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RESEARCH BRIEF

Competitive Advantages of the Palm Oil Industry: A Structural Equation Model Analysis

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The Food and Agriculture Organization (FAO, 2017) of the United Nations has reported that the top producers of palm oil are concentrated in Southeast Asia, with the top producers being Indonesia and Malaysia (85% combined). A major factor contributing to this is the climate of the region in which abundant rain, high humidity, and lots of sunshine combine to provide a suitable environment for oil palm plantations.

In 2017, it was reported that Indonesia and Malaysia were the largest oil palm producers within ASEAN (Association of Southeast Asian Nations), which had a combined output of 52.5 million tonnes, or 85% of the world's production (Petchseechoung, 2017). Thailand ranks third in both plantation area and output, with an annual output of 2 million tonnes, or 1.2% of global output. Also, oil palm has been classified as a crucial economic crop within ASEAN, and although Thailand is in the top three of global producers, it has its own uniqueness when it comes to upstream, midstream, and downstream production.

Examples of these production differences are the plantations areas in each producer country. In Indonesia, for example, there is 58 million *rai* of land used for oil palm production, Malaysia has 35 million *rai* under cultivation, while Thailand in 2016 reached 4.7 million *rai* used for production (Office of the National Economic & Social Development Board, 2016; Petchseechoung, 2017).

However, the oil palm industry in Thailand is regarded as an important and potential industry that is supported by the government throughout the supply chain. Therefore, manufacturers in Thailand need to adapt in order to gain competitive advantages by developing human resources, creating innovations, and competitive advantages. This also includes the development of infrastructure and the integration of the supply chains and logistics processes to be more competitive.

Further factors contributing to the increase in raw material value in the value chain is the lack of diversification which has caused a serious imbalance in raw materials, and fluctuations in quantity, time, price, and quality. As a result, Thailand's Department of Industrial Promotion has outlined three strategies to assist SMEs. These include 1) wisdom and cultural identity, 2) economic strategy area, and 3) diversity of natural resources conducive to production and industry. All of these strategies will help in responding to, and generating the mechanism to facilitate business expansion appropriately. It also promotes the role of "adding value" to "creating value" (Ministry of Industry, 2017).

Thailand has also promoted the development of the oil palm industry in line with the country's basic potential, such as promoting the development of agro-industrial processing by developing raw materials and production processes to meet high standards while being environmentally friendly. Moreover, the Ministry of Industry's Strategic Plan B. E. 2559–2564 and the Oil Palm and Palm Oil Strategy B.E.2558–2569 aims to increase the productivity of palm oil to meet domestic demand for the consumption of renewable energy and export by increasing the growing areas, increasing production, and increasing the oil rate. Of all oil-bearing crops grown globally, oil palm is, in terms of its oil yield, the most productive (Petchseechoung, 2017). The yields of oil production from oil palm are 6–10 times more than those of other oil-bearing crops, which although oil palm accounts for only 5% of the area under cultivation, palm oil production is as much as 36% of all vegetable oils globally.

Palm oil consumption is projected to increase to 1.35 million tons by 2026, while energy consumption will increase to 2.60 million tons and the export of 300,000–700,000 tons with the expansion of the planting areas amounting to a 3.0 million *rai* increase (Ministry of Industry, 2017).

Furthermore, there are few studies in Thailand related to the development of the oil palm industry and factors related to its competitive advantage. Moreover, development throughout the oil palm production chain, from upstream to downstream, does not concern the development of production potential for competition.

The research of Ben Mahmoud-Jouini and Lenfle (2010) proposed that development maximizes the cost and time competitive advantage to be able to serve the needs of the market for greater competitive advantage. Kocoglu, Imamoglu, Ince, and Keskin (2012) found that the development of absorption and adaptation of technology to gain exposure to new things is essential for sustainable competitive advantage by focusing on the management of knowledge, learning, technology, and production capabilities, which also serve as the basis for innovation and the performance of the organizations.

Research from Nonaka and Takeuchi (1995) and Drucker (2007) also acknowledged that organizational knowledge is the most important thing generating competitive advantage, so long as the company can protect that knowledge from competitor theft or imitation. The management of knowledge, information, and dissemination of knowledge is an important factor in promoting the development of the oil palm industry (Jones & Pimdee, 2017). When these factors are applied directly to the commercial production of oil palm by entrepreneurs, yields can be increased.

This corresponds with the study of Shih, Hsu, Zhu, and Balasubramanian (2012), which also indicated that knowledge sharing in the downstream process is a crucial aspect in increasing production efficiency. Wong, Lai, and Bernroider (2015) also found that efficient integration and management of the supply chain has an impact on the operational performance of the organization, generates efficiency, improves products, and is beneficial at reducing risks in the management of the supply chain. When combined with international quality management standards, competitive advantage can be realized in the long term, which is also beneficial for organizational strategies (Su, Dhanorkar, & Linderman, 2015).

Due to the mentioned problems and their significance, it was deemed necessary to develop a structural equation model (SEM) of variables that affect competitive advantages in the Thai oil palm industry. This work can also be used in determining the direction, visions, missions, policies, operations, and strategic planning of organizations in the industry.

Conceptual Framework

From a study of the relevant research and literature on the on the causal relationships between process improvement processes, the following model and hypotheses were formulated (Figure 1):

H1: The knowledge management process has a positive and significant impact on competitive advantage.

H2: The knowledge management process has a positive and significant impact on process improvement.

H3: The knowledge management process has a positive and significant impact on supply chain integration.

H4: Supply chain integration has a positive and significant impact on competitive advantages.

H5: Process improvement has a positive and significant impact on competitive advantages.

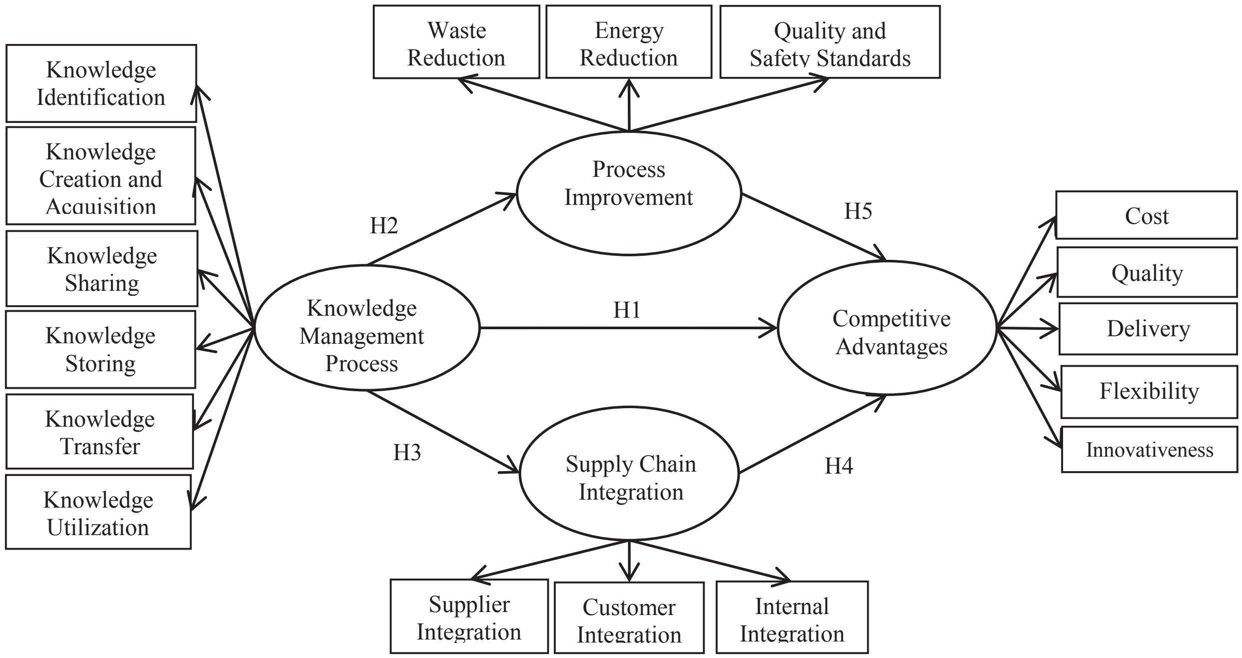


Figure 1. Conceptual framework.

Methods

Questionnaire Design

The questionnaire was developed as a measurement tool based on the conceptual framework and practical definitions. In creating the measuring tool in the form of a questionnaire, a 7-point Likert type agreement scale was used (Likert, 1972). Additionally, five experts were asked to examine the consistency of the questionnaire. The revised questionnaire was then used to collect the sample data from the initial sample of 30 individuals. Cronbach's alpha coefficient (α-coefficient) was used to measure the questionnaire's consistency (Cronbach, 1951). As the study's internal consistency was 0.972, it indicated a high level of reliability (Hair, Black, Babin, & Anderson, 2010). Table 1 presents the latent and observed variables.

Data Collection

We considered the sample group used in this study at a ratio of 10 samples per variable (Hair et al., 2010), and found that setting the size of the sample was large enough to be used for the data analysis by applying the SEM and the distribution of Normal Curve. Therefore, we collected data for this study from the population in the Thai oil palm industry. The results of data collection yielded a sample of 200 individuals using simple random sampling (Cohen & Manion, 1989). Data was then provided by the chief manager and engineers in the Thai oil palm industry, which included the extraction plant chute, the extraction plant trunk, the palm oil refinery plant, biodiesel plant (agricultural engine) and biodiesel plant (B100), and the Department of Industrial Works, Ministry of Industry. Afterward, the questionnaires were examined for completeness and then analyzed further.

Data Analysis

The data were analyzed using SPSS AMOS program Version 21 to help analyze the relationships between variables and the application of the SEM and normal curve. Correlation analysis of the observed variables was done by using Pearson's product moment correlation (PMMC) and measurement model analysis with confirmatory factor analysis (CFA; Pumim, Srinuan, & Panjakajornsak, 2017). The maximum likelihood (ML) estimation method was also used to evaluate the empirical data for the model following the theories obtained from the literature review (Hair et al., 2010; Schumacker & Lomax, 2010). Then, convergent

Table 1. Creating the Scales and Developing the Research Questions

Exogenous Latent Variable	Manifest Variables
Knowledge Management (KM) Process	1) Knowledge Identification 2) Knowledge Creation and Acquisition 3) Knowledge Sharing 4) Knowledge Storing 5) Knowledge Transfer 6) Knowledge Utilization
Intervening Variable	**Manifest Variables**
Supply Chain Integration (SCI)	1) Supplier Integration 2) Customer Integration 3) Internal Integration
Process Improvement (PI)	1) Waste Reduction 2) Energy Reduction 3) Quality and Safety Standard
Endogenous Latent Variables	**Manifest Variables**
Competition Advantages (CA)	1) Cost 2) Quality 3) Delivery 4) Flexibility 5) Innovativeness

validity was used which contained the criteria for consideration of standard regression weights at a statistical significance level of .05 ($|t| \geq 1.96$).

The CR (critical ratio) for all variables and R2 should not be lower than 0.2 (Lauro & Vinzi, 2004; Henseler & Fassott, 2010). The analysis results are shown in Table 2. It was found that the correlation between observed variables ranged from 0.463–0.882 with a statistical significance level of .01. The mean between the variables ranged from 4.84–5.90 (standard deviation 0.992–1.291).

Results

The results of analysis on the consistency of empirical data and the variables using the CFA method as well as the results of analysis by the SEM revealed that the measuring model was harmoniously correspondent with the empirical data (Model Fit; Figure 2). The knowledge management process showed a standard regression weight ranging from 0.739–0.938 and the R2 or squared multiple correlations ranged from 0.546–0.881. Process improvement had a standard regression weight from 0.764–0.895 and the R2 squared multiple correlations ranged from 0.583–0.800. Supply chain integration had a standard regression weight from 0.763–0.887 and the R2 or squared multiple correlations ranged from 0.582–0.787. Competitive advantage showed a standard regression weight from 0.752–0.906, while the R2 or squared multiple correlations were from 0.588–0.821 (as shown in Table 3).

The results of analysis on the consistency between the model of the conceptual framework and the empirical data revealed that the structural equation model was harmoniously correspondent with the empirical data (Model Fit; Figure 2). The test value was Chi-square (χ^2) = 100.280, df = 83, p = .095, CMIN/DF (χ^2/df) = 1.208, GFI = .958, CFI = .996, AGFI = .922, NFI = .980 and RMSEA = .029 (as shown in Table 4).

The analysis on the SEM revealed the following:

$$PI = 0.90KM \quad , R^2 = 0.80 \quad (1)$$

$$SCI = 0.81KM \quad , R^2 = 0.66 \quad (2)$$

$$CA = 0.23KM + 0.47PI + 0.66SCI \quad , R^2 = 0.87 \quad (3)$$

Table 2. *Mean, Standard Deviation, and Pearson's Correlation*

	Supplier	Internal	Customer	Identification	Creation	Sharing	Storing	Transfer	Utilization	Waste	Energy	Safety	Quality	Delivery	Flexibility	Cost	Innovativeness
Supplier	1																
Internal	.652**	1															
Customer	.744**	.756**	1														
Identification	.683**	.807**	.734**	1													
Creation	.698**	.782**	.763**	.848**	1												
Sharing	.603**	.655**	.670**	.769**	.844**	1											
Storing	.629**	.677**	.650**	.797**	.844**	.846**	1										
Transfer	.567**	.646**	.640**	.747**	.850**	.874**	.882**	1									
Utilization	.463**	.538**	.502**	.600**	.666**	.796**	.700**	.695**	1								
Waste	.508**	.600**	.520**	.661**	.651**	.648**	.634**	.574**	.582**	1							
Energy	.615**	.668**	.649**	.736**	.741**	.674**	.712**	.682**	.512**	.657**	1						
Safety	.554**	.598**	.574**	.621**	.637**	.670**	.666**	.614**	.577**	.705**	.727**	1					
Quality	.668**	.640**	.642**	.735**	.684**	.671**	.713**	.642**	.567**	.764**	.778**	.760**	1				
Delivery	.569**	.613**	.592**	.630**	.682**	.604**	.652**	.655**	.521**	.521**	.696**	.528**	.617**	1			
Flexibility	.613**	.628**	.606**	.720**	.753**	.724**	.771**	.720**	.611**	.597**	.699**	.618**	.744**	.747**	1		
Cost	.674**	.626**	.657**	.721**	.785**	.735**	.760**	.735**	.601**	.655**	.761**	.660**	.758**	.759**	.802**	1	
Innovativeness	.610**	.601**	.577**	.691**	.732**	.694**	.690**	.671**	.557**	.638**	.702**	.616**	.714**	.642**	.679**	.815**	1
Mean	4.84	5.63	5.22	5.48	5.19	5.00	5.42	5.17	5.16	5.28	5.58	5.16	5.33	5.90	5.33	5.37	5.24
SD.	1.467	1.106	1.210	1.076	1.113	1.269	1.203	1.101	1.227	1.291	1.136	1.255	1.199	0.992	1.029	1.084	1.162

Note. ** *Correlation is significant at the 0.01 level (2-tailed)*

Table 3. Relative Influence of Items

Relationship between variables			Standard Regression Weight	S.E.	Squared Multiple Correlation	C.R.	p
PI	<---	KM	.896	.052	.803	17.268	**
SCI	<---	KM	.811	.047	.658	17.820	**
CA	<---	KM	.228	.096	.868	2.293	.022
CA	<---	PI	.470	.094		4.812	**
CA	<---	SCI	.298	.058		4.904	**
Identification	<---	KM	.849	.036	.720	24.912	**
Creation	<---	KM	.900		.810		
Sharing	<---	KM	.929	.048	.864	24.698	**
Storing	<---	KM	.938	.044	.880	25.349	**
Transfer	<---	KM	.938	.040	.881	25.493	**
Utilization	<---	KM	.739	.060	.546	15.030	**
Customer	<---	SCI	.852		.726		
Internal	<---	SCI	.887	.051	.787	18.533	**
Supplier	<---	SCI	.763	.065	.582	16.640	**
Safety	<---	PI	.808	.062	.653	16.108	**
Energy	<---	PI	.895		.800		
Waste	<---	PI	.764	.066	.583	14.709	**
Cost	<---	CA	.906		.821		
Quality	<---	CA	.840	.054	.705	18.967	**
Delivery	<---	CA	.752	.045	.588	16.759	**
Flexibility	<---	CA	.894	.046	.764	20.539	**
Innovativeness	<---	CA	.837	.047	.701	21.219	**

*Note. ** Significant at the 0.01 level, KM=Knowledge Management Process, PI=Process Improvement, SCI= Supply Chain Integration, CA=Competitive Advantage*

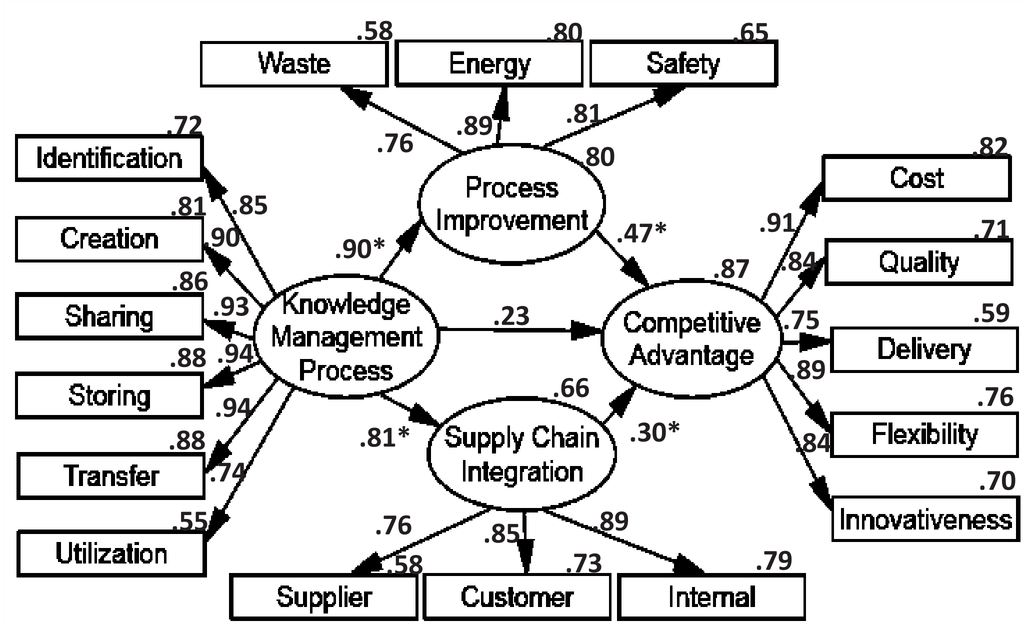
According to Equation 1, it was found that PI was positively affected by the KM process. The deviation of PI could be explained for 80% (R^2= 0.80).

According to Equation 2, it was found that SCI was positively affected by the KM process. The deviation of SCI could be explained by 66% (R^2= 0.66).

According to Equation 3, it was found that CA was positively affected by the KM process, PI, and SCI. The deviation of CA could be explained by 87% (R^2= 0.87).

Results of Hypothesis Testing

The hypotheses were tested with t-value (CR) and p-value. The influence between variables obtained from the standard regression coefficients was evaluated. It was found that the standard regression coefficients (coef.) of the correlation paths for each hypothesis were CR (t-test) at a statistical significance level of over 1.96 for all values. The results of the analysis supported all hypotheses. The results of hypothesis testing and the influence of the researcher variables are shown in Table 5.



Note. Chi-square (χ^2) = 100.280, df = 83, p = .095, CMIN/DF (χ^2 /df) = 1.208, GFI = .958, CFI = .996, AGFI = .922, NFI = .980 and RMSEA = .029

Figure 2. Final model.

Table 4. *Criteria and Theory of the Values of Goodness-of-Fit Appraisal*

Relevant statistics	Symbol	Criteria	Value	Result
CMIN-*p*	χ^2	Ns.(p>.05)	0.095	passed
Relative Chi-square	χ^2 /df	χ^2 /df ≤ 2.00	1.208	passed
Goodness of Fit Index	GFI	≥0.90	0.958	passed
Comparative Fit Index	CFI	≥0.95	0.996	passed
Normal Fit Index	NFI	≥0.90	0.980	passed
Adjusted Goodness of Fit Index	AGFI	≥0.90	0.992	passed
Root Mean Square Error of Approximation	RMSEA	≤0.05	0.029	passed
Pearson Product-Moment Correlation Coefficient	PPCM	±1	+0.463 to +0.882	passed
Cronbach’s Alpha	α	≥0.7	0.972	passed

Table 5. *Results of Research Hypothesis Testing*

Hypothesis	coef.	t-test	p	TE	DE	IE	Results
H1: The knowledge management process has a positive and significant impact on competitive advantage.	.228	2.293	.022	.891	.228	.664	Supported
H2: The knowledge management process has a positive and significant impact on process improvement.	.896	17.268	***	.896	.896	-	Supported
H3: The knowledge management process has a positive and significant impact on supply chain integration.	.811	17.820	***	.811	.811	-	Supported
H4: Supply chain integration has a positive and significant impact on competitive advantage.	.298	4.904	***	.298	.298	-	Supported
H5: Process improvement has a positive and significant impact on competitive advantage.	.470	4.812	***	.470	.470	-	Supported

*Note. ***Significant at the 0.01 level, Coefficient refers to the Beta (β), TE = total effects, DE = direct effects, IE = indirect effects, coef. = Coefficient.*

Hypothesis 1: The knowledge management process has a positive and significant impact on competitive advantage. Testing of the hypothesis revealed Coefficient = 0.228 with the fact acceptable following the hypothesis at a statistical significance level of .05.

Hypothesis 2: The knowledge management process has a positive and significant impact on process improvement. Testing of the hypothesis revealed Coefficient = 0.896 with the fact acceptable following the hypothesis at a statistical significance level of .01.

Hypothesis 3: The knowledge management process has a positive and significant impact on supply chain integration. Testing of the hypothesis revealed Coefficient = 0.811 with the fact acceptable following the hypothesis at a statistical significance level of .01.

Hypothesis 4: Supply chain integration has a positive and significant impact on competitive advantage. Testing of the hypothesis revealed Coefficient = 0.298 with the fact acceptable following the hypothesis at a statistical significance level of .01.

Hypothesis 5: Process improvement has a positive and significant impact on competitive advantage. Testing of the hypothesis revealed Coefficient = 0.470 with the fact acceptable following the hypothesis at a statistical significance level of .01.

Discussion

From the SEM development, both organizational knowledge and the knowledge management process were found to have direct positive influences on competitive advantages in the Thai oil palm industry. Additional factors of knowledge identification, knowledge creation and acquisition, sharing, storage, knowledge transfer, and utilization of knowledge to benefit organizations were found to result in a competitive advantage in quality, delivery, cost savings, flexibility, and innovation. This finding is consistent with Jiang, Bao, Xie, and Gao (2016), which concluded that successful knowledge sharing and knowledge acquisition helps to maintain competitive advantages for organizations.

Furthermore, Pai and Chang (2013) and Nguyen, Neck and Nguyen (2009) found that the knowledge management process had a significant impact on knowledge protection and knowledge application for the benefit and improvement of operational performance with significant positive influence on the competitive advantages (Seleim & Khalil, 2007). Therefore, effective knowledge management can enhance the organization's efficiency, which helps in creating sustainable competitive advantages (Alrubaiee, Alzubi, Hanandeh, & Al Ali, 2015).

Moreover, process improvement also has a direct positive influence on competitive advantages. The results of analysis on the relationships, abilities in the improvement of internal processes to deal with external pressures that affect the operation of the organizations are caused by internal and external collaboration in implementing sustainable process improvement, leading to cost savings, and an increase in profits from total sales when skills and knowledge are enhanced (Grekova, Calantone, Bremmers, Trienekens, & Omta, 2016; Veldman & Gaalman, 2015).

Additionally, supply chain integration also has a direct positive influence on competitive advantages, especially supplier integration, which is the industry's highest valued upstream component. Organizations have to focus on upstream raw materials by selecting good suppliers, which will affect the quality of the products to create sustainable growth opportunities (Beske, Land, & Seuring, 2014). This includes the improvement of internal processes to deal with the external pressures that affect operations in organizations. This is due to the internal and external collaboration in implementing sustainable process improvement, leading to cost savings and an increase in profits from total sales when skills and knowledge are enhanced (Grekova et al., 2016; Veldman & Gaalman, 2015). Ideas related to reliability and transparency can develop the traceability system in the supply chain (Heyder, Theuvsen, & Hollmann-Hespos, 2012). The operation of the organizations in the supply chain, having created the link in integrating the supplier, internal and customer within the supply chain of the oil palm industry, benefits from the knowledge management in different fields, such as knowledge identification, knowledge creation and knowledge acquisition, sharing, storage and transfer, including focusing on sustainable competitive advantages (Wong, Boon-Itt, & Wong, 2011). The primary concern is the upstream and downstream relationship throughout the supply chain.

Conclusion

At present, producers in most markets focus on creating competitive advantages in terms of higher extraction yields, lower transportation costs, and domestically sourced seeds. Furthermore, flexibility, quality, innovation, and delivery play critical roles. Thus, adding value to the oil palm production can generate increased income for palm growers as well as related industries in the country. It can adapt from being the only production for consumption to the production of renewable energy resources for biodiesel production.

According to the study, it was found that process improvement, supply chain integration, and knowledge management have significant effects on maximizing competitive advantages in terms of cost, as well as the creation of flexibility, quality, innovation, and delivery. Significant indirect impact through process improvement, the operations of the oil palm industry, and supply chain integration (supplier, internal, customer) from upstream, midstream, to downstream can create added value and reduce loss as well as create safety standards. However, linking the knowledge management process with the improvement of the quality among people, knowledge creation, and scientific development, as well as the development of technology, innovation, and creativity, are the driving forces behind the country's economic development. This is possible through the establishment of strong agricultural strategies, the creation of food security, energy, and development to generate added value in the oil palm industry throughout the production chain. In addition, stipulating cooperative development strategies can also create trade and investments, leading to economic growth and increased competitiveness in the global market.

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Ethical clearance:

This study was approved by the institution.

Conflict of interest:

None.

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