Supply Chain Management in Smart Cities: Ensuring Sustainability through Flexibility in Thailand

Khajornsak Thaiprayoon[#1], Aksorn Sawasdee[#2], Kittisak Jermsittiparsert*[3,4]

[1] *Command and General Staff College, Royal Thai Army, Bangkok, Thailand*
[2] *Faculty of Humanities and Social Sciences, Phranakhon Rajabhat University, Bangkok, Thailand*
[3]*Department for Management of Science and Technology Development, Ton Duc Thang University, Ho Chi Minh City, Vietnam*
[4]*Faculty of Social Sciences and Humanities, Ton Duc Thang University, Ho Chi Minh City, Vietnam*
[1]*khajornsakthai@gmail.com*
[2]*love2aksorn@hotmail.com*
**Corresponding author: kittisak.jermsittiparsert@tdtu.edu.vn*

Abstract--- The story which was started with the concept of carbon free city has now obtained its maturity with the new need for smart cities. Life of such smart cities can only get oxygen from efficient supply chain practices from business point of view. Because the end outcome of such smart cities is to achieve sustainability. This research is based on supply chains of manufacturing units located in smart cities that how different practices like instrumental, interconnected and intelligent supply chain have their impact on sustainability performance in mediating role of supply chain flexibility. Respondents were sampled from manufacturing industry of Thailand and especially those firms which were located in such cities which have aimed to become smart cities in next five years. Middle-level management was surveyed through questionnaire and data was then analyzed on SPSS and AMOS. All dimensions or practices of smart city supply chain found positively related with sustainability performance and results also flagged significant positive mediating role of supply chain flexibility in respective relationships. This study's originality can be found in inclusion of supply chain flexibility as mediator which also has implications for industry and literature.

Key Words: Smart City, Interconnected Supply Chain, Intelligent Supply Chain, Interconnected Supply Chain, Supply Chain Flexibility and Sustainability Performance

1. Introduction

The term smart city referred to the cities which are connected with each other for trading, through technology and different connection techniques. The trade became globally famous in these cities. Trade Data is shared in these cities and the demand and supply are managed through the shared information in between these connections [1]. This smart work helped the organization to sustain its growth for a longer run. Sustainability performance is totally dependent on the smart cities supply chain. Through this medium, many organizations got benefits in the past and they have improved their services and delivery methods as well. The smart city supply chain involves instrumental supply chain, interconnected supply chain, and intelligence supply chain.

Another technique of supply chain flexibility is very important for the well-managed supply chain for any company. It means that the risk will be a divide in a different portion in supply chain flexibility which can prove beneficial for the manufacturing sector [42]. In the case of shrink of demand or higher demand and supply, this technique is proved useful for such situations[2]. In this study, the impact of smart city supply chain on sustainability performance will be acknowledged. The impact of the instrumental supply chain, interconnected supply chain and intelligence supply chain on sustainability performance will be seen. This study will also see the mediating role of supply chain flexibility between instrumental supply chain and sustainability performance, between interconnected supply chain and sustainability performance, and between intelligence supply chain and sustainability performance[3].

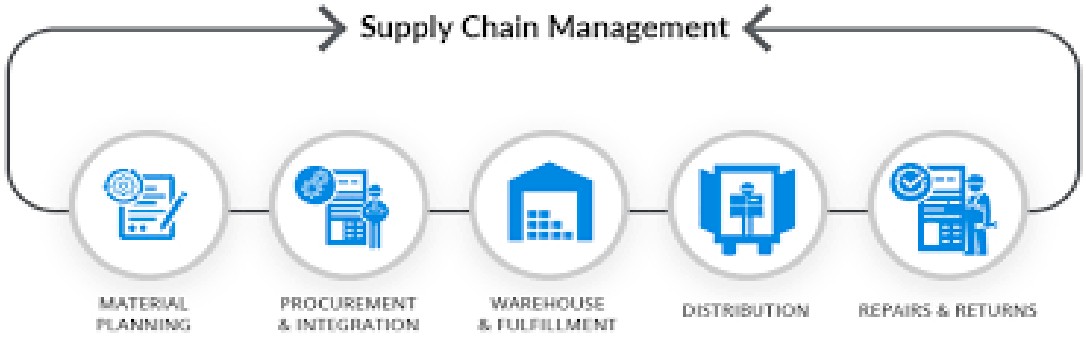


Figure 1: Supply chain management

This study will be conducted in Thailand the information through the results and conclusion will be drawn, will gather from the manufacturing sector. The discussion of this topic is a big challenge for today's world. Because manufacturing sectors were doing a lot of things to handle the sustainability performance through the mediating role of supply chain flexibility and independent role of the smart city supply chain, but they got not enough results. This is a problem for the whole world[4].

Many researchers in the past suggested some facts but most of them were old and not useful. With the role of supply chain flexibility, the issue of sustainability performance must be solved. This study will help people concerned about sustainability; they will get useful knowledge about the topic. This study is going to tell about the relationship and association between smart city supply chain and sustainability performance, this study will also tell about the impact of different aspects of smart city supply chain and their different impacts of these aspects on the sustainability performance[5]. The goal of this study is also to know about the mediating role of supply chain flexibility between smart city supply chain's different aspects and sustainability performance. This study will take place in Thailand and the data will be accumulated from the manufacturing sector. The people related to the manufacturing sector will be the sample and the manufacturing sector of Thailand will be the population. This study will positively contribute to the literature. It will definitely enhance the data material in the soft form on the internet. This study will be proving useful for concerning people who have concerns about their sustainability performance they can get reliable and suitable proposals to enhance their sustainability and improve their supply chain methods. They can also get suggestions about how to use the supply chain flexibility as a mediator to enhance their growth. This study will also contribute to government level [6, 43]. The government authorities which are concerned to enhance their industrial sector. They can get numerous suggestion which they can apply, formulate, and implement different strategies for the additional growth of the manufacturing sector of their country. It will also contribute significantly to practical life. Industrialists can have positive proposals for the better growth of the sector. Past researchers did not use the mediating role of supply chain flexibility properly. This study will use the mediator effectively and propose significant suggestions regarding sustainability performance and enhance the smart city supply chain. In last ten years, the concept of smart city supply chain did not get the attention of the people but now the era has totally changed, technological changes helped a lot of organization in selecting and adopting the smart city supply chain management [7].

2. Literature Review

2.1. Theoretical Framework of Sustainability Performance Managements and Stakeholder's Theory

According to the framework of sustainability performance management (SPMs) studies by [8] believe that sustainability conditions of organization or firms indicate business objectives beyond the affectivity of traditional models and territory. The sustainability performance [9] expands from traditional aims such as operational and financial excellence to environmental and social excellence. However, according [10] to the models of

sustainability performance seems to be 'must' for the companies in the future and also in the present. Sustainability performance is considered one of the most important factors of raising the business performance to the level of higher achievement [11]. So far, the most common response from the organizational reporting and manufacturing sector depends upon sustainability performance that further codes the sustainable practices worldwide. Therefore, the stakeholder's theory largely [12] concerns with the phenomenon of sustainability performance of managements that further emphasize the need of corporate accountability to a broad range of stakeholders. Basically, those companies or industries that are multi-national or transnational corporation are large and powerful and have a severe impact on the society and the environment. As per research theorists [13], who analyzes the impact of sustainability performance models on stakeholder's theory, reports that business are not only accountable to shareholders, however it has a wide range of stakeholders [14] that includes: employees, customers, suppliers, regulator, pressure group and other communities. Stakeholder's theory has an adequate share in the maintenance of the business performance and sustainability performance. Moreover, [15] suggest that many different business corporations realize the importance of sustainable practices to survive in global competitions.

2.2. Instrumented Supply Chain and its impact on Sustainability Performance

According to recent researches [16], that develops the concept of sustainability performance models under the view of instrumented supply chain that gains advantages at economic level as well as at competitive level. However, latest studies by [17], also elaborates the idea of smart supply chains that are introduced recently in the domains of business performance and sustainability performance. However, smarter supply chain developed from the efforts of IBM which has made smarter supply chain the source of key marketing [18] value. Instrumented supply chain is also considered one of the most important components of Smart Cities supply chain, [5] whose basic function is to be supported by pervasive data collection networks that provide real-time visibility. Sustainability performance model explains the effect of instrumented supply chain that has an effective impact on the development of corporations. [19], briefly demonstrates about the application of instrumented supply chain in business planning, strategically planning, promoting lifecycle management and sourcing and procurement. Studies by [20], explores the disciplines of instrumented supply chain and further divides it into three main elements of business operational capabilities, assets management, and logistics profiles and enterprises applications. These elements are responsible for further driving the sustainability performance beyond its scope. Thus, the following hypothesis is proposed:

H1: Instrumented supply chain has a significant impact on sustainability performance.

2.3. Interconnected Supply Chain and its impact on Sustainability Performance

[21], define the influence of interconnected supply chain on sustainability performances management. Interconnected supply chain is one of the component of Smarter supply chain that consists of system to system integration up and down the supply chain, it is not only helpful for trading partners, however it also maintains the sustainability of machinery and inventory. Literature articles [22], analyzes the impact of technical barriers that are required for integration strongly supports service oriented architecture, which further influences the performance of sustainability to improve the latest technology and we demands. However, it is considered one of the least expensive ways for the integration of sustainability systems in different enterprises. Furthermore [23], interconnected supply chain pays of the investment in connectivity with sustainability performance. Financial and sustainability performance management models usually deals with operational business system and manages the assets along with logistics capabilities. Studies, demonstrates the supply chain management [24] competency areas that figures out business planning, business processing and business management that further influences the dynamics of sustainability performances. Thus, the following hypothesis is proposed:

H2: Interconnected supply chain has a significant impact on sustainability performance.

2.4. Intelligent Supply Chain and its impact on Sustainability performance

[25] Smarter supply chain is divided into three basic components in which third one is knows as intelligent supply chain, however latest articles [26], explains the formation and function of these components more in detail. Therefore, intelligent supply chain is used by organizations and certain firms to achieve better supply chain results and decision-making through advanced analytics and which utilizes next generation optimization software. [27], displays the role of intelligent supply chain as the phenomenon that causes renaissance in the field of sustainability performance and as an effective tool for optimization performance. Moreover, supply chain complexity and lean-ness are key drivers of those trends that are related with sustainability capabilities and which enhances the potential of working tools to gain more competitive advantages [28]. Therefore, intelligence supply chain highlights many serious concerns regarding awareness environmental and social responsibility that will rather prevent massive financial losses while enhancing the value of sustainability performances. Nevertheless, supply chain execution functions on the operations of intelligence supply chain to further focus on the performance sustainability. Thus, the following hypothesis is proposed:

H3: Intelligence supply chain has a significant impact on sustainability performance.

2.5. Mediating Role of Supply chain flexibility between instrumented supply chain and sustainability performance

According to a research article [29], that explains the mediating role of supply chain flexibility between the two variables of instrumented supply chain and sustainability performance. Supply chain flexibility is basically required for the performance of environmental and social based responsibility. This type of responsibility enhances the role of sustainability performance because authors believe that the instrumented and other supply chain elements are considered as the Smarter Supply Chain of future. However, with the assistance of theoretical framework of sustainability [30] performance management, instrumented supply chain acts as the source of supply chain execution and supply chain operation which is further mediated effectively by supply chain flexibility. [31] explains the role of supply chain flexibility while dividing it into other sectors consisting of micro-flexibility operation and macro-flexibility operation that portrays the affectivity of performance and sustainability on business capabilities and on instrumented supply chain [32]. Adaptability of supply chain enhances the performance of instrumented supply chain and sustainability performance. Thus, the following hypothesis is proposed:

H4: Supply chain flexibility has a significant mediating role between the relationship of instrumented supply chain and sustainability performance.

2.6. Mediating Role of Supply chain flexibility between interconnected supply chain and sustainability performance

[33] suggests that supply chain flexibility acts between interconnected supply chain and sustainability performance. Interconnected supply chain drives the efficiency of sustainability performance with the help of the mediator supply chain flexibility. However, supply chain flexibility ensures the role of supply chain agility to increase the economic and social values of the businesses and organizational firms. Agile and adaptability supply chains [34] are similar to many micro-flexibility ideas that promote the potential performance of interconnected supply chain and sustainability performance. Thus, the following hypothesis is proposed:

H5: Supply chain flexibility has a significant mediating role between the relationship of interconnected supply chain and sustainability performance.

2.7. Mediating Role of Supply Chain flexibility between intelligent supply chain and sustainability performance

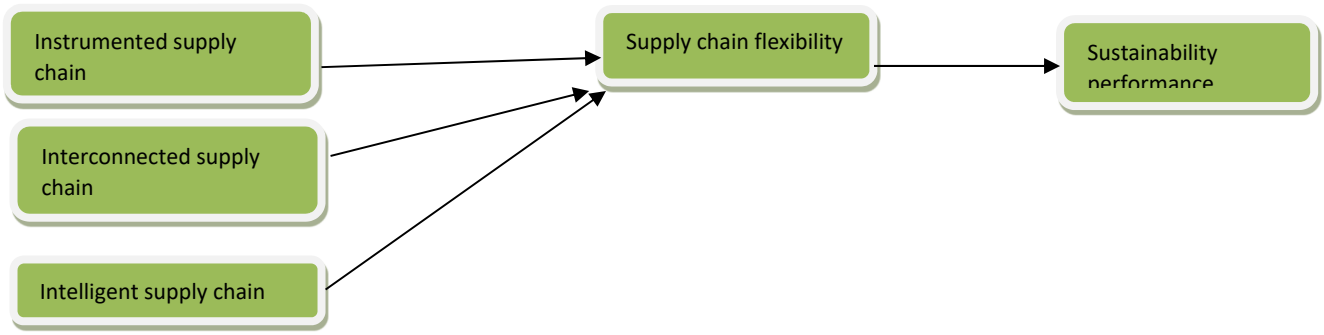
Researchers like [35], suggest that supply chain flexibility act as a mediator between intelligent supply chain and sustainability performance. The agile supply chain fulfills the demand of supply chain flexibility that defines the competencies of intelligent supply chain which further influences the sustainability performance to cooperate with the strategic planning, operations, sourcing and procurement and logistics enterprises. Furthermore,

studies by [36] evaluate the theoretical approach of sustainability performance management to focus on smart risk management that analyzes the effect of intelligent supply chain, that is used by many companies and IT sectors because of its valuable software. Intelligent strategy learns from risk based impact analysis that operates risk-adjustment inventory optimization which develops connectivity with supply chain vulnerability with the help of disaster response models. Stakeholder's theory [37] benefits the proficiency and performance of intelligent supply chain and sustainability performance. Studies that are related to supply chain flexibility usually study and investigate the effect of cost structures and investment performance of the organizational enterprises [38] that are sufficiently influences intelligent supply chain and sustainability performance. Thus, the following hypothesis is proposed:

H6: Supply chain flexibility has a significant mediating role between the relationship of intelligent supply chain and sustainability performance.

Model:

Smart Cities Supply Chain



3. Methodology

3.1. Population and Sample

In this research study, researcher examined the impact of smart cities supply chain such as interconnected, instrumented and intelligent supply chain on firm's sustainability performance, in mediating role of supply chain flexibility. The target population for this research study is manufacturing sector of Thailand. Researcher has to select those manufacturing industries which have fully developed and documented supply chain. Due to this reason, researcher selected agriculture and automotive industries as sample and observed the impact of smart cities supply chain on these industries sustainability performance, in mediating role of supply chain flexibility. By implementing purposive sampling techniques, researcher has been selected managerial employees as respondents because they have knowledge about the firm operational performance. In sampling, the main vexing point for researcher is sample size which has to be in accordance with the analysis approach. According to [25] sample size has to be large enough while using the covariance-based SEM approach. Researcher selects the sample size on the bases of the idea represented by [13] which elaborate that number of questions*10 provide with exact figure of sample size. After the calculation of the sample size, 350 questionnaires have been distributed among the respondent but after the whole procedure of data collection only 327 responses considered valid.

3.2. Data Collection Method

In this quantitative research study, questionnaire has been used for the data collection. In structured questionnaire researcher asked questions about the variables of the study. Questionnaire originally written in English language but converted into Thai language for the understanding of Thai people, after data collection back translated method has been implemented in order to again translate the questionnaire into English for the convenience of researcher. Further, content validity of scale has been checked as the previously administered scale has been used in study. It has been performed by collecting feedback from other researchers and

industrial professionals. After finalizing the questionnaire, it has been administered by online questionnaire method, for the convenience of respondents as they can solve it at any time.

3.3. Validity, Reliability and Common Bias

SPSS and AMOS have been used for the assessment of reliability and validity respectively. Coming towards validity, both elements of validity such as convergent validity and discriminant validity have been analyzed by AMOS but criteria to examine that are totally different. For convergent validity, three criteria have been used which includes (1) items loading λ, its threshold range is greater than 0.70, (2) composite constructs reliability, it has to be greater than 0.80 as its values were stronger at above 0.80 and (3) average variance extracted, which has to be exceed the specific limit such as 0.50. On the other hand, criterion used to examine the assessment of discriminant validity entails that square root of AVE of each construct has to greater as compared with inter-correlated coefficients of remaining constructs. As far as reliability is concerned, it has been assessed through criterion which entails that Cronbach's α has to be greater than 0.70 in order to achieved the desirable level of items reliability.

Common bias has been originated in the study when similar measure used for most of variance of the constructs. Risk of the common bias has also been observed in this research study, because it has been considered same measure used for the evaluation of the variables of study such as smart cities supply chain, supply chain flexibility and sustainability performance. Presence or absence of common bias in the study has been checked by Harman's single factor test. The test has been accompanied in order to observe all the variance of constructs, as researcher examined whether single factor used for accounting of most of the constructs. Inexistence of common bias has been ensured when not 50% of variance accounted for by single factor. Results shown that single factor used for the accounting of 16% of variance and 86% of variance accounted for by factors solution. Therefore, it has been proved common bias has not been generated in this research study.

3.4. Hypothesis Testing

Hypothesis testing is significant part of research methodology, because the hypotheses have been accepted or rejected on the bases of outcomes that have been generated by performing whole procedure. Hypothesis testing has been performed by structure equation modeling, which runs on AMOS. Hypothesis testing has been accomplished in two steps such as first step is to examined the direct effect such as impact of smart cities supply chain on sustainability performance and second step is to examined moderation effect such as impact of supply chain flexibility on sustainability performance. After performing these steps, researcher reports about the acceptance or rejection status of hypotheses.

3.5. Measures

SCSC was measured using the [25] scale for supply chain sustainability, four items were used for the measurement on a five-point Likert scale. SCF was measured by the scale developed by [14], and four items were measured on a five-point Likert scale. SP was measured with [16] for sustainability performance and five items were taken on a five-point Likert scale.

4. Empirical Results

4.1. Demographical Results

The study was conducted in Thailand and data was from 350 participants and the number of respondents was 327. The associations with the help of a self-organizational questionnaire were analyzed by using SPSS and Amos. It is very important to conduct the prerequisite analysis in order to check the reliability, normality, and validity of the data. The researcher applied the frequency distribution test in order to check the respondent profile. The findings showed that 133 males and 194 females participated in this study. 23 of the participants had graduation degree, 164 respondents had done post-graduation. Whereas, 130 respondents had master's degree and 10 had another degree. The participants included 274 people in age range 21 to 30 years, 42 people in age range 31 to 40 years, 9 people in age range of 41 to 50 years and only 2 participants were of age more than 50.

4.2. Descriptive Statistics

Table 1. Descriptive Statistics

	N Statistic	Minimum Statistic	Maximum Statistic	Mean Statistic	Std. Deviation Statistic	Skewness Statistic	Std. Error
SCF	327	1.00	4.90	3.5303	1.10702	-.813	.135
INST	327	1.00	5.00	3.5341	1.09030	-.799	.135
INTR	327	1.00	5.00	3.5306	1.12888	-.724	.135
INTG	327	1.00	5.00	3.4557	1.17163	-.630	.135
SUSP	327	1.00	5.00	3.4381	1.12342	-.544	.135
Valid N (listwise)	327						

Table no. 1 is showing that there is no out lair in the given data as the maximum values lie in the threshold range of 5-point Likert scale, as the skewness value is somewhere between -1 and +1 which is the threshold range of normality assumption and so the data is normal and is valid to go for further testing.

4.3. Rotated Component Matrix

Table 2. Rotated Component Matrix

	Component				
	1	2	3	4	5
SCF1	.706				
SCF2	.769				
SCF3	.824				
SCF4	.846				
SCF5	.837				
SCF6	.826				
SCF7	.826				
SCF8	.805				
SCF9	.840				
SCF10	.811				
INST1		.780			
INST2		.788			
INST3		.799			
INST4		.857			
INST5		.812			
INST6		.866			
INTR1					.799
INTR2					.831
INTR3					.886
INTR4					.802
INTG1			.774		
INTG2			.815		
INTG3			.827		
INTG4			.849		
INTG5			.834		
SUSP1				.840	
SUSP2				.860	
SUSP3				.869	
SUSP4				.871	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 7 iterations.

The above table is showing the RCM values, almost all of the indicators are showing the factor loading more than 0.7, it means that all of the indicators are eligible to be added in the further hypothesis testing because all factor loadings are in suitable threshold level and in a suitable and valid range. Moreover,

there is no cross-loading data shown in RCM so, data is good to go for further testing.

4.4. Convergent and Discriminant Validity

Table 3. Convergent and discriminant validity

	CR	AVE	MSV	Max R(H)	INTG	SCF	INST	INTR	SUSP
INTG	0.953	0.801	0.338	0.953	**0.895**				
SCF	0.967	0.745	0.300	0.981	0.548	**0.863**			
INST	0.946	0.748	0.306	0.988	0.553	0.544	**0.865**		
INTR	0.933	0.778	0.338	0.990	0.581	0.509	0.407	**0.882**	
SUSP	0.937	0.788	0.244	0.991	0.342	0.494	0.420	0.411	**0.888**

The results of convergent and discriminant validity show that the overall model is a good fit because the composite reliability of each variable is more than 70% and average variance extracted is more than 50% while the discriminant validity shows that loading of each variable discriminates from others. Every variable has maximum loading with itself as compared to with others so these validities prove the authenticity of collected data.

4.5. Confirmatory Factor Analysis

Table 4. CFA

Indicators	Threshold range	Current values
CMIN/DF	Less or equal 3	2.413
GFI	Equal or greater .80	.837
CFI	Equal or greater .90	.949
IFI	Equal or greater .90	.949
RMSEA	Less or equal .08	.066

The table no. 4 is showing that CMIN is less than 3, GFI is greater than .80, CFI is greater than .90, IFI is greater than .90 and RMSEA is less than .08, so this table is clearly showing that all of the values of all of the indicators is in the valid threshold range so data is good to go for further testing. Following is screenshot of CFA:

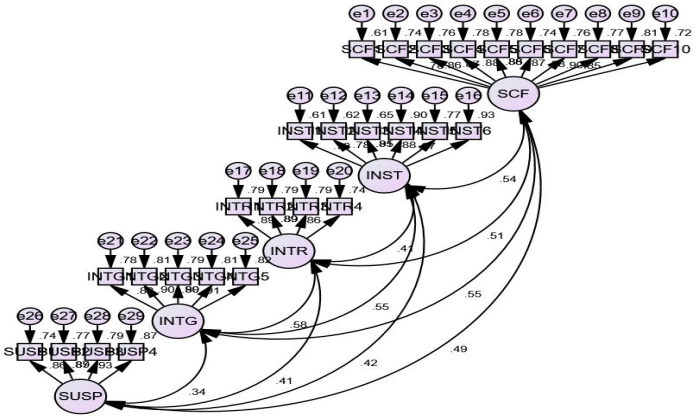


Figure 2: CFA

4.6. Structural Equation Modeling

Table 5. SEM

Total effect	INTG	INTR	INST	SCF
SCF	.239***	.230***	.304***	.000
SUSP	.017	.245***	.309***	.293***
Direct effect	INTG	INTR	INST	SCF
SCF	.239***	.230***	.304***	.000
SUSP	-.053	.178**	.220***	.293***
Indirect effect	INTG	INTR	INST	SCF
SCF	.000	.000	.000	.000
SUSP	.070**	.067**	.089**	.000

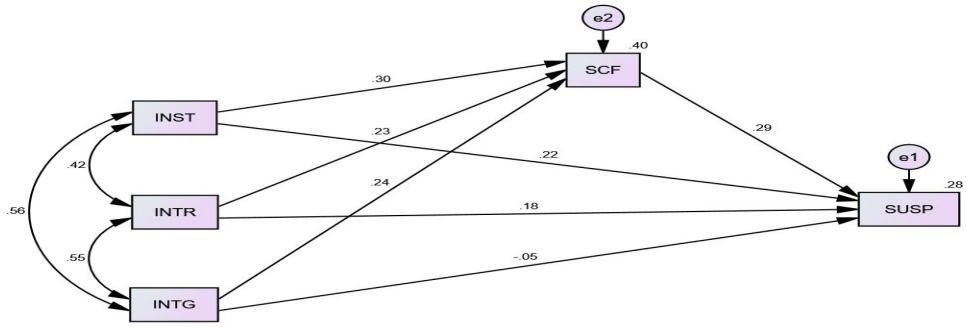


Figure 3: SEM

The total effect of INTG on SCF and SUSP is 23.9% significant and positive and 1.7% insignificant respectively. The impact of INTR on SCF and SUSP is 23% and 24.5% respectively. the impact of SCF on SUSP is 29.3% significant and positive and this means with every 1 unit increase in SCF the SUSP will increase by 29.3%. the direct effect of INTG on SCF is 23.9% which is positive and significant and the impact on SUSP is 5.3% negative and insignificant. the effect of INTR on SCF and SUSP is 23% and 17.8% positive and significant respectively. the effect of INST on SCF and SUSP is 30.4% and 22% respectively. The impact of SCF on SUSP is 29.3% that is positive and significant. The impact of INTG on SUSP is 7%, impact of INTR on SUSP is 6.7% and impact of INST on SUSP is 8.9% which means with 1 unit increase in INST the SUSP will increase by 8.9%.

5. Discussion and Conclusion

5.1. Discussion

The aim of this study was to have knowledge about the relationship between impact of smart cities supply chain (SCSC) on Sustainability Performance (SP) [39]. The smart city supply chain involves Instrumental Supply Chain (ISC-1), Interconnected Supply Chain (ISC-2), and Intelligence Supply Chain (ISC-3). The aim of this study was also to know about that how significantly Supply Chain Flexibility (SCF) mediates between ISC-1 and SP. How significantly SCF mediates between ISC-2 and SP, and between ISC-3 and SP. This study conducted a test of the hypothesis and suggested the following hypothesis; the first hypothesis suggested that ISC-1 has a significant and positive impact on SP. This hypothesis was accepted. “Antony Paulraj” state that instrumental supply chain has positive impacts on SP in every organization who know how to manage their supply chain. The next hypothesis was also accepted and suggested that ISC-2 Has a positive impact on SP [40]. “Injazz J Chen” a Chinese researcher stated

in that research the significant impact of ISC-2 on SP, and suggested that integrated supply chain always resulted in better performance and better performances led the organizations towards sustainability. The third hypothesis suggested that ISC-3 has a significant impact on SP. This hypothesis also accepted. according to the study of "C Blome,"

ISC-3 has a positive and vital impact on SP. Hypothesis number four recommended that the SCF positively mediates between ISC-1 and SP. This hypothesis was accepted as well. According to the "Ying Liao," research global marketing environment became vulnerable, uncertain and complex. So, to enhance the sustainability of the organization the positive role of SCF is required between ISC-1 and SP. Another hypothesis suggested that SCF significantly mediates between ISC-2 and SP. This hypothesis is accepted. "Paul Hong" suggested that positive SCF is necessary for the sustainable environment for the company. The last hypothesis suggested that there is a positive mediating role of SCF between ISC-3 and SP. The hypothesis was acknowledged as well. As per the study of "S Subba Rao," the impact of this mediating variable is motivating between ISC-3 and SP [41].

5.2. Conclusion

The objective of this study was to know about the relationship between ISC-1 and SP, ISC-2 and SP, and between ISC-3 and SP. Another purpose of this study was to know about the mediating role of SCF between ISC-1 and SP, ISC-2 and SP, and the mediating role of SCF between ISC-3 and SP. This study was completed in Thailand by selecting a sample of 350 people from the manufacturing sector of Thailand, 327 were valid. The data was collected through questionnaire. The study has gone through a hypothesis test and suggested some hypothesis. This study concluded that all of the hypothesis suggested positive results. The study can be conducted globally as well.

5.3. Implications of the Study

This research importantly contributes to literature material. It has significantly enhanced the literature about this topic on the internet. Future researchers can get significant and reliable data about this topic. future researchers can get knowhow about the relationship of smart cities supply chain network with sustainability performance with the mediating role of SCF. They can have more than reliable data from this research. This study also contributed to practical life. The manufacturing sectors of other than Thailand can get significant knowledge about this topic they can find an ethical and legal solution regarding this topic.

5.4. Limitations and Future Research Indications

The major drawbacks of this research paper were as follow; this study selected a sample of just 300 people from the manufacturing sector which is considered to be very small. The study took place on in Thailand. The one tool for data collection used in this research was questionnaire. The future researchers can do this study outside Thailand, they can conduct such studies all over the world. They can enhance the sample size in order to get more and comprehensive data from the manufacturing sector. Future researchers can use more than one data collection tool for gathering more reliable data. Future investigators can use SCF as a moderator rather than a mediator.

References:

[1] I. Garbie, *"Investigation of Sustainability index in Omani manufacturing firms: Evidence from industrial company,"* in 2015 International Conference on Industrial Engineering and Operations Management (IEOM), 2015, pp. 1-7.

[2] M. Tasleem, N. Khan, and S. A. Masood, *"Integrated role of TQM and technology management in organizational sustainability,"* in 2015 International Conference on Industrial Engineering and Operations Management (IEOM), 2015, pp. 1-8.

[3] S. Luthra, D. Garg, and A. Haleem, *"The impacts of critical success factors for implementing green supply chain management towards sustainability: an empirical investigation of Indian automobile industry,"* Journal of Cleaner Production, Vol. 121, pp. 142-158, 2016.

[4] E. Chardine-Baumann and V. Botta-Genoulaz, *"A framework for sustainable performance assessment of supply chain management practices,"* Computers & Industrial Engineering, Vol. 76, pp. 138-147, 2014.

[5] G. Graham, E. M. Tachizawa, M. J. Alvarez-Gil, and M. J. Montes-Sancho, *"How "smart cities" will change supply chain management,"* Supply

Chain Management: An International Journal, 2015.

[6] S. K. Mangla, P. Kumar, and M. K. Barua, *"Flexible decision approach for analysing performance of sustainable supply chains under risks/uncertainty,"* Global Journal of Flexible Systems Management, Vol. 15, pp. 113-130, 2014.

[7] V. Naidoo, *"Developing a mobile phone GIS-based application to assist in automobile least cost route planning. A case study of the City of Johannesburg municipal area."*

[8] S. Evans, D. Vladimirova, M. Holgado, K. Van Fossen, M. Yang, E. A. Silva, and C. Y. Barlow, "*Business model innovation for sustainability: Towards a unified perspective for creation of sustainable business models,"* Business Strategy and the Environment, Vol. 26, pp. 597-608, 2017.

[9] T. Clauss, *"Measuring business model innovation: conceptualization, scale development, and proof of performance,"* R&D Management, Vol. 47, pp. 385-403, 2017.

[10] A. Esfahbodi, Y. Zhang, and G. Watson, *"Sustainable supply chain management in emerging economies: Trade-offs between environmental and cost performance,"* International Journal of Production Economics, Vol. 181, pp. 350-366, 2016.

[11] S. Schaltegger, F. Lüdeke-Freund, and E. G. Hansen, *"Business models for sustainability: A co-evolutionary analysis of sustainable entrepreneurship, innovation, and transformation,"* Organization & Environment, Vol. 29, pp. 264-289, 2016.

[12] B. W. Husted and J. M. de Sousa-Filho, *"The impact of sustainability governance, country stakeholder orientation, and country risk on environmental, social, and governance performance,"* Journal of Cleaner Production, Vol. 155, pp. 93-102, 2017.

[13] D. Kannan, *"Role of multiple stakeholders and the critical success factor theory for the sustainable supplier selection process,"* International Journal of Production Economics, Vol. 195, pp. 391-418, 2018.

[14] S. Gray, M. Paolisso, R. Jordan, and S. Gray, *Environmental modeling with stakeholders: Theory, methods, and applications:* Springer, 2016.

[15] R. Nunkoo and H. Ramkissoon, *"Stakeholders' views of enclave tourism: A grounded theory approach,"* Journal of Hospitality & Tourism Research, Vol. 40, pp. 557-558, 2016.

[16] S. Gupta, V. A. Drave, S. Bag, and Z. Luo, *"Leveraging smart supply chain and information system agility for supply chain flexibility,"* Information Systems Frontiers, Vol. 21, pp. 547-564, 2019.

[17] L. Wu, X. Yue, A. Jin, and D. C. Yen, *"Smart supply chain management: a review and implications for future research,"* The International Journal of Logistics Management, Vol. 27, pp. 395-417, 2016.

[18] M. Lee, *"436 Steps to Sustainable Ruminant Livestock Production–the role of instrumented farms and networks,"* Journal of Animal Science, Vol. 96, pp. 214-214, 2018.

[19] Khan, M. A., & Nawaz, S. Does Pak-Rupee Exchange Rate Respond to Monetary Fundamentals? A Structural Analysis. The Pakistan Development Review, 57(2), 175-202, 2018.

[20] M. Peris-Ortiz, D. R. Bennett, and D. P.-B. Yábar, *Sustainable Smart Cities,* Innovation, Technology, and Knowledge Management. Cham: Springer International Publishing Switzerland, 2017.

[21] D. R. S. Martínez, T. J. H. Gracia, E. M. Muñoz, and A. C. García, *Smart Cities' Challenge: How to Improve Coordination in the Supply Chain,* in Sustainable Smart Cities, ed: Springer, 2017, pp. 129-142.

[22] G. Graham, *Smart cities and operations management,* ed: Taylor & Francis, 2016.

[23] M. J. P. L. Dos Santos, *"Smart cities and urban areas—Aquaponics as innovative urban agriculture,"* Urban forestry & urban greening, Vol. 20, pp. 402-406, 2016.

[24] S. Alotaibi and R. Mehmood, *"Big data enabled healthcare supply chain management: opportunities and challenges,"* in International Conference on Smart Cities, Infrastructure, Technologies and Applications, 2017, pp. 207-215.

[25] A. Ramaswami, A. G. Russell, P. J. Culligan, K. R. Sharma, and E. Kumar, *"Meta-principles for developing smart, sustainable, and healthy cities,"* Science, Vol. 352, pp. 940-943, 2016.

[26] X. Zhang, F. T. Chan, A. Adamatzky, S. Mahadevan, H. Yang, Z. Zhang, and Y. Deng, *"An intelligent physarum solver for supply chain network design under profit maximization and*

oligopolistic competition," International journal of production research, Vol. 55, pp. 244-263, 2017.

[27] M. Ben-Daya, E. Hassini, and Z. Bahroun, "*Internet of things and supply chain management: a literature review,"* International Journal of Production Research, pp. 1-24, 2017.

[28] Z. Mohammed, *"Impact of sexual lifestyle on hormone-related health decline case married teachers,"* International Journal of Social Sciences Perspectives, Vol. 1, No. 1, pp. 1-5, 2017.

[29] J. K. Heising, G. Claassen, and M. Dekker, *"Options for reducing food waste by quality-controlled logistics using intelligent packaging along the supply chain,"* Food Additives & Contaminants: Part A, Vol. 34, pp. 1672-1680, 2017.

[30] R. Sreedevi and H. Saranga, *"Uncertainty and supply chain risk: The moderating role of supply chain flexibility in risk mitigation,"* International Journal of Production Economics, Vol. 193, pp. 332-342, 2017.

[31] R. Srinivasan and M. Swink, *"An investigation of visibility and flexibility as complements to supply chain analytics: An organizational information processing theory perspective,"* Production and Operations Management, Vol. 27, pp. 1849-1867, 2018.

[32] A. Njegovanovic, *"hilbert space/quantum theory of the financial decision and role of the prefrontal cortex with a view to emotions, "* International Journal of Social and Administrative Sciences, Vol. 3, No.1, pp. 42-54, 2018.

[33] S. Fayezi, A. Zutshi, and A. O'Loughlin, *"Understanding and development of supply chain agility and flexibility: a structured literature review,"* International Journal of Management Reviews, Vol. 19, pp. 379-407, 2017.

[34] K. T. Stormi, T. Laine, and T. Korhonen, *"Agile performance measurement system development: an answer to the need for adaptability?,"* Journal of Accounting & Organizational Change, 2019.

[35] G. S. Matharu, A. Mishra, H. Singh, and P. Upadhyay, *"Empirical study of agile software development methodologies: A comparative analysis,"* ACM SIGSOFT Software Engineering Notes, Vol. 40, pp. 1-6, 2015.

[36] W. Shim and S.-W. Lee, *"An agile approach for managing requirements change to improve learning and adaptability,"* Journal of Industrial Information Integration, Vol. 14, pp. 16-23, 2019.

[37] J. G. Vargas-Hernandez and D. C. Gonzalez, *"The Discussion on Stakeholders in Contrast with the Shareholders Theory: Reconciliation to a Conscious Capitalism,"* SAMVAD, Vol. 14, pp. 55-57, 2018.

[38] J. Albasu and J. Nyameh, *"Relevance of stakeholders theory, organizational identity theory and social exchange theory to corporate social responsibility and employees performance in the commercial banks in Nigeria,"* International Journal of Business, Economics and Management, Vol. 4, pp. 95-105, 2017.

[39] S. C. McWaters and R. Hawkins, *"The imagined contact hypothesis: Prejudice towards asylum seekers in Australia,"* International Journal of Innovation, Creativity and Change, Vol. 3, pp. 197-210 , 2018.

[40] A. Paulraj, I. J. Chen, and C. Blome, *"Motives and performance outcomes of sustainable supply chain management practices: A multi-theoretical perspective,"* Journal of Business Ethics, Vol. 145, pp. 239-258, 2017.

[41] R. Dubey and A. Gunasekaran, *"The sustainable humanitarian supply chain design: Agility, adaptability and alignment,"* International Journal of Logistics Research and Applications, Vol. 19, pp. 62-82, 2016.

[42] J. Sutduean, W. Joemsittiprasert, and K. Jermsittiparsert, "*Uncertainty as an antecedent of the supply chain risk: Does supply chain flexibility matter in risk mitigation?,*" Humanities and Social Sciences Reviews, Vol. 7, No. 2, pp. 503-509, 2019.

[43] H.W. Kamran, S.B. Mohamed-Arshad, and A. Omran, "*Country governance, market concentration and financial market dynamics for banks stability in Pakistan,"* Research in World Economy, Vol. 10, No. 2, pp. 136-146, 2019.