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Influence of Information Sharing, Partnership, and Collaboration in Supply Chain Performance; Study on Apples Agroindustry

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Abstract: Supply chain plays an essential role in the development of business organizations to achieve competitive advantage. Supply chain studies are continuing mainly to improve supply chain performance. Many of the literature write about the role of information sharing, partnership processes and collaboration in improving the performance of the supply chain. This research was conducted to find the relationship and influence of information sharing, supply chain partnership, and collaboration on supply chain performance on SMEs. The object of research is apple agroindustry, in East Java, Indonesia. The analysis was conducted with Partial Least Square (PLS). The results indicate only an indirect effect of information sharing on supply chain collaboration. Also, indirect effect of information sharing on supply chain performance of SMEs.

Keywords: Information sharing, partnerships, collaboration, partial least square, small and medium enterprises, supply chain performance.

1. INTRODUCTION

Apple is an annual fruit plant originating from the West Asian region with a sub-tropical climate. In Indonesia, apples can grow and bear good fruit in the highlands. The centers of apple production in East Java are Malang (Batu, Pujon, and Poncokusumo) and Pasuruan (Nongkojajar). In addition to apple cultivation, the processed industries of apples continue to be developed. Processed industries are conducted to increase the added value of apples into various food and beverage products. The majority of the processed apple industry is a micro and small business unit (SMEs), which is a home industry.

The apple agroindustry supply chain is dynamic because it involves the flow activity, among others: raw materials, finished products, ordering, shipping, payment, and information among the parties involved. It causes the overall management of these streams to be challenging to perform effectively. It is hard to meet the production targets due to the absence of raw materials at certain times, due to failure to share information and establish coordination and collaboration between actors in the supply chain of apple agroindustry.

The supply chain (SC) is defined as the management of upstream and downstream relationships with suppliers and customers in order to deliver superior customer value at less cost to the supply chain as a whole [10]. SC has become an essential focus for business organizations to enhance competitive advantage. Companies must implement the right supply chain management strategy to compete at the SC level. This strategy needs to be integrated and coordinated throughout the SC to produce the performance of SC members [14,18]. Supply chain management (SCM) studies emphasize how to maximize the overall value of a

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company by using and sharing resources across the company better. Its become apparent for many organizations that are assessing their performance is essential to succeeding efficient and effective SC [1].

Due to globalization, outsourcing, customization, time to market, and pricing pressure have compelled enterprises to adopt efficient and effective SCM [40]. Therefore, it is crucial to coordinate decisions and actions among partners in SC to improve the performance of the SC [47]. A suitable coordination mechanism between actors in SC through an online information network plays an essential role in increasing the effectiveness of material flow, information, and money [34].

That is, if companies want to improve collaborative capabilities, then companies need to prepare themselves by building a network of information technology to support the ability to share information first. Furthermore, the ability to share information and collaborative capabilities jointly affects supply chain performance [46]. The benefits of information sharing include improving inventory management, increasing sales, and knowing the demand better [19]. Failure to share information in the supply chain causes a bullwhip effect [11], i.e., amplification of the demand flow variance, which is flowing in the entire SC, from customer to factory. SC collaboration is also influenced by the practice of partnerships among actors taking place in it [50].

2. MATERIALS AND METHODS

Information Sharing

Information sharing refers to the extent to which critical information is communicated to other supply chain partners [27]. Many researchers have emphasized the importance of sharing information in SCM practice. Moreover, Yu et al. [49] suggest that the adverse effects of the bullwhip effect on the supply chain can be reduced or eliminated by sharing information with trading partners. The empirical findings of Childerhouse & Towill [9] reveal that a simplified flow of materials, including streamlining and making all the information flows through the chains, is an integrated and effective supply chain.

Currently, the companies do not operate alone; they are now connected to many other partners [29]. Information sharing can help supply chain members establish partnerships for better supply chain system performance [49]. Information sharing is found to impact operational performance [13]. Meanwhile, information sharing is one of the characteristics of collaboration [35]. Information sharing also plays an important role in supporting collaborative capabilities [46].

H1$_a$: Information Sharing has a positive impact on SC Partnership.
H1$_b$: Information Sharing has a positive impact on SC Collaboration.
H1$_c$: Information Sharing has a positive impact on SC Performance.

Partnership

The partnership is defined as purposive strategic relationships between independent firms having common goals, striving for mutual benefit, and recognizing a high degree of interdependence [25].

In the context of cooperation, the relationship between the company and its suppliers can take many forms. The first, such as joint ventures or strategic alliances, involves negotiating and maintaining explicit contracts that explain expectations and deliveries and sometimes revenue-sharing [7] and they have a legal structure that sets the boundaries [45]. Supply chain partnerships, on the other hand, tend to operate without formal contracts [22].

The type of relationship between buyers and suppliers might vary from hostilities to cooperatives [6]. Research from Zhang et al. [50] has concluded that partnership management

had a significantly positive influence on supply chain collaboration. Moreover, the partnership has an importance role to supply chain performance [20,33,49].

$H2_a$: Partnership has a positive impact on SC Collaboration.
$H2_b$: Partnership has a positive impact on SC Performance.

Collaboration

Collaboration is a process of participation of a group of people or organizations, working together to achieve mutually desired outcomes, and building interconnected systems to address problems and opportunities. Collaboration is defined by several researchers among others, [26], which refer to long-term conditions, win-win conditions, and open information exchange agreements, in which both parties are engaged in joint efforts to improve performance and commit to quality, cooperation, and conflict resolution. Meanwhile, [2] defines collaboration as two or more companies sharing responsibility in planning, management, execution, and performance measurement information.

From the above understanding, it can be concluded that collaboration is a form of cooperation, interaction, and compromise of some individuals, or organizations, involved directly or indirectly, over a long period, receiving consequences and benefits. Collaboration is based on values among others, the common goal, the similarity of perception, the willingness to process, and mutual benefit. Collaboration involves multiple shared resources and responsibilities, in planning, implementing, and evaluating all activities to achieve common goals. All parties involved must be willing to share their vision, mission, resources, and strengths.

In supply chains, collaboration involves designing a set of strategies where two or more different actors, with complementary capabilities, achieve shared aspirations and goals in a competitive environment, which cannot be achieved individually [21]. From this perspective, collaboration in the supply chain becomes an essential strategy for achieving competitive advantage. The escalation of competition, the flow of globalization, and the increasing demands of customers led to the idea that companies cannot compete on their own in the marketplace. Therefore, companies look beyond their boundaries and establish cooperation with other complementary firms to minimize potential risks [32]. The literature suggests that collaboration is associated with increased performance, regarding increased visibility, increased service levels, increased flexibility, improved end-customer satisfaction, and reduced cycle time [12,37,43].

$H3_a$: Collaboration has a positive impact on SC Performance.

Supply Chain Performance

Some experts and practitioners recommend several methods that accommodate all the dimensions of supply chain performance [39], namely:

- Total supply chain cost. Fulfillment costs as a percentage of revenues or fulfillment costs per order case.
- Service level. It includes the level (availability - the ratio of the number of items ordered by the customer and the number of items sent to the customer).
- Asset management. It focuses on capital utilization of investments in facilities and equipment and working capital invested in inventories.
- Customer accommodation. It aims to capture the size of the request flawlessly.
- Cash-to-cash cycle time. It is time it takes to convert the costs spent on inventory into profits that are collected from the proceeds of the sale.
- Benchmarking. It makes management aware of state-of-the-art business practices. It includes: internal benchmarking, competitor benchmarking, and benchmarking limited.

The global performance of the supply chain can be enhanced by exchanging information between its members at different decision levels [28].
The performance of the supply chain is strongly influenced by two things, namely information sharing and collaboration capabilities [28,38,46,48]. The research framework is shown in Fig. 1.

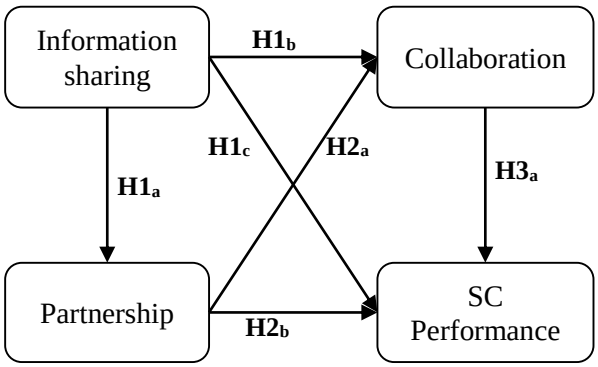

Fig. 2.1. Research Framework

Methodology
The research was conducted in the supply chain of apple agroindustry, from apple farmers, suppliers of food additives, suppliers of plastic cups and bottles, packaging suppliers, apple processing agroindustry, distribution, and retailers, in Batu City, East Java.

Data collection was done by distribution the questionnaire, which was compiled to know how the process of share the information, partnership and collaboration in the supply chain of apple agroindustry, as well as supply chain performance.
Research variables and measuring instruments have described in Table 2.1. Data were collected from 36 SMEs, with product classification as in Table 2.2.

Table 2.1. Variable and its Measuring Instruments

Variable	**Measuring Instrument**	**Ref.**
Information Sharing (X_1)	• SMEs only shares inventory data with supply chain partners (X_{1-1}); • SMEs shares inventory and demand data with other supply chain partners. (X_{1-2}) • SMEs shares inventory, demand, and capacity or production data with other supply chain partners. (X_{1-3}).	[8]
Partnership (Y_1)	• Trust (Y_{1-1}) • Commitment (Y_{1-2})	[5] [16]
Collaboration (Y_2)	• Resource Sharing (Y_{2-1}) • Decision Synchronization (Y_{2-2}) • Incentive Alignment (Y_{2-3})	[4]
Supply Chain Performance (Y_3)	• Supply chain flexibility (Y_{3-1}) • The extent of co-operation (Y_{3-2}) • Customer responsiveness (Y_{3-3})	[42] [17] [51]

Data analysis and structural equation modeling using Partial Least Square (PLS), are as follows:

1. Measurement Model (Outer Model).
   The Measurement Model defines how each indicator block corresponds to its latent variable. The Measurement Model Design determines the indicator properties of each latent variable, whether reflexive or formative, based on the operational definition of the variable.
2. Structural Model (Inner Model).
   The structural model describes the relationship between latent variables based on substantive theory. The latent variables in this study are Information Sharing, Partnership, Collaboration, and Supply Chain Performance.
3. Path diagram.
4. Evaluation of the Goodness of Fit
   Q-Square can be calculated by the equation:
   $$Q^2 = 1 - (1 - R_1^2)(1 - R_2^2)..\left(1 - R_p^2\right) \quad (2.1)$$
   Where: R_1^2, R_2^2 ... R_p^2 are R-Square of the endogenous variable in the model.
5. Hypothesis Testing (Resampling Bootstrapping)

Table 2.2. Product Classification of Respondents

Product	Number of Respondents
Apple cider	14
Apple chips	9
Apple vinegar	2
Another apple processed	11

3. RESULTS AND DISCUSSION

Evaluation of Measurement Model

Convergent Validity is used to measure the validity of a reflexive indicator as a latent variable measure, which can be seen from the outer loading of each variable indicator. An indicator is said to have excellent reliability if the value of outer loading above 0.70. Results of outer loadings can be seen in Table 3.1.

For information sharing variables (X_1), the three indicators show values greater than 0.7. Thus, it can be concluded that the three indicators are capable of measuring information sharing variables well.

In partnership variable (Y_1), two indicators, also have outer loading value more than 0.7, which means that both indicators capable of measuring partnership variables well.

For collaboration variable (Y_2), which is an endogenous latent variable, capable explained by three indicators. So is the performance variable (Y_3), which has outer loading value greater than 0.7.

Table 3.1. Outer Loadings

Variables	X_1	Y_1	Y_2	Y_3
$X_{1\text{-}1}$	0.901			
$X_{1\text{-}2}$	0.935			
$X_{1\text{-}3}$	0.923			
$Y_{1\text{-}1}$		0.914		
$Y_{1\text{-}2}$		0.916		

Y_{2-1}				0.919
Y_{2-2}				0.946
Y_{2-3}				0.910
Y_{3-1}			0.918	
Y_{3-2}			0.897	
Y_{3-3}			0.822	

The criteria for measuring discriminant validity can be seen on the cross-loading between the indicator and the construct. The result of cross-loading is shown in Table 3.2.

Table 3.2. Cross Loading

Variables	**X_1**	**Y_1**	**Y_2**	**Y_3**
X_{1-1}	**0.901**	0.587	0.528	0.559
X_{1-2}	**0.935**	0.641	0.711	0.646
X_{1-3}	**0.923**	0.586	0.599	0.577
Y_{1-1}	0.633	**0.914**	0.674	0.637
Y_{1-2}	0.574	**0.916**	0.715	0.676
Y_{2-1}	0.563	0.648	0.703	**0.919**
Y_{2-2}	0.636	0.703	0.835	**0.946**
Y_{2-3}	0.598	0.637	0.702	**0.910**
Y_{3-1}	0.661	0.753	**0.918**	0.759
Y_{3-2}	0.589	0.622	**0.897**	0.831
Y_{3-3}	0.509	0.625	**0.822**	0.509

The result of cross-loading shows that the correlation of the construct between each variable with the indicator has a higher value than the correlation with other indicators. It is concluded that the latent variables predict the indicator on it block better than the indicator on the other block.

Construct Reliability can be measured by *Cronbach's Alpha*. This value reflects the reliability of all indicators in the model. The minimum value of 0.7 is ideally 0.8 or 0.9. Results of data processing can be seen in Table 3.3.

Table 3.3. Construct Reliability and Validity

	Cronbach's Alpha	**rho_A**	**Composite Reliability**
Information	0.909	0.917	0.943
Partnership	0.806	0.806	0.912
Performance	0.855	0.876	0.911
Collaboration	0.916	0.923	0.947

From Table 3.3, it can be seen that all variables have *Cronbach's Alpha* more than 0.7 with the lowest value in the partnership variable. Thus, it can be concluded that no reliability or unidimensionality problems were found in the established model.

Evaluation of the Structural Model

The structural model analysis was conducted to examine the effect of information sharing, partnership, and collaboration on supply chain performance of apple agro-industrial. The analysis is done by using *R-Square*.

R-Square indicates the extent to which a construct can describe the model as a whole, or by indicating the magnitude of a particular influence of latent variables on the latent dependent variable. *R-square* value can be seen in Table 3.4.

Table 3.4. R-Square

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics	P Values
Partnership	0.434	0.441	0.153	2,835	0.005
Performance	0.733	0.754	0.075	9,758	0,000
Collaboration	0.569	0.594	0.096	5.904	0,000

From Table 3.4., it can be summarized as follows:

- R-Square of Partnership variables indicates that Information sharing gives 43.4% influence on the Partnership.
- R-Square of Performance variable indicates that Information sharing (X_1), Partnership (Y_1) and Collaboration (Y_2) give the effect of 73.3% to Performance.
- R-Square of the Collaboration variable indicates that the Information Sharing (X_1) and Partnership (Y_1) give 56.9% influence to the Collaboration variables (Y_2).

Path Diagram

Fig. 3.1 shows the path diagram obtained. The diagram shows the relationships among information sharing, partnerships, collaboration and supply chain performance of apple agro-industry.

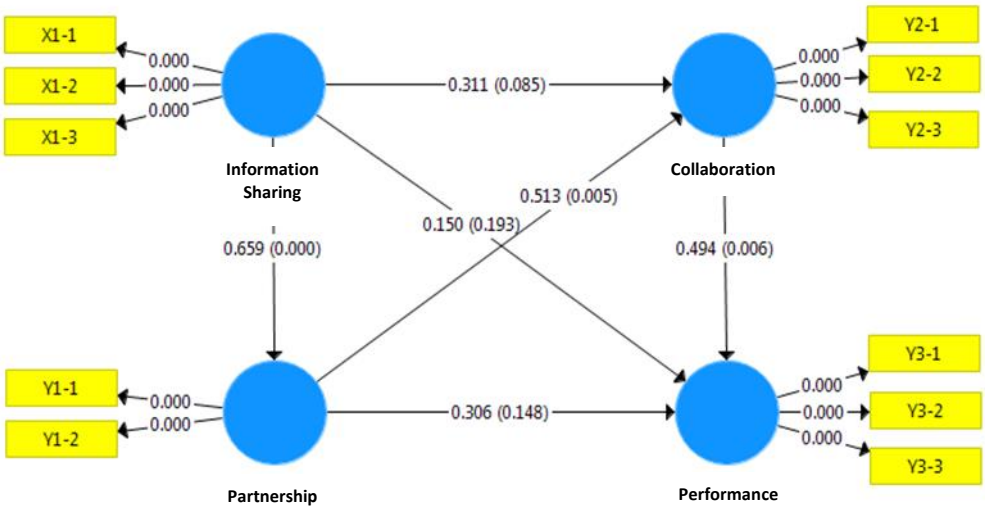

Fig. 3.1. Path Diagram

Evaluation of the Goodness of Fit

Evaluation of the Goodness of Fit is done by calculating a Q-Square value for the constructive model. Q-Square measures how well the model and its parameter estimation generate the observation value. The Q-Square value > 0 indicates that the model has predictive relevance, otherwise if the Q-Square value ≤ 0 indicates the model lacks predictive relevance.

Q-Square can be calculated by equation (1):

$$Q^2 = 1 - (1 - R_1^2)(1 - R_2^2)(1 - R_3^2)$$

Where: R_1^2 = 0.434; R_2^2 = 0.569; and R_3^2 = 0.733 (see Table 6)
So,
Q^2 = 0,935
From the calculation of Q-Square, it can be concluded that the resulting model has a very good predictive relevance of 93.5%.

Hypothesis Testing

The impact of Information Sharing on Supply Chain Partnership.
Path diagram results in Fig. 3.1 shows that at 5 percent significant level, information sharing affects SC partnership, with Path Coefficient 0.659 (P-value = 0.000). Thus, this result support **H1$_a$** is Information Sharing has a positive impact on SC Partnership.

The impact of Information Sharing on Supply Chain Collaboration.
Path diagram results in Fig. 3.1 shows that at 5 percent significant level, information sharing has no impact on SC collaboration, with Path Coefficient 0.311 (P-value = 0.077). Thus, this result does not support **H1$_b$** is Information Sharing has a positive impact on SC Collaboration.

The impact of Information Sharing on Supply Chain Performance
Path diagram results in Fig. 3.1 shows that at 5 percent significant level, information sharing has no impact on SC performance, with Path Coefficient 0.150 (P-value = 0.188). Thus, these results not support **H1$_b$** is Information Sharing has a positive impact on SC Performance.

The impact of Partnership on Supply Chain Collaboration
Path diagram results in Fig. 3.1 shows that at 5 percent significant level, the partnership has a positive impact on SC collaboration, with Path Coefficient 0.513 (P-value = 0.005). Thus, this result support **H2$_a$** is Partnership has a positive impact on SC Collaboration.

The impact of the Partnership on Supply Chain Performance
Path diagram results in Fig. 3.1 shows that at 5 percent significant level, the partnership does not affect SC performance, with Path Coefficient 0.306 (P-value = 0.110). Thus, these results do not support **H2$_b$** is Partnership has a positive impact on SC Performance.

The impact of Collaboration on Supply Chain Performance
Path diagram results in Fig. 3.1 shows that at 5 percent significant level, collaboration has a positive effect on SC performance, with Path Coefficient 0.494 (P-value = 0.003). Thus, this result support **H3$_a$** is collaboration has a positive impact on SC Performance.

Indirect Effect Testing

Table 3.5 shows the indirect effects of the research variables. Indirect effect on Table 7 show that at 5 per cent significant level, information sharing has indirect effect to the SC Performance (T-Statistic = 4.636; p-value = 0.000), Information Sharing has indirectly effect to the SC Collaboration (T-Statistics = 2.643; p-value = 0.008) and Partnership has indirectly effect to the SC Performance (T-Statistics = 2.025; p-value = 0.043)

Table 3.5. Indirect Effects

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics	P Values
Information -> Partnership					
Information -> Performance	0.522	0.522	0.113	4,636	0,000
Information -> Collaboration	0.338	0.316	0.323	2,643	0.008
Partnerships -> Performance	0.253	0.237	0.125	2,025	0.043
Partnerships -> Collaboration					
Collaboration -> Performance					

4. DISCUSSION

This study uses PLS to analyze the correlation between information sharing, partnerships, and collaboration on SC performance. The research was conducted at the Apple Agroindustry Supply Chain, Batu City, Indonesia.

The results of the study did not find the direct effect of information sharing on SC performance, nor the direct effect of partnerships on SC performance. Likewise, the direct effect of information sharing on SC collaboration was not found. The results of the study only indicate that there is an indirect effect of information sharing on SC collaboration, information sharing on SC performance, and partnerships on SC performance. This result is in line with the study from Baihaqi and Sohal [3], which states that information sharing does not have a direct relationship with organizational performance. This relationship is mediated by the practice of collaboration between supply chain actors. The absence of such correlations is typical for energy consumption since power grids possess constructive constraints and, hence, other tools have to be developed to improve performance of energy supply chains [30].

The present result is in line with the findings of Zhao et al. [51], which states that information sharing significantly affects the supply chain performance, both in total costs and service levels. Zhou & Benton [52] also state that supply chain practices will be effective when the level of information sharing increases, which in turn will also improve supply chain performance. This result also supports the results of research by Lin et al. [23], which states that information sharing can reduce demand uncertainty, which will improve supply chain performance. Information sharing provides a large number of benefits, which in turn will increase the efficiency of supply chain performance in the manufacturing sector [24].

The effect of partnership on SC performance was following the results proposed by Khan et al. [20] that buyer-supplier partnerships in the supply chain have a positive effect on supply chain performance. Results of Gallear et al. [15] also show that there is a positive relationship between partnership management and supply chain performance. Wibowo and Sholeh [44] also state that supplier partnerships are one of the supporting factors for supply chain performance in construction projects.

The effect of collaboration on SC Performance was following the findings of Vereecke & Muylle [41], who found empirically the relationship between SC collaboration and improved performance obtained. These empirical findings support the statement that proper collaboration with suppliers and customers provides benefits for improving performance. Singhry et al. [36] found a significant relationship between SCC and SC Performance, which has been tested through covariance structural equation modeling. Ramanathan and Gunasekaran [31] also found that collaborative alliances improve SC Performance,

However, there are no results of research that show an indirect relationship of the effect of information sharing on SC performance. This condition can be caused by the population, which is mostly SMEs with limited resources. The process of information sharing is not carried out as done by large companies.

This present study is subject to a few limitations that should be addressed in future research. First, although the number of samples is considered satisfactory for the research model using PLS techniques, there are still opportunities to complete this study. Second, with extensive sampling and covering more SMEs, the relationship model between variables can be further clarified.

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