply chain strategy (X1) remains, the sustainable performance value (Y) will increase by 0.796 units. This means that the effect of agile supply chain strategy (X2) on sustainable performance partially is 79.6%.

PLS-SEM is a modeling approach that focuses on maximizing the explained variance of the dependent latent construct. In contrast, CB-SEM's goal is to reproduce a theoretical covariance matrix, without prioritizing the variance explained. PLS-SEM is particularly relevant in cases where smaller sample sizes pose empirical research challenges. CB-SEM requires several assumptions to be met, including normality of multivariate data and minimum sample size. However, if these assumptions cannot be met, or if the study's aim is prediction rather than confirmation of structural relationships, then variance-based PLS-SEM is the more suitable method. PLS-SEM often provides stronger estimates than structural models, as CB-SEM results can be highly imprecise when assumptions are violated.

There exists a philosophical distinction between CB-SEM and PLS-SEM in terms of their suitability for research objectives. CB-SEM is the recommended method when the goal is to test and confirm theory, while PLS-SEM is better suited for prediction and theory development. The primary objective is to optimize differences in the dependent construct and assess data quality based on the measurement model's characteristics. As PLS-SEM is more flexible in accommodating a broader spectrum of sample sizes and models with increased complexity, it requires less stringent data assumptions and can tackle a more extensive range of research problems than CB-SEM.

PLS-SEM allows for less restrictive construct measurement compared to CB-SEM, permitting the use of constructs with fewer items (e.g., one or two). PLS-SEM is a more suitable option when the nature of the model or its measurement limits the use of CB-SEM or when the focus is on exploration rather than confirmation. PLS-SEM's broader applicability necessitates researchers' awareness of differences in result interpretation, particularly concerning construct measurement nature. For instance, researchers must consider whether PLS-SEM can be appropriately applied in cases where measurement theory fails to meet confirmatory factor analysis criteria, such as tests of convergent validity and discriminant validity.

PLS-SEM determines variable indicator loadings for exogenous constructs based on their predictions of endogenous constructs rather than the joint variance among indicator variables within the same construct. Loadings in PLS-SEM are evaluated by their contribution to the path coefficient. CB-SEM typically yields unsatisfactory measurement model results but significant structural model relationships, while PLS-SEM provides acceptable measurement model outcomes but insignificant structural model relationships. This suggests that the disparity in

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outcomes is largely dependent on the measurement model's quality. For both approaches, obtaining comparable results requires utilizing "good" measures and data, and researchers must comprehend each approach's development objectives and apply them accordingly. Additionally, both approaches must address concerns such as proper formative and reflective measure usage and interpretation. These situations often involve questioning the measurement nature and possibly differing results, necessitating the researcher's reasonable judgment to determine the most appropriate approach.

CONCLUSIONS

PLS-SEM and CB-SEM have their own advantages and disadvantages. PLS-SEM has the advantage of being more robust, as it can provide a solution even if there are problems that could prevent a solution in SEM. Poor measurement, which is one of the main barriers to obtaining an SEM solution, can be overcome with PLS-SEM. For example, if researchers are trying to test a structural model with a single item size or a combination of multiple one- and two-item measures, PLS-SEM may be an option due to identification problems that may occur in SEM. In contrast to SEM, all recursive models were identified without any statistical identification problems in PLS-SEM, even with single item sizes. Therefore, PLS-SEM is not constrained by these problems, while validating one- and two-item measures in the context of measurement theory does not provide much value in SEM. The analysis results using SPSS and Smart-PLS software showed that there was a significant difference in the significance value of p-value and t-value for the sample. The determination value and correlation value in the resulting structural equation were also significant. Many researchers have used PLS-SEM for this reason, given the perceived difficulty in the specification of formative models in SEM. Furthermore, PLS-SEM can be a useful way to quickly explore a large number of variables to identify sets of principal component variables that can predict multiple outcome variables.

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