# EVALUATION OF CRITERIA FOR ONLINE FOOD DELIVERY SERVICES IN MALAYSIA BY USING AN IMPROVED CONSISTENT FUZZY PREFERENCE RELATION (i-CFPR)

**Nur Elinda Izzati Ariffin**[1], **Nor Farah Izzaty Nordin**[2] **and Norhidayah A Kadir**[3*]

*Department of Mathematics, Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor*

[1]2019685528@student.uitm.edu.my , [2]2019207696@student.uitm.edu.my,

[3*]norhidayah@tmsk.uitm.edu.my

*(* indicates the corresponding author)*

## ABSTRACT

*Online food delivery (OFD) services is one of the important industries in Malaysia and the acceptance of OFD services in countries over the past year has been seen and well received. However, there are many complaints and comments in websites and OFD applications related to services provided by the companies. Hence, this study will evaluate the criteria of OFD services in Malaysia using a method proposed by Kamis et al. (2010) which is an improved Consistent Fuzzy Preference Relation (i-CFPR). A questionnaire pertaining to four main criteria followed by the sub-criteria is developed and distributed among students at Universiti Teknologi MARA (UiTM) Shah Alam. Based on the results, the criteria that OFD companies need to improve the most is economic (C1), followed by technology (C2), then service quality (C3) and social and environmental (C4). The most significant sub- criteria of C1 is delivery cost (C11), operational capability (C12) and risk management (C13). For C2, applications design (C21) is the most important sub-criteria, followed by real-time tracking system (C22) and the marketing techniques. Then, the ranking for sub- criteria of C3 that need to be improved the most is order fulfilment (C31), delivery speed (C32), convenience of payment (C33), online service level (C34), offline service level (C35) and the customer feedback (C36). Lastly, for sub-criteria C4 is health and safety (C41), information security (C42) and environmental impact (C43). From the result obtained, the objectives is to evaluate criteria for online food delivery services in Malaysia has been established. Then, the objective to rank the most effective criteria that contribute to OFD services by using an improved Consistent Fuzzy Preference Relations (i-CFPR) and to analyse the result obtained from i-CFPR achieved successfully. To obtain more precise findings, the sample size can be extended to include all Malaysian people.*

**Keywords***: i-CFPR, FMCDM, Online food delivery.*

Received for review: 07-09-2022; Accepted: 21-09-2022; Published: 01-11-2022

## 1. Introduction

Nowadays, an online food ordering platform where food and beverages businesses get to stay connected with customers is called food delivery marketplace. Traditionally, customers purchase through 'conventional' modes of order visiting food outlets in-person or contacting food outlets directly to place orders before collection or delivery. With the help of the internet, the online business has become viable and popular for online food delivery (Chong et al., 2012). Now, customers can place orders through a selected online platform where the orders will be forwarded to food outlets to be cooked, and once ready, meals are delivered to customers by couriers working for the food outlet or the online food delivery service and get their craving delivered to their front door. Customers will be charged a flat delivery fee based on the restaurant distance from the customer place.

Dazmin and Ho (2019) stated that there are two types of food delivery service providers in Malaysia which are retailers themselves and restaurant intermediaries. The first type is they own and run their fast food chain where food is ordered online through website or mobile application and delivered directly by the restaurant. The examples of retailers are Kentucky Fried Chicken (KFC), Pizza Hut and Domino's Pizza. The second type is to provide delivery services for a large range of restaurants by appointed companies such as FoodPanda, GrabFood, DahMakan and more. Consumers who use a food delivery application or website can compare costs from many websites and select the best deal for them. This is because the applications allow people to compare prices. As a result, it gives important information for online buyers looking to purchase products at a lesser cost (Moshrefjavadi et al., 2012) while maintaining high service quality (Doherty & Ellis-Chadwick, 2010).

In terms of technology, an online food delivery (OFD) mobile application is a clever and efficient channel that allows mobile phone users to buy from and pay for a range of restaurants, the food is frequently delivered to customers' doorsteps without any face-to-face interaction with others (Chotigo & Kadono, 2021). OFD applications, in particular, provide a variety of services, including providing users with a variety of food selections, collecting orders and transferring them to the food producer, monitoring payment, scheduling food delivery, and providing tracking features (Tran, 2021).

However, even though online food delivery service makes someone's life easier, there are some problems that are often encountered. Customers lodge complaints at the company's website or mobile application about the services provided by a food delivery company. For instance, customers complain that the OFD companies raise food prices excessively compared to the original price when dining at the restaurant. Hong, Li and Wang (2016) stated that some businesses intentionally raise the price of food just to make more profit. Then, customers also complain about the service quality. A study about technical requirements for improving OFD services in Indonesia by Elvandari et al. (2018) stated that the top priority that needs to be upgraded is service quality which include order fulfilment and delivery speed.

There are several criteria that may be taken into account when evaluating OFD companies, however this research will only be focusing on four of them which are economic, technology, service quality and social and environmental (Nguyen et al., 2021).The first and foremost criteria is economic. The sub-criteria was categorised into three which are delivery cost, operational capability and risk management. A study was conducted to improve the price associated with the food delivery service which include cost of the orders, cost of the transport and additional taxes has a significant impact on the food-delivery consumers' perception of reputation (Dospinescu et al., 2020). The findings show that the price largely affected

perception of customers to use OFD services. As for conclusion, under this main criteria of economic the sub-criteria chosen are delivery cost, operational capability and risk management used for this study.

The second criteria is technology which has three sub-criteria under it namely applications design, real-time tracking system and marketing techniques (Nguyen et al., 2021). With the advent of technology such as food delivery applications, it is easier for customers to get information about food ordered. For instance, with the real-time tracking system customers can easily track the rider's location. In terms of marketing techniques, OFD companies need to be more creative to attract more customers. Social media such as Instagram and Tiktok can be used as a platform to advertise about the service provided since there are some OFD services that do not get the attention of customers especially in rural areas. To conclude, under this main criteria of technology the sub-criteria chosen are applications design, real-time tracking system and marketing techniques used for this study.

Next criteria is service quality. The sub-criteria are order fulfilment, delivery speed, convenience of payment, online service level, offline service level and customer feedback (Nguyen et al., 2021). A study was conducted to know about factors in service quality that influenced the consumer to use OFD (Yusra & Agus, 2018). The results of the study suggest that service quality is positively related to customer loyalty. In addition, another study done by Mat Nayan and Hassan (2020) on customer satisfaction resulted in respondents satisfied with the service provided by FoodPanda and GrabFood because it is faster and delivery time is equitable. The latter study, Ghosh and Saha (2018) used the statistical technique ANOVA to assess the relationship between demographic factors of clients and online food companies, as well as the influence of the e-transaction processing system in the field, in a study of e- payment systems on the OFD industry. The result of the study stated that customers prefer to use e-payment because payment is secured and their personal data are safe. As for conclusion, under this main criteria of service quality the sub-criteria chosen are order fulfilment, delivery speed, convenience of payment, online service level, offline service level and customer feedback used for this study.

The last criteria is social and environment. The criteria was categorised into three sub-criteria which are health and safety, information security and environmental impact (Nguyen et al., 2021). Al Amin et al. (2021) defined the term “food delivery hygiene” related to the riders’ ability to keep the food safe and clean. The quality of the food served will determine whether the restaurant maintains their hygiene and sanitation or vice versa. Major problems in food hygiene are not only in the kitchen but it is also including food delivery stages (Chandrasekhar et al., 2019). Riders should take care of personal hygiene and the cleanliness of the delivery box so that customers will tend to use OFD when they are enthused about the cleanliness provided. As for conclusion, under this main criteria of social and environmental the sub-criteria chosen are health and safety, information security and environmental impact used for this study.

There are several ways to assess the criteria that are most important in evaluating OFD companies in Malaysia. Fuzzy theory is highly useful in dealing with the fuzziness of human judgement, according to Gong et al. (2010). Numerous inputs and outputs must be taken into account in order to achieve the optimal result. Multiple criteria decision-making (MCDM) is a branch of operations research that deals with developing computational and mathematical tools to aid decision-makers in subjectively evaluating performance criteria (Zavadskas et al., 2014). In the actual world, decision-making issues are inherently unpredictable in a variety of ways. Lack of knowledge might cause the system's future state to be uncertain. Probability theory and statistics have been used to address this ambiguity. Natural language is frequently used to

communicate ideas and subjective impressions in numerous circumstances of daily life for assessment, judgement, and decision. Words may not have a clear and well-defined meaning in these natural languages. As a result, when the term is employed as a set label, the borders of the set to which objects belong or do not belong become fuzzy. Furthermore, even when individuals use the same words to judge an event, their judgments may differ greatly since each of them has a different subjective view or personality. To address this issue, fuzzy numbers are used to aid in the accurate expression of linguistic variables. Because investors frequently assess investment plans based on their own subjective preferences in terms of numerical values from several criteria, this scenario is best referred to as a Fuzzy Multiple Criteria Decision-Making (FMCDM) problem.

Numerous FMCDM approaches have been offered in the literature throughout the years, with differences in areas such as the type of questions asked, theoretical foundation, and type of answers obtained. Many approaches have been developed for a specific proble and are hence inapplicable to other problems. Recently, a variety of FMCDM approaches for selecting the optimal compromise solutions have been presented. The FMCDM approaches were developed not only as a result of motivation from various real- world problems requiring the consideration of multiple criteria, but also from practitioner's desire to improve decision-making techniques by leveraging recent advances in computer technology, scientific computing and mathematical optimization (Wiecek et al., 2008). The goal of all strategies is to make the decision-making process more informed and codified. FMCDM has been categorised into numerous fields and approaches in a number of earlier research (Baležentis et al., 2010). Options are sorted and selected from a list of feasible alternatives in the fuzzy MCDM approach. The nature of FMCDM problems varies, thus a number of strategies have been presented as solutions. Complete aggregation methods were the first to be proposed. For example, WASPAS (Zavadskas et al., 2012), MOORA (Brauers & Zavadskas, 2006) and MAUA (Keeney & Raiffa, 1976). Furthermore, the AHP and ANP relies on the pairwise comparison (Saaty, 2003).

Wang and Chen (2007) employ consistent fuzzy preference relations (CFPR) in a study on choosing a partnership using CFPR. The researcher first employed the Fuzzy Preference Programming (FPP) approach suggested by Mikhailov (2002) before utilising CFPR. Because certain choice criteria are subjective and qualitative, several decision makers found it difficult to categorise the criteria they wanted from their partner in this study. However, CFPR gave the decision-maker the opportunity to assign values to the options and criteria that were chosen. The value given by the decision maker, which indicates how much they favour the first choice over the second, suggests that the first alternative is more significant than the second since it has a greater value. According to Wang and Chen (2007), the CFPR technique is more practical and offers a ranking of several alternatives to decision-making difficulties.

Additionally, commercial banks might utilise CFPR to choose merger strategies in a changing financial climate. Six primary criteria which are management performance, customer orientation, financial analysis, worker rights and interests, government policy, and risk management included in a research by Wang and Lin (2009). Twelve stakeholders were polled for this study in order to determine how they prioritised the goals and evaluation standards. The study came to the conclusion that risk management is the most crucial factor banks take into account when choosing merger strategies. Therefore, in order to prevent misleading solutions, it is crucial, according to Herrera-Viedma et al. (2004), to analyse consistency when the decision makers present their viewpoints. It is for this reason that the researcher presented a new characterisation of the consistency property, which is characterised by the additive

transitivity property of the fuzzy preference relations from a collection of n-1 preference data. In this study, it was presupposed that the expert's choices were predetermined across a limited number of options. The outcome is better when CFPR is used, and inconsistent solutions are avoided during the decision-making process.

Kamis et al. (2010) provide an improved CFPR (i-CFPR), which modifies Wang and Chen (2006) study, for a better decision-making process. Using triangular fuzzy integers as input values, Wang and Chen (2006) conducted a study on the selection of computer-integrated manufacturing (CIM) systems. But as the calculation progresses, inconsistent situations are more likely to appear. Because of this, Kamis et al. (2010) employed the centroid-index technique developed by Chen and Chen (2003) to defuzzify the fuzzy integers in their research. The ultimate ranking of alternatives is likewise determined using the centroid formula. The construction of the evaluation matrix using a novel method created by combining the centroid-index formula with the CFPR is stated to be more straightforward while still producing accurate and reliable results. The study demonstrated that the suggested technique was capable of rating alternatives and criteria in a systematic manner with a consistent ranking order.

The acceptance of OFD services in countries has been visible. However, there are many complaints and comments in websites and OFD applications related to services provided by the companies. From this situation, the scene where Food and Beverages (F&B) business owners take advantage of the high-demand online food ordering competitive food delivery has appeared. As such, it is necessary to run a study where online food delivery providers need to understand their clients' needs and requirements as well as the pertinent aspects that are important and relevant to the industry. In response to this problem, the i-CFPR method has been used to evaluate the customers' preference on OFD services. By using this method, online food delivery providers will know the most important criteria that customers look for. Based on the result obtained, some initiatives can be done to make sure the services provided are excellent and no problem in the future.

In the process, factors influencing the evaluation of OFD services in Malaysia are identified. Next, an improved consistent fuzzy preference relation (i-CFPR) is used to rank the most effective factors that contribute to OFD services. Lastly, the result obtained from i-CFPR was analysed. By identifying the criteria that might affect the sustainable OFDs, hopefully improvement can be made to the OFD services. The scope of this study involved 100 respondents from students in UiTM Shah Alam and the company involved is a company who joined the industry for the past five years.

## 2. Methodology/Implementation

In general, the research will be conducted with evaluating and describing sustainable OFDs based on the applicable criteria. The evaluation of OFDs will be using an improved method by Kamis et al. (2010). The implementation will exist in i-CFPR on comparing the criteria for main and sub criteria.

### 2.1 Main criteria and Sub-criteria Ranking Determination using i-CFPR

The linguistic variables for criteria will be represented by trapezoidal fuzzy numbers. The fuzzy linguistic variables are used in evaluating respondent references.

**STEP 1:** Set the input values in terms of linguistic variables. The input values will be represented as a fuzzy scale.

**Table 1:** The fuzzy linguistic variables for criteria

| **Linguistic Variable** | **Fuzzy Scales** |
|---|---|
| Equally important | <1,1,1,1> |
| Between equally and weakly important | <1,1,2,3> |
| Weakly important | <2,3,3,4> |
| Between weakly and strongly important | <3,4,4,5> |
| Strongly important | <4,5,5,6> |
| Between strongly and very strongly important | <5,6,6,7> |
| Very strongly important | <6,7,7,8> |
| Between very strongly and absolutely important | <7,8,8,9> |
| Absolutely important | <8,9,9,9> |

**STEP 2:** Transform the data from the questionnaire to the collective decision matrices based on the maximum number of preferences from the respondents.

**STEP 3:** Determine the center points of fuzzy numbers using centroid-index formula by Chen and Chen (2003).

Centroid-index method has been used to determine the center point of fuzzy numbers. Let $A = (a, b, c, d, w)$ be a generalized trapezoidal fuzzy numbers in the universe X, where $w \in [0,1]$ represents the height of $A$ and $a, b, c$ and $d$ are real values.

$$\overline{y_0} = \begin{cases} \frac{w \times \left[\left(\frac{c-b}{d-a}\right)+2\right]}{6}, & a \neq d \text{ and } 0 < w \leq 1 \\ \frac{w}{2}, & a = d \text{ and } 0 < w \leq 1 \end{cases} \quad (1)$$

$$\overline{x_0} = \frac{\overline{y_0}(b+c)+(d+a)(w-\overline{y_0})}{2w} \quad (2)$$

**STEP 4**: Transform the centroid point ($\overline{x0}$, $\overline{y0}$) into a single value by using the distance formula.

$$d(\overline{x_0}, \overline{y_0}) = \sqrt{(\overline{x_0})^2 + (\overline{y_0})^2} \quad (3)$$

**STEP 5:** Normalize the coefficient value that represents the distance of the centroid point in the form of i-CFPR.

**STEP 6:** Construct the decision matrix based on i-CFPR by using Proposition 1, 2 and 3 given below.

**Proposition 1:**

Consider a set of alternatives, $X = \{x_1, \ldots, x_n\}$, and the associate reciprocal multiplicative preference relation $A = (a_{ij})$ for $a_{ij} \in [\frac{1}{9}, 9]$. Then, the corresponding reciprocal fuzzy preference relation $p = (p_{ij})$ with $p_{ij} \in [0,1]$ associated with $A$ is given by

$$p_{ij} = g(a_{ij}) = \frac{1}{2}(1 + \log_9 a_{ij}) \quad (4)$$

Generally, if $a_{ij} \in [\frac{1}{n}, n]$, then $\log_n a_{ij}$ is used in particular, when $a_{ij} \in [\frac{1}{9}, 9]$; $\log_9 a_{ij}$ is considered as in above proposition.

**Proposition 2:**

For a reciprocal fuzzy preference relation $\tilde{P} = (p_{ij})$, the following statements are equivalent:

$$P_{ij} + P_{jk} + P_{ki} = \frac{3}{2}, \qquad \forall i, j, k$$

$$P_{ij} + P_{jk} + P_{ki} = \frac{3}{2}, \qquad \forall i < j < k$$

**Proposition 3:**

For a reciprocal fuzzy preference relation $\tilde{P} = (p_{ij})$, the following statements are equivalent:

$$P_{ij} + P_{jk} + P_{ki} = \frac{3}{2}, \qquad \forall i < j < k$$

$$P_{i(i+1)} + P_{(i+1)(i+2)} + \cdots + P_{j-1} + P_{ji} = \frac{j-i-1}{2}, \qquad \forall i < j$$

If some of the entries are not in the interval [0,1], construct the transformation matrix by using Proposition 4. Otherwise, this step can be omitted.

**Proposition 4:**

If the preference matrix contains any values that are not in the interval [0,1] , but are in an interval [-a, 1+a], a>0, then to preserve the reciprocity and additive transitivity, that is $f: [-a, 1+a] \rightarrow [0,1]$, the consistent fuzzy preference relation is obtained as:

$$f\left(p_{ij}^{k}\right) = \frac{p_{ij}^{k}+a}{1+2a} \tag{5}$$

**STEP 7:** Compute the average value of criteria, $A_i$ by using

$$A_i = \frac{\sum_{j=1}^{n} p_{ij}}{n}; i = 1,2,3, \ldots, n \tag{6}$$

**STEP 8:** Normalize criteria weight, $W_i$ by using

$$W_i = \frac{A_i}{\sum_{i=1}^{n} A_i} \tag{7}$$

**STEP 9:** Rank the criteria in descending order based on weights obtained.

**STEP 10:** Repeat STEP 1 to STEP 9 for all sub-criteria

## 3. Results and Discussion

In this study, an improved Consistent Fuzzy Preference Relations (i-CFPR) to rank the criteria and sub-criteria for evaluation of online food delivery has been used. The result of this study is from 100 respondents of UiTM Shah Alam's students.

The result of ranking the main criteria is economic (C1)≻technology (C2) ≻service quality (C3) ≻social and environment (C4). The results show that C1 is the most important criteria for respondents in OFD services. As the COVID-19 pandemic began to pose an existential threat to restaurants, OFD services became a saving grace which helped in economic growth of the country and a family. Economic growth leads to increased profitability for companies, enabling more spending on research and development which can lead to technological breakthroughs. Also, sustained economic growth increases confidence and encourages companies to take risks and innovate. The second important main criterion is C2. Technology is the key to a successful online food delivery service and it provides many benefits including capabilities to find information about deliverable food in the desired region, as well as the convenience of ordering and paying for food once the application was installed on a device. Based on the result obtained, C3 is the third significant main criteria. Customers always perceive a company's services as being high quality and are more likely to do business with that company. Also, customers who buy from companies with high service quality are more likely to continue buying from those companies regularly. Lastly, the least important main criteria is C4. Customers do not view this as important even though this matter is very close to oneself and aware of the environmental impact.

The rank of sub-criteria of C1 are delivery cost (C11) ≻ operational capability (C12) ≻risk management (C13). For sub-criteria of C1, the most important criteria is delivery cost (C11). From the results obtained, the respondents consisting of students are very serious about the cost of delivery. This is because the delivery costs charged for a delivery service are different and significant. The total food price charged including delivery costs may be higher than the price charged if the customer physically purchases the food to the restaurant. This can be overcome if the cost of delivery is reduced or the provision of free vouchers for food delivery. Therefore, students or other customers will continue to use the food delivery service instead of going out to buy food in the restaurant which takes more time while that time can be filled by completing other tasks. The least important criteria for this criterion is C13 which is risk management. Risk management is not important to students since they only need to buy food that is affordable to them.

Next, the ranking for sub-criteria of C2 is applications design (C21) ≻ real-time tracking system (C22) ≻ marketing techniques (C23). The most important sub-criteria is application design (C21). Intended applications design includes update-to-date platform, page visual effects, user-friendly. The page visual effects and user-friendly are important because through the application can attract more users, especially among teenagers and adults. The delivery application should be simple and easy to use. The function of the buttons in the application should be more clear so that errors such as the location of residence, the type of food ordered and most importantly the online payment do not occur. User friendly is not only important to the customer but also to the riders as there are cases that result in the delivery of food elsewhere. For the least important subcriteria of criterion C2 which is marketing techniques (C23), the advertising efforts that companies of online food delivery provide are

easier to find because it is not only shown in social media but any discount or voucher can be searched directly to the google.

Then I-CFPR also find the rank of sub criteria for C3 where the order fulfilment (C31) ≻ delivery speed (C32) ≻convenience of payment (C33) ≻online service level (C34) ≻offline service level (C35) ≻customer feedback (C36). C3 or service quality will help the owner of the company to boost the sales. C31 in terms of order taking time and cleanliness of food packaging is highly emphasised by customers. Packaged food hygiene consists of proper packaging containers and practising best hand hygiene when preparing food for customers. Food must be packaged in suitable packaging materials that can last throughout the delivery period. As we know there are some stores that use paper packaging and cause leaks or tears when not handled properly and also become wet due to melted food after a long period of time. This can lead to significant food contamination and safety risks. Besides, while handling food packages especially to students, riders and those who handle food should frequently wash or sterilise their hands. In order to prevent the spread of germs, they should also wash their hands after each and every delivery. C33 is in the middle of the ranking for service quality . At UiTM Shah Alam, there are some students who have used the cashless method because cafes and shops in campus allow students to pay online or cash transactions. Because of that, this causes students to have the courage to do online banking or in cash during the food purchase process through food delivery applications. The least important is C36 which is customer feedback. This sub-criteria is least important to students because usually students will buy food from the same restaurant or restaurant they used to dine in. Online reviews or online rating is not important to them because everyone has different tastes in food. So it will not give a big impact to students but it will give a big impact to the restaurant to fix weaknesses in terms of quality service.

For C4, there are a few sub-criteria, namely health and safety (C41), information study (C42) and environmental impact (C43). For single-use packaging in food delivery is a contributor to solid waste because during the food ordering process the type of food container by each store is not specified in the application. Disposable containers will make customers' daily life easier because they do not have to do housework like washing dishes. Customers seldom think about how food and food-related wastes are produced, and many do not consider keeping leftover food for future meals or think to reuse the meal boxes, plastic bags or disposal chopsticks. Therefore, we cannot take it as an important criteria that contributes to OFD services.

## 4. Conclusion and Recommendations

This research reported about the evaluation of online food delivery (OFD) companies by using the selected criteria. Moreover, the first objectives of this study are to evaluate criteria for online food delivery services in Malaysia has been established. The main criteria that has been evaluated are economic, technology, service quality and social and environment. For economic, the sub-criteria involved are delivery cost, operational capability and risk management. Next, technology involved applications design, real-time tracking systems and marketing techniques. Moreover, order fulfilment, delivery speed, convenience of payment, online service level, offline service level and customer feedback are sub-criteria for service quality. Lastly, the sub-criteria for social and environmental include health and safety, information security and environmental impact.

The second objective is to rank the most effective criteria that contribute to OFD services by using an improved Consistent Fuzzy Preference Relations (i-CFPR) achieved successfully. The result shows that the most important main criteria is economic, followed by technology, service quality and social and environmental. The most significant sub- criteria for economic, technology, service quality and social and environmental are delivery cost, applications design, order fulfilment and health and safety respectively. The obtained results from this research can be utilised as a guideline for the OFD companies to make improvements in the services offered. The criteria that were chosen for this study's research will assist OFD companies in the future as they deal with a variety of issues and challenges that will help them perform better and draw in more customers. Lastly, analysis of results by using i-CFPR was achieved.

The scope of the research can be extended to include all Malaysian people. Then, to obtain more precise findings, the sample size can also be increased. In the future, there will be more criteria that will contribute to evaluating the OFD companies. However, the questionnaire we used for this study, which is displayed in Appendix A, is solely appropriate for this study. As a result, the questionnaire's content can be improved in the future so that it will be reliable and appropriate for certain case studies.

**Acknowledgement**

The authors would like to thank to Department of Mathematics, Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA for supporting this project.

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