

ISSN 2090-3359 (Print)
ISSN 2090-3367 (Online)



Advances in Decision Sciences

Volume 25
Issue 2
June 2021

Michael McAleer
Editor-in-Chief
University Chair Professor
Asia University, Taiwan



Published by Asia University, Taiwan

ADS@ASIAUNIVERSITY

Evaluating ASEAN E-commerce Laws Using Fuzzy Multi-Criteria Decision Making *

Ali Alibeigi **

Faculty of Law, University of Malaya, Malaysia
Department of Law, Faculty of Law and Humanities, Isfahan (Khorsagan)
Islamic Azad University, Iran

Adeleh Asemi

Faculty of Computer Science & IT
University of Malaya, Malaysia

Abu Bakar Munir

Faculty of Law, International Islamic University, Malaysia
Faculty of Law, University of Malaya, Malaysia

Mohd Sapiyan Baba

Faculty of Computer Science & IT
University of Malaya, Malaysia

Revised: June 2021

* This research work has funded by the University of Malaya Research Grant (UMRG), Project No: RP006C/13ICT. The authors are most grateful to a reviewer for very helpful comments and suggestions.

** Correspondence: alibeigi_a_80@yahoo.com

Abstract

An evaluation of the ASEAN Electronic Commerce Acts (ECAs) is a specific primary step toward their harmonization. This evaluation is complex due to multiple criteria and uncertain information, especially in the case of electronic contracts. This study aims to evaluate and rank the ECAs of the ASEAN countries using a fuzzy multi-criteria decision making method. Seven criteria are determined for the evaluation of ASEAN ECAs. The Fuzzy Analytic Hierarchy Process (FAHP) is applied for weighting of the criteria as well as the evaluation of alternatives. We applied the judgment of 10 experts to fill out the FAHP comparison matrices. The experts' opinions are fuzzified and aggregated using the fuzzy set theory. We found the weight of criteria, rank of ECAs in each criterion and the final rank on overall comprehensiveness of the ASEAN ECAs. The results show that the FAHP address the multi criteria evaluation of the laws and regulations. The recognition of the Electronic Message with a weight of 0.216684 is the most important criterion in the evaluation of ECAs, and the Place of Dispatch with a weight of 0.0276018 is the least important. This study has the potential to harmonize the ECAs among ASEAN countries which in turn will increase the number of online transactions and reduce the number of legal disputes.

Keywords: Legal Harmonization, Fuzzy AHP, Electronic Message, Time of Dispatch, Time of Receipt.

1. Introduction

The association of Southeast Asian Nations (ASEAN) includes ten countries with nine Electronic Commerce Acts (ECAs) in place, Malaysia Electronic Commerce Act (MECA), Singapore Electronic Transactions Act (SETA), Thailand Electronic Transactions Act (TETA), Indonesia Electronic Information and Transactions Act (IEITA), Philippines Electronic Commerce Act (PECA), Brunei Electronic Transactions Act (BETA), Myanmar Electronic Transactions Law (METL), Vietnam Law on E-transactions (VLET).

The legal analysis and evaluation of ASEAN ECAs are a strategic approach to identify the strengths and weaknesses of these Acts. As a practical reference, it will lead the member countries in future amendments of their ECA to be more harmonized. In this study, we purpose to evaluate and rank the ECAs of eight ASEAN countries with respect to electronic contracts. In the case of Lao People's Democratic Republic (LPDR), there is no official translation of its ECA and Cambodia lacks any ECA.

Currently, lawyers use the theoretical and general analytic method for evaluation and comparison of laws [1]. However, the evaluation of law is complex due to the consideration of a set of qualitative criteria. Moreover, the factors have considerably different importance in terms of decision-making. Multi Criteria Decision-making (MCDM) methods have frequently been applied in decision-making with multiple criteria [2].

The Analytic Hierarchy Process (AHP) is the mathematical based MCDM method. Fuzzy AHP is a more systematic method than other MCDM methods, and, significantly, it captures the human assessment of qualitative options. This is true because pairwise comparisons provide a flexible and realistic way to accommodate real-life data [3]. Moreover, it is the most applicable MCDM method for decision-making with a limited number (less than ten) of criteria and alternatives [3].

We determined a set of seven criteria by reviewing and analyzing the ASEAN ECAs. The pairwise comparison matrices have been constructed to compare the criteria and countries with each other. A group of ten experts in the area of electronic commerce law were requested for data collection.

An easy reference based on the ASEAN ECAs, including the related provisions in each criterion along with the related provisions of the international instruments, were prepared for experts. The in depth interviews with experts, which is a qualitative strategy [4], was used in the determination of the evaluation criteria. We requested the experts to complete the questionnaire regarding the pairwise comparison of the criteria and alternatives.

A nine-point linguistic variable scale was used for the experts' responses in the questionnaire. The experts expressed their opinion regarding the qualitative criteria through uncertain linguistic variables. As the conventional AHP method cannot deal with uncertainty [5], the fuzzy set theory was applied to handle the uncertainty of the decision-makers [6]. Various studies have used the fuzzy technique to deal with the uncertainty in the AHP [7-10]. We employed the FAHP for the weighting of each criterion, the ranking of countries in each criterion and the final ranking concerning the overall comprehensiveness of ASEAN countries in respect of their ECA.

The remainder of this paper is organized as follows. The background of this research is provided in section 2; the general process and methodology is explained in section 3; section 4 provides the implementation of the FAHP for the weighting of criteria and evaluation of countries. In this section, the achieved results are discussed. Finally, section 5 concludes the paper.

2. Research Background

In August 1967, five founding countries – Indonesia, Thailand, Singapore, Malaysia and the Philippines – established ASEAN in Bangkok. Between 1984 and 1999, Brunei, Vietnam, Lao PDR, MrECA and Cambodia joined the association, and now ASEAN has ten members [11]. ASEAN with an area of 4,435,617 million km² has a population of approximately 625 million people and US\$2.511 trillion of total international merchandise trade [12].

Accelerating the economic growth, social progress and cultural development in the region is the first clause of the aims and purposes of ASEAN [13]. The decisions and measures taken by ASEAN, mostly in the last decade, indicate the priority of economic development and the

advancement of information and communication technology for the organization. The ASEAN Free Trade Area (AFTA) 1992, ASEAN Framework Agreement on Trade in Services (AFAS) 1995, e-ASEAN Framework Agreement 2000 to facilitate e-commerce progress through legal development, and the Bali Concord II 2003 and ASEAN ICT Masterplan 2015 (adopted in 2011 containing action plans for social and economic integration through ICT), are some of the decisions.

The ASEAN Economic Community Blueprint 2007 was signed in Singapore by the ASEAN leaders. The ASEAN Economic Community (AEC) is one of the important goals of ASEAN in line with economic integration. It is one of the three pillars of a cohesive ASEAN community. The two other pillars are Political-Security and Social-Cultural. The AEC Blueprint aims to establish (a) a single market and production base; (b) a highly competitive economic region; (c) a region of equitable economic development; and (d) a region fully integrated into the global economy [14].

The Blueprint asks member states to provide harmonized laws on electronic contracting, mutual recognition of digital signature and dispute resolution. Thus, the harmonization of the electronic commerce laws is in line with these initiatives to facilitate regional and international trade, economic integration and to minimize conflicts.

2.1. ASEAN e-Commerce Acts and Harmonization

The development in the areas of information and communication technology (ICT) have changed the methods of traditional paper based trade into electronic commerce (e-commerce), and, such advancements have affected the international and domestic socio-economic and legal schemes. From the legal point of view, regional initiatives to harmonize the e-commerce laws are admirable, such as the Central America and Caribbean [15], or East African Community [16].

The extra-border feature of e-commerce and facilitating international trade, have led the universal and regional trends toward a universal law governing the online transactions. The harmonization of electronic commerce laws will highly affect the ASEAN economic integration mission and may increase the trust factor and reduce future legal disputes.

ASEAN is one of the pioneers to have initiated the e-commerce legal harmonization for its member states through international cooperation. The United Nations Conference on Trade and Development (UNCTAD) collaborated with the ASEAN through two projects since 2003 [17]. The electronic commerce legal harmonization project with the Australian Agency for International Development (AusAID) 2004-2009 resulted in considerable legal ratifications in the region [17]. The enactment of ECAs with an emphasis on harmonization was based on a Reference Framework for Electronic Commerce Legal Infrastructure provided by ASEAN in 2001.

This Framework itself was based on some partial electronic commerce laws of five ASEAN member states at that time. These partial laws were also prepared based on the United Nations Commission on International Trade Law (UNCITRAL) Model Laws on Electronic Commerce 1996 (MLEC) and Electronic Signatures 2001 (MLES), electronic commerce and electronic signature laws of USA and Europe as well [18]. The member states have enacted their domestic ECA during the last decade in line with the ASEAN harmonization action plan and the said ASEAN collaborative projects. However, the legal analysis of these ECAs indicates that they are still far from an ideal harmonized legal regime. This legal disharmony will affect the ASEAN economic integration and create legal barriers for regional e-transactions.

2.2. Analytic Hierarchy Process

The AHP method is a mathematical based MCDM method that was proposed by Saaty [19]. It is based on the additive weighting method, in which a number of criteria are represented by their relative importance. The AHP can deal with decision-making that has multiple levels of criteria [20]. This method is suitable for the evaluation and ranking in MCDMs with less than ten criteria and alternatives [3]. Generally, the AHP is based on composing a hierarchy decision tree [21]. A hierarchy has three levels as with the overall goal of the problem at the top, multiple criteria that define alternatives in the middle, and decision alternatives at the bottom (Fig 1).

The AHP method can be employed for the weighting of criteria as well as for the evaluation of alternatives. It uses the same strategy to calculate criteria weights and alternative ranks. The

considered strategy is to obtain an eigenvector as a vector of ranks and weights. The evaluation of criteria is based on pairwise comparisons of criteria. The experts express the relative importance of one criterion over another criterion. Finally, the calculation of the eigenvector draws out the weighting of the criteria and the ranking of alternatives from the pairwise comparison matrix.

3. Method

This study is an applied research because it undertakes to solve practical problems in e-commerce law. It comprises both qualitative and quantitative research. We use the qualitative approach in the determination of criteria for the evaluation ECAs. The comparative analysis of the ECAs is also a part of the qualitative method. The in-depth interviews and questionnaire is utilized for data collection while using related documents.

In the interviews, we discussed with the experts regarding the current e-commerce Acts in the ASEAN countries and the determination of criteria. Then we requested them to complete the questionnaire. The questionnaire has two parts, the first and second parts are related to the pairwise comparison of criteria and ASEAN ECAs, respectively. The quantitative strategies, such as the AHP method and Fuzzy techniques are used to prioritize the criteria and rank of the ASEAN ECAs.

We proposed a three-stage method for the evaluation of ASEAN ECAs based on multiple criteria (Fig 2). The first stage is the determination of the critical factors, which is done through the literature review and analysis of the ASEAN ECAs, as well as consulting with experts. The literature review is used for a survey of all the existing secondary sources, which are interpreted as the characteristics and general principles of the electronic contracts. The second stage is weighting of the determined criteria. The weighting of criteria is conducted using the Fuzzy AHP method. In this stage, the required data for the pairwise comparison of criteria is collected from ten experts. The experts with expertise in the electronic commerce law and the contract law, were selected from the faculties of law in various Malaysian universities.

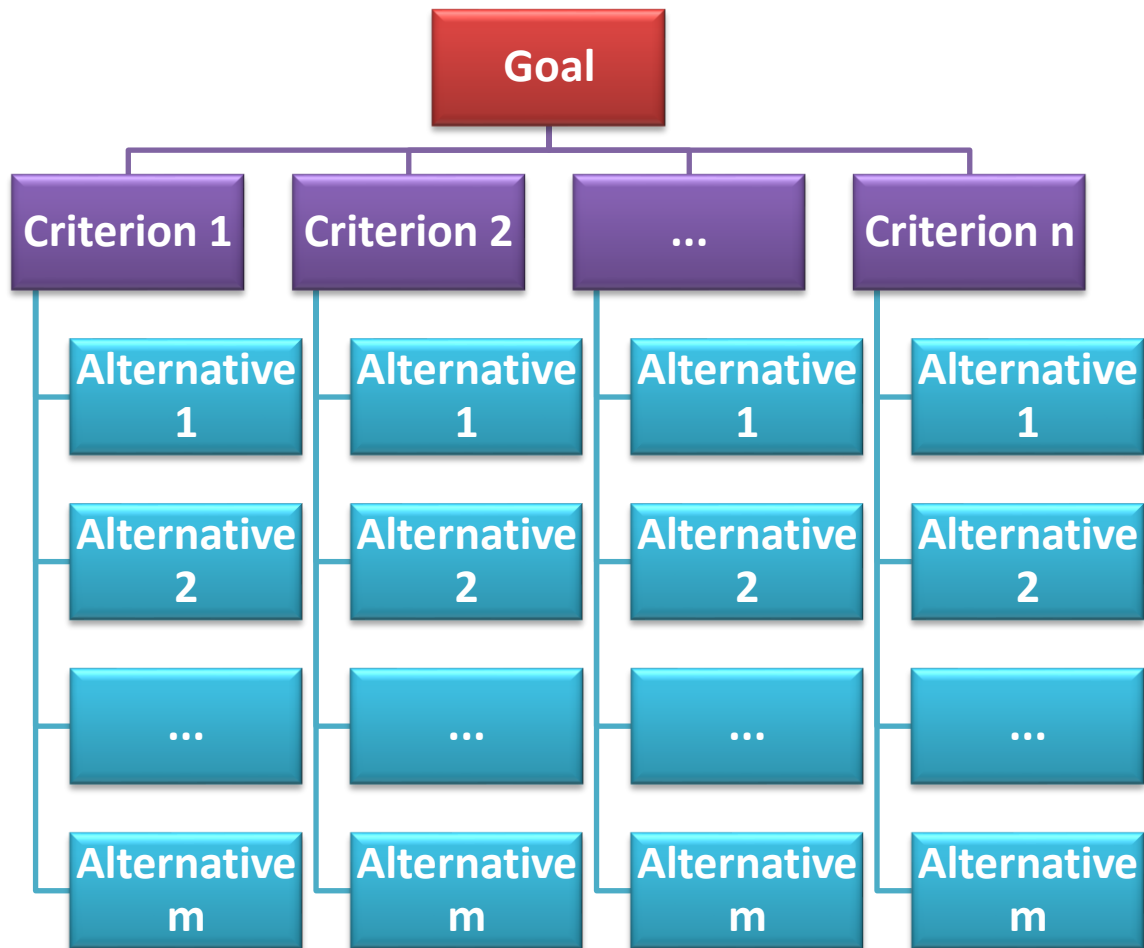


Figure 1
Hierarchical Decision Making tree for n criteria and m alternatives

Due to the inconsistency of linguistic variables expressed by the experts, the Fuzzy set theory is used in fuzzification, aggregation of linguistic variables and defuzzification of fuzzy numbers. Finally, in the third stage, we provide a structured evaluation of ASEAN ECAs through Fuzzy AHP. The pairwise comparison of ECAs in all criteria delivers a comprehensive assessment. Calculation of the inconsistency index is used to check the constancy of collected data. The Fuzzy AHP produces the important measures of criteria in stage 2 and the preference measure of ASEAN ECAs in stage 3. We rank the countries in each criterion according to their related rates, which are obtained by Fuzzy AHP. The summation of the rates in all criteria and descending sort is used to obtain the final ranking of ASEAN ECAs.

3.1. Determination of criteria

We applied three approaches for the determination of criteria, i) the literature review of electronic commerce laws, ii) the legal analysis of the Acts, and iii) consulting with experts. The analysis of the legal instruments and review of secondary sources concerning e-commerce law, especially the e-contracts, indicates that the general principles of the law of contracts are applicable in e-contracts but may differ in application [22]. However, there are some procedural differences in the case of the online contracting arising from the means of formation. Therefore, the scope of e-commerce law is usually delimited to the consideration of the new features of online transactions [23-27]. These features constitute the general discussion in the area of electronic commerce laws. We prepared a common criteria list based on the literature review.

The ECAs of the ASEAN member states are mostly based on the UNCITRAL Model Laws. For instance, the MLEC have a recommendatory feature that is not binding upon countries, although it highly affects the legislators of the world. The MLEC and the United Nations Convention on the Use of Electronic Communications in International Contracts 2005 (UNCUEC), which is the latest document and binding upon its signatories are two leading international instruments provided by the UNCITRAL. Hence, we have legally analyzed the above-mentioned international instruments along with the ASEAN ECAs using a comparative method. Based on this, we determined the principal common provisions.

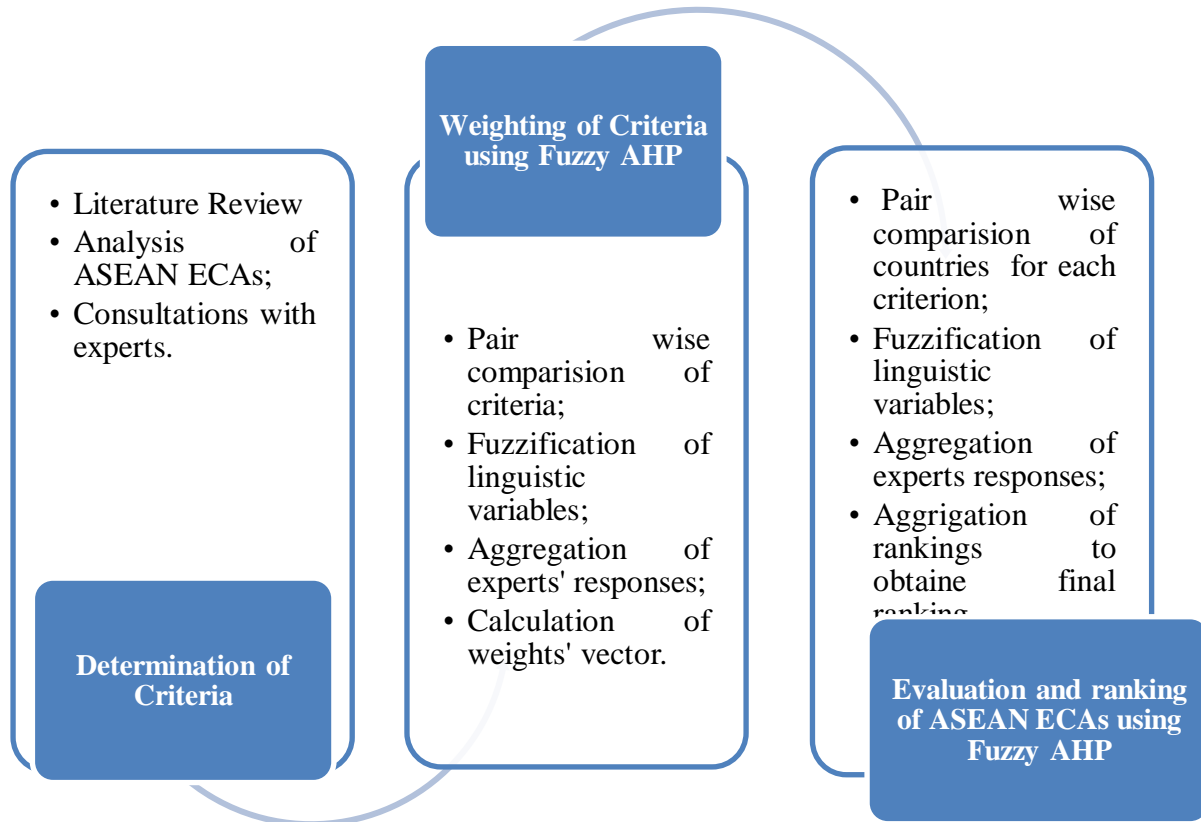


Figure 2
Proposed method

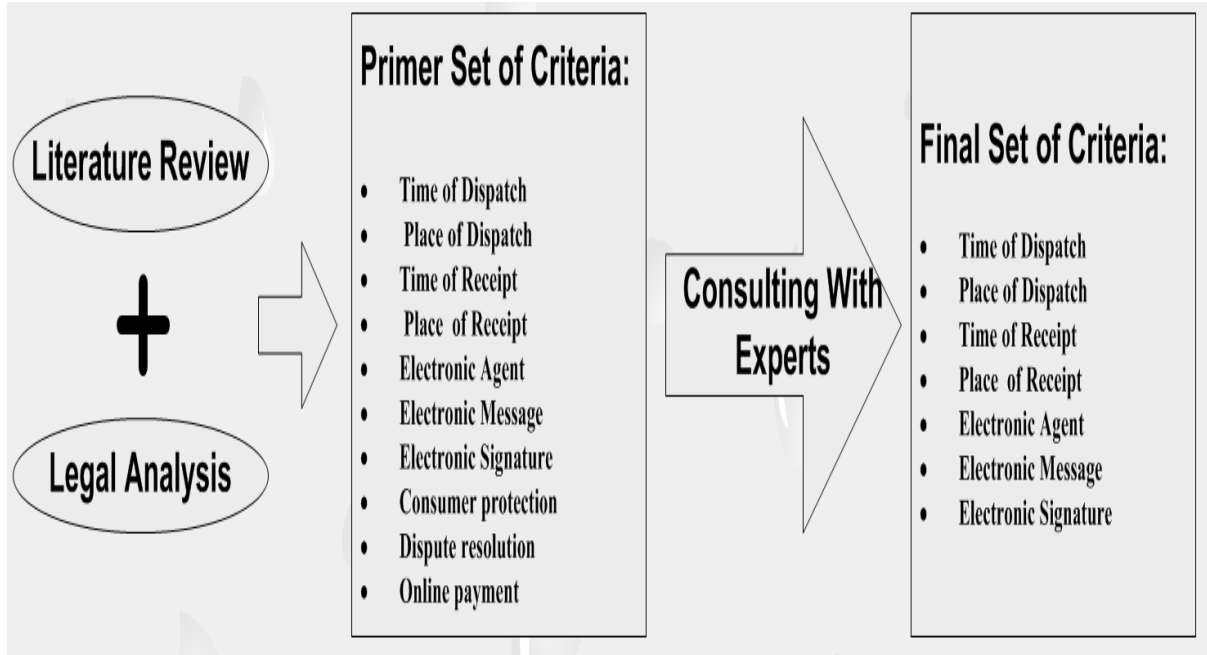


Figure 3

Determination of criteria

The review of general features of electronic commerce law, especially e-contracts and the legal analysis of the ECAs led to the provision of a primer set of ten important criteria (Fig 3). We presented the primer set of criteria to a group of ten experts who were also asked for comparisons. The experts' opinions were used to select the correct criteria. Finally, seven criteria were determined as Time of Dispatch of an Electronic Message (TD), Pace of Dispatch of an Electronic Message (PD), Time of Receipt of an Electronic Message (TR), Place of Receipt of an Electronic Message (PR), Electronic Agent (EA), Electronic Message (EM), and Electronic Signature (ES) (Fig 3).

3.1.1. Time of Dispatch of an Electronic Message (TD)

The time of dispatch of an electronic message is the time when the originator sends the offer of a contract to the addressee. According to Article 15 (1) of the MLEC, unless otherwise agreed, the time of dispatch is when a data message enters an information system outside the control of the originator or his representative. Article 10 (1) of the UNCUEC considers the time of dispatch as the time when the electronic communication leaves the originators' information system. If it did not leave the information system, then the time when it was received.

The drafters of the UNCUEC tried to consider new technologies that emerged after the adoption of the MLEC. Hence, they adopted new rules concerning the time of dispatch to be more adaptive with new technologies and the Internet compared with the MLEC, which was mostly based on Electronic Data Interchange (EDI) [28]. It has to be mentioned that the time and place of dispatch and receipt play a significant role in determining the commencement of a contract and the governing law in the case of disputes.

3.1.2. Place of Dispatch of an Electronic Message (PD)

Under Article 10 (3) of the UNCUEC, the place of business is adopted to determine the place of dispatch of an electronic message. The convention provided detailed rules in Article 6. Article 15

(4) of the MLEC also clarifies that unless otherwise agreed, the place of business of the originator is considered as the place of dispatch of a data message.

3.1.3. Time of Receipt of an Electronic Message (TR)

Article 15 (2) of the MLEC clarifies that unless otherwise agreed, the time of receipt is when the data message enters the designated information system of the addressee. If sent to a non-designated information system, the time is when it is retrieved by the addressee. In case there is no determination by the addressee, then it is the time when it enters any information system of the addressee. However, the UNCITRAL changed the receipt rule in the later convention. Under Article 10 (2) of the UNCUEC, the time of receipt is when the electronic communication is capable of being retrieved at the addressee's designated electronic address. If sent to another electronic address, then it is when it becomes retrievable at that address by the addressee and they become aware of it.

3.1.4. Place of Receipt of an Electronic Message (PR)

Article 15 (4) of the MLEC, adopted the place of business as a criterion to determine the place of receipt unless otherwise agreed by the contracting parties. The place of legal domicile (habitual residence) has also been referred to as another criterion. As the location of communication systems may change, the UNCITRAL selected the place of business as an objective criteria [29]. The UNCUEC also adopted the place of business as a criterion for PR in Article 10 (3) and Article 6.

3.1.5. Electronic Agent (EA)

Article 12 of the UNCUEC on the use of automated message systems for contract formation provides that: "A contract formed by the interaction of an automated message system and a natural person, or by the interaction of automated message systems, shall not be denied validity or enforceability on the sole ground that no natural person reviewed or intervened in each of the individual actions carried out by the automated message systems or the resulting contract".

3.1.6. Electronic Message (EM)

The legal recognition of an electronic communication or data message is an important provision embedded in almost all ECAs and the said international instruments. This means that a data message is regarded valid and enforceable like a written document. The said recognition will automatically indicate the legal effect and validity of the electronic contracts, e-documents and e-signatures. The said international instruments have addressed this principle.

3.1.7. Electronic Signature (ES)

Article 2 (a) of the MLES defines electronic signature as: “Electronic signature” means data in electronic form in, affixed to or logically associated with, a data message, which may be used to identify the signatory in relation to the data message and to indicate the signatory’s approval of the information contained in the data message”.

3.2. Fuzzy AHP

The Fuzzy AHP is the fuzzy extension of AHP method that addresses the uncertainty of experts’ opinions using the fuzzy set theory [5]. In pairwise comparisons, the experts express the relative importance of one criterion over another criterion by linguistic variables. The fuzzified pairwise comparison matrix is obtained from the fuzzification of linguistic variables. Let $C = [C_i]_n$ $i = 1, 2, \dots, n$ be the set of criteria. The results of the pairwise comparison can be summarized in an evaluation matrix as:

$$CW = \begin{bmatrix} CW_{11} & \dots & CW_{1n} \\ \vdots & \ddots & \vdots \\ CW_{n1} & \dots & CW_{nn} \end{bmatrix} \quad (1)$$

where $CW = [cw_{ij}]_{n \times n}$ and cw_{ij} is the importance of the criterion C_i over criterion C_j .

Through the following steps the weighting of criteria and ranking of countries using Fuzzy AHP are conducted:

- 1- Squaring pairwise comparison matrix and construct S as:

$$S = [s_{ij}]_{n \times n}.$$

- 2- Summarization row elements of matrix S and construct $\overrightarrow{CS} = [cs_i]_n$ where:

$$cs_i = \sum_{j=1}^n s_{ij} \quad (2)$$

- 3- Normalization of vector \overrightarrow{CS} to reach eigenvector $\overrightarrow{CN} = [cn_i]_n$ where:

$$cn_k = \frac{cs_k}{\sum_{i=1}^n cs_i} \quad (3)$$

- 4- Iteration of steps 1-3 and compare eigenvector in each iteration with previous one until differences between eigenvectors become much lower. Therefore, the last eigenvector is the priority vector.

The probability of high inconsistency is a problem of the AHP method. Therefore, to rely on an answer, the rate of inconsistency should be calculated. The principal eigenvalue λ_{\max} is used to calculate the ratio of inconsistency. This value is calculated from the summation of product between each element of the priority vector \overrightarrow{CN} and the sum of columns of the pairwise comparison matrix:

$$\lambda_{\max} = \sum_{k=1}^n \sum_{i=1}^n cw_{ik} cn_k \quad (4)$$

The relation between CW entries determines the inconsistency index (II) as:

$$II = (\lambda_{\max} - n) / (n - 1) \quad (5)$$

When $\lambda_{\max} = n$, it means that the answers are completely consistent. The ratio of inconsistency is achieved by dividing II by the random index (RdI) as:

$$IR = II / RdI \quad (6)$$

The reliability of the result of AHP is strictly related to the ratio of inconsistency. If IR is more than 0.1 then the results cannot be reliable. This ratio of inconsistency can also evaluate the inconsistency of decision-makers' opinions in pairwise comparison [30].

3.2.1. Basic definitions of Fuzzy Sets

The Fuzzy set theory is an extension of the classical set theory proposed by Prof. Zadeh, which is utilized to defuzzify and computerize Linguistic or fuzzy variables [31]. The Triangular Fuzzy Number (TFN) is a simple and popular fuzzy number, which can be utilized to manage the ambiguity of the decision-makers' judgments in Fuzzy AHP. Here, some of the basic major definitions of fuzzy sets are provided [32-35].

Definition 1. A fuzzy set \tilde{A} in a universe of discourse X is characterized by a MF $\mu_{\tilde{A}}(x)$, which is associated with every element x in X a real number in the interval $[0, 1]$. The function value $\mu_{\tilde{A}}(x)$ is termed the grade of membership of x in \tilde{A} .

Definition 2. A TFN \tilde{a} is defined through a trio (l, m, u) , as shown in Fig. 4. The membership function $\mu_{\tilde{a}}(x)$ is defined as:

$$\mu_{\tilde{a}}(x) = \begin{cases} (x - l)/(m - l), & l \leq x \leq m \\ (u - x)/(u - m), & m \leq x \leq u \\ 0, & \text{Otherwise} \end{cases} \quad (7)$$

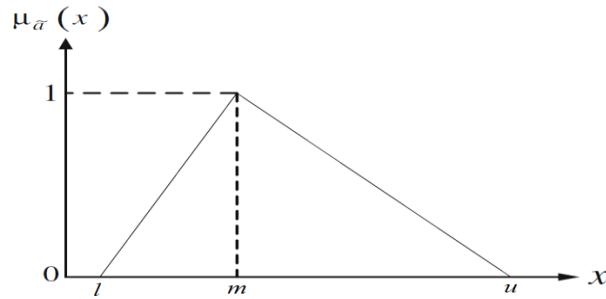


Figure 4

Triangular Fuzzy Number \tilde{a}

Let \tilde{a}_1 and \tilde{a}_2 be two TFNs defined through the trio (l_1, m_1, u_1) and (l_2, m_2, u_2) , respectively, then the related operating rules are as follows:

$$\tilde{a}_1 + \tilde{a}_2 = (l_1, m_1, u_1) + (l_2, m_2, u_2) = (l_1 + l_2, m_1 + m_2, u_1 + u_2), \quad (8)$$

$$\tilde{a}_1 - \tilde{a}_2 = (l_1, m_1, u_1) - (l_2, m_2, u_2) = (l_1 - l_2, m_1 - m_2, u_1 - u_2), \quad (9)$$

$$\tilde{a}_1 \times \tilde{a}_2 = (l_1, m_1, u_1) \times (l_2, m_2, u_2) = (l_1.l_2, m_1.m_2, u_1.u_2), \quad (10)$$

$$\tilde{a}_1 / \tilde{a}_2 = (l_1, m_1, u_1) / (l_2, m_2, u_2) = (l_1/u_2, m_1/m_2, u_1/l_2), \quad (11)$$

$$k * \tilde{a} = (k.l, k.m, k.u). \quad (12)$$

Definition 3. Linguistic variables are variables with linguistic term values. The concept of a linguistic variable is very useful in dealing with the situations that are too complex or too ill-defined to be reasonably described in conventional quantitative expressions [31, 36].

3.2.2. Fuzzification and aggregation of linguistic variables

The experts' opinions are the main source for the evaluation of criteria and ECAs. In this study, we asked experts to express their ideas through linguistic terms. In the fuzzy set theory, the linguistic terms are considered as variables. The linguistic variables related to comparison of the importance of criteria are defined as:

- “Perfect”, “very important”, “fairly important” “important” to express the higher importance.
- “Equal” to express equal importance.
- “Not important”, “very less important”, “fairly less important” and “less important” to express the lower importance.

In this paper, the computational technique for the fuzzification of linguistic terms is according to the triangular Membership Functions (MFs). Figure 5 shows five MFs with respect to linguistic variables that present the equal or higher importance of one criterion over another criterion. The selection of the aforementioned linguistic variables and their membership functions are based on five level fuzzy scales [37-39].

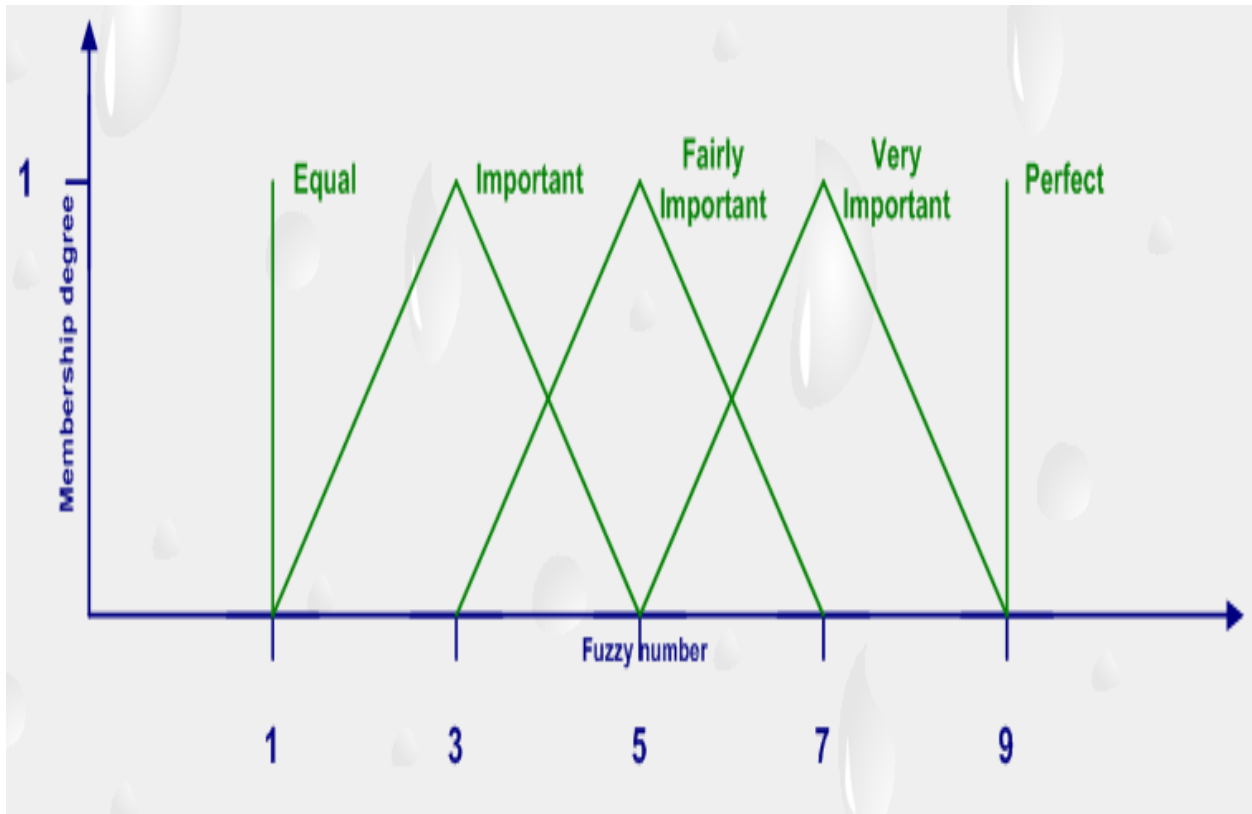


Figure 5

Membership function of linguistics variables for comparing two criteria

Table 1 shows the linguistic variables with their corresponding TFNs. If criterion i has one TFN as (l, m, u) when compared to factor j , then j has the reciprocal value as $(1/l, 1/m, 1/u)$ when compared to i . In this case, criterion i is more important than j and criterion j is less important than i . The reciprocal TFN is considered to cover the inverse importance relation between the criteria.

Table 1

Linguistic variables with corresponding TFNs for comparison of criteria

LVs (For higher importance)	TFN	LVs (For lower importance)	Reciprocal TFN
Perfect (PF)	(9, 9, 9)	Not Important (NI)	(1/9, 1/9, 1/9)
Very Important (VI)	(5, 7, 9)	Very Less Important (VLI)	(1/9, 1/7, 1/5)
Fairly Important (FI)	(3, 5, 7)	Fairly Less Important (FLI)	(1/7, 1/5, 1/3)
Important (IP)	(1, 3, 5)	Less Important (LI)	(1/5, 1/3, 1)
Equal (Eq)	(1, 1, 1)	Equal (Eq)	(1, 1, 1)

The experts were also asked to compare the strengths of each country over other countries in each criterion. The related linguistic variables for comparison of strengths comparison are defined as the levels of strength and weakness (table 2).

Table 2

Linguistic variables with corresponding TFNs for comparison of countries

LVs (For higher importance)	TFN	LVs (For lower importance)	Reciprocal TFN
Completely Strong (CS)	(9, 9, 9)	Completely Weak (CW)	(1/9, 1/9, 1/9)
Very Strong (VS)	(5, 7, 9)	Very Weak (VW)	(1/9, 1/7, 1/5)
Fairly Strong (FS)	(3, 5, 7)	Fairly Weak (FW)	(1/7, 1/5, 1/3)
Strong (ST)	(1, 3, 5)	Weak (WK)	(1/5, 1/3, 1)
Equal (EQ)	(1, 1, 1)	Equal (EQ)	(1, 1, 1)

3.2.3. Fuzzy group decision-making:

The experts gave different answers in each comparison. In fuzzy group decision-making the answers are aggregated and converted to one fuzzy value. The following equation is defined to aggregate the experts' answers that are based on fuzzy definitions (equations 8 and 12):

$$\begin{aligned} \tilde{A} &= \frac{\tilde{a}_1 + \tilde{a}_2 + \dots + \tilde{a}_n}{n} = \frac{(l_1, m_1, u_1) + (l_2, m_2, u_2) + \dots + (l_n, m_n, u_n)}{n} \\ &= \left(\frac{l_1 + l_2 + \dots + l_n}{n}, \frac{m_1 + m_2 + \dots + m_n}{n}, \frac{u_1 + u_2 + \dots + u_n}{n} \right) \end{aligned} \quad (13)$$

where

\tilde{a}_k is the fuzzy value that is expressed by expert "k",

n is the number of experts (responses),

\tilde{A} is the aggregation value of all experts' answers.

4. Results and Discussion

This study evaluated and ranked the ASEAN ECAs except the Lao PDR and Cambodia. The seven identified criteria are as follows: Time of Dispatch (TD), Place of Dispatch (PD), Time of Receipt (TR), Place of Receipt (PR), Electronic Agent (EA), Electronic Message (EM), and Electronic Signature (ES). The weighting of criteria and ranking of ASEAN ECAs are conducted using equations 1-6, and we use Equations 7-13 for fuzzification and aggregation of the experts' opinions.

4.1. Weighting of criteria

The experts were requested to complete the part of the questionnaire regarding pairwise comparison of criteria through the linguistic terms that are shown in table 1. Table 3 is a sample of the criteria comparison part of the questionnaire that is answered by one of the experts. In table 3, each row delivers a question as: what is the importance of the left criterion compared to the right criterion? The experts choose one of the linguistic variable scales provided in the top of the table to answer the question.

Table 3
Criteria comparison part of questionnaire

LVs Criteria	PF	VI	FI	IP	EQ	LI	FLI	VLI	NI	LVs Criteria
TD			*							PD
TD						*				TR
TD						*				PR
TD		*								EA
TD					*					EM
TD								*		ES
PD							*			TR
PD							*			PR
PD						*				EA

PD								*		EM
PD							*			ES
TR				*						PR
TR			*							EA
TR							*			EM
TR					*					ES
PR			*							EA
PR								*		EM
PR						*				ES
EA								*		EM
EA								*		ES
EM		*								ES

Table 4

Pairwise comparison of criteria by ten experts

Criteria	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	Criteria
TD	FI	FI	EQ	VI	IP	FI	FI	VI	EQ	VI	PD
TD	LI	EQ	VLI	FLI	LI	EQ	EQ	EQ	VLI	LI	TR
TD	LI	EQ	VLI	FLI	EQ	LI	VLI	FLI	EQ	EQ	PR
TD	VI	FI	EQ	FI	VI	FI	VI	FI	EQ	FI	EA
TD	EQ	EQ	VLI	LI	VLI	EQ	EQ	EQ	LI	EQ	EM
TD	VLI	FLI	VLI	FLI	VLI	FLI	VLI	VLI	VLI	LI	ES
PD	FLI	FLI	VLI	VLI	FLI	FLI	FLI	FLI	FLI	FLI	TR
PD	FLI	VLI	VLI	FLI	VLI	FLI	FLI	FLI	VLI	FLI	PR
PD	LI	VLI	VLI	FLI	LI	VLI	LI	VLI	FLI	VLI	EA
PD	VLI	FLI	VLI	FLI	FLI	VLI	VLI	FLI	FLI	VLI	EM
PD	FLI	VLI	VLI	VLI	FLI	VLI	FLI	VLI	VLI	FLI	ES
TR	EQ	EQ	IP	IP	EQ	EQ	EQ	IP	EQ	IP	PR
TR	FI	FI	VI	IP	VI	FI	FI	FI	FI	IP	EA
TR	FLI	EQ	EQ	EQ	FLI	EQ	FLI	EQ	EQ	EQ	EM
TR	EQ	EQ	IP	IP	EQ	EQ	EQ	EQ	EQ	IP	ES
PR	FI	FLI	VI	EQ	FI	EQ	FI	EQ	VI	EQ	EA
PR	VLI	EQ	EQ	EQ	EQ	VLI	VLI	EQ	EQ	EQ	EM
PR	LI	EQ	EQ	EQ	LI	EQ	LI	EQ	EQ	EQ	ES
EA	VLI	IP	VLI	VLI	VLI	IP	VLI	IP	VLI	IP	EM
EA	VLI	EQ	FLI	VLI	FLI	VLI	VLI	LI	FLI	LI	ES
EM	VI	EQ	VI	IP	EQ	VI	IP	IP	EQ	IP	ES

We collected the judgments of ten experts individually, as shown in table 3. Then, a general table including all the judgments is constructed (Table 4).

Table 5

Fuzzified pairwise comparison of criteria

Criteria	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	Aggregated fuzzy value	Criteria
TD	(3, 5, 7)	(3, 5, 7)	(1, 1, 1)	(5, 7, 9)	(1, 3, 5)	(3, 5, 7)	(3, 5, 7)	(5, 7, 9)	(1, 1, 1)	(5, 7, 9)	(3.00, 4.60, 6.20)	PD
TD	(1/5, 1/3, 1)	(1, 1, 1)	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(1/5, 1/3, 1)	(1, 1, 1)	(1, 1, 1)	(1, 1, 1)	(1/9, 1/7, 1/5)	(1/5, 1/3, 1)	(0.496, 0.548, 0.753)	TR
TD	(1/5, 1/3, 1)	(1, 1, 1)	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(1, 1, 1)	(1/5, 1/3, 1)	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(1, 1, 1)	(1, 1, 1)	(0.490, 0.535, 0.706)	PR
TD	(5, 7, 9)	(3, 5, 7)	(1, 1, 1)	(3, 5, 7)	(5, 7, 9)	(3, 5, 7)	(5, 7, 9)	(3, 5, 7)	(1, 1, 1)	(3, 5, 7)	(3.20, 4.80, 6.40)	EA
TD	(1, 1, 1)	(1, 1, 1)	(1/9, 1/7, 1/5)	(1/5, 1/3, 1)	(1/9, 1/7, 1/5)	(1, 1, 1)	(1, 1, 1)	(1, 1, 1)	(1/5, 1/3, 1)	(1, 1, 1)	(0.662, 0.695, 0.840)	EM
TD	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(1/9, 1/7, 1/5)	(1/9, 1/7, 1/5)	(1/9, 1/7, 1/5)	(1/5, 1/3, 1)	(0.129, 0.159, 0.32)	ES
PD	(1/7, 1/5, 1/3)	(1/7, 1/5, 1/3)	(1/9, 1/7, 1/5)	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(1/7, 1/5, 1/3)	(1/7, 1/5, 1/3)	(1/7, 1/5, 1/3)	(1/7, 1/5, 1/3)	(1/7, 1/5, 1/3)	(0.136, 0.188, 0.306)	TR
PD	(1/7, 1/5, 1/3)	(1/9, 1/7, 1/5)	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(1/7, 1/5, 1/3)	(1/7, 1/5, 1/3)	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(0.130, 0.177, 0.28)	PR
PD	(1/5, 1/3, 1)	(1/9, 1/7, 1/5)	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(1/5, 1/3, 1)	(1/7, 1/5, 1/3)	(1/5, 1/3, 1)	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(1/9, 1/7, 1/5)	(0.144, 0.211, 0.466)	EA
PD	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(1/7, 1/5, 1/3)	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(1/7, 1/5, 1/3)	(1/7, 1/5, 1/3)	(1/9, 1/7, 1/5)	(0.126, 0.171, 0.266)	EM
PD	(1/7, 1/5, 1/3)	(1/9, 1/7, 1/5)	(1/9, 1/7, 1/5)	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(1/9, 1/7, 1/5)	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(0.123, 0.165, 0.253)	ES
TR	(1, 1, 1)	(1, 1, 1)	(1, 3, 5)	(1, 3, 5)	(1, 1, 1)	(1, 1, 1)	(1, 1, 1)	(1, 3, 5)	(1, 1, 1)	(1, 3, 5)	(1.00, 1.80, 2.60)	PR
TR	(3, 5, 7)	(3, 5, 7)	(5, 7, 9)	(1, 3, 5)	(5, 7, 9)	(3, 5, 7)	(3, 5, 7)	(3, 5, 7)	(3, 5, 7)	(1, 3, 5)	(3.00, 5.00, 7.00)	EA
TR	(1/7, 1/5, 1/3)	(1, 1, 1)	(1, 1, 1)	(1, 1, 1)	(1/7, 1/5, 1/3)	(1, 1, 1)	(1/7, 1/5, 1/3)	(1, 1, 1)	(1, 1, 1)	(1, 1, 1)	(0.742, 0.760, 0.800)	EM
TR	(1, 1, 1)	(1, 1, 1)	(1, 3, 5)	(1, 3, 5)	(1, 1, 1)	(1, 1, 1)	(1, 1, 1)	(1, 1, 1)	(1, 1, 1)	(1, 3, 5)	(1.00, 1.60, 2.20)	ES
PR	(3, 5, 7)	(1/7, 1/5, 1/3)	(5, 7, 9)	(1, 1, 1)	(3, 5, 7)	(1, 1, 1)	(3, 5, 7)	(1, 1, 1)	(5, 7, 9)	(1, 1, 1)	(2.314, 3.32, 4.33)	EA

PR	(1/9, 1/7, 1/5)	(1, 1, 1)	(1, 1, 1)	(1, 1, 1)	(1, 1, 1)	(1/9, 1/7, 1/5)	(1/9, 1/7, 1/5)	(1, 1, 1)	(1, 1, 1)	(1, 1, 1)	(0.733, 0.743, 0.760)	EM
PR	(1/5, 1/3, 1)	(1, 1, 1)	(1, 1, 1)	(1, 1, 1)	(1/5, 1/3, 1)	(1, 1, 1)	(1/5, 1/3, 1)	(1, 1, 1)	(1, 1, 1)	(1, 1, 1)	(0.760, 0.800, 1.00)	ES
EA	(1/9, 1/7, 1/5)	(1, 3, 5)	(1/9, 1/7, 1/5)	(1/9, 1/7, 1/5)	(1/9, 1/7, 1/5)	(1, 3, 5)	(1/9, 1/7, 1/5)	(1, 3, 5)	(1/9, 1/7, 1/5)	(1, 3, 5)	(0.466, 1.285, 2.120)	EM
EA	(1/9, 1/7, 1/5)	(1, 1, 1)	(1/7, 1/5, 1/3)	(1/9, 1/7, 1/5)	(1/7, 1/5, 1/3)	(1/9, 1/7, 1/5)	(1/9, 1/7, 1/5)	(1/5, 1/3, 1)	(1/7, 1/5, 1/3)	(1/5, 1/3, 1)	(0.227, 0.283, 0.480)	ES
EM	(5, 7, 9)	(1, 1, 1)	(5, 7, 9)	(1, 3, 5)	(1, 1, 1)	(5, 7, 9)	(1, 3, 5)	(1, 3, 5)	(1, 1, 1)	(1, 3, 5)	(2.20, 3.60, 5.00)	ES

The corresponding TFN of each linguistic variable (see table 1) is replaced and presented in table 5. In addition, equation 13 is employed to generate the aggregated fuzzy value (Table 5).

The pairwise comparison matrix of criteria is constructed with the aggregated fuzzy values obtained. (Table 6).

Table 6
Pairwise comparison matrix of criteria

Criteria	TD	PD	TR	PR	EA	EM	ES
TD	1	(3.00, 4.60, 6.20)	(0.496, 0.548, 0.753)	(0.490, 0.535, 0.706)	(3.20, 4.80, 6.40)	(0.662, 0.695, 0.840)	(0.129, 0.159, 0.32)
PD	-	1	(0.136, 0.188, 0.306)	(0.130, 0.177, 0.28)	(0.144, 0.211, 0.466)	(0.126, 0.171, 0.266)	(0.123, 0.165, 0.253)
TR	-	-	1	(1.00, 1.80, 2.60)	(3.00, 5.00, 7.00)	(0.742, 0.760, 0.80)	(1.00, 1.60, 2.20)
PR	-	-	-	1	(2.314, 3.32, 4.33)	(0.733, 0.743, 0.760)	(0.760, 0.800, 1.00)
EA	-	-	-	-	1	(0.466, 1.285, 2.120)	(0.227, 0.283, 0.480)
EM	-	-	-	-	-	1	(2.20, 3.60, 5.00)
ES	-	-	-	-	-	-	1

The median defuzzification method is applied for defuzzification of fuzzy values in table 6 and for constructing the defuzzified matrix (table 7).

Table 7

Defuzzified pairwise comparison matrix of criteria

Criteria	TD	PD	TR	PR	EA	EM	ES
TD	1	4.60	0.599	0.577	4.80	0.732	0.202
PD	-	1	0.210	0.195	0.273	0.187	0.180
TR	-	-	1	1.80	5.00	0.767	1.60
PR	-	-	-	1	3.32	0.745	0.853
EA	-	-	-	-	1	1.290	0.33
EM	-	-	-	-	-	1	3.60
ES	-	-	-	-	-	-	1

We had one comparison for each two criteria to avoid the inconsistency of data; hence, half of the comparison matrix is empty. The reciprocal values are used to fill in the pairwise comparison matrix (see table 8).

Table 8

Completed pairwise comparison matrix of criteria

Criteria	TD	PD	TR	PR	EA	EM	ES
TD	1	4.60	1/1.66	1/1.79	4.80	1/1.36	1/4.95
PD	1/4.60	1	1/4.76	1/5.12	1/3.66	1/5.34	1/5.55
TR	1.66	4.76	1	1.80	5.00	1/1.30	1.60
PR	1.79	5.12	1/1.80	1	3.32	1/1.34	1/1.17
EA	1/1.80	3.66	1/5.00	1/3.32	1	1.29	1/3.03
EM	1.36	5.34	1.30	1.34	1/1.29	1	3.60
ES	4.95	5.55	1/1.60	1.17	3.03	1/3.60	1

The completed matrix (table 8) is used in equations (1-7) for calculation of the eigenvalue and obtaining the weight of the criteria. The obtained weights and ranks are shown in Table 9.

Table 9

Criteria weights and ranks

Criteria	Weights (Eigen vector)	Rank
Electronic Message (EM)	0.216684	1
Time of Receipt (TR)	0.207009	2
Electronic Signature (ES)	0.193709	3
Place of Receipt (PR)	0.149811	4
Time of Dispatch (TD)	0.127152	5
Electronic Agent (EA)	0.0780345	6
Place of Dispatch (PD)	0.0276018	7

The inconsistency of FAHP is checked using equation 6. The maximum eigenvalue = 8.14415 and the inconsistency ratio is $IR=0.090692$ when it is less than 0.1; therefore, the answer is significant. The results indicate that the EM with a weight of 0.216684 is the most important criterion in the electronic commerce law and that TR, with a difference of 0.009675 to the EM, is in second place. The PD, with a weight of 0.0276018, was allocated the least importance and stood in last place.

4.2. Ranking of ASEAN ECAs

The experts filled out the second part of the questionnaire regarding pairwise comparison of ASEAN ECAs for all of the criteria. Table 10 is obtained from the second part of the questionnaire that is related to a comparison of countries in terms of ECA. This table shows the answers of ten experts (E1, E2, ..., E10) for a comparison of the countries with TD as a sample.

Table 10

Pairwise comparison of countries

Country	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	Country
MECA	VW	FW	CW	VW	VW	CW	VW	VW	VW	VW	SETA
MECA	FW	VW	FW	WK	VW	FW	FW	WK	WK	FW	IEITA
MECA	EQ	EQ	EQ	EQ	WK	EQ	EQ	EQ	EQ	EQ	PECA
MECA	FS	VS	VS	CS	VS	FS	FS	VS	ST	VS	TETA
MECA	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	BETA
MECA	FS	VS	VS	CS	VS	FS	FS	VS	ST	VS	METL
MECA	VW	FW	CW	VW	FW	CW	VW	VW	FW	VW	VLET
SETA	FS	VS	ST	VS	VS	VS	FS	ST	VS	FS	IEITA
SETA	FS	VS	CS	FS	VS	VS	ST	FS	VS	ST	PECA
SETA	CS	VS	FS	CS	VS	CS	CS	VS	CS	CS	TETA
SETA	FS	VS	VS	VS	VS	ST	FS	VS	ST	VS	BETA
SETA	CS	VS	CS	CS	FS	CS	VS	VS	CS	VS	METL
SETA	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	ST	EQ	VLET
IEITA	ST	EQ	ST	ST	ST	ST	FS	FS	ST	VS	PECA
IEITA	CS	VS	FS	CS	VS	VS	VS	VS	FS	CS	TETA
IEITA	ST	EQ	FS	ST	ST	ST	FT	FS	ST	VS	BETA
IEITA	VS	CS	VS	FS	FS	VS	VS	VS	CS	ST	METL
IEITA	FW	VW	WK	VW	VW	VW	FW	WK	FW	FW	VLET
PECA	FS	VS	VS	CS	VS	FS	FS	VS	ST	VS	TETA
PECA	EQ	EQ	EQ	EQ	WK	EQ	EQ	EQ	EQ	EQ	BETA
PECA	FS	VS	VS	FS	VS	FS	FS	VS	ST	VS	METL
PECA	VW	FW	CW	VW	FW	CW	VW	VW	FW	VW	VLET
TETA	FW	VW	VW	CW	VW	FW	VW	VW	WK	VW	BETA
TETA	EQ	EQ	EQ	EQ	EQ	WK	EQ	EQ	EQ	EQ	METL
TETA	CW	VW	CW	FW	CW	VW	CW	CW	VW	CW	VLET
BETA	FS	VS	VS	CS	VS	FS	VS	VS	ST	VS	METL
BETA	VW	FW	CW	VW	VW	CW	VW	VW	FW	VW	VLET
METL	CW	VW	CW	FW	CW	VW	CW	CW	VW	CW	VLET

Table 11 Ranking of countries in each criterion

TD			PD			TR			PR			EA			EM			ES		
Country	Weight	Rank	Country	Weight	Rank	Country	Weight	Rank	Country	Weight	Rank	Country	Weight	Rank	Country	Weight	Rank	Country	Weight	Rank
SETA	0.33481	1	PECA	0.28152	1	SETA	0.41061	1	PECA	0.29143	1	TETA	0.17472	1	METL	0.30000	1	MECA	0.31965	1
VLET	0.33481	1	BETA	0.22336	2	PECA	0.15235	2	METL	0.25553	2	MECA	0.15769	2	SETA	0.10000	2	SETA	0.21576	2
IEITA	0.12016	2	MECA	0.19347	3	METL	0.15235	2	BETA	0.17277	3	METL	0.13255	3	MECA	0.10000	2	IEITA	0.09429	3
PECA	0.0596878	3	METL	0.12336	4	BETA	0.15235	2	MECA	0.12377	4	PECA	0.1325	3	TETA	0.10000	2	PECA	0.08217	4
BETA	0.0596878	3	TETA	0.07687	5	MECA	0.06240	3	TETA	0.05508	5	BETA	0.1187	4	PECA	0.10000	2	BETA	0.08217	4
MECA	0.0579279	4	VLET	0.05641	6	TETA	0.03145	4	VLET	0.05508	5	IEITA	0.11852	5	VLET	0.10000	2	VLET	0.08024	5
TETA	0.0164554	5	SETA	0.03181	7	IEITA	0.02265	5	SETA	0.03361	6	SETA	0.10606	6	BETA	0.10000	2	METL	0.07231	6
METL	0.0164554	5	IEITA	0.01322	8	VLET	0.01585	6	IEITA	0.01272	7	VLET	0.05917	7	IEITA	0.10000	2	TETA	0.05339	7

The process of defuzzification and aggregation of data is similar to what we did for the criteria weighting. The results of the ranking of countries in each criterion are stated separately in table 11. The value of IR in all calculations is less than 0.1, which shows the significance of data and the consistency of the experts' answers.

The overall ranking of the eight ASEAN ECAs with respect to the TD rule is shown in Figure 6. While SETA and VLET both stood in the first place by acquiring a weight of 0.334811, TETA and METL obtained the last grade and were ranked fifth with a weight of 0.0164554. Except SETA and VLET, which have adopted a similar approach to the UNCUEC in drafting the TD provision, the rest have more or less adopted Article 15 (1) of the MLEC with respect to the determination of the TD rule. Although the drafters selected Article 15 as their basis, their provisions may have some strong points or defects resulting in a different ranking. For instance, IEITA obtained the best rank among them. The MLEC determines the time when a data message enters an information system outside the control of the originator as the time of dispatch. The results clearly show that the experts believe that the TD rules of SETA and VLET that were based on Article 10 (1) of the UNCUEC are more applicable. This indicates that the time when the electronic communication leaves the originators' information system is the time of dispatch. These two countries have provided rules concerning a situation when an electronic communication does not leave the information system of the originator.

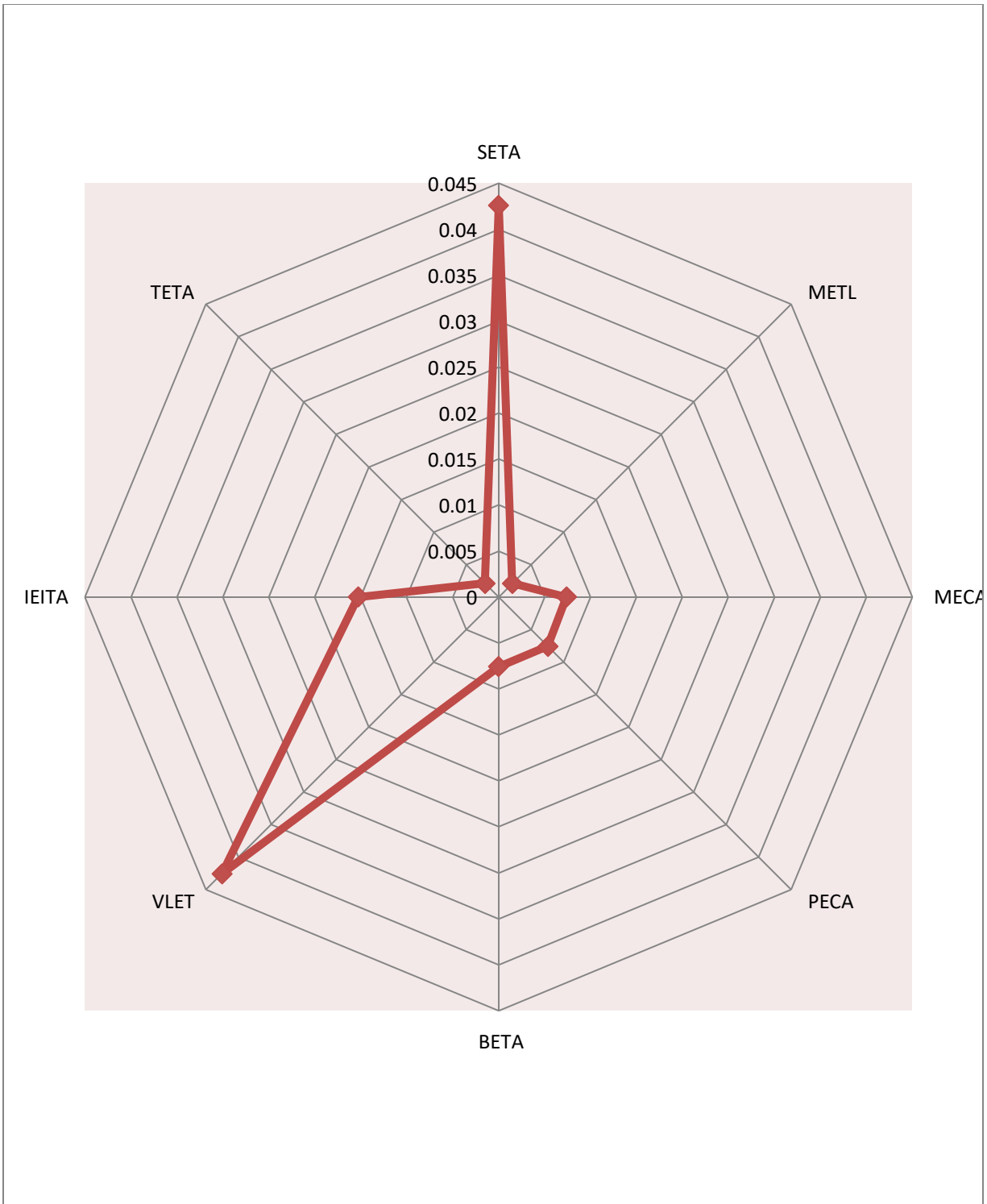


Figure 6

Status of ASEAN ECAs with respect to TD

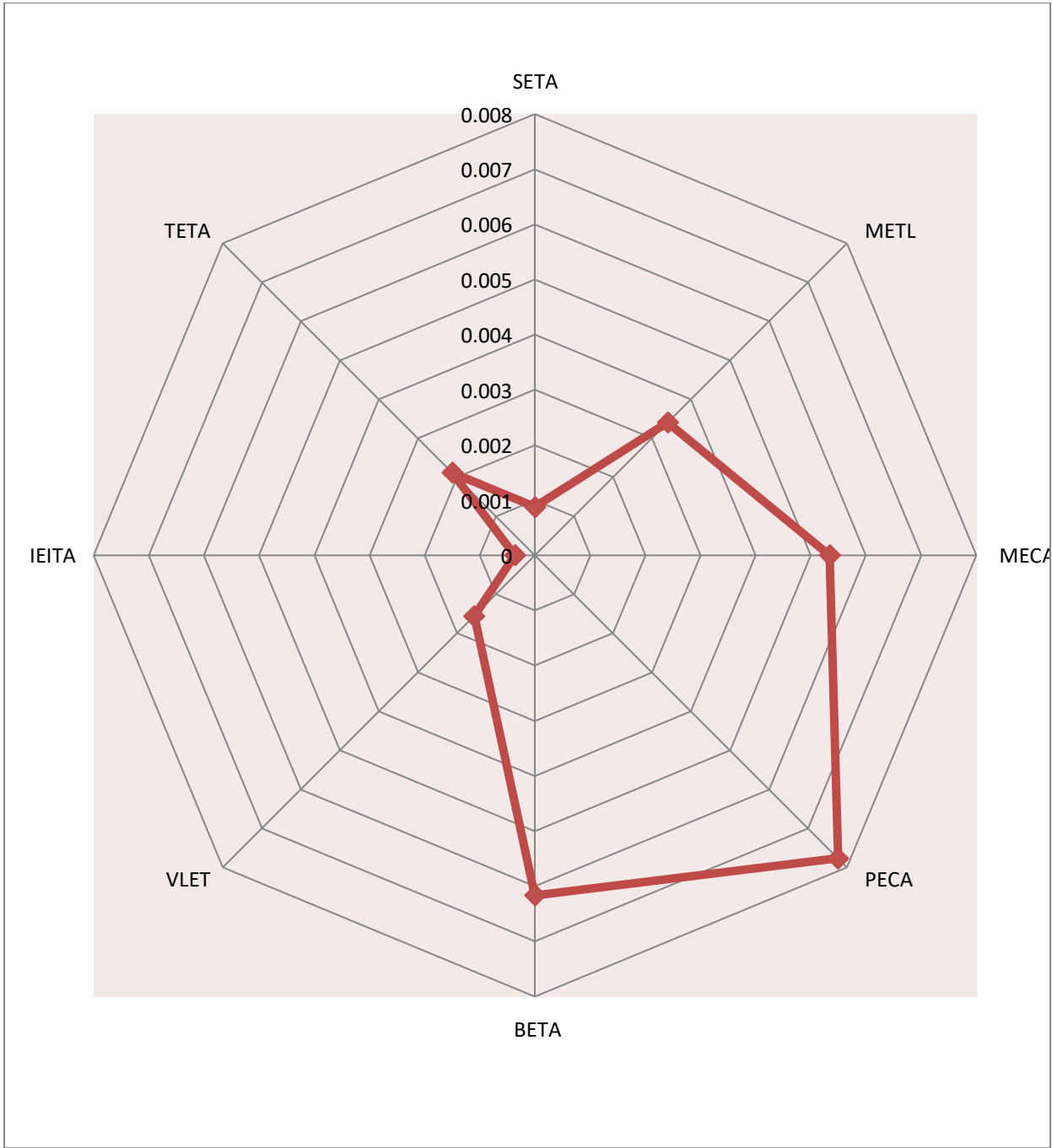


Figure 7

Rank of ASEAN ECAs with respect to PD

The overall ranking of the ASEAN ECAs with respect to the TR rules indicates that SETA, with a weight of 0.410606, stood in first position. It drafted a completed provision on the TR rule based on the UNCUEC. The MLEC considers the TR as when a data message enters the designated information system of the addressee. Article 10 (2) of the UNCUEC improved Article 15 (2) of the MLEC concerning the time of receipt.

For instance, the retrievability of electronic communication, awareness of the addressee and using the phrase ‘electronic address’ instead of ‘information system’ are considerable. The TR rules in the convention are more adaptive with current technologies. The PECA, METL and BETA stand in second position collectively and VLET is last. All the statutes, except SETA, followed Article 15 (2) in drafting the TR rules. Figure 8 represents the ranking of the ASEAN ECAs in terms of the TR rules.

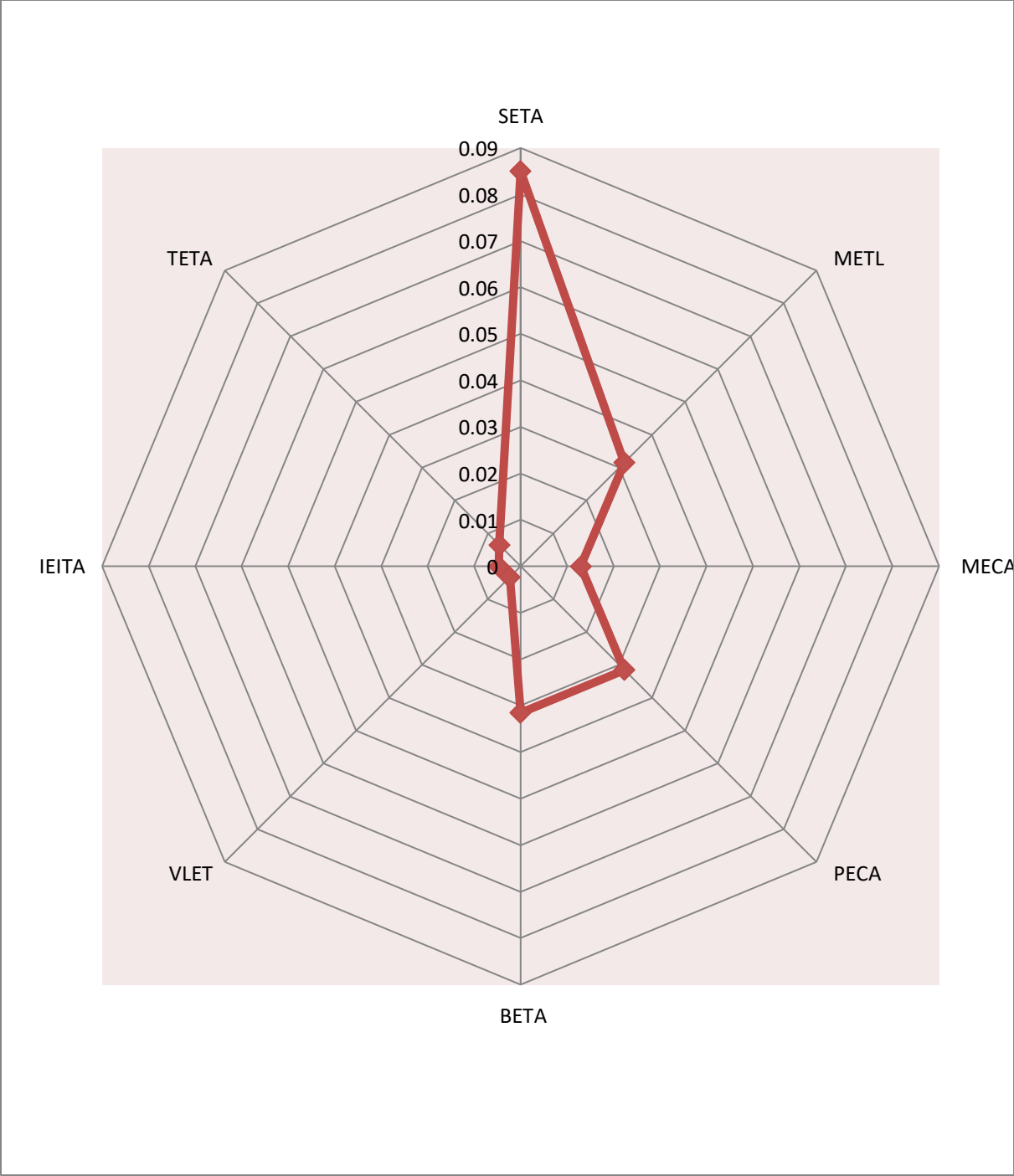


Figure 8

Rank of ASEAN ECAs with regard to TR

Figure 9 displays the evaluation of the ASEAN ECAs based on their PR rules. The PECA and METL obtained the first and second rank, respectively. Almost all states based their PR rules on Article 15 (4) of the MLEC but in a different format. Article 15 (4) determines the place of business as PR including different scenarios, such as habitual residence if the addressee does not have a place of business. As the place of business is more objective, the UNCITRAL also adopted the place of business in Article 6 and Article 10 (3) of the UNCUEC. SETA followed the UNCUEC in drafting PR rules. IEITA stood last, as its ECA does not have a clear rule on PR.

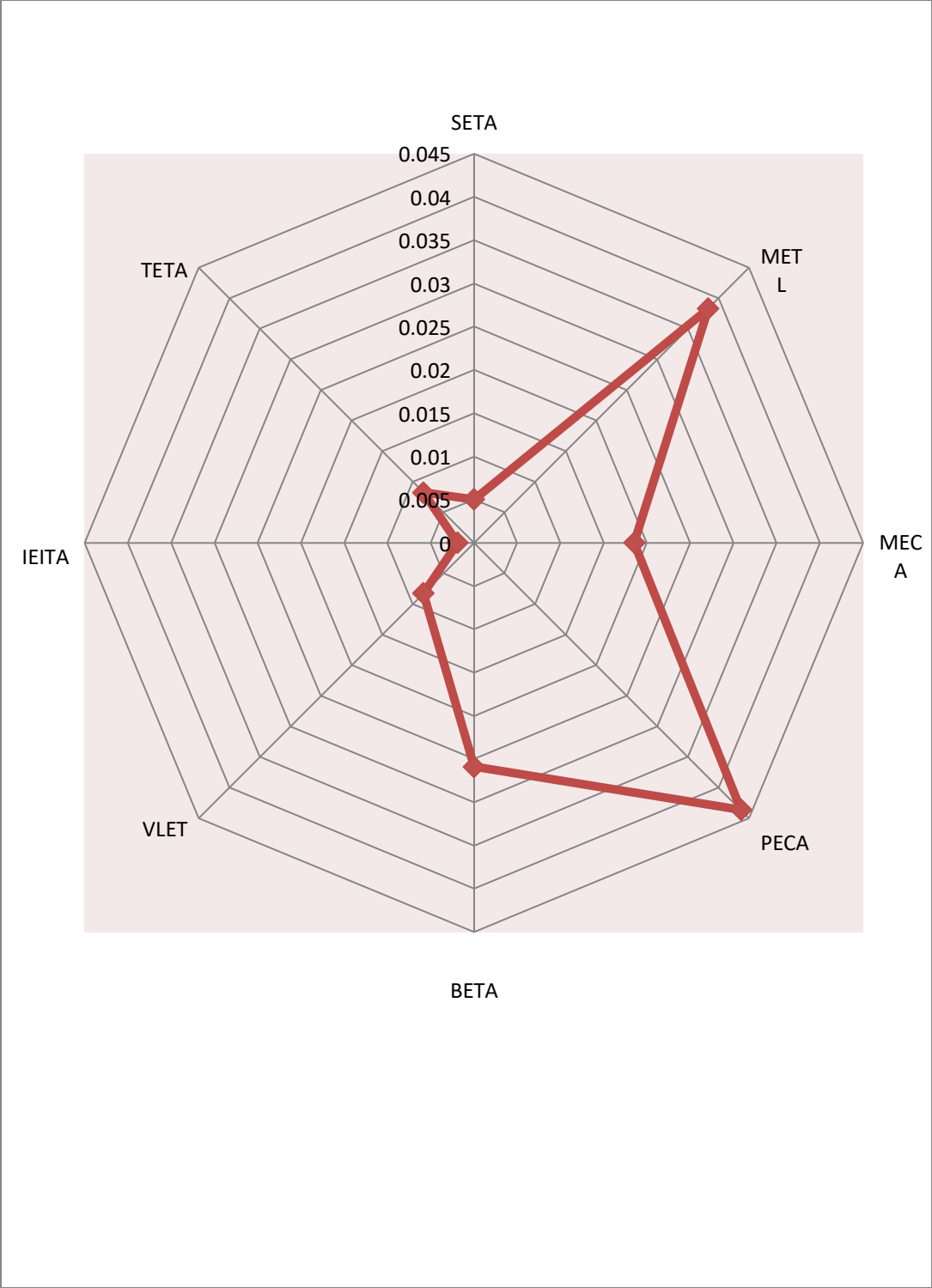


Figure 9

Rank of ASEAN ECAs with respect to PR

Although all states have adopted a more or less similar approach to the MLEC in recognition of the EA, they obtained different positions. TETA, with a weight of 0.17472, is the first country and VLET is the last one. SETA followed the UNCUEC in drafting the EA rule and stood in sixth place. Figure 10 demonstrates the rank of ASEAN ECAs with respect to EA.

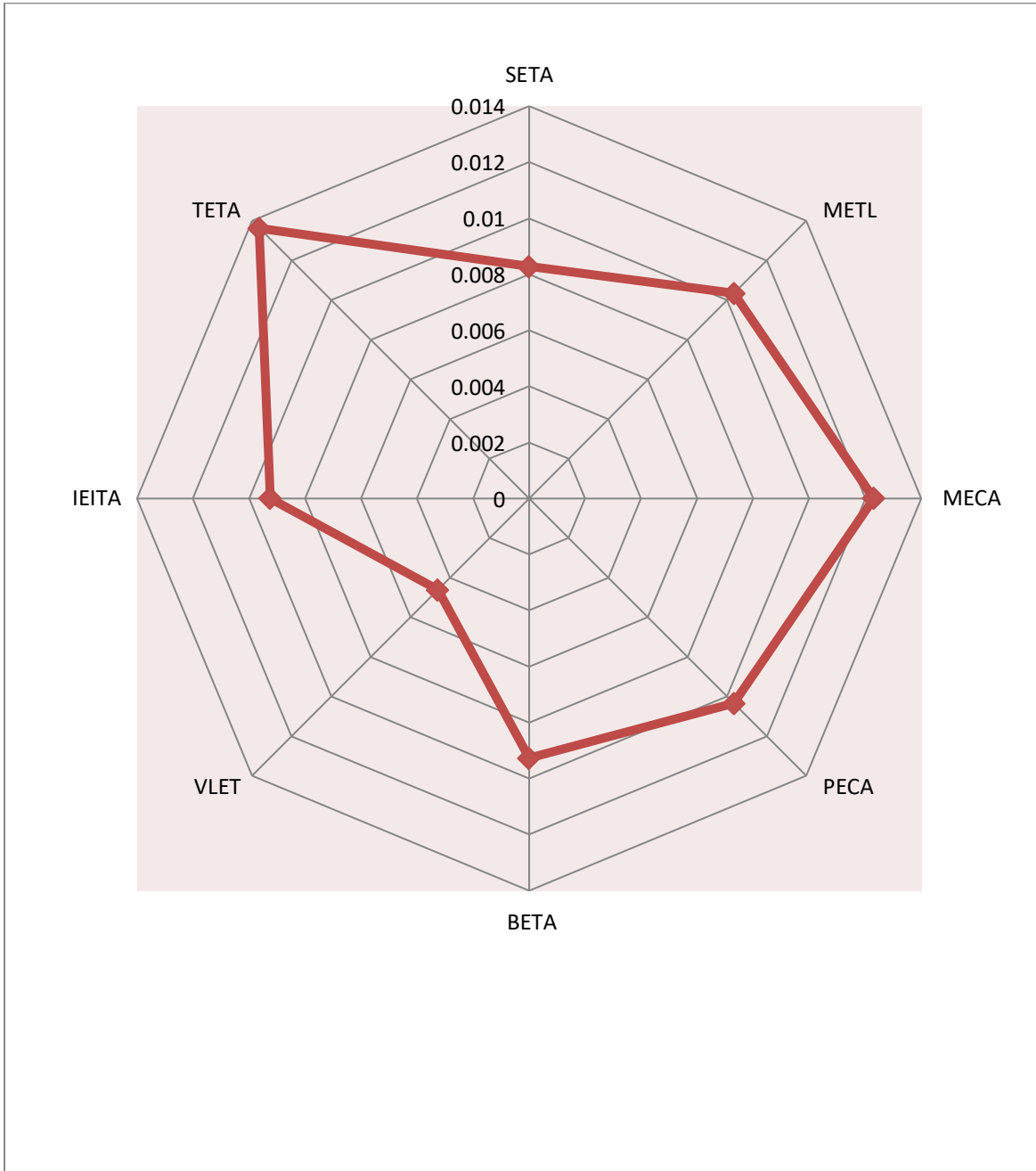


Figure 10

Status of ASEAN ECAs with respect to EA

The legal recognition of EM, which results in recognition of the e-contracts, is one of the important principles in all ECAs. Seven states were placed in the second rank, as they have a similar weight for the EM. They drafted their EM rules following Article 5 and Article 5 bis of the MLEC. Although the MLEC and the UNCUEC have almost similar rules concerning the legal recognition of the EM, they have a different appearance. However, METL was ranked as first using the pairwise comparison of the ECAs by experts. METL has drafted a more comprehensive provision on legal recognition of the EM, although the general rule stated is the same as that of the other countries. Figure 11 shows the overall ranking of the ASEAN ECAs regarding the EM criterion.

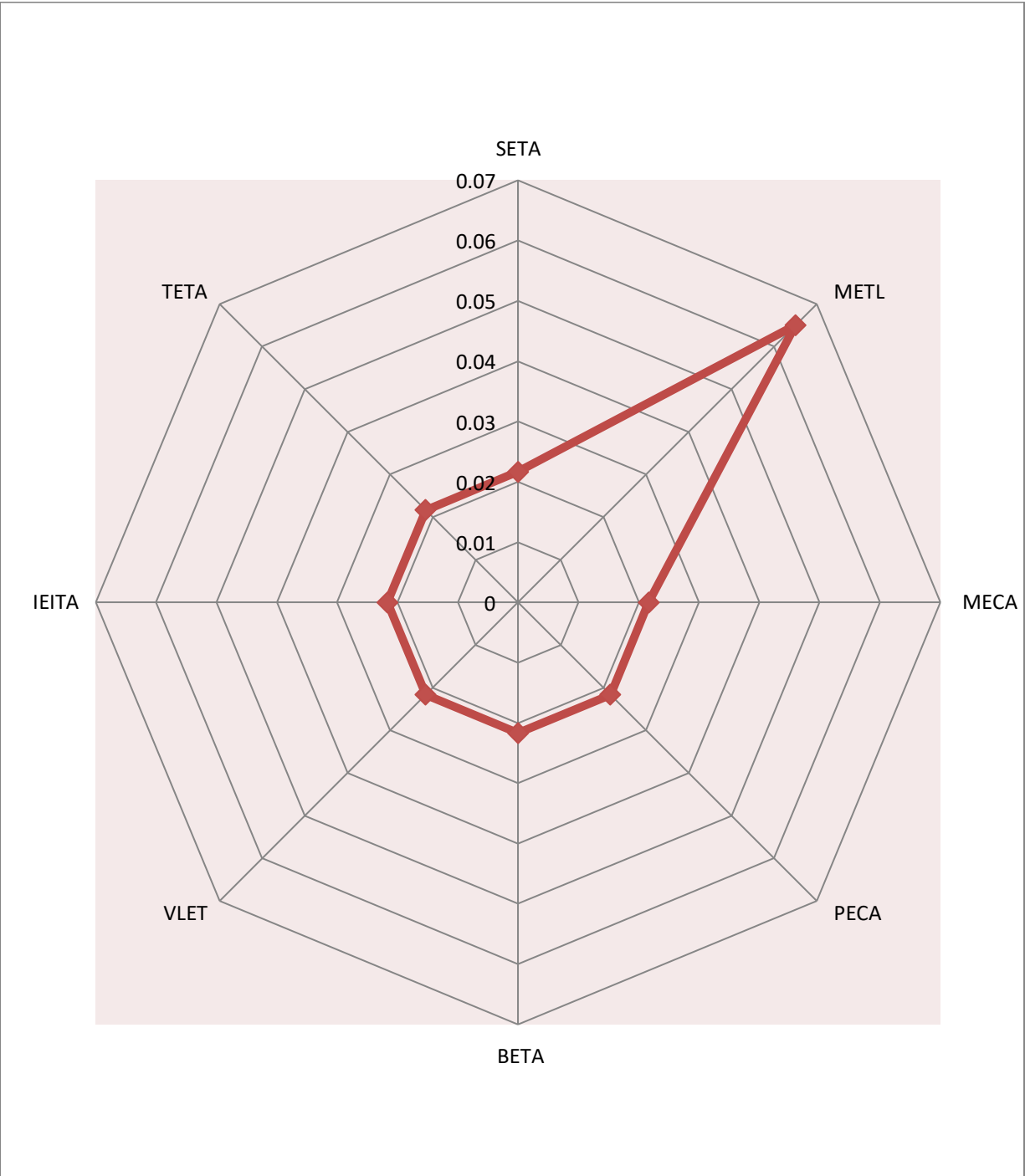


Figure 11

Rank of ASEAN ECAs with regard to EM

Among the eight ECAs, MECA stood in first place with respect to the ES rules. Although MECA has pointed out the legal effect of ES in the Electronic Commerce Act 2006, it has passed a separate Act on ES called the Digital Signature Act in 1997. Hence, having almost a complete and separate Act even before enacting the ECA may be considered its priority with respect to the ES criterion. The rest have recognized the validity and legal effects of ES in their ECAs. The PECA and BETA were both placed in fourth, and VLET, with a low difference in weight, obtained fifth position. Figure 12 illustrates the evaluation of ASEAN ECAs concerning the ES rules.

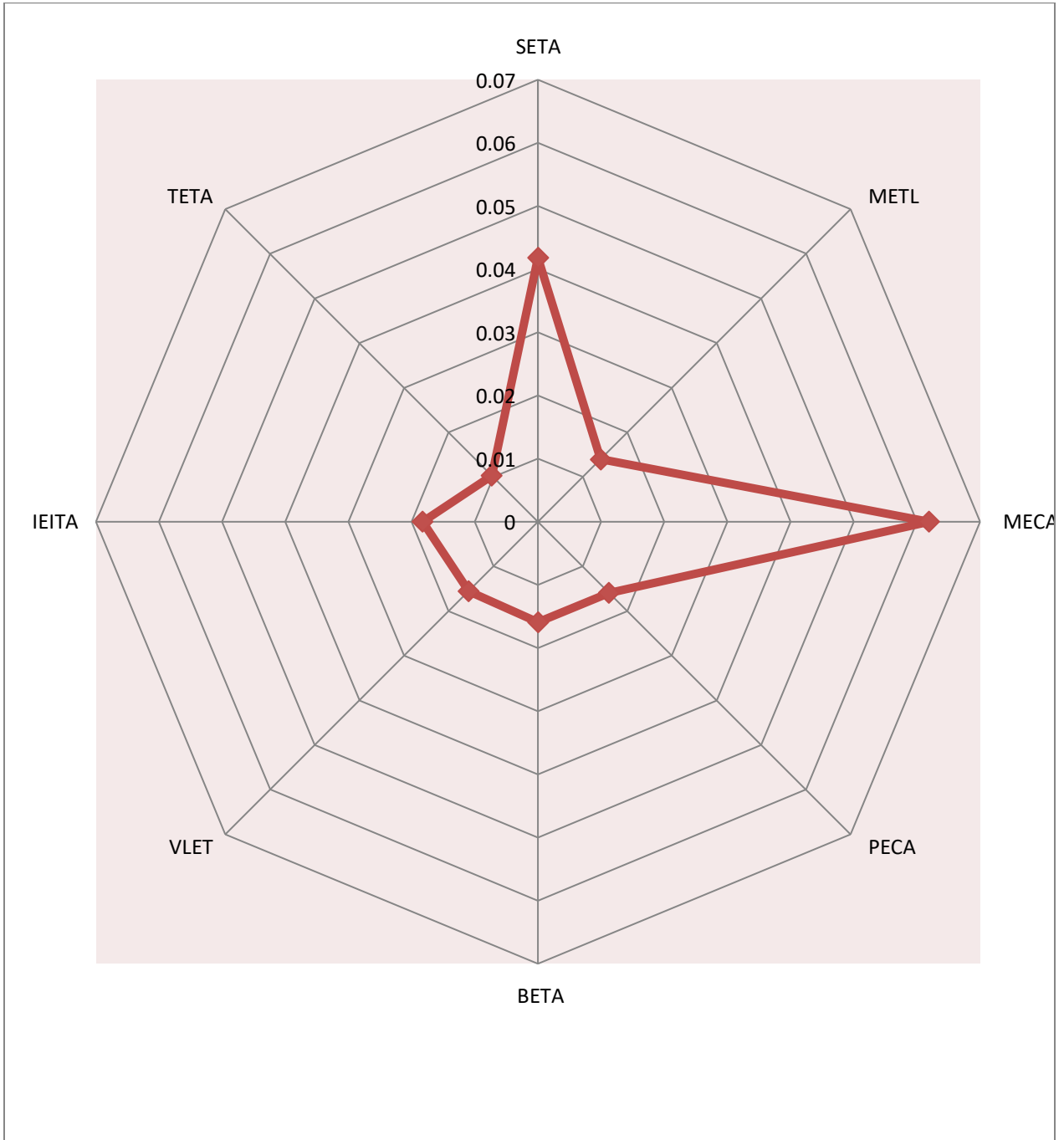


Figure 12

Rank of ASEAN ECAs with respect to ES

The overall rate and ranking of ASEAN ECAs obtained from stage 3 is shown in table 12. Although the rank of an ECA may differ for each criterion, the summation of rates for all criteria is the overall rate for each country. This ranking indicates the effectiveness and comprehensiveness of the ASEAN ECAs. SETA stood in first place among all ASEAN ECAs.

Table 12
Rates and rank of ASEAN ECAs

Country	EM (* 0.216684)	TR (* 0.207009)	ES (* 0.193709)	PR (* 0.149811)	TD (* 0.127152)	EA (* 0.0780345)	PD (* 0.0276018)	Overall rate	Fin al Ra nk
SETA	0.0216684	0.084999 14	0.041795	0.005035 612	0.042571 89	0.0082766	0.0008779 7	0.20522 461	1
METL	0.0650052	0.031536 99	0.014007678 917	0.038281 65	0.002092 337	0.0103433169 06	0.0034048 48	0.16467 202	2
MECA	0.0216684	0.012918 38	0.061919469 268	0.018542 71	0.007365 648	0.0123051822 705	0.0053402 31	0.14006 002	3
PECA	0.0216684	0.031536 99	0.015917727 1406	0.043659 87	0.007589 423	0.0103433169 06	0.0077704 04	0.13848 613	4
BETA	0.0216684	0.031536 99	0.015917727 1406	0.025882 55	0.007589 423	0.0092659725 99	0.0061650 28	0.11802 609	5
VLET	0.0216684	0.003280 389	0.015543713 8034	0.008251 59	0.042571 89	0.0046170750 6495	0.0015568 8	0.09748 993	6
IEITA	0.0216684	0.004688 961	0.018265673 9296	0.001905 401	0.015279 09	0.0092488830 435	0.0003647 854	0.07142 119	7
TETA	0.0216684	0.006511 199	0.010342104 1391	0.008251 59	0.002092 337	0.0136341878 4	0.0021216 43	0.06462 146	8

Singapore enacted the Electronic Transaction Act (ETA) in 1998 based on the MLEC. However, it replaces the ETA 1998 with a new law called the Electronic Transaction Act (ETA) in 2010. This new Act was mostly based on the UNCUEC, which may be the main reason for SETA obtaining the maximum rate in the TR and TD rules (Fig 13). As stated earlier, the UNCUEC is the second general document adopted by the UNCITRAL on the law of electronic commerce and is binding upon its signatories. The drafters of this convention, tried to consider new technologies in drafting the provisions and somehow amend the MLEC rules. The other seven states followed the MLEC as a basis for their ECAs.

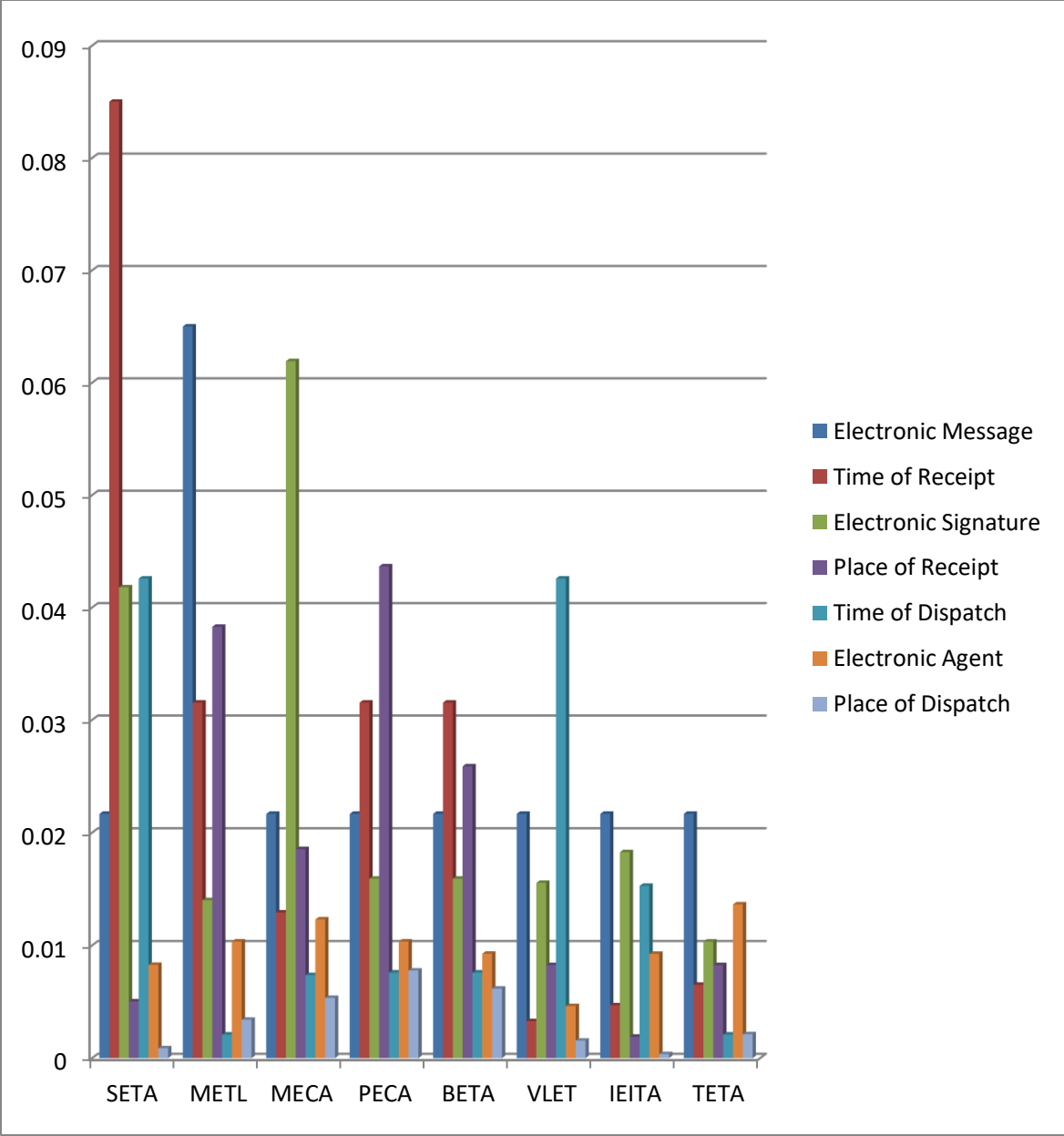


Figure 13

Rates of ASEAN ECAs in all criteria

5. Conclusions and Future Work

There are various considerations, such as time and place for the evaluation of ECAs, with respect to the electronic contracts. In investigating these considerations, we established the procedures for identifying the most important attributes of the e-commerce Acts. Since the characteristics of electronic contracts are the main concern in the ECAs, we focused on it for our evaluation. We captured the experts' assessment on these ECAs based on the said attributes.

The evaluation procedure consists of the following steps: i) determination of the evaluation criteria for ECA; ii) obtaining the importance of each criterion by Fuzzy AHP according to all of the experts' opinion; iii) representing the evaluation of ASEAN ECAs for each criterion by Fuzzy AHP. Fuzzification of assessors' responses has captured their real preference accurately.

The individual assessments were aggregated as an overall assessment for each country under each criterion. We employed the fuzzy set theory for the fuzzification of AHP to deal with uncertain and subjective data, and the environment.

In traditional legal research, the evaluation of Acts is not structured. To the best of our knowledge, quantitative strategies have not been used for the evaluation and comparison of the Acts. In this paper, we used the Fuzzy AHP and the concept of hierarchical structure to make the pairwise comparison among elements.

In the AHP method, where there are many elements, the long investigation time causes the interviewees to feel impatient and inconsistency increases. However, in this research the number of determined criteria and the ASEAN ECAs is less than ten; therefore, applying Fuzzy AHP is not only permissible with a lower inconsistency index, but it is significant due to constructing pairwise comparison and structured evaluation.

In this study, using the membership function to measure the linguistic variables can exactly reflect the experts' opinions. Therefore, the fuzzy logic, thinking and results of the fuzzy approach are better than the traditional MCDM approach.

The results consist of the weighting of each criterion, ranking of ECAs in each criterion and the final ranking on overall comprehensiveness of the ASEAN ECAs. The results show that the recognition of the Electronic Message (EM) with a weight of 0.216684 is the most important criterion followed by TR, ES, PR, TD, EA and PD. These results suggest the direction for the improvement and unification of ECAs.

The legislators should also be more committed to an improvement of the legislation and be alert on the implication of poor legislation in e-commerce laws. SETA stood in first place among all the ASEAN ECAs with a rate of 0.2052 followed by METL, MECA, the PECA, BETA, VLET, IEITA and TETA, respectively.

The significant findings of this study cover several perspectives. The ECAs that have followed the UNCUEC in drafting TD and TR rules, rated in the higher level. However, as the majority followed the MLEC, those that followed the MLEC provisions accurately or improved its principles, obtained a significant rate. The findings suggest that the integration of MLEC and UNCUEC resulting in a unified electronic commerce regulation would be more comprehensive if taking into account the recent technological developments.

The achieved results could provide a reference guide in the said legal harmonization process or for future amendments of the present ECAs. This would be in line with the ASEAN regional economic integration mission and the ASEAN Economic Community (AEC) scheme.

The harmonization of ECAs among ASEAN countries will increase the number of online transactions affecting the traders' trust. Subsequently, the number of related legal disputes will reduce. Furthermore, it would be a reference to harmonize related commercial laws in the region to support economic integration. The evaluation of ASEAN ECAs would play a significant role to help legislators to provide a unified e-commerce law at the regional level.

This study has a few limitations. Firstly, our survey respondents were chosen from academic members of the Malaysian universities due to the difficult process of approaching legislators of ASEAN member states. Therefore, the results represent the preference of academic lawyers. Secondly, two countries are not involved because Laos lacks any English translation of its ECA

and Cambodia has no law in place. Future research should prepare a unified academic draft on ECA for the ASEAN region considering other related criteria that is compatible with new technological advancements and new commercial needs.

References

1. Eberle, E.J., *The Method and Role of Comparative Law*. Wash. U. Global Stud. L. Rev., 2009. **8**: p. 451.
2. Opricovic, S. and G.-H. Tzeng, *Compromise solution by MCDM methods: A comparative analysis of VIKOR and TOPSIS*. European Journal of Operational Research, 2004. **156**(2): p. 445-455.
3. Bozdağ, C.E., C. Kahraman, and D. Ruan, *Fuzzy group decision making for selection among computer integrated manufacturing systems*. Computers in Industry, 2003. **51**(1): p. 13-29.
4. Patton, M.Q., *Qualitative research*. 2005: Wiley Online Library.
5. Kahraman, C., U. Cebeci, and Z. Ulukan, *Multi-criteria supplier selection using fuzzy AHP*. Logistics Information Management, 2003. **16**(6): p. 382-394.
6. Bellman, R.E. and L.A. Zadeh, *Decision-Making in a Fuzzy Environment*. Management Science, 1970. **17**(4): p. B141-B164.
7. Calabrese, A., R. Costa, and T. Menichini, *Using Fuzzy AHP to manage Intellectual Capital assets: An application to the ICT service industry*. Expert Systems with Applications, 2013. **40**(9): p. 3747-3755.
8. Kutlu, A.C., H. Behret, and C. Kahraman, *A Fuzzy Inference System for Multiple Criteria Job Evaluation Using Fuzzy AHP*. Journal of Multiple-Valued Logic and Soft Computing, 2014. **23**(1-2): p. 113-133.
9. Shaverdi, M., et al., *Developing sustainable SCM evaluation model using fuzzy AHP in publishing industry*. First International Conference on Information Technology and Quantitative Management, 2013. **17**: p. 340-349.
10. Tadic, D., et al., *An evaluation of quality goals by using fuzzy AHP and fuzzy TOPSIS methodology*. Journal of Intelligent & Fuzzy Systems, 2013. **25**(3): p. 547-556.
11. ASEAN. *Overview*. September 8, 2014]; Available from: <http://www.asean.org/asean/about-asean/overview>.
12. ASEANstats, *Selected Basic ASEAN Indicators (Table 1)*. 15 August 2014, ASEAN Secretariat: Jakarta, Indonesia.

13. Ministers, A.F., *ASEAN Declaration (Bangkok Declaration)*. 8 August 1967, ASEAN Secretariat.
14. ASEAN Leaders, *ASEAN ECONOMIC COMMUNITY BLUEPRINT*. 2007, ASEAN Secretariate.
15. UNCTAD, *Study on Prospects for Harmonizing Cyberlegislation in Central America and the Caribbean*. 2011, UNCTAD United Nations: Geneva. p. i-81.
16. UNCTAD, *Harmonizing Cyberlaws and Regulations: the Experience of East African Community*. 2012, UNCTAD United Nations: Geneva. p. i-58.
17. UNCTAD, *Review of e-Commerce Legislation Harmonization in the Association of Southeast Asian Nations*. 2013, UNCTAD United Nations: Geneva. p. i-58.
18. ASEAN, *E-ASEAN Refrence Framework for Electronic Commerce Legal Infrastructure*. 2001, ASEAN Secretariat: Jakarta, Indonesia.
19. Saaty, T.L., *The analytic hierarchy process: Planning, priority setting, resource allocation* McGraw-Hill International Book Co. New York and London, 1980.
20. Lin, C.T. and C.S. Wu, *Selecting a marketing strategy for private hotels in Taiwan using the analytic hierarchy process*. Service Industries Journal, 2008. **28**(8): p. 1077-1091.
21. Albayrak, E. and Y.C. Erensal, *Using analytic hierarchy process (AHP) to improve human performance: An application of multiple criteria decision making problem*. Journal of Intelligent Manufacturing, 2004. **15**(4): p. 491-503.
22. Todd, P., *E-Commerce Law*. 2006, Oxon: Routledge-Cavandish.
23. Hedley, S., *The Law of Electronic Commerce and the Internet in the UK and Ireland*. 2007, Abingdon, Oxon: Routledge-Cavandish.
24. Maggs, G.E., *Regulating Electronic Commerce*. The American Journal of Comparative Law, 2002. **50**: p. 665-685.
25. Martin, C.H., *UNCITRAL Electronic Contracts Convention: Will It Be Used or Avoided, The*. Pace Int'l L. Rev., 2005. **17**: p. 261-300.
26. Tan, H.S.K., *ELECTRONIC TRANSACTIONS REGULATION — SINGAPORE: THE IMPACT OF THE SINGAPORE ELECTRONIC TRANSACTIONS ACT ON THE FORMATION OF E-CONTRACTS — PART II*. Computer Law & Security Review, 2002. **18**(5): p. 345-351.

27. Tan, H.S.K., *ELECTRONIC TRANSACTIONS REGULATION — SINGAPORE*. Computer Law & Security Review, 2002. **18**(4): p. 272-277.
28. Chong Kah, W. and J. Chao Suling, *United Nations Convention on the Use of Electronic Communications in International Contracts-A New Global Standard*. SAclJ, 2006. **18**: p. 116-202.
29. UNCITRAL, *UNCITRAL Model Law on Electronic Commerce with Guide to Enactment 1996 with Additional Article 5 bis as Adopted in 1998*, U. Nations, Editor. 1999, United Nations Publication: New York.
30. Wang, J.J. and D.L. Yang, *Using a hybrid multi-criteria decision aid method for information systems outsourcing*. Computers & Operations Research, 2007. **34**(12): p. 3691-3700.
31. Zadeh, L.A., *Fuzzy sets*. Information and Control, 1965. **8**(3): p. 338-353.
32. Buckley, J.J., *Fuzzy hierarchical analysis*. Fuzzy Sets and Systems, 1985. **17**(3): p. 233-247.
33. van Laarhoven, P.J.M. and W. Pedrycz, *A fuzzy extension of Saaty's priority theory*. Fuzzy Sets and Systems, 1983. **11**(1-3): p. 199-227.
34. Oenuet, S., T. Efindigil, and S.S. Kara, *A combined fuzzy MCDM approach for selecting shopping center site: An example from Istanbul, Turkey*. Expert Systems with Applications, 2010. **37**(3): p. 1973-1980.
35. Zimmermann, H.J., *Fuzzy set theory--and its applications*. 2001: Springer.
36. Chen, C.T., *Extensions of the TOPSIS for group decision-making under fuzzy environment*. Fuzzy Sets and Systems, 2000. **114**(1): p. 1-9.
37. Chiou, H.-K. and G.-H. Tzeng, *Fuzzy hierarchical evaluation with grey relation model of green engineering for industry*. International Journal of Fuzzy Systems, 2001. **3**(3): p. 466-475.
38. Hsieh, T.-Y., S.-T. Lu, and G.-H. Tzeng, *Fuzzy MCDM approach for planning and design tenders selection in public office buildings*. International journal of project management, 2004. **22**(7): p. 573-584.

39. Mon, D.-L., C.-H. Cheng, and J.-C. Lin, *Evaluating weapon system using fuzzy analytic hierarchy process based on entropy weight*. Fuzzy sets and systems, 1994. **62**(2): p. 127-134.