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Article

Performance Evaluation of Operational Activities in Logistics Functionality Using F-DEMATEL and F-TOPSIS Approach

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Abstract: Logistics plays a significant role in the economy with its main contribution to the gross domestic product (GDP) of many countries. In highly developed countries, logistics costs compared to their GDP range between 8 and 10%. As globalization of trade develops, the importance of improving logistics' active efficiency is essential for any business enterprise to gain a competitive advantage. Many scholars have so far made great efforts to study logistics functionality, and a large number of relative literature on basic logistics activities of transportation, warehousing, and inventory have been published. Unfortunately, past studies on logistics operational activities are mostly categorized as single research themes of basic logistics activities. Few studies comprehensively considered basic and value-adding activities with entire logistics operational activities. Therefore, for typical multi-criterion decision-making (MCDM), the F-DEMATEL technique is adopted for evaluating the crucial performance indicators of time, cost, quality, service, and innovation to improve the reliability of expert evaluations under uncertain environments in this study. Also, the F-TOPSIS technology is used to calculate all alternatives to help decision-makers develop appropriate operational activities of logistics management. The study result identifies 13 important operational activities of logistics functionality. Besides, the data from a case study of the elite interview is used for validation. The F-DEMATEL is used to obtain the weights of the core criteria. The importance of critical weighted indicators from the F-DEMATEL calculation show "Service" > "Cost" > "Quality" > "Time" > "Innovation". In addition, the F-TOPSIS is used to prioritize critical activities in logistics functionality. The ranking of the critical basic activities demonstrates that "Transportation/ Distribution" is the most critical logistic activity, followed by "Information" and "Pick and Pack". Also, the ranking result of the critical value-adding activities shows that "Consignment Stock" is the most critical value-adding activity, followed by "Returns and Quality Control" and "Repair and Maintenance". Therefore, the logistics managers give priority to the formulation of improvement management based on these ranks. The proposed suggestions of evaluating methods of F-DEMATEL and F-TOPSIS, important 13 crucial activities of logistics, evaluating indicators of logistics activity, and ranks of crucial activities in logistics functionality, thus, make up for a deficiency in previous research that lacks an empirical analysis of the crucial operational activities in logistics functionality.

Keywords: Performance evaluation, Logistics functionality, Value-adding activities, F-DEMATEL technique, F-TOPSIS approach

1. Introduction

Logistics plays a significant role in the economy, for it is one of the main contributors to the gross domestic product (GDP), especially in developing countries. For example, Thailand's logistics costs reach even as much as 20% of its GDP. In highly developed countries, such as the United States, the proportion is up to 7.7%. Meanwhile, logistics costs range between 8 and 10% in most countries of the Organization for Economic Co-operation and Development (OECD) (Liu, 2016). Logistics functionality plays an important role in operational activities in creating economic values for customers and suppliers of the firm, including the firm's stakeholders as well (Ballou, 1997). The value or usefulness comes from the fact that a customer can take possession of a product through Omni-channel physical distribution (Ishfaq et al.,2016), including the requisite operational activities in logistics functionality, which enables the products to be available when/ where they are needed at the right time and the right place in the desired condition (Ishfaq et al.,2016). Therefore, the digital transformation and adoption of the latest technological advancements have become necessary for logistics providers who aim to significantly improve their activities in the communication era (Borgi et al., 2017).

For example, the radio frequency (RF) device is used to improve the productivity of the order-picking process by using robotic picking. Omni-channel retailing is used to provide customers with a seamless shopping experience regardless of the sales channel. Big-box retailers provide large amounts of floor space and products for sale such as Walmart, Carrefour, and Dick's Sporting Goods (Paul, 2018). As globalization of trade develops, free trade is encouraged and tariffs are being eliminated. Thus, the free flow of goods across political boundaries becomes easier than ever before among countries (Ballou, 1997). People realize that improving operational active efficiency and updating logistics effectiveness is essential for any business enterprise to gain a competitive advantage (Sakchutchawan, et al., 2011). Also, operational activities usually aim at the logistics functionality of transportation/ distribution, warehousing, inventory of packaging, and materials handling (Williams and Tokar, 2008). Therefore, many scholars have so far made great efforts to study logistics functionality, and much relative literature on basic operational activities of transportation, warehousing, and inventory has been published (Williams and Tokar, 2008; Krauth et al., 2005).

Unfortunately, previous studies on operational activities of logistics functionality among manufacturers, distributors, transporters wholesalers, retailers, and customers mostly belong to the separate research theme of logistics activities such as transportation, warehousing, inventory, and others (Paul, 2018). Few studies comprehensively considered or integrated basic and value-adding activities with entire operational activities for developing more innovative and diversified logistic services (Williams and Tokar, 2008; Krauth et al., 2005). Also, all the logistics operational activities were viewed as a network of interlinked activities only to be optimized as a whole by focusing on total throughput time (Christopher, 2016). The entire operational activities of logistics functionality are complex interactions, interrelations, and interdependence. However, previous research works have shown neither a comprehensive exploration of the complex interactions and interrelations nor interdependent discussion for evaluating the operational activities of the entire logistics functionality. For the analysis of the mutually influential relationship among the logistics development trends of operational activities, the decision-making trial and evaluation laboratory (DEMATEL) of typical multi-criterion decision-making (MCDM) is an excellent analytical approach (Govindan and Chaudhuri, 2016). The F-number method gives better confidence in the evaluation of environments under uncertainty to improve the reliability of expert evaluations (Mavi, 2013). Therefore, the F-numbers decision-making trial and evaluation laboratory (F-DEMATEL) technique (Hsu et al., 2021) is adopted in this study to evaluate the crucial performance indicators of the mutual influential relationships and weightings for the operational activities of logistics. In addition, the crucial performance indicators include time, cost, quality, service, and innovation (Moons et al., 2019; Marti et al., 2014). The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is a multi-criteria decision analysis method. Its chosen alternative is based on the positive and negative ideal solution (PIS and NIS) (Hsu et al., 2021). When using TOPSIS in several cases, the PIS and NIS may not present the most appropriate result for ranking (Morash, 1996). Therefore, the fuzzy TOPSIS (F-TOPSIS) technology is used to calculate all alternatives as reference points, as it is a better method than the TOPSIS for helping decision makers to develop appropriate strategy management (Lo et al.,2018). Therefore, the F-TOPSIS is also used to evaluate the importance of operational activities of logistics functional management.

For the aforementioned reasons, we apply F-DEMATEL and F-TOPSIS to evaluate the crucial operational activities in logistics functionality for providing the decision-maker with the following objectives.

(1) Collecting the important basic and value-adding activities in logistics functionality by the relative literature and interviewees of a case study;
(2) Calculating the weights and influential relationships of five performance indicators (time, cost, quality, service, and innovation) by the F-DEMATEL method;
(3) Prioritizing the crucial operational activities of logistics functionality through the methods of elite interview and F-TOPSIS for providing decision-makers with references.

This article comprises six sections. The second section reviews the theoretical literature, the third section explains the research method, the fourth section presents the results, the fifth section discusses the results, and the conclusion is drawn in the sixth section.

2. Materials and Methods

2.1. Operational Activities in Logistics Functionality

The term "logistics" was first mentioned during 1779−1869 and used in the civilian sector of the trade industry in the 1960s (Tepić, 2011). In military science, logistics is concerned with maintaining army supply lines while disrupting those of the enemy, since an armed force without enough logistics resources is defenseless (Kinger, 2012). Logistics is a systematic service in an enterprise operation and management, whose objective is that the various activities of logistic functionality are combined or integrated to shorten commodity circulation times, reduce routes and delivery costs, and provide quick responses to meet customer needs (Paul et al., 2018). To meet the requirements of end customers, a logistics activity between two destinations usually can be improved by efficiently providing relative information for various cross-functional departments (Christopher, 2016) which include

manufacturers, distributors, wholesalers, warehousing, transporters, retailers, and customers (Mentzer, 1991). The purpose of cross-functional departments is to enable the business enterprise to efficiently store and deliver goods to enhance the services and satisfaction of customers (Christopher, 2016), including basic activities (Christopher, 2018) and value-adding activities (Rivera et al., 2016; Shou et al., 2020; Madhani, 2017).

2.2. Performance Indicators in Logistics Functionality

To evaluate the operational activities of logistics functionality, it is necessary to use proper indicators to monitor performance (Krauth et al., 2005). So far, researchers (Sakchutchawan et al., 2011; Krauth et al., 2005; Christopher, 2016; Moons et al., 2019; Martí et al., 2014) have proposed various performance indicators to fit different models based on research of the different objectives. The performance indicators of the evaluating operational activities are suggested in this study to fit different industries (Christopher, 2016). As a result, five commonly used indicators, including time, cost, quality, service, and innovation (Christopher, 2016) are directly cited for evaluating logistics operational activities, which are described as follows (Sakchutchawan et al., 2011; Christopher, 2016; Bai, 2014).

(1) **Time:** Time seems to be the simplest way to measure performance since the length of time can be measured for a critical business process completed. Four indicators are usually used for evaluating logistics activities, including process time, interval time, speed (how fast the goods are moved), and throughput (how fast a process is completed).
(2) **Cost:** There are a variety of costs for the logistics industry, which makes cost assessment more difficult with complications. There are five indicators including direct cost, indirect cost (the expenses for supporting systems), error cost, periodic cost (assessments based on the time consumed), and incremental cost (assessments based on the workload).
(3) **Quality:** Quality can be evaluated with yield rate. Utilization of resources is usually the biggest concern for most businesses. Three used indicators are used: the use of inventory, capacity (measure the efficiency of storage), and capital (measure the return on investment or cash turnover).
(4) **Service:** The term refers to the response to a program to achieve corporate objectives such as replenishment and order fulfillment. Two main indicators are service level (set as a goal for a business enterprise to achieve performance such as on-time deliveries) and satisfaction (showing customers' satisfaction or a reference for a business to actively improve its performance).
(5) **Innovation:** Innovation has been a crucially evaluated approach to improving the logistics capacities and performance of firms properly, as well as enhancing customer value (Sakchutchawan et al., 2011). The competitive model relied heavily on innovations of products and processes for increasing greater value for key customers. Especially, in terms of innovative processes, the critical operational activities are usually cross-functional departments and interdisciplinary teams to conduct a continuous program of improvement to ensure continued competitive advantage for increasing profits to firms (Christopher, 2016).

In summary, the aforementioned five performance indicators of time, cost, quality, service, and innovation are indispensable for the performance assessment of logistics activities so that any business enterprise can identify whether the logistics activities are effectively executed or not. In practice, different industries use any measurement(s) of proper indicators to obtain the best performance according to different industrial environments.

3. Methods

3.1. Fuzzy Decision-Making Trial and Evaluation Laboratory (F-DEMATEL)

Most studies in economics and social sciences often lack prior information or objective data as references, and sometimes, the data collected are inadequate and discrete. An analysis of MCDM for weight analysis is usually considered a better method for researching the exploratory explanation (Hwang et al., 2020). Also, an influential network relationship map (INRM) is obtained by using DEMATEL to assist in identifying the importance of the critical activities (Lo et al., 2020).

The DEMATEL technique was submitted by the Battelle Memorial Association of the Geneva Research Center, which was used to analyze the correlations among five performance indicators (Lo and Shiue et al., 2020). DEMATEL is widely used for solving MCDM problems because it is based on graph theory, which analyzes and solves problems by providing a method for visualization. The structural schematic diagram is presented as a directed line graph representing the interdependent relationships between the influential effects among the criteria. The obtained cause-effect diagram can help decision-makers better understand which factors are critical for helping them assess complicated problems (Lo et al., 2020). Because the crucial performance indicators of time, cost, quality, service, and innovation for assessing logistics activities are not acting independently but interacting and

interdepending to determine the overall operational performance. Thus, it is analyzed by the DEMATEL method (Lo and Shiue et al., 2020; Lu et al., 2018).

The purpose of the fuzzy DEMATEL proposed is to improve the decision-making alternatives for environmental uncertainty. As many decisions in the real world involve imprecision since goals, constraints, and possible actions are not known precisely. When making decisions in a fuzzy environment, the result of decision-making is highly affected by subjective judgments that are vague and imprecise. Experts find it difficult to make precise judgments in this situation of incomplete information or knowledge limitation (Wu and Liou, 2007). To solve this sort of imprecision problem for obtaining the best of our knowledge, fuzzy set theory can serve as a better method to improve handled vagueness in decision-making (Wu and Liou, 2007). The fuzzy linguistic scale is shown in Table 1 (Lo et al., 2020). The methodological steps are described as follows (Lo and Shiue et al., 2020).

Table 1. Fuzzy linguistic scale (Lo et al., 2020).

Linguistic Variable	Crisp Value	Triangular Fuzzy Number
Very high influence	VH (4)	(3, 4, 4)
High influence	H (3)	(2, 3, 4)
Medium influence	M (2)	(1, 2, 3)
Low influence	L (1)	(0, 1, 2)
Very Low influence	VL (0)	(0, 0, 1)

Step 1. Calculating the direct relationship matrix A

Experts, applying their professional knowledge and experience, identify the degrees of direct influence between indicators *i* and *j*, namely a_{ij}, using a 5-point scale. The evaluation scale ranges from 0 to 4, specifically, ‘‘0, very Low influence,’’ ‘‘1, low influence,’’ ‘‘2, medium influence,’’ ‘‘3, high influence,’’ and ‘‘4, very high influence.’’ The arithmetic means calculated for individual questionnaires are integrated into the average direct-relation matrix *A*.

$$A=\left[a_{ij}\right]=\begin{bmatrix} 0 & a_{12} & \mathsf{L} & a_{1n} \\ a_{21} & 0 & \mathsf{L} & a_{2n} \\ \mathsf{M} & \mathsf{M} & \mathsf{O} & \mathsf{M} \\ an_{n1} & a_{n2} & \mathsf{L} & 0 \end{bmatrix}, i,j=1,2,\mathsf{L}\ ,n;\ \ \%=\left[\%_{ij}\right];\ \text{where}\ \ \%_{ij}=\left(a_{ij}^{l},a_{ij}^{m},a_{ij}^{u}\right), \tag{1}$$

Step 2. Calculating the normalized direct-relation matrix X

Applying Eqs. (2) and (3), matrix A is normalized to matrix *X* with all diagonal indicators being 0, and the other indicators being between 0 and 1.

$$X=k\times A\,, \tag{2}$$

$$K=\min\left[\frac{1}{\max_i\sum_{j=1}^{n}a_{ij}},\frac{1}{\max_i\sum_{i=1}^{n}a_{ij}}\right], i,j=1,2,\mathsf{L}\ ,n\,, \tag{3}$$

Step 3. Deriving the total-relation matrix T

The total-relation matrix T, calculated by Eq. (4), represents the influence of indicator *i* on indicator *j*. The indirect effects of the system along with the powers of $X,e.g.,\mathrm{X}^2,X^3,\mathsf{L}\ ,X^h$ and $\lim X^p=\left[0\right]_{n\times n}$,where $X=\left[x_{ij}\right]_{n\times n}$, $0\le x_{ij}<1,0<\sum_i x_{ij}\le 1,0<\sum_j x_{ij}\le 1,0$ and at least on column sum $\sum_i x_{ij}$ is set equal to one. $T=\left[t_{ij}\right]_{n\times n}, i,j=1,2,\mathsf{L}\ ,n$

$$T^h=X+X^2+\mathsf{L}\ +X^h=X\left(I-X\right)^{-1},\text{when}\lim_{p->\infty}X^p=\left[0\right]_{n\times n},, \tag{4}$$

which represents the identity matrix.

Step 4. Determining the row and column sums of the matrix $\tilde{T} = [\tilde{t}_{ij}]$; where $\tilde{t}_{ij} = (t_{ij}^{*l}, t_{ij}^{*m}, t_{ij}^{*u})$,

$$R_i = (r_1, r_2, \ldots, r_n)^T = (r_i)_{n\times 1} = \left[\frac{\sum_{j=1}^{n} t_{ij}^{*l} + 2 \times \sum_{j=1}^{n} t_{ij}^{*m} + \sum_{j=1}^{n} t_{ij}^{*u}}{4} \right]_{nx1}, j = 1, 2, \ldots, n; \quad (5)$$

$$C_j = (c_1, c_2, \ldots, c_n) = (c_j)_{1\times n} = \left[\frac{\sum_{i=1}^{n} t_{ij}^{*l} + 2 \times \sum_{i=1}^{n} t_{ij}^{*m} + \sum_{i=1}^{n} t_{ij}^{*u}}{4} \right]_{1xn}, i = 1, 2, \ldots, n; \quad (6)$$

Here, $r_i + c_j$ represents an index of the strength of the influences given and received, while $r_i - c_j$ represents the net influence. If $r_i - c_j$ is positive, then indicator i affects the other indicator (so is called a causal factor), and if $r_i - c_j$ is negative, then the other indicator influences indicator i (so is called an affected factor).,

Step 5. Obtaining the weights of the risk factors

With Eq. (7), the risk indicator weights (w_i) are obtained by normalizing the prominence vector ($r_i + c_j$) in which the sum of the normalized weights is equal to 1.

$$w_i = (r_i + c_j) \div \sum_{i=1}^{n} (r_i + c_j). \quad (7)$$

3.2. Fuzzy Technique for Order Preference by Similarity to Ideal Solution (F-TOPSI)

TOPSIS is a multi-criteria decision analysis method based on the concept that the chosen alternative must have the shortest geometric distance from the positive ideal solution (PIS) and the longest geometric distance from the negative ideal solution (NIS) (Ramkumar et al., 2009; Hajduk, 2021). The TOPSIS is a compensatory method and provides clear trade-offs among criteria, whose method allows a compromise between various decision factors where a bad effect in one factor may be compensated with a good effect in the other factor (Hajduk, 2021). In addition, fuzzy TOPSIS is an important fuzzy multi-criteria decision-making (FMCDM) method, which is used in logistics as shown in Table 2 (Chang et al., 2019).

Table 2. Linguistic variables and corresponding triangular fuzzy numbers (Chang et al., 2019).

Linguistic Variables	Code	Fuzzy Numbers
Very poor	VP (1)	(0, 1, 2)
Poor	P (3)	(2, 3, 4)
Fair	F (5)	(4, 5, 6)
Good	G (7)	(6, 7, 8)
Very good	VG (9)	(8, 9, 10)
Intermediate values	2, 4, 6, 8	

Depending on the areas of decision-making applications to fuzzy TOPSIS between 2007 and 2017, logistics and supply chain management are the top application and account for 15.47 %, followed by business and marketing management accounting for 14.88% (Salih et al., 2019). For the aforementioned reason, the method of the F-TOPSIS (Chang et al., 2019) is directly cited for this study to evaluate logistics activities, whose key methodological steps are explained as follows:

Step 1. Constructing a normalized fuzzy decision matrix

$$\tilde{R} = [\tilde{r}_{ij}]_{mxn} = \begin{bmatrix} \tilde{r}_{11} & \tilde{r}_{12} & \cdots & \tilde{r}_{1n} \\ \tilde{r}_{21} & \tilde{r}_{22} & \cdots & \tilde{r}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{r}_{m1} & \tilde{r}_{m1} & \cdots & \tilde{r}_{mn} \end{bmatrix} \quad (8)$$

$$\tilde{r}_{ij}^{*} = \frac{\tilde{r}_{ij}}{x^{aspire}}, \quad (9)$$

Step 2. Constructing the weighted normalized fuzzy decision matrix

$$\tilde{V} = [\tilde{v}_{ij}]_{mxn} = \tilde{r}_{ij}^{*} * w_j, \quad (10)$$

Step 3. Defining positive ideal solutions and negative ideal solutions (PIS and NIS)

$$\begin{aligned} PIS = A_j^{asprie} &= (1*w_1, 1*w_2, \cdots, 1*w_n) = (w_1, w_2, \cdots, w_n) \\ NIS = A_j^{worst} &= (0*w_1, 0*w_2, \cdots, 0*w_n) = (0, 0, \cdots, 0) \end{aligned} \quad (11)$$

Step 4. Calculating the distances between each alternative and the PIS and NIS

$$\begin{aligned} D_i^{+} &= \sum_{j=1}^{n} \sqrt{\frac{\left(A_j^{asprie} - x_{ij}^{**1}\right)^2 + 2*\left(A_j^{asprie} - x_{ij}^{**m}\right)^2 + \left(A_j^{asprie} - x_{ij}^{**u}\right)^2}{4}} \\ D_i^{-} &= \sum_{j=1}^{n} \sqrt{\frac{\left(A_j^{worst} - x_{ij}^{**1}\right)^2 + 2*\left(A_j^{worst} - x_{ij}^{**m}\right)^2 + \left(A_j^{worst} - x_{ij}^{**u}\right)^2}{4}} \end{aligned}, \quad (12)$$

Step 5: Calculating the closeness coefficient (CC_i)

$$CC_i = \left(D_i^{-} \div \sum_{i=1}^{m} D_i^{-}\right) - \left(D_i^{+} \div \sum_{i=1}^{m} D_i^{+}\right), \begin{cases} -1 \le CC_i \le 1 \\ 0 \le D_i^{-} \le 1 \\ 0 \le D_i^{+} \le 1 \end{cases}, i = 1, 2, \cdots, m. \quad (13)$$

4. Results

4.1. Collecting Critical Activities in Logistics Functionality

We created a five-person decision-making group as the research committee to explore critical basic and adding-value activities in logistics functionality, including two published authors specialized in logistics and three invited experts from logistics industrial areas: Ming-Hon Hwang, Hsin-Yao Hsu, Zhang Jiyu, Ying-zhan Shue, and Po-Heng Tsou. Zhang Jiyu is a site manager of PX Mart Guanyin Logistics Center and is responsible for the storage and distribution of goods sold in 500 supermarkets in northern Taiwan and for the operation management of logistics centers and professional distribution services for normal and low-temperature products. Ying-zhan Shue is the site supervisor of Cheng-gong Logistics Co., Ltd. which belongs to the third-party logistics. He is responsible for the distribution of goods sold in 200 supermarkets such as PX Mart, Hi-Life, 7-Eleven, McDonald's, and others in northern Taiwan and the distribution management of logistics centers for normal and low-temperature products. Po-Heng Tsou is currently the CEO of the Global Logistics and Commerce Council of Taiwan, where he is mainly in charge of planning, matching, training, consultation, and cross-border e-Commerce. Philip Tsou acts as the CEO of SOLE-The International Society of Logistics Taiwan (Taipei) Chapter, an important logistics education and research institution of which the goals are to enhance technology management, education, humanities, and social sciences in logistics, and particularly promote international logistics certification. After four discussions and revisions, there are 13 critical operational activities in logistics functionality to be integrated into classification for the research purpose as shown in Table 3.

Table 3. Descriptions of 13 critical operational activities in logistics functionality.

	S1	Basic Activities
S11	Loading/ Unloading and Transport	The warehousing personnel uses handling equipment to unload the commodities from trucks, place on the pallets, and stack/ move them, as well as prepare them for loading onto trucks from the delivery area and stacking them well as the transfer requirement.
S12	Pick and Pack	Based on the order details, the commodities are picked and placed into the appropriate cartons. After filling the cushioning or thermal insulation material according to the product characteristics, the boxes/ cartons are completely packed and sealed with tape.
S13	Storage of Warehousing	In order to guarantee the value of goods, the entry and exit need to be safe and smooth, the accounts need to be consistent, and the inventory quantity must be effectively controlled at a reasonable level in the storage period. In addition, the goods and equipment in the areas of operation, storage, inbound, and outbound need to be clean, tidy, and in excellent situations of maintenance and inspection.
S14	Transportation/ Distribution	Based on the delivery details of the recipient address, volume, and weight provided by the customer, the number of vehicles and the required tonnages are calculated and arranged for a qualified transportation company which is contacted to pick up the goods at the warehouse. Also, the designated recipient must provide the whole delivery information of tracking and receipt according to the route planning while the goods are being delivered to the customer.
S15	Information	The information of each linked logistics operational activity is collected, counted, analyzed, planned, forecasted, and transmitted through the use of information technology for increasing the transparency of inventory information. The objective is to provide customers with the latest status of logistics distribution and immediately various inventory information for increasing logistics efficiency.
S16	Order Processing	In order to shorten lead time and improve delivery accuracy, and adjust demand-supply efficiency, the extended/ processed scope of ordering operational activities includes comparing available inventory, verifying placed order procedures and customer credit, controlling originated orders from various channels, as well as collecting, recording, confirming, picking, shipping, fulfilling delivery of merchandise.
	S2	**Value-adding Activities**
S21	Distribution Processing	According to the instructions of the distribution processing, warehousing personnel carries out scheduling and operations of the value-added activity. It can be product assembly, accessories assembly, cutting, sorting/grading packaging, sub-packaging, filling, label printing, labeling, and hanging brand.
S22	Returns and Quality Control	Returns: the goods are returned to the original shipping warehouse when the recipient conducts returning goods of not up to standard or cancels orders. And then, the warehousing staff retrieves the original order, compares the returned qualities, and checks the quality of goods, as well as issues a comprehensive report to the customer. Quality control: to prevent unqualified goods from entering the warehouse, warehousing staff conducts operations of quality control based on the accepted standards of incoming goods, as well as issues a comprehensive report to the customer. The activities include inspections of quantity, appearance, packaging, label, shape, weight, color, and anti-counterfeiting label for ensuring quality reliability.
S23	POS-linking Processing	In order to improve sales forecasts, suppliers are allowed to monitor each terminal point of sale (POS), understand the items/quantities merchandised in the store and procured lead time, and amend safety stocks or reorder points for each warehousing item/quantity.
S24	Repair and Maintenance	Warehousing personnel carry out regularly commodity maintenance based on the special equipment, maintenance manual, and professional training provided by the customer. The warehousing personnel usually need to issue the customer with a comprehensive report which includes pictures and images of the quality state of the goods of being originally exported.
S25	Substitute Procurement	Every item requires a certain amount of inventory. Some of them need to be adjusted in one day or week, which refers to be automatically replenished the delivered according to the increase or decrease of stock. Also, in order to speed up warehousing operational activities, substitute procurement is conducted when the goods are in storage. The items involve necessary auxiliary materials such as packaging materials, accessories, labels, utensils, etc. according to the quality, specification, quantity, and price.
S26	Prepare for Opening and Promotion	To assist promotions for new productions or preparation for new opening stores, the points of sales materials (POSM) can be planned, assembled, posted, and subsequently maintained. The operational activities of POSM include various types of display stands, display cabinets, output pictures, tags, visual objects, and so on.
S27	Consignment Stock	Before the products are sold to the end customer, the supplier will be the inventory holder and will not charge the distributor. The activities of consignment stock enable goods to be placed in distributor warehouses or on retail shelves. Therefore, the supplier can reduce costs of warehouse and inventory management, as well as keep abreast of sales information to improve forecast accuracy for reducing inventory. Also, the distributor is not only to reduce costs of inventory holding and lead time of procurement but also to integrate multiple products and provide more diversified products to increase sales.

4.2. Calculating Weights of Five Critical Indicators

To calculate the weights of five critical indicators and to rank 13 critical logistics activities, the professional interviewees are invited to participate in this study as shown in Appendix A. The selected logistics experts are knowledgeable and trustworthy

because of their good backgrounds and more than 10 years of work experience in their respective fields. First, the interview illustrates the previously proposed critical indicators as the most important and influential relationship indicators. The processes are to invite them to fill out a questionnaire. Also, the filled-in data are analyzed for understanding the important and influential relationships of critical indicators through the F-DEMATEL technique in which Eq. (1) to (7) are used for ranking as described in section 3.1, as well as is calculated by EXCEL as shown in Appendices B and C.

Then, the F-DEMATEL is applied to achieve the total-relation matrix and to obtain the inner dependence matrix and impact relationship map, which help decision-makers acquire more firm decisions. In this step obtaining the inner dependence matrix, the sum of each column in the total-relation $n \times n$ matrix is equal to 1 by the normalization method. Then, the inner dependence matrix is acquired. "R_i" demonstrates the total effects including both direct and indirect. Similarly, "C_j" represents total direct and indirect effects. As a result, the sum ($R_i + C_j$), "Prominence'' proves the degree of the important role. Also, the sum ($R_i - C_j$) that is called "Relation" shows the net effect. When ($R_i - C_j$) is positive, the criterion is the cause group. When ($R_i - C_j$) is negative, the criterion is a net receiver as shown in Table 4 and Fig. 1.

Table 4. Results of F-DEMATEL analysis for five critical indicators.

	R_i	C_j	$R_i + C_j$	$R_i - C_j$	W_i	Rank
Time	6.713	6.440	13.154	0.273	0.191	4
Cost	7.143	7.326	14.468	−0.183	0.210	2
Quality	6.867	7.585	14.452	−0.719	0.210	3
Service	7.323	7.724	15.048	−0.401	0.218	1
Innovation	6.407	5.377	11.783	1.030	0.171	5
			68.905			

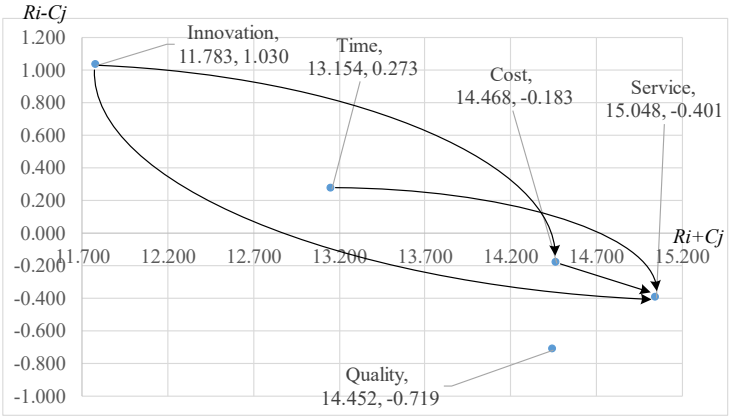

Fig. 1. INRM of five critical indicators of performance.

The correlations of differences are visualized using the INRM of five critical indicators of performance. The results of Table 4 are depicted in a model to reveal the relationships among the main indicators according to the T values as shown in Fig. 1. ($R_i + C_i$) shows the important rates of five critical indicators on "Service," "Cost," "Quality," "Time," and "Innovation" of which T = 15.048, 14.468, 14.452, 13.154, and 11.783, respectively. Therefore, the results of the F-DEMATEL analysis present that the importance of critical weighted indicators is decreased in the order of "Service" > "Cost" > "Quality" > "Time" > "Innovation". This means that if we select and improve "Service", we gain a better performance in the entire operational activities because it is the most important crucial indicator. In addition, the result of ($R_i - C_i$) shows that the influence rate (T) of five critical indicators on "Time," "Cost," "Quality," "Service," and "Innovation" are respectively, 0.273, −0.183, −0.719, −0.401, and 1.030. Therefore, the crucial indicators of "Time," "Cost" and "Innovation" have a more significant impact on "Service." Also, "Innovation" has a more significant impact on on "Cost."

4.3. Ranking Critical Logistics Activities

The purpose of ranking the critical logistics activities is to acquire importance prioritized for providing decision-makers with a reference to enhance logistics active performance. The evaluation of the critical logistics activities is based on expert opinions. Because the interval weights of critical indicators are determined using the interval concept of F-DEMATEL to improve the

information uncertainty, the interval concept with F-TOPSIS is also used to obtain the rank of each logistics activity. The calculation method is explained in Section 3.2 and Eqs. (8) to (14) are used for ranking. The information of data collected by eight experts for ranking the critical logistics activities is described in an Excel Table in Appendix D.

Based on the evaluation of time, cost, quality, service, and innovation, the F-TOPSIS calculation is detailed through EXCEL tool for ranking 13 critical operational activities in logistics functionality as shown in Appendix E. Table 5 describes the important ranks of 13 critical operational activities in logistics functionality and shows the distance of each critical logistics activity from the PIS and NIS. The higher the value of "D_i^-", the higher the importance level of the logistics activities. High "D_i^+" value indicates that the logistics activity is relatively less important.

Table 5. Ranks of 13 critical operational activities in logistics functionality.

No.	Item	D_i^+	D_i^-	CC_i	W_i	Rank	Logistics Activities
1	S11	0.2132	0.2517	0.0051	0.0535	6	Loading/ Unloading and Transport
2	S12	0.1501	0.3182	0.0481	0.5066	3	Pick and Pack
3	S13	0.1954	0.2675	0.0163	0.1713	5	Storage of Warehousing
4	S14	0.1072	0.3629	0.0771	0.8126	1	Transportation/ Distribution
5	S15	0.1467	0.3218	0.0504	0.5306	2	Information
6	S16	0.1853	0.2896	0.0268	0.2819	4	Order Processing
7	S21	0.2429	0.2162	−0.0165	−0.1737	10	Distribution Processing
8	S22	0.2273	0.2346	−0.0052	−0.0550	8	Returns and Quality Control
9	S23	0.2861	0.1767	−0.0440	−0.4637	11	POS-linking Processing
10	S24	0.2323	0.2309	−0.0082	−0.0859	9	Repair and Maintenance
11	S25	0.3602	0.0973	−0.0949	−1.0000	13	Substitute Procurement
12	S26	0.3033	0.1587	−0.0557	−0.5868	12	Prepare for Opening and Promotion
13	S27	0.2179	0.2434	0.0008	0.0086	7	Consignment Stock
		2.8680	3.1695	−0.0949			

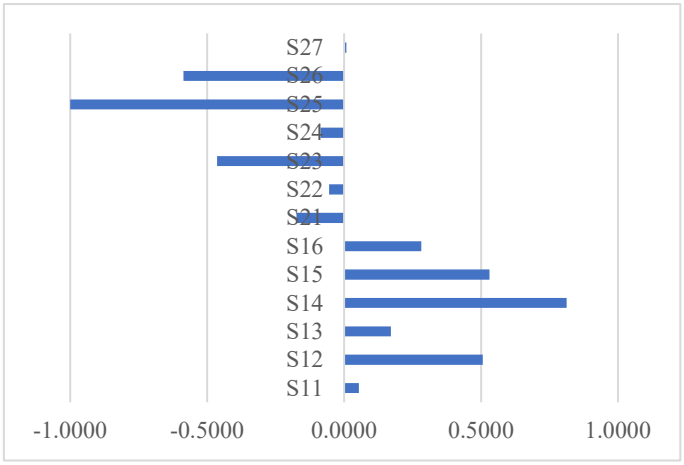

Fig. 2. Ranks of 13 critical operational activities in logistics functionality.

According to Table 5 and Fig. 2, the ranking result of the critical basic activities in logistics functionality can be seen that "S14" (Transportation/ Distribution) is the most critical logistic activity, followed by "S15" (Information) and "S12" (Pick and Pack). Also, the ranking result of the critical value-adding activities in logistics functionality shows that "S27" (Consignment Stock) is the most critical value-adding activity, followed by "S22" (Returns and Quality Control) and "S24" (Repair and Maintenance). Therefore, the logistics managers can give priority to formulating improvement plans based on these ranks.

5. Discussions

According to the interviewee with Jiyu Zhang, the result of relative ranking seems to be consistent with the logistics industrial activities evaluated, or in line with the current industrial situation in Taiwan. Therefore, the developed results of evaluating the logistics activities are valuable in Taiwan for providing logistics managers with reference in practice. For example, he agrees that "Transportation/Distribution" is the most important activity in logistics functionality. He explains that in terms of logistics cost allocations in Taiwan, "Transportation/Distribution" accounts for 50%, "Loading/Unloading and Transport" accounts for 20%, "Storage of Warehousing" accounts for 20%, and "Pick and Pack" accounts for 10%.

"Information" is the second most important activity, of which a narrow definition refers to Warehouse Management System (WMS) for primarily focusing on physical distribution management, and the corresponding definition emphasizes the movement and storage of goods. Currently, activities in the logistic channel due to continually increasing electronic procurement, online retailing, internet of things (IoT), and cloud computing, information technology is focused on the entire logistics of internal enterprise as well as its role in external supply chain management. Therefore, information technology is required to be continually enhanced for improving demand forecasting, inventory, and order management.

The result of critical activity shows that "Consignment Stock" is the most important value-adding activity in the current PX Mart's operational situation. Jiyu Zhang explains that PX Mart is a successful enterprise in Taiwan. The benefits of the "Consignment Stock" inventory solution demonstrate that the supplier can enjoy lower management costs (transportation/inventory/ warehouse) via stable production and flow of inventory due to logistics centers integrating demands. On the other hand, the retailers bear less operational risk cost because they do not receive a payment bill from the supplier until the goods are sold by retailers.

The strategy of Consignment Stock/Vendor Owned Inventory/Supplier Owned Inventory (CS/VOI/SOI) is important and widely used in Business-to-business (B2B) commerce. The inventory supply process can be divided into the following three categories: replenishment warehouse (the supplier establishes a warehouse for the manufacturer in its warehouse), distribution center (the supplier sets up a warehouse near the manufacturer or outsources third-party warehouse for delivering goods directly as needed), and consignment warehouse (according to the forecast demand, the goods being placed to the nearest warehouse for the manufacturer).

This study only illustrates the proposed evaluation of operational activities which mainly focus on PX Mart of logistics center for normal and low-temperature products in Taiwan, so it is suggested that future research needs to focus on the issue of different rankings in different industries and different product lines such as green, cold chain, or safe logistics.

6. Conclusions

Logistics plays a significant role in the economy with its main contribution to the gross domestic product (GDP) of many countries. As globalization of trade develops, the importance of improving logistics active efficiency becomes more essential for any business enterprise to gain a competitive advantage. Many scholars have studied logistics functionality, and many publications on logistics activities have been published. Unfortunately, previous studies dealt with single research themes of main logistics activities. Few studies comprehensively considered basic and value-adding activities of logistics. Therefore, we aim to carry out this study to make up for a deficiency in previous research. The main contributions of the proposed suggestions are summarized as follows.

(1) Identifying 13 critical activities that include basic activities and adding-value activities in the logistics functionality;
(2) Considering five important performance indicators of logistics, including time, cost, quality, service, and innovation;
(3) Using F-DEMATEL to obtain standard weights is used to improve the consistency of the evaluation;
(4) Using F-TOPSIS to obtain ranks is also used to improve the shortcomings of information uncertainty in practical applications;
(5) Based on the F-DEMATEL technique, helping decision-makers clearly understand the relevance and importance of each weighted indicator of time, cost, quality, service, and innovation;
(6) Through the F-TOPSIS evaluation of 13 critical logistics activities, allowing decision-makers to be more aware of the importance of properly developing and improving operational activities of logistics management.

Using the method of feasibility and applicability of this study, the logistics efficiency of the operational activities in practice can be improved in the logistics activities of different product lines.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Profiles of the eight experts.

No.	Expert	Working	Years of experience	Education
1	Zhong-yi Guo	Logistics center	17	Bachelor
2	Wei-xiong Chen	Logistics center	15	Bachelor
3	Wen-han Li	Logistics transportation	15	Bachelor
4	Dong-liang Lu	Logistics center	25	college
5	Hong-ting Wang	Logistics center	25	Bachelor
6	Ji-yu Zhang	Logistics center	15	Bachelor
7	Ying-zhan Shue	Logistics transportation	9	college
8	Po-Heng Tsou	Logistics institutions	23	Master

Appendix B

Table A2. Information of the data collected by eight experts for F-DEMATEL.

Expert 1	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN
Time	0	VH	VH	M	L	0	3	3	1	0	0	4	4	2	1	0	4	4	3	2
Cost	VH	0	H	H	L	3	0	2	2	0	4	0	3	3	1	4	0	4	4	2
Quality	VH	H	0	H	M	3	2	0	2	1	4	3	0	3	2	4	4	0	4	3
Service	H	H	H	0	M	2	2	2	0	1	3	3	3	0	2	4	4	4	0	3
Innovation	L	M	M	M	0	0	1	1	1	0	1	2	2	2	0	2	3	3	3	0
Expert 2	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN
Time	0	VH	M	H	L	0	3	1	2	0	0	4	2	3	1	0	4	3	4	2
Cost	VH	0	H	H	L	3	0	2	2	0	4	0	3	3	1	4	0	4	4	2
Quality	H	VH	0	H	M	2	3	0	2	1	3	4	0	3	2	4	4	0	4	3
Service	H	VH	H	0	M	2	3	2	0	1	3	4	3	0	2	4	4	4	0	3
Innovation	L	M	H	M	0	0	1	2	1	0	1	2	3	2	0	2	3	4	3	0
Expert 3	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN
Time	0	L	H	VH	M	0	0	2	3	1	0	1	3	4	2	0	2	4	4	3
Cost	L	0	H	VH	M	0	0	2	3	1	1	0	3	4	2	2	0	4	4	3
Quality	M	L	0	VH	H	1	0	0	3	2	2	1	0	4	3	3	2	0	4	4
Service	M	L	VH	0	H	1	0	3	0	2	2	1	4	0	3	3	2	4	0	4
Innovation	M	L	H	VH	0	1	0	2	3	0	2	1	3	4	0	3	2	4	4	0
Expert 4	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN
Time	0	H	VH	M	L	0	2	3	1	0	0	3	4	2	1	0	4	4	3	2
Cost	VH	0	H	M	M	3	0	2	1	1	4	0	3	2	2	4	0	4	3	3
Quality	VH	M	0	H	M	3	1	0	2	1	4	2	0	3	2	4	3	0	4	3
Service	VH	VH	VH	0	M	3	3	3	0	1	4	4	4	0	2	4	4	4	0	3
Innovation	M	VH	H	M	0	1	3	2	1	0	2	4	3	2	0	3	4	4	3	0
Expert 5	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN
Time	0	VH	M	H	M	0	3	1	2	1	0	4	2	3	2	0	4	3	4	3
Cost	M	0	H	VH	VH	1	0	2	3	3	2	0	3	4	4	3	0	4	4	4
Quality	H	VH	0	H	M	2	3	0	2	1	3	4	0	3	2	4	4	0	4	3
Service	H	VH	VH	0	M	2	3	3	0	1	3	4	4	0	2	4	4	4	0	3
Innovation	M	VH	H	H	0	1	3	2	2	0	2	4	3	3	0	3	4	4	4	0
Expert 6	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN
Time	0	VH	M	H	M	0	3	1	2	1	0	4	2	3	2	0	4	3	4	3
Cost	M	0	H	VH	VH	1	0	2	3	3	2	0	3	4	4	3	0	4	4	4
Quality	H	VH	0	H	M	2	3	0	2	1	3	4	0	3	2	4	4	0	4	3
Service	H	H	VH	0	M	2	2	3	0	1	3	3	4	0	2	4	4	4	0	3
Innovation	M	VH	H	H	0	1	3	2	2	0	2	4	3	3	0	3	4	4	4	0
Expert 7	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN
Time	0	M	H	H	VH	0	1	2	2	3	0	2	3	3	4	0	3	4	4	4
Cost	H	0	H	VH	M	2	0	2	3	1	3	0	3	4	2	4	0	4	4	3
Quality	L	M	0	H	L	0	1	0	2	0	1	2	0	3	1	2	3	0	4	2
Service	M	VH	M	0	H	1	3	1	0	2	2	4	2	0	3	3	4	3	0	4
Innovation	L	M	H	H	0	0	1	2	2	0	1	2	3	3	0	2	3	4	4	0
Expert 8	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN
Time	0	M	H	H	L	0	1	2	2	0	0	2	3	3	1	0	3	4	4	2
Cost	M	0	H	VH	L	1	0	2	3	0	2	0	3	4	1	3	0	4	4	2
Quality	M	H	0	VH	L	1	2	0	3	0	2	3	0	4	1	3	4	0	4	2
Service	M	VH	H	0	M	1	3	2	0	1	2	4	3	0	2	3	4	4	0	3
Innovation	L	M	H	VH	0	0	1	2	3	0	1	2	3	4	0	2	3	4	4	0

Appendix C

Table A3. F-DEMATEL technique of Excel calculation steps.

Step 1	TI	CO	QU	SE	IN			TI	CO	QU	SE	IN			TI	CO	QU	SE	IN	
Time	0.000	2.000	1.875	1.875	0.750	6.500		0.000	3.000	2.875	2.875	1.750	10.500		0.000	3.500	3.625	3.750	2.625	13.500
Cost	1.750	0.000	2.000	2.500	1.125	7.375		2.750	0.000	3.000	3.500	2.125	11.375		3.375	0.000	4.000	3.875	2.875	14.125
Quality	1.750	1.875	0.000	2.250	0.875	6.750		2.750	2.875	0.000	3.250	1.875	10.750		3.500	3.500	0.000	4.000	2.875	13.875
Service	1.750	2.375	2.375	0.000	1.250	7.750		2.750	3.375	3.375	0.000	2.250	11.750		3.625	3.750	3.875	0.000	3.250	14.500
Innovation	0.500	1.625	1.875	1.875	0.000	5.875		1.500	2.625	2.875	2.875	0.000	9.875		2.500	3.250	3.875	3.625	0.000	13.250
	5.750	7.875	8.125	8.500	4.000	8.500		9.750	11.875	12.125	12.500	8.000	12.500		13.000	14.000	15.375	15.250	11.625	15.375
Step 2	TI	CO	QU	SE	IN			TI	CO	QU	SE	IN			TI	CO	QU	SE	IN	
Time	0.000	0.235	0.221	0.221	0.088			0.000	0.240	0.230	0.230	0.140			0.000	0.228	0.236	0.244	0.171	
Cost	0.206	0.000	0.235	0.294	0.132			0.220	0.000	0.240	0.280	0.170			0.220	0.000	0.260	0.252	0.187	
Quality	0.206	0.221	0.000	0.265	0.103			0.220	0.230	0.000	0.260	0.150			0.228	0.228	0.000	0.260	0.187	
Service	0.206	0.279	0.279	0.000	0.147			0.220	0.270	0.270	0.000	0.180			0.236	0.244	0.252	0.000	0.211	
Innovation	0.059	0.191	0.221	0.221	0.000			0.120	0.210	0.230	0.230	0.000			0.163	0.211	0.252	0.236	0.000	
Step 3	TI	CO	QU	SE	IN			TI	CO	QU	SE	IN			TI	CO	QU	SE	IN	
Time	1							1							1					
Cost		1							1							1				
Quality			1							1							1			
Service				1							1							1		
Innovation					1							1							1	
Step 4	TI	CO	QU	SE	IN			TI	CO	QU	SE	IN			TI	CO	QU	SE	IN	
Time	1.000	-0.235	-0.221	-0.221	-0.088			1.000	-0.240	-0.230	-0.230	-0.140			1.000	-0.228	-0.236	-0.244	-0.171	
Cost	-0.206	1.000	-0.235	-0.294	-0.132			-0.220	1.000	-0.240	-0.280	-0.170			-0.220	1.000	-0.260	-0.252	-0.187	
Quality	-0.206	-0.221	1.000	-0.265	-0.103			-0.220	-0.230	1.000	-0.260	-0.150			-0.228	-0.228	1.000	-0.260	-0.187	
Service	-0.206	-0.279	-0.279	1.000	-0.147			-0.220	-0.270	-0.270	1.000	-0.180			-0.236	-0.244	-0.252	1.000	-0.211	
Innovation	-0.059	-0.191	-0.221	-0.221	1.000			-0.120	-0.210	-0.230	-0.230	1.000			-0.163	-0.211	-0.252	-0.236	1.000	
Step 5	TI	CO	QU	SE	IN			TI	CO	QU	SE	IN			TI	CO	QU	SE	IN	
Time	1.671	1.019	1.024	1.059	0.543			2.126	1.495	1.507	1.542	1.056			2.601	1.875	2.008	2.005	1.594	
Cost	0.911	1.919	1.127	1.202	0.627			1.382	2.390	1.603	1.666	1.140			1.840	2.753	2.092	2.078	1.660	
Quality	0.862	1.037	1.872	1.116	0.570			1.329	1.515	2.347	1.589	1.082			1.822	1.913	2.858	2.056	1.638	
Service	0.938	1.170	1.188	2.010	0.656			1.411	1.636	1.657	2.483	1.171			1.884	1.984	2.125	2.915	1.706	
Innovation	0.670	0.913	0.951	0.982	1.422			1.176	1.406	1.438	1.471	1.884			1.715	1.837	1.990	1.971	2.425	
Step 6	TI	CO	QU	SE	IN			TI	CO	QU	SE	IN			TI	CO	QU	SE	IN	
Time	0.671	1.019	1.024	1.059	0.543	4.316		1.126	1.495	1.507	1.542	1.056	6.727		1.601	1.875	2.008	2.005	1.594	9.084
Cost	0.911	0.919	1.127	1.202	0.627	4.785		1.382	1.390	1.603	1.666	1.140	7.181		1.840	1.753	2.092	2.078	1.660	9.423
Quality	0.862	1.037	0.872	1.116	0.570	4.457		1.329	1.515	1.347	1.589	1.082	6.861		1.822	1.913	1.858	2.056	1.638	9.288
Service	0.938	1.170	1.188	1.010	0.656	4.962		1.411	1.636	1.657	1.483	1.171	7.359		1.884	1.984	2.125	1.915	1.706	9.613
Innovation	0.670	0.913	0.951	0.982	0.422	3.938		1.176	1.406	1.438	1.471	0.884	6.376		1.715	1.837	1.990	1.971	1.425	8.938
	4.052	5.057	5.161	5.369	2.818			6.424	7.442	7.553	7.752	5.333			8.862	9.362	10.074	10.025	8.023	
Step 7	*Ri*	*Ci*	*Ri+Ci*	*Ri-Ci*	*Wi*	Rank		*Ri*	*Ci*	*Ri+Ci*	*Ri-Ci*	*Wi*	Rank		*Ri*	*Ci*	*Ri+Ci*	*Ri-Ci*	*Wi*	Rank
Time	4.316	4.052	8.367	0.264	0.186	4		6.727	6.424	13.151	0.302	0.191	4		9.084	8.862	17.946	0.222	0.194	4
Cost	4.785	5.057	9.843	-0.272	0.219	2		7.181	7.442	14.623	-0.261	0.212	2		9.423	9.362	18.785	0.061	0.203	3
Quality	4.457	5.161	9.618	-0.704	0.214	3		6.861	7.553	14.414	-0.692	0.209	3		9.288	10.074	19.362	-0.786	0.209	2
Service	4.962	5.369	10.331	-0.407	0.230	1		7.359	7.752	15.110	-0.393	0.219	1		9.613	10.025	19.639	-0.412	0.212	1
Innovation	3.938	2.818	6.756	1.119	0.150	5		6.376	5.333	11.708	1.043	0.170	5		8.938	8.023	16.961	0.915	0.183	5
			44.915							69.006							92.692			
		Ri			*Ci*			*Ri+Ci*			*Ri-Ci*									
Step 8	L	M	U	L	M	U	L	M	U	L	M	U	*Ri*	*Ci*	*Ri+Ci*	*Ri-Ci*	*Wi*	Rank		
Time	4.316	6.727	9.084	4.052	6.424	8.862	8.367	13.151	17.946	-4.546	0.302	5.032	6.713	6.440	13.154	0.273	0.191	4		
Cost	4.785	7.181	9.423	5.057	7.442	9.362	9.843	14.623	18.785	-4.577	-0.261	4.366	7.143	7.326	14.468	-0.183	0.210	2		
Quality	4.457	6.861	9.288	5.161	7.553	10.074	9.618	14.414	19.362	-5.617	-0.692	4.126	6.867	7.585	14.452	-0.719	0.210	3		
Service	4.962	7.359	9.613	5.369	7.752	10.025	10.331	15.110	19.639	-5.063	-0.393	4.244	7.323	7.724	15.048	-0.401	0.218	1		
Innovation	3.938	6.376	8.938	2.818	5.333	8.023	6.756	11.708	16.961	-4.085	1.043	6.120	6.407	5.377	11.783	1.030	0.171	5		
															68.905					

Appendix D

Table A4. Information of the data collected by eight experts for F-TOPSIS.

NO.	Expert 1	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN
1	S11	G	G	G	G	G	6	6	6	6	6	7	7	7	7	7	8	8	8	8	8
2	S12	VG	VG	VG	G	G	8	8	8	6	6	9	9	9	7	7	10	10	10	8	8
3	S13	F	G	G	F	G	4	6	6	4	6	5	7	7	5	7	6	8	8	6	8
4	S14	VG	VG	VG	VG	F	8	8	8	8	4	9	9	9	9	5	10	10	10	10	6
5	S15	F	F	F	F	VG	4	4	4	4	8	5	5	5	5	9	6	6	6	6	10
6	S16	G	P	G	VG	G	6	2	6	8	6	7	3	7	9	7	8	4	8	10	8
7	S21	F	F	F	G	G	4	4	4	6	6	5	5	5	7	7	6	6	6	8	8
8	S22	G	G	G	G	F	6	6	6	6	4	7	7	7	7	5	8	8	8	8	6
9	S23	VP	F	F	F	F	0	4	4	4	4	1	5	5	5	5	2	6	6	6	6
10	S24	P	P	F	P	F	2	2	4	2	4	3	3	5	3	5	4	4	6	4	6
11	S25	VP	VP	F	P	VP	0	0	4	2	0	1	1	5	3	1	2	2	6	4	2
12	S26	F	F	VP	F	F	4	4	0	4	4	5	5	1	5	5	6	6	2	6	6
13	S27	F	G	P	VP	P	4	6	2	0	2	5	7	3	1	3	6	8	4	2	4
NO.	Expert 2	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN
1	S11	G	F	F	P	G	6	4	4	2	6	7	5	5	3	7	8	6	6	4	8
2	S12	G	VG	VG	F	G	6	8	8	4	6	7	9	9	5	7	8	10	10	6	8
3	S13	F	F	G	F	G	4	4	6	4	6	5	5	7	5	7	6	6	8	6	8
4	S14	VG	VG	VG	VG	F	8	8	8	8	4	9	9	9	9	5	10	10	10	10	6
5	S15	VG	G	F	VG	VG	8	6	4	8	8	9	7	5	9	9	10	8	6	10	10
6	S16	VG	P	G	VG	G	8	2	6	8	6	9	3	7	9	7	10	4	8	10	8
7	S21	F	F	G	G	G	4	4	6	6	6	5	5	7	7	7	6	6	8	8	8
8	S22	G	G	G	G	F	6	6	6	6	4	7	7	7	7	5	8	8	8	8	6
9	S23	VP	F	F	F	F	0	4	4	4	4	1	5	5	5	5	2	6	6	6	6
10	S24	F	P	F	F	F	4	2	4	4	4	5	3	5	5	5	6	4	6	6	6
11	S25	P	VP	P	P	P	2	0	2	2	2	3	1	3	3	3	4	2	4	4	4
12	S26	P	G	VP	VP	VP	2	6	0	0	0	3	7	1	1	1	4	8	2	2	2
13	S27	F	G	F	F	P	4	6	4	4	2	5	7	5	5	3	6	8	6	6	4
NO.	Expert 3	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN
1	S11	F	F	F	P	P	4	4	4	2	2	5	5	5	3	3	6	6	6	4	4
2	S12	G	F	VG	G	G	6	4	8	6	6	7	5	9	7	7	8	6	10	8	8
3	S13	F	VG	F	F	F	4	8	4	4	4	5	9	5	5	5	6	10	6	6	6
4	S14	VG	G	G	VG	F	8	6	6	8	4	9	7	7	9	5	10	8	8	10	6
5	S15	F	G	P	F	G	4	6	2	4	6	5	7	3	5	7	6	8	4	6	8
6	S16	F	F	F	G	VG	4	4	4	6	8	5	5	5	7	9	6	6	6	8	10
7	S21	G	F	G	G	G	6	4	6	6	6	7	5	7	7	7	8	6	8	8	8
8	S22	P	P	P	F	F	2	2	2	4	4	3	3	3	5	5	4	4	4	6	6
9	S23	P	P	P	P	P	2	2	2	2	2	3	3	3	3	3	4	4	4	4	4
10	S24	P	F	F	F	F	2	4	4	4	4	3	5	5	5	5	4	6	6	6	6
11	S25	VP	VP	VP	VP	VP	0	0	0	0	0	1	1	1	1	1	2	2	2	2	2
12	S26	P	P	P	P	P	2	2	2	2	2	3	3	3	3	3	4	4	4	4	4
13	S27	F	G	F	P	P	4	6	4	2	2	5	7	5	3	3	6	8	6	4	4
NO.	Expert 4	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN
1	S11	F	G	G	P	P	4	6	6	2	2	5	7	7	3	3	6	8	8	4	4
2	S12	VG	VG	VG	G	F	8	8	8	6	4	9	9	9	7	5	10	10	10	8	6
3	S13	F	F	G	F	G	4	4	6	4	6	5	5	7	5	7	6	6	8	6	8
4	S14	VG	VG	VG	VG	F	8	8	8	8	4	9	9	9	9	5	10	10	10	10	6
5	S15	F	G	G	G	VG	4	6	6	6	8	5	7	7	7	9	6	8	8	8	10
6	S16	G	P	G	VG	G	6	2	6	8	6	7	3	7	9	7	8	4	8	10	8
7	S21	F	P	F	F	P	4	2	4	4	2	5	3	5	5	3	6	4	6	6	4
8	S22	P	G	G	P	P	2	6	6	2	2	3	7	7	3	3	4	8	8	4	4
9	S23	VP	F	G	P	P	0	4	6	2	2	1	5	7	3	3	2	6	8	4	4
10	S24	G	P	F	F	F	6	2	4	4	4	7	3	5	5	5	8	4	6	6	6
11	S25	VP	P	VP	VP	F	0	2	0	0	4	1	3	1	1	5	2	4	2	2	6
12	S26	P	VP	P	F	VP	2	0	2	4	0	3	1	3	5	1	4	2	4	6	2
13	S27	F	F	P	F	P	4	4	2	4	2	5	5	3	5	3	6	6	4	6	4
NO.	Expert 5	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN
1	S11	G	G	G	P	G	6	6	6	2	6	7	7	7	3	7	8	8	8	4	8
2	S12	F	F	VG	F	F	4	4	8	4	4	5	5	9	5	5	6	6	10	6	6
3	S13	F	F	G	F	F	4	4	6	4	4	5	5	7	5	5	6	6	8	6	6
4	S14	G	VG	VG	VG	G	6	8	8	8	6	7	9	9	9	7	8	10	10	10	8
5	S15	VG	G	F	VG	VG	8	6	4	8	8	9	7	5	9	9	10	8	6	10	10
6	S16	VG	P	F	G	P	8	2	4	6	2	9	3	5	7	3	10	4	6	8	4
7	S21	VP	VP	P	P	P	0	0	2	2	2	1	1	3	3	3	2	2	4	4	4
8	S22	P	G	P	P	P	2	6	2	2	2	3	7	3	3	3	4	8	4	4	4
9	S23	P	F	F	P	P	2	4	4	2	2	3	5	5	3	3	4	6	6	4	4
10	S24	VG	P	P	G	G	8	2	2	6	6	9	3	3	7	7	10	4	4	8	8
11	S25	VP	P	VP	VP	VP	0	2	0	0	0	1	3	1	1	1	2	4	2	2	2
12	S26	P	G	P	P	F	2	6	2	2	4	3	7	3	3	5	4	8	4	4	6
13	S27	F	VG	G	F	VG	4	8	6	4	8	5	9	7	5	9	6	10	8	6	10
NO.	Expert 6	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN
1	S11	G	G	G	P	G	6	6	6	2	6	7	7	7	3	7	8	8	8	4	8
2	S12	F	F	VG	F	F	4	4	8	4	4	5	5	9	5	5	6	6	10	6	6
3	S13	F	F	G	F	F	4	4	6	4	4	5	5	7	5	5	6	6	8	6	6
4	S14	G	VG	VG	VG	G	6	8	8	8	6	7	9	9	9	7	8	10	10	10	8
5	S15	VG	G	F	VG	VG	8	6	4	8	8	9	7	5	9	9	10	8	6	10	10
6	S16	VG	P	F	G	P	8	2	4	6	2	9	3	5	7	3	10	4	6	8	4
7	S21	VP	VP	P	P	P	0	0	2	2	2	1	1	3	3	3	2	2	4	4	4
8	S22	P	G	P	P	P	2	6	2	2	2	3	7	3	3	3	4	8	4	4	4
9	S23	P	F	F	P	P	2	4	4	2	2	3	5	5	3	3	4	6	6	4	4
10	S24	VG	P	P	G	G	8	2	2	6	6	9	3	3	7	7	10	4	4	8	8
11	S25	VP	P	VP	VP	VP	0	2	0	0	0	1	3	1	1	1	2	4	2	2	2
12	S26	P	G	P	P	F	2	6	2	2	4	3	7	3	3	5	4	8	4	4	6
13	S27	F	VG	G	F	VG	4	8	6	4	8	5	9	7	5	9	6	10	8	6	10
NO.	Expert 7	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN
1	S11	G	G	F	P	F	6	6	4	2	4	7	7	5	3	5	8	8	6	4	6
2	S12	G	F	VG	F	F	6	4	8	4	4	7	5	9	5	5	8	6	10	6	6
3	S13	F	G	VG	VP	G	4	6	8	0	6	5	7	9	1	7	6	8	10	2	8
4	S14	F	VG	F	VG	G	4	8	4	8	6	5	9	5	9	7	6	10	6	10	8
5	S15	VG	VG	F	VG	VG	8	8	4	8	8	9	9	5	9	9	10	10	6	10	10
6	S16	VG	F	P	G	G	8	4	2	6	6	9	5	3	7	7	10	6	4	8	8
7	S21	P	P	G	F	F	2	2	6	4	4	3	3	7	5	5	4	4	8	6	6
8	S22	P	G	G	F	VP	2	6	6	4	0	3	7	7	5	1	4	8	8	6	2
9	S23	VP	P	F	P	P	0	2	4	2	2	1	3	5	3	3	2	4	6	4	4
10	S24	VG	F	P	G	G	8	4	2	6	6	9	5	3	7	7	10	6	4	8	8
11	S25	VP	P	P	F	P	0	2	2	4	2	1	3	3	5	3	2	4	4	6	4
12	S26	P	F	VP	F	F	2	4	0	4	4	3	5	1	5	5	4	6	2	6	6
13	S27	F	F	F	G	VG	4	4	4	6	8	5	5	5	7	9	6	6	6	8	10
NO.	Expert 8	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN	TI	CO	QU	SE	IN
1	S11	G	F	F	P	P	6	4	4	2	2	7	5	5	3	3	8	6	6	4	4
2	S12	VG	F	VG	G	F	8	4	8	6	4	9	5	9	7	5	10	6	10	8	6
3	S13	F	G	VG	F	G	4	6	8	4	6	5	7	9	5	7	6	8	10	6	8
4	S14	F	VG	G	VG	F	4	8	6	8	4	5	9	7	9	5	6	10	8	10	6
5	S15	G	VG	F	G	VG	6	8	4	6	8	7	9	5	7	9	8	10	6	8	10
6	S16	VG	G	F	G	F	8	6	4	6	4	9	7	5	7	5	10	8	6	8	6
7	S21	F	F	G	F	G	4	4	6	4	6	5	5	7	5	7	6	6	8	6	8
8	S22	F	G	G	G	P	4	6	6	2	2	5	7	7	7	3	6	8	8	8	4
9	S23	P	P	F	F	VP	2	2	4	4	0	3	3	5	5	1	4	4	6	6	2
10	S24	G	F	P	P	G	6	4	2	2	6	7	5	3	3	7	8	6	4	4	8
11	S25	VP	VP	P	P	P	0	0	2	2	2	1	1	3	3	3	2	2	4	4	4
12	S26	P	P	VP	VP	P	2	2	0	0	2	3	3	1	1	3	4	4	2	2	4
13	S27	P	G	P	F	F	2	6	2	4	4	3	7	3	5	5	4	8	4	6	6

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Appendix E

Table A5. F-TOPSIS method of Excel calculation steps.

NO.	Average	TI			CO			OU			SE			IN		
1	S11	5.5	5.25	5	2.5	4.25	6.5	6.25	6	3.5	5.25	7.5	7.25	7	4.5	6.25
2	S12	6.25	5.5	8	5	4.75	7.25	6.5	9	6	5.75	8.25	7.5	10	7	6.75
3	S13	4	5.25	6.25	3.5	5.25	5	6.25	7.25	4.5	6.25	6	7.25	8.25	5.5	7.25
4	S14	6.5	7.75	7	8	4.75	7.5	8.75	8	9	5.75	8.5	9.75	9	10	6.75
5	S15	6.25	6.25	4	6.5	7.75	7.25	7.25	5	7.5	8.75	8.25	8.25	6	8.5	9.75
6	S16	7	3	4.5	6.75	5	8	4	5.5	7.75	6	9	5	6.5	8.75	7
7	S21	3	2.5	4.5	4.25	4.25	4	3.5	5.5	5.25	5.25	5	4.5	6.5	6.25	6.25
8	S22	3.25	5.5	4.5	4	2.5	4.25	6.5	5.5	5	3.5	5.25	7.5	6.5	6	4.5
9	S23	1	3.25	4	2.75	2.25	2	4.25	5	3.75	3.25	3	5.25	6	4.75	4.25
10	S24	5.5	2.75	3	4.25	5	6.5	3.75	4	5.25	6	7.5	4.75	5	6.25	7
11	S25	0.25	1	1.25	1.25	1.25	1.25	2	2.25	2.25	2.25	2.25	3	3.25	3.25	3.25
12	S26	2.25	3.75	1	2.25	2.5	3.25	4.75	2	3.25	3.5	4.25	5.75	3	4.25	4.5
13	S27	3.75	6	3.75	3.5	4.5	4.75	7	4.75	4.5	5.5	5.75	8	5.75	5.5	6.5

		TI			CO			QU			SE			IN		
NO.		L	M	U	L	M	U	L	M	U	L	M	U	L	M	U
1	S11	5.5	6.5	7.5	5.25	6.25	7.25	5	6	7	2.5	3.5	4.5	4.25	5.25	6.25
2	S12	6.25	7.25	8.25	5.5	6.5	7.5	8	9	10	5	6	7	4.75	5.75	6.75
3	S13	4	5	6	5.25	6.25	7.25	6.25	7.25	8.25	3.5	4.5	5.5	5.25	6.25	7.25
4	S14	6.5	7.5	8.5	7.75	8.75	9.75	7	8	9	8	9	10	4.75	5.75	6.75
5	S15	6.25	7.25	8.25	6.25	7.25	8.25	4	5	6	6.5	7.5	8.5	7.75	8.75	9.75
6	S16	7	8	9	3	4	5	4.5	5.5	6.5	6.75	7.75	8.75	5	6	7
7	S21	3	4	5	2.5	3.5	4.5	4.5	5.5	6.5	4.25	5.25	6.25	4.25	5.25	6.25
8	S22	3.25	4.25	5.25	5.5	6.5	7.5	4.5	5.5	6.5	4	5	6	2.5	3.5	4.5
9	S23	1	2	3	3.25	4.25	5.25	4	5	6	2.75	3.75	4.75	2.25	3.25	4.25
10	S24	5.5	6.5	7.5	2.75	3.75	4.75	3	4	5	4.25	5.25	6.25	5	6	7
11	S25	0.25	1.25	2.25	1	2	3	1.25	2.25	3.25	1.25	2.25	3.25	1.25	2.25	3.25
12	S26	2.25	3.25	4.25	3.75	4.75	5.75	1	2	3	2.25	3.25	4.25	2.5	3.5	4.5
13	S27	3.75	4.75	5.75	6	7	8	3.75	4.75	5.75	3.5	4.5	5.5	4.5	5.5	6.5
	Aspiration	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	Worst	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

		TI			CO			QU			SE			IN		
NO.		L	M	U	L	M	U	L	M	U	L	M	U	L	M	U
1	S11	0.55	0.65	0.75	0.525	0.625	0.725	0.5	0.6	0.7	0.25	0.35	0.45	0.425	0.525	0.625
2	S12	0.625	0.725	0.825	0.55	0.65	0.75	0.8	0.9	1	0.5	0.6	0.7	0.475	0.575	0.675
3	S13	0.4	0.5	0.6	0.525	0.625	0.725	0.625	0.725	0.825	0.35	0.45	0.55	0.525	0.625	0.725
4	S14	0.65	0.75	0.85	0.775	0.875	0.975	0.7	0.8	0.9	0.8	0.9	1	0.475	0.575	0.675
5	S15	0.625	0.725	0.825	0.625	0.725	0.825	0.4	0.5	0.6	0.65	0.75	0.85	0.775	0.875	0.975
6	S16	0.7	0.8	0.9	0.3	0.4	0.5	0.45	0.55	0.65	0.675	0.775	0.875	0.5	0.6	0.7
7	S21	0.3	0.4	0.5	0.25	0.35	0.45	0.45	0.55	0.65	0.425	0.525	0.625	0.425	0.525	0.625
8	S22	0.325	0.425	0.525	0.55	0.65	0.75	0.45	0.55	0.65	0.4	0.5	0.6	0.25	0.35	0.45
9	S23	0.1	0.2	0.3	0.325	0.425	0.525	0.4	0.5	0.6	0.275	0.375	0.475	0.225	0.325	0.425
10	S24	0.55	0.65	0.75	0.275	0.375	0.475	0.3	0.4	0.5	0.425	0.525	0.625	0.5	0.6	0.7
11	S25	0.025	0.125	0.225	0.1	0.2	0.3	0.125	0.225	0.325	0.125	0.225	0.325	0.125	0.225	0.325
12	S26	0.225	0.325	0.425	0.375	0.475	0.575	0.1	0.2	0.3	0.225	0.325	0.425	0.25	0.35	0.45
13	S27	0.375	0.475	0.575	0.6	0.7	0.8	0.375	0.475	0.575	0.35	0.45	0.55	0.45	0.55	0.65
	Aspiration	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Worst	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Criteria weights	0.1909			0.2100			0.2097			0.2184			0.1710		
		TI			CO			QU			SE			IN		
NO.		L	M	U	L	M	U	L	M	U	L	M	U	L	M	U
1	S11	0.105	0.124	0.143	0.110	0.131	0.152	0.105	0.126	0.147	0.055	0.076	0.098	0.073	0.090	0.107
2	S12	0.119	0.138	0.157	0.115	0.136	0.157	0.168	0.189	0.210	0.109	0.131	0.153	0.081	0.098	0.115
3	S13	0.076	0.095	0.115	0.110	0.131	0.152	0.131	0.152	0.173	0.076	0.098	0.120	0.090	0.107	0.124
4	S14	0.124	0.143	0.162	0.163	0.184	0.205	0.147	0.168	0.189	0.175	0.197	0.218	0.081	0.098	0.115
5	S15	0.119	0.138	0.157	0.131	0.152	0.173	0.084	0.105	0.126	0.142	0.164	0.186	0.133	0.150	0.167
6	S16	0.134	0.153	0.172	0.063	0.084	0.105	0.094	0.115	0.136	0.147	0.169	0.191	0.086	0.103	0.120
7	S21	0.057	0.076	0.095	0.052	0.073	0.094	0.094	0.115	0.136	0.093	0.115	0.136	0.073	0.090	0.107
8	S22	0.062	0.081	0.100	0.115	0.136	0.157	0.094	0.115	0.136	0.087	0.109	0.131	0.043	0.060	0.077
9	S23	0.019	0.038	0.057	0.068	0.089	0.110	0.084	0.105	0.126	0.060	0.082	0.104	0.038	0.056	0.073
10	S24	0.105	0.124	0.143	0.058	0.079	0.100	0.063	0.084	0.105	0.093	0.115	0.136	0.086	0.103	0.120
11	S25	0.005	0.024	0.043	0.021	0.042	0.063	0.026	0.047	0.068	0.027	0.049	0.071	0.021	0.038	0.056
12	S26	0.043	0.062	0.081	0.079	0.100	0.121	0.021	0.042	0.063	0.049	0.071	0.093	0.043	0.060	0.077
13	S27	0.072	0.091	0.110	0.126	0.147	0.168	0.079	0.100	0.121	0.076	0.098	0.120	0.077	0.094	0.111
	Aspiration	0.191	0.191	0.191	0.210	0.210	0.210	0.210	0.210	0.210	0.218	0.218	0.218	0.171	0.171	0.171
	Worst	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

		TI			CO			QU			SE			IN		
NO.	D+	L	M	U	L	M	U	L	M	U	L	M	U	L	M	U
1	S11	0.007	0.004	0.002	0.010	0.006	0.003	0.011	0.007	0.004	0.027	0.020	0.014	0.010	0.007	0.004
2	S12	0.005	0.003	0.001	0.009	0.005	0.003	0.002	0.000	0.000	0.012	0.008	0.004	0.008	0.005	0.003
3	S13	0.013	0.009	0.006	0.010	0.006	0.003	0.006	0.003	0.001	0.020	0.014	0.010	0.007	0.004	0.002
4	S14	0.004	0.002	0.001	0.002	0.001	0.000	0.004	0.002	0.000	0.002	0.000	0.000	0.008	0.005	0.003
5	S15	0.005	0.003	0.001	0.006	0.003	0.001	0.016	0.011	0.007	0.006	0.003	0.001	0.001	0.000	0.000
6	S16	0.003	0.001	0.000	0.022	0.016	0.011	0.013	0.009	0.005	0.005	0.002	0.001	0.007	0.005	0.003
7	S21	0.018	0.013	0.009	0.025	0.019	0.013	0.013	0.009	0.005	0.016	0.011	0.007	0.010	0.007	0.004
8	S22	0.017	0.012	0.008	0.009	0.005	0.003	0.013	0.009	0.005	0.017	0.012	0.008	0.016	0.012	0.009
9	S23	0.030	0.023	0.018	0.020	0.015	0.010	0.016	0.011	0.007	0.025	0.019	0.013	0.018	0.013	0.010
10	S24	0.007	0.004	0.002	0.023	0.017	0.012	0.022	0.016	0.011	0.016	0.011	0.007	0.007	0.005	0.003
11	S25	0.035	0.028	0.022	0.036	0.028	0.022	0.034	0.026	0.020	0.037	0.029	0.022	0.022	0.018	0.013
12	S26	0.022	0.017	0.012	0.017	0.012	0.008	0.036	0.028	0.022	0.029	0.022	0.016	0.016	0.012	0.009
13	S27	0.014	0.010	0.007	0.007	0.004	0.002	0.017	0.012	0.008	0.020	0.014	0.010	0.009	0.006	0.004

NO.	D+	TI	CO	QU	SE	IN
1	S11	0.005	0.006	0.007	0.020	0.007	0.213
2	S12	0.003	0.006	0.001	0.008	0.005	0.150
3	S13	0.009	0.006	0.004	0.015	0.004	0.195
4	S14	0.002	0.001	0.002	0.001	0.005	0.107
5	S15	0.003	0.004	0.011	0.003	0.001	0.147
6	S16	0.002	0.016	0.009	0.003	0.005	0.185
7	S21	0.013	0.019	0.009	0.011	0.007	0.243
8	S22	0.012	0.006	0.009	0.012	0.013	0.227
9	S23	0.024	0.015	0.011	0.019	0.013	0.286
10	S24	0.005	0.017	0.016	0.011	0.005	0.232
11	S25	0.028	0.028	0.027	0.029	0.018	0.360
12	S26	0.017	0.012	0.028	0.022	0.013	0.303
13	S27	0.010	0.004	0.012	0.015	0.006	0.218

		TI			CO			QU			SE			IN		
NO.	D-	L	M	U	L	M	U	L	M	U	L	M	U	L	M	U
1	S11	0.011	0.015	0.020	0.012	0.017	0.023	0.011	0.016	0.022	0.003	0.006	0.010	0.005	0.008	0.011
2	S12	0.014	0.019	0.025	0.013	0.019	0.025	0.028	0.036	0.044	0.012	0.017	0.023	0.007	0.010	0.013
3	S13	0.006	0.009	0.013	0.012	0.017	0.023	0.017	0.023	0.030	0.006	0.010	0.014	0.008	0.011	0.015
4	S14	0.015	0.020	0.026	0.026	0.034	0.042	0.022	0.028	0.036	0.031	0.039	0.048	0.007	0.010	0.013
5	S15	0.014	0.019	0.025	0.017	0.023	0.030	0.007	0.011	0.016	0.020	0.027	0.034	0.018	0.022	0.028
6	S16	0.018	0.023	0.030	0.004	0.007	0.011	0.009	0.013	0.019	0.022	0.029	0.037	0.007	0.011	0.014
7	S21	0.003	0.006	0.009	0.003	0.005	0.009	0.009	0.013	0.019	0.009	0.013	0.019	0.005	0.008	0.011
8	S22	0.004	0.007	0.010	0.013	0.019	0.025	0.009	0.013	0.019	0.008	0.012	0.017	0.002	0.004	0.006
9	S23	0.000	0.001	0.003	0.005	0.008	0.012	0.007	0.011	0.016	0.004	0.007	0.011	0.001	0.003	0.005
10	S24	0.011	0.015	0.020	0.003	0.006	0.010	0.004	0.007	0.011	0.009	0.013	0.019	0.007	0.011	0.014
11	S25	0.000	0.001	0.002	0.000	0.002	0.004	0.001	0.002	0.005	0.001	0.002	0.005	0.000	0.001	0.003
12	S26	0.002	0.004	0.007	0.006	0.010	0.015	0.000	0.002	0.004	0.002	0.005	0.009	0.002	0.004	0.006
13	S27	0.005	0.008	0.012	0.016	0.022	0.028	0.006	0.010	0.015	0.006	0.010	0.014	0.006	0.009	0.012

NO.	D-	TI	CO	QU	SE	IN
1	S11	0.016	0.017	0.016	0.006	0.008	0.252
2	S12	0.019	0.019	0.036	0.017	0.010	0.318
3	S13	0.009	0.017	0.023	0.010	0.012	0.267
4	S14	0.021	0.034	0.028	0.039	0.010	0.363
5	S15	0.019	0.023	0.011	0.027	0.023	0.322
6	S16	0.024	0.007	0.014	0.029	0.011	0.290
7	S21	0.006	0.006	0.014	0.013	0.008	0.216
8	S22	0.007	0.019	0.014	0.012	0.004	0.235
9	S23	0.002	0.008	0.011	0.007	0.003	0.177
10	S24	0.016	0.006	0.007	0.013	0.011	0.231
11	S25	0.001	0.002	0.002	0.003	0.002	0.097
12	S26	0.004	0.010	0.002	0.005	0.004	0.159
13	S27	0.008	0.022	0.010	0.010	0.009	0.243

NO.		$D+$	$D-$	CC	$*Wi$	RANK
1	S11	0.2132	0.2517	0.0051	0.0535	6
2	S12	0.1501	0.3182	0.0481	0.5066	3
3	S13	0.1954	0.2675	0.0163	0.1713	5
4	S14	0.1072	0.3629	0.0771	0.8126	1
5	S15	0.1467	0.3218	0.0504	0.5306	2
6	S16	0.1853	0.2896	0.0268	0.2819	4
7	S21	0.2429	0.2162	-0.0165	-0.1737	10
8	S22	0.2273	0.2346	-0.0052	-0.0550	8
9	S23	0.2861	0.1767	-0.0440	-0.4637	11
10	S24	0.2323	0.2309	-0.0082	-0.0859	9
11	S25	0.3602	0.0973	-0.0949	-1.0000	13
12	S26	0.3033	0.1587	-0.0557	-0.5868	12
13	S27	0.2179	0.2434	0.0008	0.0086	7
		2.8680	3.1695	-0.0949		

	draw picture	
	S11	0.0535
	S12	0.5066
	S13	0.1713
	S14	0.8126
	S15	0.5306
	S16	0.2819
	S21	-0.1737
	S22	-0.0550
	S23	-0.4637
	S24	-0.0859
	S25	-1.0000
	S26	-0.5868
	S27	0.0086

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