Response to Reviewer 2 Comments

We are very grateful to reviewer for their valuable comments and suggestions that have much improved the manuscript. In the revised manuscript, we have carefully addressed these comments and suggestions, and these revisions are marked in red. The following is summary of the main revisions, and we have made in response to the referees’ comments as below;

Point 1: The introduction has been improved. The motivation, however, remains weak. While there is a good review of the antecedents to the study (p. 2, lines 47-61), the apparent motivation for the study (p. 2, lines 62-68) has not been clearly explained. At the core, the issue seems to be one of ‘dealing with uncertain and fuzzy decision information’ and the resulting ‘information loss.’ These issues need to be much more clearly identified and explained.

Response: Introduction section, we have rewritten and have been clearly explained the motivation for our study as following motivation for the study (p. 2, lines 62-72).

“...In the real-life, human beings are always faced with the decision-making process under uncertain environment and fuzzy decision information. The traditional way which represents human thinking indicates data in the form of a crisp number, but it has many weaknesses. For example, the crisp number cannot handle the uncertainty of human judgment, which may lead to information loss and decrease the efficiency of decision-making analysis such as evaluating and alternative ranking. In order to overcome this deficiency, the linguistic number should be evaluated more conveniently and reliably. In the field of supplier selection method, most research uses MCDM techniques based on conventional fuzzy set theory to determine the weights and solve uncertain information without analyzing the impact of each factor on the final decision-making results. Furthermore, the limitation of fuzzy set theory is that it is not sufficient for denoting the data on human judgments.”

Point 2: The problem is also apparent in Section 2.2.1 on MCDM for SSS: while there is extensive talking about other MDCM over pages 4-5, the limitations or problems are not highlighted here. I would expect to see a critical discussion of the management of uncertainty, fuzzy decision information, and information loss with a clear explanation of why other methods cannot address these issues. So far, this section is not convincing. As a result, the rest of the paper is poorly motivated and just seems to be a ‘new combination’ of approaches or techniques that is not solving a real/genuine problem.

Response: In Section 2.2.1 and 2.2.2 on MCDM for SSS: we have highlighted the limitations and more explain a critical discussion of the management of uncertainty, fuzzy decision information,
and information loss with a clear explanation of why other methods cannot address these issues.

( p. 5, in section 2.2.1, lines 181-187 )

“Although, MCDM method is more popular in the field of sustainable supplier selection, it
is always used to determine the relative importance weights of each criterion. The conventional
MCDM methods do not consider the uncertain information in human judgments which may
allow the decision-makers to get the partial relationships among alternatives [1]. To fill this
research gap, the present study proposes a novel MCDM model that aims to enhance the
decision-making process and implement more in-depth analysis of the supplier selections among
the considered plausible interrelationships criteria under uncertain environment.”

( p. 5, in section 2.2.2, lines 189-194 )

“In general, the uncertainty in the decision-making process is unavoidable [49]. Decision-
makers may have different levels of experience, skill, and manner features. Therefore, when they
lack the knowledge or experience about the decision information problem, they cannot determine
the precise preferences [50]. In order to solve such challenges in the decision-making processes,
the Fuzzy set theory proposed by Zadeh (1965) can be used for the linguistic term in decision
making processes [51]. Most of the existing studies integrated fuzzy concept into traditional
MCDM”

( p. 5, in section 2.2.2, lines 213-220 )

“However, various tools for evaluating sustainable supplier and available literature reviews
expose several methods. The interdependencies among dimension and criteria under uncertainty
are thoroughly analyzed, and strategies are provided for selecting improve alternatives to reach
the desired aspiration levels apart. However, the ranking and selections were not considered. To
make up for this limitation, this study build an IF-DANP-mV model to enhance the decision
making in a fuzzy environment and investigate more in-depth analysis on the interrelationships
among criteria. Meanwhile, to help enterprises aid their suppliers in improving sustainability and
enhance enterprises’ socio-environmental performance is the key to achieving sustainable
development.”

In addition, we have expanded and improved literature review in order to better frame our
study in the existing body of knowledge. (p. 3, in section 2.1, lines 107-123)

“Recently, there has been an increase in the global trends on environmental sustainability
policy and practices [2-6]. The difference between sustainable supply chain and green supply
chain is that the basic goal of the green supply chain is to reduce wastes and greenhouse gases in
production. Yet, the definition of green supply chain generally emphasizes the characteristics of
environmental process flow [7]. Whereas, the scope of sustainable supply chain is developed
based on green supply chain management considering economic, environmental, and social
dimensions [6]. Carter and Jennings [6] suggested that social awareness and environmental
preservation are important components for an organization. Therefore, organizations should
connect with environmental, social, and economic goals to achieve the organization strategy.
Seuring and Müller [8] explained this topic that SSCM is a strategic management that covers risk
management, strategy and corporate based on the triple bottom line principle, including systematic coordination of business processes. Meanwhile, sustainability is receiving consumers’ attention regarding the relationship between organizations and their suppliers in order to understand the sustainable development [9]. Hence, investigating the sustainability of suppliers is important to consider their social responsibility [10].”

Point 3: While I think the manuscript is interesting and the method (combination of methods) is novel, I am not convinced that this proposed approach is adding value and this has not been clearly demonstrated or explained in the revised manuscript. The manuscript therefore fails the “so what” test for me – it appears, at the end, that the ‘traditional DANP’ approach is just as effective and gives the same results – why shouldn’t a manager skip the complexity of your approach and use this approach?

Response: Comparisons with other existing methods in section 4.5, which show on pages 18. We have rewritten the comparisons proposed approach by adding value and have been clearly demonstrated. (p. 18, in section 4.5, lines 511-534)

“In order to verify the validity of the proposed method, a comparative analysis was conducted with the traditional DANP-VIKOR to prove this example. The results are shown in Table 10. It can be found that S3 is still the most suitable and sustainable supplier. However, the results obtained by traditional DANP-VIKOR methods demonstrate that the lowest of ranking was changed from supplier S1 to supplier S2. Detailed comparisons of the results with different methods are explained as follow:

First of all, the comparison is conducted between the crisp numbers and intuitionistic fuzzy numbers. The proposed approach uses the linguistic terms to describe the uncertainty, while traditional DANP-VIKOR uses the crisp number without considering uncertain information in human judgments. For example, if the procurement expert gives the score 5 (very high influence), the score can be transformed into (0.90, 0.10, 0.00). Obviously, in the traditional method, the procurement team can get the partial ranking among alternatives, which will interrupt the procurement team to directly identify the efficiency supplier.

Secondly, it is further supported by the results of sensitivity runs of VIKOR with different weight values. As shown in Figure 5, supplier S3 is also the smallest as v varies from 0.1 to 1.0, but the order with other supplier changed. Supplier S2 has the orders changed when v varies, which interprets that the percentage of variability is 12% whilst IF-DANP-mV is 8.5%. Therefore, we can see that the traditional DANP-VIKOR method is rather sensitive to the changes in the weight of the evaluation value.

Finally, it is evident that considering uncertainties of evaluations has the potential to solve the uncertainty problem with a different kind of evaluation information compared with the traditional DAN-VIKOR. This merit of the comparative analysis will help the procurement and researcher to analyze and verify the advantages of this method more accurately.”
In section 4.6 the results and discussion, we have been more clarified and refer back to the existing literature. (p. 19-20, in section 4.6, lines 562-584)

This result were compatible with Zhou and Xu [10] where the most experts in case was recognized the sustainability of supplier should be pay attention the social responsibility.

Based on the results utilizing IF-DANP, the final weights can be ranked as; environmental planning (C24) ranks first with the highest weight value (0.083), and safety and health system (C32) occupies the last rank with lowest value (0.053) in all evaluation criteria. Environmental planning (C24), green image (C21), cost reduction activities (C14), delivery and service of product (C15), environmentally friendly materials (C22) criteria have been ranked as top five criteria to SSS based on SSCM practices. Interestingly, from the results ranking, the enterprises are usually more sensitive to the environmental planning than the social responsibility. Therefore, consider only the score of the experience and knowledge is difficult to judge the social responsibility, which is in accordance with Zhou and Xu [10].

Furthermore, our findings are also applicable to improvements because they can be used to determine gaps in the aspired level of the criteria. Upon examining the findings obtained through the IF-DANP-mV model (Table 9), the performance results generated values which were arranged as $S^3 > S^2 > S^1$. This finding indicates that the best sustainable supplier in this case study is $S^3$. Moreover, our model also illustrates the means by which alternatives help a company reach its aspiration level for each criterion. Besides, the sensitivity analysis can be significant to evaluate the alternatives for SSS in SSCM practices. In the end, to further verify the validity of our proposed method, we provides the realistic evidence for the comparative analysis, the result shown that an integrated DEMATEL-ANP-VIKOR combine with intuitionistic fuzzy number can provides strategies for selecting improved alternatives to reach the desired aspiration levels apart from the ranking and selections, as also emphasized in Büyükozkan et al. [1].”

In the conclusion, we have more expand to specific what is the addition of our study and the knowledge show in p. 20-21, in section 6, lines 602-643.

1. We have the supplier evaluation criteria based on SSCM practice in economic, environmental, social aspects. In order to investigate suppliers’ implementation of SSCM practices, the potential suppliers with sustainability were discovered and selected. The data were obtained by combining them from the interview with procurement experts, and the validity of the three dimensions and a total of 13 criteria were confirmed. By constructing the list of evaluation criteria for suppliers and measuring their relative importance, enterprises can better understand the concept of sustainability [11]. Besides, enterprises can be employed for early supplier development, which also helps to focus on the target suppliers. Meanwhile, SSCM practices help suppliers to pay close attention to the area in which they can satisfy the requirements of enterprises.

2. This study extended MCDM under intuitionistic fuzzy environment, and proposed an IF-DANP-mV model. First, we applied the DEMATEL combined with the intuitionistic fuzzy method to construct a relationship network. Second, the IF-DANP approach was used to calculate the substantial weight of the criteria and overcome the dependence and feedback among the conflicting criteria and uncertain environment. As a result, intuitionistic fuzzy set is
helpful to cope with uncertainty, and it is more flexible to handle precise problems. Meanwhile, DANP is a powerful technique which can be used to determine the relative weights of criteria, which is consistent with the results obtained by Govindan et al.[12] and Büyüközkan et al. [1]. Hence, enterprises can effectively enhance decision-making capability, and this model has the efficiency to consider uncertainty in human judgments. In order to evaluate the total performance scores and gaps (that is, the smaller, the better) at each aspiration level, VIKOR concepts were further modified. Our model demonstrates the case study of three supplier candidates, namely, S1, S2 and S3. The VIKOR results indicate the ranking of sustainable supplier in descending order as S3 > S2 > S1. A sensitivity analysis was also conducted to test the robustness of the proposed framework. Finally, in order to prove the merit of the propose approach, the comparison with traditional DANP-VIKOR methods shows that the IF-DANP-mV method performs better than the traditional DANP-VIKOR in dealing with uncertain information.

The benefits of a new extension approach can enhance decision making in a fuzzy environment and investigate more in-depth analysis of the interrelationships among criteria. By using the proposed approach, suppliers are more accurately ranked when various uncertainties are coped with. Enterprises can analyze the suppliers that have a great difference compared with the other methods. Moreover, the results can help suppliers to discover their weak links and improve their management level. On this basis, a strong relationship can be built between managers and their partners.

3. This work narrows the theoretical gaps identified by Memari et al. [13], who proposed SSS problem by using a multi-criteria intuitionistic fuzzy TOPSIS model to apply intuitionistic fuzzy number. However, their results demonstrate that the integration with TOPSIS ignores the interdependencies among criteria which can influence the outcome of the alternative ranking. Therefore, our study distinguishes itself from the study of Memari et al. to extend the MCDM method by applying the DANP to handle with the dependencies among decision criteria and modify the VIKOR method to identify the suitable alternative ranking. Our results are more accurate, and the realistic investigation based on a real-world case study is better than using single method.

With an increasing number of entrepreneurs focusing on sustainable development, especially sustainable supplier management [6], it is a challenge for several industries to consider the selection of sustainable suppliers. This study not only provides the effective model for measuring supplier selection performance, but also plays an audit role for practitioners to evaluate the standardized procedure based on sustainable supply chain management practices.

Point 5: The paper needs extensive editing of the English language, including grammatical errors and sentence constructions.

Response 5: We have corrected grammar errors in red colour (As per attached file for corrected grammar errors).
1. Introduction

In the past, various activities in the supply chain were done conducted in a simple linear model, uncomplicated, and consisting of a small number of stakeholders. Therefore, most companies are commonly focused on the development of focused on enhancing the efficiency in economic dimensions such as technical quality development, cost reduction, and product delivery speed. Later, the business is generally becomes increasingly complex and consists of a variety of more stakeholders. As a result, the relationship between the various activities in the supply chain has shifted from a linear model to a network model. As an example, customer needs become the major driving force in determining the relationship model in the supply chain system, and whether suppliers, manufacturers, and distributors need to improve the competitiveness through cooperation to raise the level of competitiveness. Besides, the sustainable development in the modern business world, sustainable development has earned increasing attention. Essentially, during in production operation management, the balancing of economic benefits and sustainable development has become a crucial topic for modern enterprises.

Sustainable supply chain management (SSCM) is one of the key success factors for the success of the globalization business which that is highly competitive under rapidly changing environments. It is an effective management model that includes economic, environmental, and social performances. SSCM involves several practices, for example, such as sustainable supplier selection, sustainable production and sustainable products, etc. Especially, sustainability goals can be achieved through the sourcing of suppliers is the way to reach sustainability goals, not only for both the focal company but also for and the entire supply chain.

In the real-life, the human always face human beings are always faced with the decision-making process under uncertain environment and fuzzy decision information. The traditional way which represents human thinking which indicates data in the form of a crisp number, but it has many weaknesses. For example, the crisp number cannot handle the uncertainty of human judgments, so there might which may lead to information loss and decrease the efficiency of decision-making analysis such as evaluating and alternative ranking. In order to overcome this deficiency, the linguistic number should be evaluated more conveniently and reliable evaluation. In the field of supplier selection method, most researchers use MCDM techniques such as conventional fuzzy set theory to determine the weights and solve uncertain information without an in-depth analysis of each factor analyzing the impact of each factor on the final decision-making results. Furthermore, the limitation of fuzzy set theory may be that it is not sufficient for denoting the data on human judgment.

Based on the above discussion, this paper aims to strengthen the decision-making process and explore a deeper analysis of thoroughly analyze the supplier selection under in uncertain environments. Meanwhile, to help based on the study results, enterprises not only enhance their socio-environmental performance but also help their suppliers in improving the sustainability and improve enterprise socio-environmental performance, which is crucial to realize sustainable development. To achieve these purposes, this study makes the following improvement:

1) Establish the criteria influencing SSS based on SSCM practices for supplier evaluation, which are grouped into the economic, environmental, and social aspects.

2) Considering sustainable suppliers based on conflicting criteria and uncertain decision information. We are extended, IFS with DEMATEL is extended to analyze the cause and effect relationships. Moreover, an approach featuring a DEMATEL-based ANP is used to calculate the substantial weight of the criteria. This approach aims to overcome the dependence and feedback that
accompanied the selection criteria and other alternatives. Finally, from a set of alternatives in the supply chain, we modified VIKOR is modified to evaluate the most efficient sustainable supplier with the highest efficiency. The new ranking method for this purposes, called IF-DANP-mV.

3) To prove the feasibility of this method and to realize sustainable development by enhancing SSS based on SSCM practice to realize sustainable development, it is applied in a real case, where in which a Thailand palm oil products industry intends to select sustainable suppliers.

There are three main contributions of this study. First, of all, we consider the economic, environmental, and social aspects in the SSCM condition, the paper establishes 3 dimensions and 13 criteria, which can help enterprises in the process of identifying potential improvement areas of improvement for sustainable supplier, while on the premise of avoiding the potential risk of selecting unsuitable suppliers. Secondly, for suppliers, they can apply the ranking results of relevant SSS criteria into their operations. Suppliers may enhance the long-term relationship with buyers by promoting their sustainable practices as valuable contributions towards the sustainable supply chain. Finally, we design a new extension to MCDM model is designed for SSS under intuitionistic fuzzy environment for solving a problem in the selection of sustainable supplier selection in an uncertain environment. Also, the findings of the study can improve management practices concerning the criteria to be used in SSS problem as well as provide and provide an accurate sustainable supplier ranking and a reliable solution for sourcing decisions validated through by a company.

2. Literature Review

2.1 SSS based on SSCM practices

Recently, there has been an increase in the global trends on environmental sustainability policy and practices have increased. The difference between sustainable supply chain and green supply chain is that the basic goal of the green supply chain is to reduce waste and greenhouse gases from in productions. Yet, the definitions of green supply chain is generally emphasized on environmental process flow of environmental. Whereas, the scope of sustainable supply chain is developed on green supply chain management through considering economic, environmental, and social dimensions. Carter and Jennings suggested that the social awareness of society together with environmental preservation are important components for the organization to the. Therefore, organizations should clearly connect with environmental, social, and economic goals to achieve the organization strategy. Seuring and Müller further explained that SSMC is a strategic management that covers risk management, strategy and corporate based on the triple bottom line principle, including systematic coordination of business processes based on the triple bottom line principle. At the same time, sustainability is receiving consumer attention regarding the relationship between organization and their suppliers in order to understand and manage the sustainable development. Hence, investigating the sustainability of suppliers is important to consider their social responsibility.

In recent reviews, some studies have driven to integrate sustainability into their organization. For example, Paulraj et al. [32] established three dimensions, namely, sustainable product design, sustainable process design, and demand-side sustainability collaboration. Das [33] further incorporated three dimensions into the SSCM practices with three dimensions, including environmental management, socially inclusiveness, operations performance, and supply chain integration. Meanwhile, Varges et al. [34] studied organizational capabilities by focusing on the environmental and social aspects of SSCM practices.
In terms of economic criteria, aspect, it aims to increase the profit flow that could be yield while reducing the investment capital [34]. For such as example, cost, quality, delivery, service, price of the products, profit on products, and flexibility, etc [4,35,36]. For environmental aspect defined at [4,47].

The assessment of suppliers’ environmental performance is defined from the environmental perspective. For instance, including green image, environmental management system, environmentally friendly materials, etc [4,37,38]. From this, the social aspect is concerned with social management by a focus on focuses on working place and employees’ related determinant. For example, such as protection of employees’ right, safe and healthy working conditions, etc [5,34,39]. After considering the reviews in all three dimensions of sustainability, most researchers used different criteria in several scholars’ research. In this study, we combined almost of researchers used different criteria in several scholars’ research. Moreover, the importance of each criterion is assessed and weighed using expert judgment (shown in Table 1).

2.2.1 MCDM methods for SSS

Several methods for supplier selection, which rank from a basic single method to complex multi-objective methods, have been developed and proposed [40]. In order to determine the best approach in solving problems related to decision making, present the researchers have used different approaches based on MCDM [5]. By combining more than two techniques, hybrid methods have recently received increasing attention due to their flexibility [41]. To position our study in this literature set, we aim to review popular MCDM methods that have been adopted in previous studies on sustainable supplier selection.

To explore and rank the important measures for sustainable supplier selection, Gören [34] presented a sustainable supply chain decision framework for an online retailer company. The model calculated the performance value of each supplier supplied by using DEMATEL and the Topsis loss function to calculate the performance value of each supplier, in order to determine the weights of the dependent criteria. Results showed that each supplier’s ranking differed according to the common MCDM methods. Hamurcu and Eren [42] combined ANP and Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) methods, which provided a suitable ranking of Monorail routes. Based on the combination of MCDM model and best-worst method (BMW), Liu et al. [43] integrated MCDM model and best-worst method (BMW) to obtaining the optimal weights of sustainable suppliers. A literature review indicates that the existing methods have provided many relevant tools for SSS problem. However, the majority could benefit from the further exploration of the interrelationships among the selection criteria for a more in-depth analysis. The DEMATEL method is used to determine the degrees of influence among the criteria and capable of solving the criteria issues, namely, dependence and feedback. However, DEMATEL is not able to determine the weights of individual criteria, whereas ANP can. ANP was created on the basis of AHP in order to consider the existence of interdependence among the criteria in the model [43]. ANP breaks down problems into clusters, each comprising each of which containing a number of variables or criteria to be evaluated. Notably, traditional ANP techniques assume equal weighting. Both methods can be added to improve and enhance the solution through solving with the interrelationships among the criteria. Liu et al. [44] presented a hybrid model for supplier selection of green supply chains in Taiwanese electronic companies by combining DEMATEL based ANP and complex proportional assessment of alternative with gray relations. Their results prove that the obtained weights in each criterion are more reasonable and consistent with the DEMATEL results. Chen et al. [45] applied DEMATEL to build an influence network relation flow and modified ANP to determine the influential weights and applied. Moreover, VIKOR was used to improve wetlands environmental management. Zhou and Xu [17] introduced another method.
integrated evaluation model, including the DEMATEL-ANP-VIKOR, to evaluate sustainable supplier selection. By combining fuzzy Delphi and ANP methods, Kamran [46] combined fuzzy Delphi and ANP methods and generated a tool to identify the critical attributes of the suppliers’ sustainable compliance. In a case study in the electronic goods manufacturing company, Awasthi et al. [47] utilized fuzzy ANP to generate the criteria weights, and fuzzy VIKOR was used to rank the sustainable global supplier selection.

Although, MCDM method is more popular in the field of sustainable supplier selection, there is a lack of methods to determine the relative importance weights of each criterion. Therefore, the conventional MCDM methods do not consider the uncertain information in human judgments which may allow the decision-makers to get the partial relationships among alternatives [48]. To fill this research gap, the current study proposes a novel MCDM model that aims to enhance the decision-making process and investigate for more in-depth analysis of the supplier selections among the considered criteria under uncertain environment.

2.2.2 MCDM methods with IFS for SSS

In general, the uncertainty in the decision-making process is unavoidable [49]. Besides, several decision-makers may have different levels of experience, skill, and manner features. Therefore, when there is a lack of knowledge or experience about the decision information problem, it will prevent them from determining the precise preferences [50]. In order to solve such challenges in the decision-making processes, proposed by Zadeh [1965], the fuzzy set theory proposed by Zadeh [1965] can be helped by using used for the linguistic term in decision making processes [51]. Almost of studies had Most of the existing studies integrated fuzzy concept into traditional MCDM [8]. Wang et al. [52] proposed fuzzy AHP, and considered green data envelopment analysis (DEA) within the sustainable supplier selection framework of the SMEs in the food processing industry. Rashidi and Cullinan [53] studied the sustainable supplier selection by comparing fuzzy DEA with fuzzy TOPSIS methods for ensuring in order to ensure the commitment of suppliers to the sustainability concept. A considerable amount of literature has highlighted the application of traditional fuzzy set theory combined with various MCDM techniques. However, less attention was paid to IFS. An IFS is a generalization of the fuzzy set concept and is considerably more ideal for handling real-world cases as compared to the classical fuzzy sets. The efficacy of IFS has efficacy in representing uncertainty and vagueness in three—membership, non-membership and hesitancy values [54]. To achieve the advantage of IFS methods, some studies are reviewed. In a case study on the automotive industry, Memari et al. [55] utilized an intuitionistic fuzzy TOPSIS methods to select the right sustainable supplier. Sen et al. [56] applied three decision-making approaches combined with IFS, which overcome the imprecision of human judgment and encouraged supplier selection in sustainable supply chain. Krishnakumar et al. [54] solved the problem of supplier selection with linguistic preferences by extending the intuitionistic fuzzy set based preference ranking organization method for enrichment (PROMETHEE). Çal et al. [56] integrated elimination and choice translating reality (ELECTRE) and VIKOR under in intuitionistic fuzzy environment to cope with uncertain situations and hesitancy in the supplier evaluation process.

However, various tools for evaluating sustainable supplier and available literature reviews expose several methods. It does seem that in-depth analyses on the interdependencies among dimension and criteria under uncertainty as well as are thoroughly analyzed, provide and strategies are provided for selecting improve alternatives to reach the desired aspiration levels apart. However, from the ranking and selections were not considered. To fill make up for this limitation, this study build an IF-ANP-mV model aims to enhance the decision making under in a fuzzy environment and investigate for more in-depth analysis on the interrelationships among criteria. At the same time, Meanwhile, to help
4.5 Comparisons with other existing methods

In order to verify the validity of the proposed method, we complete a comparative analysis with the traditional DANP-VIKOR to prove this example. The results are shown in Table 10. From the Table 10, we finally can be found that S3 is still the most suitable and sustainable supplier. However, the results obtained by traditional DANP-VIKOR methods has demonstrate that the lowest of ranking was changed from supplier S3 to supplier S2 in the result obtained by traditional DANP-VIKOR methods. Detailed comparisons of the results with different methods are explained as follow:

First of all, the comparison is conducted between the crisp numbers and intuitionistic fuzzy numbers. Our proposed approach uses the linguistic terms to describe the uncertainty, while traditional DANP-VIKOR uses the crisp number without which does not considering the uncertain information in human judgments. For example, if the procurement expert gives the score 5 (very high influence), then the score can be transformed into (0.90, 0.10, 0.00). Obviously, in the traditional method, the procurement team can get the partial ranking among alternatives and it which will interrupt the procurement team to directly identify the efficiency supplier.

Secondly, it is further supported by the results of sensitivity runs of VIKOR with different weight values. As shown in Figure 5, supplier S3 is also the smallest during v varies from 0.1 to 1.0, but the order with other supplier changed when v varies, which interprets that the percentage of variability comes into 12% whilst IF-DANP-mV is 8.5%. Therefore, we can see that the traditional DANP-VIKOR method is rather sensitive to the change in weight of the evaluation value compared.

Finally, it is evident that considering uncertainties of evaluations have has the potential to solves the uncertainty problem with a different kind of evaluation information than compared with the traditional DAN-VIKOR. This merit of the comparative analysis will help the procurement and researcher to analyze and verify the advantages of this method clearly and more accurately.

6. Conclusions

The purpose of this paper is to validate its effectiveness and feasibility. The major contributions and innovations of this paper are summarized as follows:

1. We have the supplier evaluation criteria to evaluate suppliers based on SSCM practice, where in economic, environmental, social aspects. In order to investigate suppliers’ implementation of SSCM practices, the potential suppliers with sustainability were discovered and selected. Then, we obtained the data by combining them from interview with procurement experts and finally, confirmed and the validity of the three dimensions and a total of 13 criteria were confirmed. By constructing the list of evaluation criteria for suppliers and measuring their relative importance, enterprises can better understand the concept of sustainability [69]. Besides, the enterprises can be employed for early supplier development which also as well as helps to focus on the target suppliers. Meanwhile, for suppliers, SSCM practices help them suppliers to pay close attention to the area in which they can satisfy the requirements of enterprises.

2. This study extended MCDM under intuitionistic fuzzy environment, and proposed the IF-DANP-mV model. First, we applied the DEMATEL combined with the intuitionistic fuzzy method to construct a relationship network of relationships. Then, the IF-
DANP approach was used to calculate the substantial weight of the criteria and to overcome the dependence and feedback among the conflicting criteria and uncertainties environment. As a result, intuitionistic fuzzy set is helpful to cope with uncertainty, and it is more flexible to handle precise problems. Meanwhile, DANP is a powerful technique for determining which can be used to determine the relative weights of criteria, which is in accordance consistent with the results obtained by Govindan et al. [49] and Büyükközkan et al. [48]. Hence, the enterprises can effectively enhance decision-making capability and this model has the efficiency to consider sustainable in human judgments. In order to evaluate the total performance scores and gaps (that is, the smaller, the better), in each aspiration level, we modified VIKOR concepts were further modified. Our model demonstrates the case study of three supplier candidates, which are namely S1, S2 and S3. The VIKOR results indicated the ranking of sustainable supplier in descending order as S1 > S2 > S3. A sensitivity analysis was also conducted to test the robustness of the proposed framework. Finally, in order to prove the merit of the propose approach, the comparison with traditional DANP-VIKOR methods shows that the IF-DANP-enV method performs better than the traditional DANP-VIKOR in dealing with uncertain information.

The benefits of a new extension approach can enhance decision making under-in a fuzzy environment and investigate for more in-depth analysis of the interrelationships among criteria. Through using the proposed approach, suppliers are more accurately ranked when various uncertainties are coped with. The enterprises can analyze the suppliers that have a great difference compared with the other methods. Moreover, the results are also helpful for suppliers to discover their weak links and improve their management level. Based on this, on this basis, a strong relationship can be built between managers and their partners.

3. This work narrows the theoretical gaps that were also identified by Memari et al. [55]. In their study, they who proposed SSS problem by using a multi-criteria intuitionistic fuzzy TOPSIS model which is the same to apply intuitionistic fuzzy number, but in. However, their results found demonstrate that an integrated integration with TOPSIS to ignore the interdependencies among criteria which can be an effect reduce the outcome of the alternative ranking. Therefore, our study distinguishes itself from the study of Memari et al. to extend the MCDM method by applying the DANP to handle with the dependencies among decision criteria and modified modify the VIKOR method to determine identify the suitable alternative ranking as. Our results the results of our propose are are more accurate, and the realistic investigation based on a real-world case study is better than using single method.

With the increasing number of entrepreneurs focusing on sustainable development, especially sustainable supplier management [28], it is a challenge for several industries to consider an applicable selection of sustainable suppliers. in this study. This study not only provides the effective model for measuring supplier selection performance but also can play an audit role for practitioners to evaluate the standardized procedure based on sustainable supply chain management practices.

Although this model can effectively handle uncertainties in decision making, there are still has some limitations. First, this study has only identified one case study in the palm oil product industry, and conclusions may not be generally suitable to other industries. Different industries have different ways may have several products and procedure characteristics, which can influence SSCM practices. Furthermore, we found that the experts’ weights in the decision-making group are not consistent with the reality because their opinions can be effective in the decision-making process. Further study should mention focus on the understanding of sustainable supplier selection with risk criteria under SSCM performance, in order to help the enterprises introduce effective SSCM selection practices.