Risk Modeling of the Supply Chain for Thai Cassava Chip Exports to China

Suthep Nimsai [#1], Thagoon Siriyod [*2]
[#] College of Management, Mahidol University, Bangkok, 10400, Thailand
[*] Faculty of Management Science, Lampang Rajabhat University, Lampang, 52100, Thailand
[1]suthep.cmmu@gmail.com
[2]thagoon.lpru@gmail.com

***Abstract*— This study aims to review supply chain risks and construct a model of supply chain performance for Thai cassava chip exports to China to test the relationship between supply chain risks and supply chain performance. The primary theoretical model was constructed from four main supply chain risk factors, product risks, demand-side risks, logistical and infrastructural risks, and political risks, and five main supply chain performance variables, dependability, speed, qualities, information and response, adapted from [1] and S.M. [2]. Questionnaires were distributed to 46 Thai cassava chip exporters and stakeholders and analyzed using the PLS-SEM algorithm. With confidence intervals of 95%, demand-side risks and political risks impact supply chain performance. The Thai government and Thai entrepreneurs can analyze the results of possible risk factors to develop a supply chain for the Thai cassava chip industry.**

***Keywords*—** *Cassava in ASEAN, Thai cassava chip, Supply chain risks, Supply chain performance, PLS-SEM*

1. Introduction

Cassava is used to provide food and energy, and it provides income to farmers. From 2012 to 2016, world cassava production increased 2.88% per year. Most cassavas are planted in Africa, followed by Asia, Latin America and Oceania, with54.44, 34.52, 10.94 and 0.10% of area planted, respectively. In 2016, Thailand had the largest planted area in ASEAN with approximately 38%, followed by Indonesia, Vietnam, Cambodia and the Philippines at 28, 14, 13 and 6%, respectively. Cassava is the fifth most common agricultural crop in Thailand after wheat, maize, rice and potato. Thailand's average growth rate of cassava planted area, harvested area and production from 2012-2017 was 0.45, 0.36 and 0.95%, respectively [3]. In 2017, Thailand had approximately 322 drying yards (cassava chip producers). Most Thai manufacturers are highly experienced and utilize high-tech machinery. Thailand exports more than 85% of its cassava chips, while the rest is consumed domestically in alcohol, chemical and animal feed production. Moreover, in 2018, Thailand was the largest cassava exporter in the world with 53% market share, and it had the highest cassava chip export value ratio in the world at 90.52%. 99.35% of Thai cassava chips are exported to China. Therefore, the export of cassava chips plays an important role in Thailand, especially in relation to China [4].

From 2015 to 2017, cassava chip exports to China decreased due to high competition in the cassava chip market in ASEAN countries, especially Vietnam and Cambodia. Therefore, to prepare for the high intensity of market competition, supply chain risks and supply chain performance are considered important issues in the industry and are critical to improving Thai cassava chip exports to China.

2. Literature Review

2.1. Supply chain risk

Any events disrupting important flows in the supply chain to limit distribution are considered supply chain risks [5]-[6]-[7]-[8]-[9]. However, supply chain risks can be difficult to identify depending upon the industry. According to [10], there is not a certain definition of risk in supply chain management because it is still a controversial topic. Furthermore, the risk formula depends on the perspective and understanding of the assessors in each field and can be perceived as a knowledge-based evaluation [11]. Therefore, the study adapts risks in the agricultural product from the study of [1] to the cassava chip supply chain. In the agricultural food supply chain, there are many risks (disruptions), including market issues, logistical and infrastructural issues and political issues [12]-[13]-[14]. In addition, according to the study of [2], product risks include quality of the product, cost (the price of the product) and process (product manufacturing process) [15]-[7].

2.2 Supply chain performance

Supply chain performance is important to enhance the industry's competitiveness. Supply chain integration can improve competitiveness and give insights for effective decision making from supply chain performance measurements [16]. However, supply chain performance is difficult to measure. Supply chain performance measurement is important to monitor strategic achievement, but the measurement of each supply chain depends on its own specific variables [17]. Therefore, the study adapts supply chain performance measurements from the closest industry from the study of [1]. This study suggests agri-food supply chain performance measurements of dependability, speed, quality and information response [18]-[19]-[1].

Many studies show that supply chain risks can affect supply chain performance. Supply chain risks result in unreliability and uncertainty, which interrupts the response between demand and supply in the supply chain [20], and the uncertainty can affect supply chain performance. Study [21] examines negative factors in the supply chain, with the purpose of identifying factors that disturb the supply chain's effectiveness, illustrating how supply chain performance is affected by vertical and horizontal concepts due to supply chain risk. Hence, firms should focus on supply chain risks to improve supply chain performance. It is very difficult to have an effective supply chain [22] because of the importance of dealing with the consequences of the risks affecting supply chain performance [23]-[24]-[25]. According to the study of [1], observing the agricultural food supply chain can help managers and firms manage risks and develop supply chain performance. Therefore, the authors reviewed supply chain risks and constructed a supply chain performance model of Thai cassava chip exports to China according to the adaptation of the following table:

Table 1. The supply chain risk and the supply chain performance variables

Main variables	Sub-variables
Supply chain performance	
Supply chain performance (SCP)	- Dependability: meeting quoted or anticipated delivery dates and quantities on a consistent basis (DEP) - Speed: time between order receipt and customer delivery (SP) - Qualities: number of faultless delivery (Q) - Information: information richness in carrying out delivery (INF) - Response: response to the number of urgent deliveries (RES)
Supply chain risk factors	
Demand-side risk (DS risks)	- Unanticipated or very volatile customer demand (UNA) - Insufficient or distorted information from customers about orders or demand quantities (INS) - Changes in food safety requirements (REQ)
Logistical and infrastructural risks (L&I risks)	- Incremental changes in energy cost (ENE) - Undependable transport (TRANS) - Conflicts, labor disputes affecting transport (LB) - Lack of infrastructure and services unit (INFR)
Political risks (Pol risks)	- Political instability, war, civil unrest or other socio-political crises (CP) - Interruption of trade due to disputes with other countries (INT) - Changes in the political environment due to the introduction of new laws, stipulations (CR)
Product risk (Pro risks)	- Quality of product (QP) - Cost (C) - Process (PROC)

Source: Adapted from (E.Y. Nyamah et al., 2017; S.M. Zanjirchi et al., 2016

2.3 Effects of supply chain risks to supply chain performance

From the literature review, the authors constructed the supply chain risk factors consisting of demand-side risk, a product risks, logistical and infrastructural risks, political risks, and the construct of supply chain performance consists of dependability, speed, qualities, information and response. Therefore, the study hypothesizes the impact of the supply chain risks and the supply chain performance by the following reasons:

H1. The demand-side risk affects supply chain performance:

Demand-side risks can be the source of mismatch between the expectation of the customer and the reality so that it can disturb the physical distribution of products from the firm to the customer [23]. Moreover, from the study's result of [26], the demand side risks which were considered as independent variables had a positive relationship to the seller performance in the supply chain. Therefore, demand-side risks can be the impact of supply chain performance.

H2. The product risks will affect supply chain performance:

Product risks have three sub-variables consisting of product quality, the price of the product and product manufacturing process [15]-[7]. Furthermore, quality of product and process is one of the main ASCOS (Absolute Supply Chain Strategy Orientation) factors affecting supply chain performance [27]. Moreover, from the result of the study of academician's perspectives present three major risks in the shallot supply chain from Brebes to Jakarta is price and quality risks followed by market risk [28]. Therefore, the product risk can be influential the supply chain performance.

H3. The logistical and infrastructural risks will affect supply chain:

Logistics and infrastructure are one of the important issues in most supply chains. Logistics and infrastructure are the important factors in agri-food supply chain concerning the right product delivering to the customer at the right volume with the right condition to the right time, place and cost [28]-[29]-[30]. Hence, the ineffective logistics and infrastructure can lead some disruptions in the supply chain performance. The interruption of any decision making, for example, reliable and affordable transportation, information system and effective communication can negatively affect the agri-food supply chain performance [31]-[19. Therefore, the logistical and infrastructural risks can lead to some impacts to the supply chain performance.

H4. The political risks will affect supply chain performance:

The political issues can displace the employees and workers from the duties, and it can cause export's delay, logistics payment process of the work and firms' performance [32]. Therefore, the political risks can be the risk factor affecting the supply chain performance.

3. Research and Methodology

The study combines qualitative and quantitative methods, using in-depth interviews, field work and questionnaires to achieve its objectives. The respondents are Thai cassava chip exporters and stakeholders in the Thai cassava industry who export Thai cassava chips to China and who are registered in The Thai Tapioca Trade Association. The data were analyzed by the PLS-SEM algorithm using SmartPLS 3.2.7 software to test the relationship between supply chain risks and supply chain performance in Thai cassava exports to China.

The authors applied the PLS-SEM sampling guideline technique of the ten-time rule; the minimum sample size should be more than 1) 10 times the highest number of formative indicators used to measure one construct in the constructed model and 2) 10 times the highest number of structural paths directed at a particular dependent variable construct in the structural model [33]. The highest number of formative indicators in this study is 5; therefore, the sample size should be a minimum of 50. Hence, 100 Thai cassava chip exporters and stakeholders are the samples in the study.

The data were collected from both primary and secondary sources. For the primary source, the authors visited Thai cassava chip exporters and the stakeholders and conducted in-depth interviews to identify supply chain risks and supply chain performance. The authors then reinforced the supply chain risks and supply chain performance using literature review as a secondary source. The interview questionnaire consisted of 3 parts: general information (company profile name, annual company revenue, age of the company, number of employees, exporting transportation mode, export proportion to China and export quantity), supply chain risks affecting the cassava supply chain, and supply chain performance factors affecting the cassava supply chain. Respondents used the Likert scale (1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree). Therefore, the primary theoretical model was constructed as the following figure:

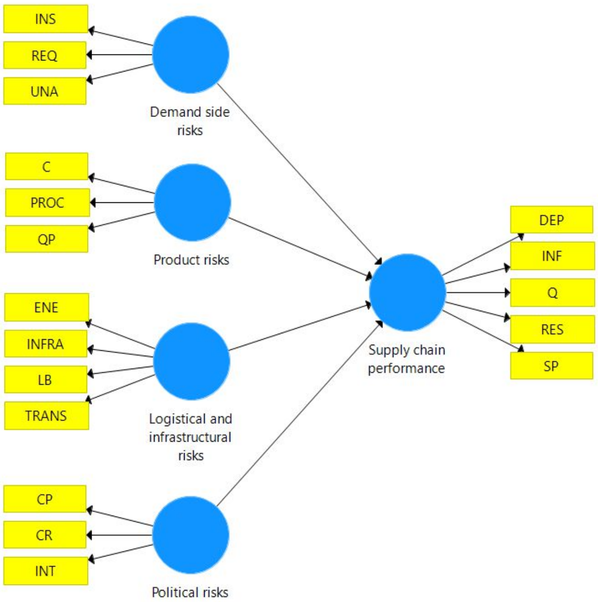

Figure 1. Primary theoretical model

4. Result

4.1 Outer model evaluation

The authors ran the data by PLS-SEM algorithm with SmartPLS 3.2.7 software, and it showed the correlation between observed variables and latent variables in the model.

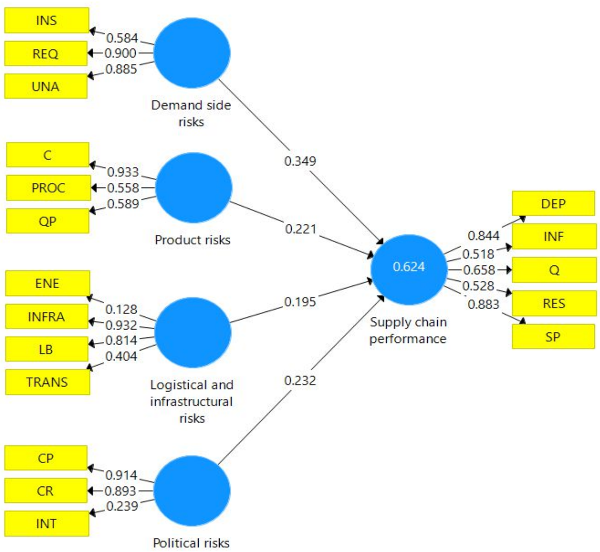

Figure 2. Full PLS-algorithm model

Figure 2 shows the outer loading score between observed variables and latent variables in the model. According to [34], the convergent validity of all subvariables must be more than 0.7. Therefore, the indicators of all subvariables which are less than 0.7 would be removed. The removed subvariables are INS (0.584) from Demand-side risk (latent variable 1), PROC (0.558) from Product risk (latent variable 2), ENE (0.128) and TRANS (0.404) from Logistical and infrastructural risks (latent variable 3), INT (0.239) from Political risks (latent variable 4), and INF (0.518), Q (0.658) and RES (0.528) from Supply chain performance (latent variable 5).

4.2 Construct Reliability and Validity

After running the PLS-SEM algorithm and removing the subvariables which are less than 0.7, the correlations among the rest of the constructed model were evaluated to meet the requirement of construct validity (table 2) and discriminant validity (tables 3 and 4) shown in the following table:

Table 1. Construct validity

Latent variables	Formative variables	Loading	Cronbach's α	Composite reliability	AVE
DS risks	REQ	0.919	0.820	0.917	0.85
	UNA	0.922			
Pro risks	C	0.979	0.705	0.839	0.73
	QP	0.705			
L&I risks	INFRA	0.932	0.778	0.898	0.82
	LB	0.873			
Pol risks	CP	0.938	0.812	0.913	0.84
	CR	0.894			
SCP	DEP	0.957	0.896	0.951	0.91
	SP	0.946			

Note: AVE stands for average variance extracted

According to [35], the loading must be higher than 0.7 for reliability indicators. On the other hand, for consistency reliability Cronbach's α must be higher than 0.7, composite reliability must be higher than 0.8, and AVE must be higher than 0.5. From table 2, all the indicator loading values are higher than 0.7. Additionally, all of Cronbach's α values are larger than 0.7, all the composite reliability values are larger than 0.8, and all of the AVE values are higher than 0.5. Therefore, all the values meet the requirements of reliability and validity. To elaborate further, Cronbach's α is able to estimate the reliability of the variables due to their interrelationships, and the composite reliability can show the individual reliability of items due to their different indicator loadings [34]. Additionally, AVE is considered the great mean value of squared loadings of the indicators group which is similar to a construct's commonality. Hence, 0.5 of AVE means that the construct can describe its indicators with larger than half of the variance [34].

Table 2. Discriminant validity: Fornell-Larcker Criterion

	DS risk	L&I risk	Pol risks	Pro risks	SCP
DS risk	**0.921**				
L&I risk	0.489	**0.903**			
Pol risks	0.512	0.494	**0.916**		
Pro risks	0.359	0.591	0.533	**0.853**	
SCP	0.569	0.571	0.615	0.503	**0.952**

Note: The bold numbers are the square root of the AVE values of each respective construct.

According to [36], AVE's square root values must be equal to or higher than all off-diagonal values of each construct. For example, off-diagonal values of demand-side risk are 0.921 which is equal to or less than AVE's square root values of demand risk, which is 0.921 (from original AVE value of demand-side risk, which is 0.847). Similarly, off-diagonal values of supply chain performance are 0.952, which is equal to or less than AVE's square root values of supply chain performance which is 0.952 (from original AVE value of supply chain performance, which is 0.906). All the off-diagonal values of latent variables in the Fornell-Larcker Criterion are equal to or less than AVE's square root values themselves. According to [37], Fornell-Larcker Criterion can test discriminant validity; therefore, the Fornell-Larcker Criterion's evaluation meets all the requirements for discriminant validity.

Table 3. Discriminant validity: Loading and Cross Loadings Criterion

	DS risk	Pro risk	L&I risks	Pol risks	SCP
REQ	**0.919**	-	-	-	-
UNA	**0.922**	-	-	-	-
C	-	**0.979**	-	-	-
QP	-	**0.705**	-	-	-
INFRA	-	-	**0.932**	-	-
LB	-	-	**0.873**	-	-
CP	-	-	-	**0.938**	-
CR	-	-	-	**0.894**	-
DEP	-	-	-	-	**0.957**
SP	-	-	-	-	**0.946**

Note: The bold numbers describe an item's loadings which are larger than all of its cross-loadings compared to other constructs.

According to [38], for cross-loading criterion, the values of loading indicators must be equal to or higher than their cross-loading constructs. From table 4, the loading of all independent variables is equal to or higher than their cross-loading constructs from other latent variables except their latent variables. For example, REQ has the highest cross-loading construct (0.919) in demand-side risk, and it is similar to UNA which has the highest cross-loading construct (0.922) in demand-side risk. Moreover, DEP has the highest cross-loading construct (0.957) in supply chain performance, and it is similar to SP which has the highest cross-loading construct (0.946) in supply chain performance. Therefore, evaluation of loading and cross-loading criterion in the model meets the requirement of discriminant validity.

4.3 Inner Model Evaluation

The PLS-SEM algorithm cannot construct a standard goodness-of-fit statistic despite prior efforts to develop a corresponding statistic the model can produce [39]. However, the PLS-SEM algorithm can be accessed by using the model's quality due to the capability of the endogenous constructs (inner model) consisting of the coefficient of determination (R^2), and path coefficient [34]. Therefore, the study will show R^2 values in the following table while the path coefficient will be presented in the next step.

Table 4. R-Square

	R^2
Supply chain performance (latent variable 5)	0.524

R^2 measured the model's accuracy of prediction, or to put it another way, R^2 can represent how much exogenous variables can affect endogenous variable(s). The value of R^2 ranges from 0 to 1 with 1 signifying perfectly predictive ability. Additionally, there are many disciplines related to R^2, but the scholar must meet a "rough" rule of thumb which considers R^2 values of 0.75, 0.50 and 0.25 to mean substantial, moderate and weak levels of predictive ability, respectively [40]-[41]. To illustrate, table 5 shows R^2 value (0.524) which means supply chain performance (latent variable 5) can be explained by supply chain risks consisting of demand-side risk (latent variable 1), product risk (latent variable 2), logistical and infrastructural risks (latent variable 3), and political risks (latent variable 4) in the amount of 52.4%. Therefore, the predictive ability of supply chain risks to supply chain performance is 0.524, which is moderate.

4.4 Inner Model Evaluation

The results of hypothesis tests are computed by a bootstrapping technique with 5000 iterations (one-tail) to analyze the significance level of structural relationships. Therefore, Path coefficient values are evaluated from the PLS-SEM algorithm while the bootstrapping technique provides standard error and T statistics values in the following table:

Table 5. Structural relationships, path coefficient and hypothesis testing

	Original sample	Sample mean	Standard error	T statistics	Decision
DS risks → SCP	0.260	0.252	0.122	2.130	Supported
L&I risks → SCP	0.225	0.230	0.163	1.376	Not supported
Pol risks → SCP	0.312	0.306	0.167	1.869	Supported
Pro risks → SCP	0.111	0.119	0.133	0.830	Not supported

The path model is run through the bootstrapping technique with 5000 iterations and one-tail results in the figure below.

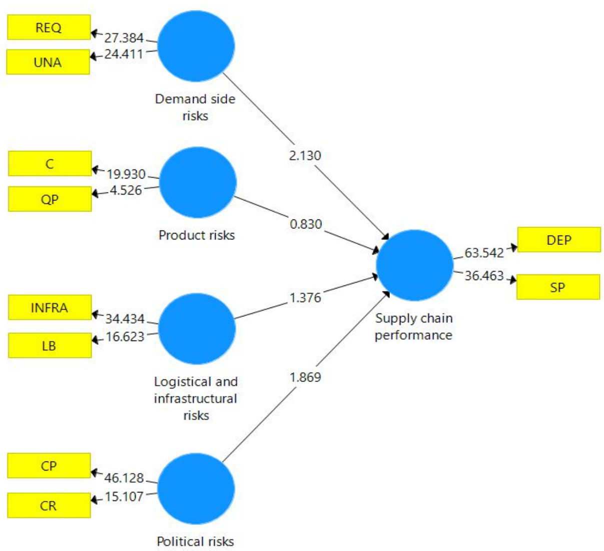

Figure 3. Bootstrapping results with 5000 iterations

According to the hypotheses of the study, the indicators meeting the requirements for further analysis were demand-side risks (REQ = changes in food safety requirements and UNA = unanticipated or very volatile customer demand), product risks (C = cost and QP = quality of product), logistical and infrastructural risks (INFRA = lack of infrastructure and services unit and conflicts and LB = labor disputes affecting transport), political risks (CP = political instability, war, civil unrest or other sociopolitical crises and CR = changes in the political environment due to the introduction of new laws, stipulations), and supply chain performance (DEP = dependability and SP = speed).

H1. Demand-side risks affect supply chain performance:

The results show that demand-side risks affect supply chain performance with a coefficient parameter of 0.260, standard error of 0.122 and a t-statistic of 2.130 (from t-table with a 5% significance level and 99 degrees of freedom), which is larger than 1.66. Therefore, H1 is supported by these statistics as well as by many studies. Demand-side risks can be the source of mismatch between customer expectations reality, which can disturb the physical distribution of products from the firm to the customer [23]. Moreover, [26] shows that demand-side risks which were considered as independent variables had a positive relationship to seller performance in the supply chain. Therefore, demand-side risks can impact supply chain performance.

H2. Product risks affect supply chain performance:

The results show that product risks do not affect supply chain performance with a coefficient parameter of 0.111, standard error of 0.133 and a t-statistic of 0.830 (from t-table with a 5% significance level and 99 degrees of freedom) which is less than 1.66. Therefore, H2 is not supported. However, based on the statistics of cassava production and the in-depth interviews, Thailand has the highest cassava production in ASEAN compared to their competitors Vietnam and Cambodia. However, China, with its high cassava demand, imports cassava chips from Thailand with less consideration of product risk.

H3. Logistical and infrastructural risks affect the supply chain:

The results show that logistical and infrastructural risks do not affect supply chain performance with a coefficient parameter of 0.225, standard error of 0.163 and a t-statistic of 1.376 (from t-table with a 5% significance level and 99 degrees of freedom), which is less than 1.66. Therefore, H3 is not supported. According to [42], Thailand ranks 32nd in the logistics performance index with a 3.41 LPI score, which is higher than Vietnam and Cambodia and is substantially higher than most ASEAN countries; moreover, the in-depth interviews showed that from an exporter's perspective, Thailand has more effective logistics and infrastructure compared to competitors such as Vietnam and Cambodia.

H4. Political risks affect supply chain performance:

The results show that political risks affect supply chain performance with a coefficient parameter of 0.312, standard error of 0.167 and a t-statistics of 1.869 (from t-table with a 5% significance level and 99 degrees of freedom), which is larger than 1.66. Therefore, H4 is supported. Moreover, political issues can displace employees and workers from their duties, and it can cause export delays, logistics payment process of the work and firms' performance [32].

Furthermore, in developing countries, political policy can change frequently, and high political risk can lead to market failures [43]. For example, according to [44], the Zambian Government changed its corn export policies three times in one year. In conclusion, political risks can affect supply chain performance in Thailand due to the abovementioned reasons for the developing country.

5. Conclusions

The study was conducted to review supply chain risks and supply chain performance factors of Thai cassava chip exports to China. The study showed that supply chain risks for Thai cassava chip exports to China consist of demand-side risks (from independent variables Changes in food safety requirements and Unanticipated or very volatile customer demand), product risks (from independent variables Cost and Quality of product), logistical and infrastructural risks (from independent variables Lack of infrastructure and services unit and Conflicts, labor disputes affecting transport), and political risks (from independent variables Political instability and Changes in the political environment). On the other hand, supply chain performance for Thai cassava chip exports to China consists of dependability and speed.

Additionally, the study was conducted to enhance the understanding of how the stated supply chain risks affect supply chain performance in a particular industry. The construct validity (consisting of loading, Cronbach's α, composite reliability, and AVE values), and discriminant validity (consisting of Fornell-Larcker Criterion and Loading and Cross-Loading Criterion) meet the requirement. Furthermore, the R-Square value is equal to 0.524. This means the supply chain risks (demand-side, product, logistical and infrastructural, and political) are moderate predictive indicators of supply chain performance. However, from the hypothesis testing, H1 "demand side risks affect supply chain performance", and H4 "political risks affect supply chain performance" are supported due to coefficient parameter, standard error and t-statistics values (from t-table with a 5% significance level and 99 degrees of freedom). H2 "product risks affect supply chain performance", and H3 "logistical and infrastructural risks affect supply chain performance" are not supported. Therefore, demand-side risks and political risks in the supply chain share a relationship and have a direct effect on supply chain performance in Thai cassava chip exports to China from the perspective of Thai exporters and stakeholders.

Acknowledgments

The authors would like to thanks College of Management Mahidol University and the Faculty of Management Science, Lampang Rajabhat University for financial support together with facilitating working places and academic sources.

References

[1] Nyamah, E. Y., Jiang, Y., Feng, Y., & Enchill, E., *"Agri-food supply chain performance: an empirical impact of risk"*, Management Decision, Vol 55, No. 5, pp. 872-891, 2017

[2] Zanjirchi S. M., Jalilian N., Mirhoseini A., *"Risk-agility interactive model: a new look at agility drivers"*, Journal of Modelling in Management, Vol 12, No. 4, pp. 690-711, 2016.

[3] Office of Agricultural Economics Thailand, http://www.oae.go.th (20-09-2018)

[4] Global Trade Atlas®, https://www.gtis.com, (22-02-2018)

[5] Ho, W., Zheng, T., Yildiz, H., & Talluri, S., *"Supply chain risk management: a literature review"*, International Journal of Production Research, Vol 53, No. 16, pp. 5031-5069, 2015.

[6] Harland, C., Brenchley, R., & Walker, H., *"Risk in supply networks"*, Journal of Purchasing and Supply Management, Vol 9, No. 2, pp. 51-62, 2003.

[7] Tang, C., *"Perspectives in supply chain risk management"*, International Journal of Production Economics, Vol 103, No. 2, pp. 451-488, 2006.

[8] Zsidisin, G., *"A grounded definition of supply risk"*, Journal of Purchasing and Supply Management, Vol 9, No. 5-6, pp. 217-224, 2003.

[9] Jüttner, U., Peck, H., & Christopher, M., *"Supply chain risk management: outlining an agenda for future research"*, International Journal of Logistics Research and Applications, Vol 6, No. 4, pp. 197-210, 2003.

[10] Rao, S., and Golbsby, T.J. "Supply Chain Risk: A Review and Typology", The International Journal of Logistics Management 20 (1): 97-123, 2009.

[11] Aven, T., "*Foundations of risk analysis*", Wiley, 2013.

[12] Fitzgerald, K., *"Big savings, but lots of risk"*, Supply chain management review, Vol 9, No. 9, pp. 16-20, 2005.

[13] LaLonde, B., *"A crisis in transportation"*, Supply Chain Management Review, pp. 7-8, 2004.

[14] Liu, P., & Wang, T., *"Research on Risk Evaluation in Supply Chain Based on Grey Relational Method Article in Journal of Computers"*, 2008.

[15] Schoenherr, T., Rao Tummala, V., & Harrison, T., *"Assessing supply chain risks with the analytic hierarchy process: Providing decision support for the offshoring decision by a US manufacturing company"*, Journal of Purchasing and Supply Management, Vol 14, No. 2, pp. 100-111, 2008.

[16] Chan, F., & Qi, H., *"Feasibility of performance measurement system for supply chain: a process-based approach and measures"*, Integrated Manufacturing Systems*, Vol 14, No. 3, pp. 179-190, 2003.*

[17] Cedillo-Campos, M., & Sánchez-Ramírez, C., Journal of applied research and technology, UNAM, Centro de Ciencias Aplicadas y Desarrollo Tecnológico. Vol 11, 2013.

[18] Lee, H., & Billington, C., *"Material Management in Decentralized Supply Chains"*, Operations Research, Vol 41, No. 5, pp. 835-847, 1993.

[19] Aramyan, L., Oude Lansink, A., van der Vorst, J., & van Kooten, O., *"Performance measurement in agri-food supply chains: a case study. Supply Chain Management"*, An International Journal, Vol 12, No. 4, pp. 304-315, 2007.

[20] Tang, O., & Nurmaya Musa, S., *"Identifying risk issues and research advancements in supply chain risk management"*, International Journal of Production Economics, Vol 133, No. 1, pp. 25-34, 2011.

[21] Badea, A., Prostean, G., Goncalves, G., & Allaoui, H., *"Assessing Risk Factors in Collaborative Supply Chain with the Analytic Hierarchy Process (AHP)"*, Procedia - Social and Behavioral Sciences, Vol 124, pp. 114-123, 2014.

[22] Vahid Nooraie, S., & Parast, M., *"Mitigating supply chain disruptions through the assessment of trade-offs among risks, costs and investments in capabilities"*, International Journal of Production Economics, Vol 171, pp. 8-21, 2016.

[23] Christopher, M., & Lee, H., *"Mitigating supply chain risk through improved confidence",* International Journal of Physical Distribution & Logistics Management, Vol 34, No. 5, pp.388-396, 2004.

[24] Chandra, C., & Grabis, J., *"Supply chain configuration: concepts, solutions and applications"*, Springer, 2007.

[25] Ritchie, B., & Brindley, C., *"Supply chain risk management and performance"*, International Journal of Operations & Production Management, Vol 27, No. 3, pp. 303-322, 2007.

[26] Avelar-Sosa L., Garcia-Alcaraz J.L., Castrellón-Torres J.P., *"The Effects of Some Risk Factors in the Supply Chains Performance: A Case of Study"*, Journal of

applied research and technology, Vol 12, No. 5, 2014.
[27] Morita, M., Machuca, J., & Pérez Díez de los Ríos, J., *"Integration of product development capability and supply chain capability: The driver for high performance adaptation"*, International Journal of Production Economics, Vol 200, pp. 68-82, 2018.
[28] Susanawati, S.P., M. P & Fauzan, M., *"Risk of shallot supply chain: an Analytical Hierarchy Process (AHP) model in Brebes Java, Indonesia"*, International Journal of Supply Chain Management, Vol 8, No.1, pp. 124-131, 2019.
[29] Brimer, R., *"Logistics networking*", Logistics Information Management, Vol 8, No 4, pp. 8-11, 1995.
[30] Tarantilis, C., Kiranoudis, C., & Vassiliadis, V., *"A threshold accepting metaheuristic for the heterogeneous fixed fleet vehicle routing problem"*, European Journal of Operational Research, Vol 152, No. 1. pp. 148-158, 2004.
[31] Aghazadeh, *"Improving logistics operations across the food industry supply chain"*, International Journal of Contemporary Hospitality Management, Vol 16, No. 4, pp. 263-268, 2004.
[32] Joshi, S., & Arano, K., *"Determinants of private forest management decisions: A study on West Virginia NIPF landowners"*, Forest Policy and Economics, Vol 11, No. 2, pp. 118-125, 2009.
[33] Ksoll, C., Macchiavello, R., & Morjaria, A., *"Guns and Roses: Flower Exports and Electoral Violence in Kenya"*, SSRN Electronic Journal, 2016.
[34] Barclay, D., Higgins, C. and Thompson, R., *"The partial least squares (PLS) approach to causal modeling: personal computer adoption and use as an illustration"*, Technology Studies, Vol 2, No. 2, pp. 285-309, 1995.
[35] Stiglitz, J., *"Distinguished Lecture on Economics in Government: The Private Uses of Public Interests: Incentives and Institutions"*, Journal of Economic Perspectives, Vol 12, No. 2, pp. 3-22, 1998.
[36] De Juana-Espinosa, S., & Rakowska, A., *"Public sector motivational practices and their effect on job satisfaction: country differences"*, European Journal of Management and Business Economics, Vol 27, No. 2, pp. 141-154, 2018.
[37] Valaei, N., & Nikhashemi, S., *"Generation Y consumers' buying behaviour in fashion apparel industry: a moderation analysis"*, Journal of Fashion Marketing and Management: An International Journal, Vol 21, No. 4, pp. 523-543, 2017.
[38] Fornell, C., & Larcker, D., *"Structural Equation Models with Unobservable Variables and Measurement Error: Algebra and Statistics"*, Journal of Marketing Research, Vol 18, No. 3, pp. 382, 1981.
[39] Chin, W. W., Modern methods for business research, Mahwah: Erlbaum, 1998.
[40] Henseler, J., & Sarstedt, M., *"Goodness-of-fit indices for partial least squares path modeling"*, Computational Statistics, Vol 28, No. 2, pp. 565-580, 2013.
[41] Hair, J. F., Ringle, C. M., & Sarstedt, M., *"PLS-SEM: Indeed a silver bullet"*, Journal of Marketing Theory and Practice, Vol 19, No. 2, pp. 139-151, 2011.
[42] Henseler, J., Ringle, C. M., & Sinkovics, R. R., *"The use of partial least squares path modeling in international marketing"*, Advances in International Marketing, Vol 20, pp. 277-319, 2009.
[43] World Bank Group, https://lpi.worldbank.org/, 20-10-2018
[44] Stiglitz, J., *"Distinguished Lecture on Economics in Government: The Private Uses of Public Interests: Incentives and Institutions"*, Journal of Economic Perspectives, Vol 12, No. 2, pp. 3-22, 1998.
Zinyama, F., *"WFP awards NMC Zim maize export contract"*, The Post, pp. 11, 2007.