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The Study of DANP and VIKOR Multiple Criteria Decision Making in the Post Pandemic Era Logistics: A Case of Contactless Distribution Scheme Selection

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Abstract. Nowadays, the coronavirus disease, aka COVID-19, has caused a great impact. In a very short time, the epidemic has swept the world. There are many restrictions on work, eating, shopping and even social distance. For these reasons, there is no contact for these activities. Delivery has become the best preferred method of logistics distribution. In addition to unmanned delivery vehicles (for example, autonomous vehicles, unmanned aircraft, autonomous mobile robots), contactless delivery also includes i-mailboxes, delivery platforms, smart food drawers, unmanned stores, etc. These methods avoid direct contact between people and reduce the risk of infection. In this study, the decision-making trial and evaluation laboratory analysis method (DEMATEL) combined with the analytic network process analysis method (ANP), named DEMATEL-based ANP (DANP), and the VIKOR (VlseKriterijumska optimizacija I Kompromisno Resenje) compromise ranking method are proposed to optimize the compromise solution method for contactless distribution plan rating. This research proposes five dimensions: security, delivery, convenience, competitive condition and temperature control, and 20 criteria under these dimensions, and select the most suitable solution through the above two methods. The results of this research show that the contactless distribution scheme selection method is competent to analyze the weight and performance evaluation of the relationship structure of consumers in the contactless distribution scheme selection structure through questionnaires, explore the most suitable distribution scheme, and provide consumers with reference for choosing a distribution solution alternative.

Keywords: post-epidemic era, contactless distribution, DANP, VIKOR, COVID-19

1. Introduction

The COVID-19 pandemic rages on. all people entering the country must be quarantined at home. Recently, the number of people in self-isolation has also increased, causing the retail industry (such as department stores, chain brands, shopping malls and retail stores, etc.) and the food service industry (such as chain restaurants and restaurants, etc.) to face operating difficulties. The history shows that even after the pandemic, people's usage habits may slightly return to the pre-pandemic, but some new usage behaviors or new lifestyle may accelerate acceptance, or even mix with the original behaviors [1]. During the pandemic, social intervention measures are dedicated to reduce interpersonal contact and avoid spatial clusters. These measures are collectively referred to as "social distancing" by the public health community and officials resulting in "Contactless economy" [2].

"Contactless" did not appear recently. As early as 2002, when SARS broke out, a trend of "Touchless Economy" was also spawned. The COVID-19 brought new business opportunities to various industries. So as to reduce the need of going out and gathering during the epidemic, many delivery platforms have become the first choice for the stay-at-home economy, as contactless delivery services are safe and can be selected on the delivery platform [3]. Therefore, in the post-pandemic era, how to make good use of high-tech contactless delivery and meet the needs of consumers with the most suitable delivery method is worthy of our discussion and research. Though the coronavirus has strong interpersonal transmission characteristics, the basic needs of consumers in daily life still need to be fulfilled. In order to prevent and control the

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pandemic, contactless delivery has become the current inelastic demand [4]. In the case of people eating out less, the performance of food delivery platforms have improved. Recently, Uber Eats, Foodpanda, Deliveroo all launched "contactless food delivery" options to users, allowing customers to specify the location of meals to avoid direct contact with others to reduce the risk of infection [5]. The appearance of contactless delivery in Taiwan is diversified. In addition to the delivery platform, there are also i-mailboxes, drones, and intelligent meal taking platform.

This study utilizes the DEMATEL-based ANP (DANP) and the best multi-criteria compromise solution (VlseKriterijumska Optimizacija I Kompromisno Resenje, VIKOR) in the multi-criteria decision-making method to establish the best choice for the contactless distribution plan. Besides, the study also explores the most suitable contactless distribution plan for consumers based on these two analytical methods.

1) Based on logistics in the post-epidemic era, DANP is used to explore the influence correlation between consumers and safety, convenience and delivery structures and guidelines under omnichannel logistics , and then convert the influence of contactless delivery factors into importance. To establish a contactless distribution plan program evaluation system.

2) VIKOR is used to evaluate the contactless distribution plan and to find the most suitable solution in the candidate through the system structure model.

The remainder of this paper is organized as follows. Section 2 conducts a review of the relevant literature. Section 3 explains the proposed method for the selection problem. Section 4 illustrates an experimental example of the proposed selection method. Section 6 concludes the results and remarks some management Implications of this study.

2. Literature Review

Delivery without physical touch, this new concept and new changes in logistics and distribution have triggered heated discussions in various industries. Due to the strong interpersonal transmission characteristics of the Covid-19, but the basic needs of consumers' daily lives still need to be met. In order to prevent and control the epidemic, contactless delivery has become an urgent need. Recently, food delivery companies see the crisis as a turning point, completed the research and development of the contactless distribution solution. Ensure the safety of meal suppliers, distributors and consumers in the process of receiving and delivering meals, try to reduce the chance of infection from person-to-person contact [6].

Most contactless delivery is food delivery. Food hygiene refers to all measures necessary to ensure the safety, completeness and integrity of food in the whole process from cultivation (or breeding), production, manufacturing to the final consumer. Take appropriate measures for food corruption, rancidity, toxic and harmful substances, contamination of pathogenic microorganisms, and mixing of foreign objects, and try to avoid food, packaging equipment, etc. from contaminating food with toxic substances [7]. Perishable foods include fruits, vegetables, beans, eggs, meat and fish, which can be divided into plant products and animal products [8]. For perishable food, customer satisfaction is mainly reflected in the freshness. Because a lot of value will be lost in the delivery process, it has increased the complexity of many perishable food truck routing issues [9].

Compared to most product supply chains, food supply chains are often more complex and more difficult to manage because the food product is perishable and has a short shelf life. A cold chain or temperature-controlled supply chain provides the essential facilities and methods required to maintain the quality and quantity of foods. Since foods can be time and temperature sensitive in nature, they need to be properly taken care of in terms of harvesting, preparation, packaging, transportation and handling – in other words, throughout the entire chain. Temperature is the most important factor in prolonging or maintaining the shelf life of perishables. Refrigeration is one of most widely used methods to date to slow the bacteria growth that leads to food deterioration. The proper control and management of temperature is crucial in delivering perishables to consumers and ensuring that those perishables are in good condition and safe to eat [10].

In addition to perishable food that needs to be refrigerated, it is also necessary to consider cooked food that needs to be kept warm. Used to keep the pre-cooked food at the selected holding temperature. The device includes a cabinet, the cabinet has at least one accommodating chamber, and pre-cooked food in the

accommodating chamber, and the food has been pre-cooked in a cooking appliance. At least one radiant heat source is spaced less than 12 inches above the food to transfer radiant heat to the food. The control mechanism changes the radiant heat transferred from the heat source to the food to keep the food at the selected holding temperature [11]. The way of picking up goods also affects people's willingness to use contactless delivery, like home delivery, pick up at designated locations, etc. Therefore, Therefore, it is necessary to propose a set of effective evaluation and selection methods for the contactless distribution scheme selection problem.

3. Proposed Method

This study adopts DANP and VIKOR as a hybrid multiple criteria decision making (MCDM) proposed by [12] and [13] to find the most suitable solution for the system structure model. The procedures that are used in the proposed method are described as follows.

3.1. DEMATEL

Step1: The relevant literature lists the factors in the system for pairwise comparison to evaluate each respondent's perception of the impact of the dimension. The integer evaluation scales are: no impact (0), low impact (1), medium impact (2), high impact (3), and very high impact (4). The initial direct relationship matrix A is obtained by averaging the scoring matrix of the degree of influence of all the factors judged by the experts, and a_ij represents the influencing factor of the i factor affecting the j factor, as shown in formula (1).

$$A = \begin{bmatrix} a_{11} & \cdots & a_{1j} & \cdots & a_{1n} \\ \vdots & & \vdots & & \vdots \\ a_{i1} & \cdots & a_{ij} & \cdots & a_{in} \\ \vdots & & \vdots & & \vdots \\ a_{n1} & \cdots & a_{nj} & \cdots & a_{nn} \end{bmatrix} \tag{1}$$

Step2: Formalization of the initial direct relationship matrix A is obtained by formalization of formula (2) and (3) of the formalized direct relationship matrix D, while formalization of direct relationship matrix D will be directly and indirectly affected by itself, and the total influence relationship matrix T can be derived from formula (4).

$$S = max\left[\max_{1\le i\le n}\sum_{j=1}^{n} a_{ij} \ , \ \max_{1\le i\le 1in}\sum_{i=1}^{n} a_{ij}\right] \tag{2}$$

$$D = \frac{A}{S} \tag{3}$$

$$T = D + D^2 + \cdots + D^m \quad = D(I + D + D^2 + \cdots + D^{m-1}) \quad = D(I - D)^{-1} \tag{4}$$

Step3: Draw an Influential Network Relation Map(INRM). By adding up the rows and columns of T individually, the sum of the rows and columns T_d and the sum of the rows T_r can be obtained. $T_r + T_d$ represents the strength of the relationship between the factors called centrality; $T_r - T_d$ Represents the influence between factors or the intensity of the influence is called the degree of cause.Use D+R as the X axis and D-R as the Y axis to draw the influence network relationship diagram.

3.2. ANP

Step4: Establish a matrix of criteria and total influence of dimensions. The total influence relationship matrix T generated by DEMATEL is divided into $T_C = T = \left[t_C^{ij}\right]_{n\times n}$ and $T_D = \left[t_D^{ij}\right]_{m\times m}$, defined as formula (5) and (6).

$$T_C = \begin{array}{c} \\ D_1 \\ \vdots \\ D_i \\ \vdots \\ D_m \end{array} \begin{array}{c} \begin{array}{ccccc} D_1 & \cdots & D_i & \cdots & D_m \end{array} \\ \begin{bmatrix} T_C^{11} & \cdots & T_C^{1j} & \cdots & T_C^{1m} \\ \vdots & & \vdots & & \vdots \\ T_C^{i1} & \cdots & T_C^{ij} & \cdots & T_C^{im} \\ \vdots & & \vdots & & \vdots \\ T_C^{m1} & \cdots & T_C^{mj} & \cdots & T_C^{mm} \end{bmatrix} \end{array} \tag{5}$$

$$T_D = \begin{bmatrix} t_D^{11} & \cdots & t_D^{1j} & \cdots & t_D^{1m} \\ \vdots & & \vdots & & \vdots \\ t_D^{i1} & \cdots & t_D^{ij} & \cdots & t_D^{im} \\ \vdots & & \vdots & & \vdots \\ t_D^{m1} & \cdots & t_D^{mj} & \cdots & t_D^{mm} \end{bmatrix} \begin{matrix} \\ \\ \rightarrow \sum_{j=1}^{m} t_D^{ij} = t_D^{i} \\ \\ \\ \end{matrix} \quad (6)$$

Step5: Establish the total influence relationship matrix of the dimension and standard normalization. Through the T_D dimension total influence relationship matrix in formula (6), the sum of the columns of the matrix is $t_D^i = \sum_{j=1}^{m} t_D^{ij}$, and the corresponding values of the dimensions of each column are normalized, That is, the dimension normalization affects the relationship matrix T_D^{nor}, as in formula (7). The normalization procedure similar to formula (6) can normalize the total influence relationship matrix T_C of n criterion factors into T_C^{nor} using the sum of the columns of each dimension.

$$T_D^{nor} = \begin{bmatrix} t_D^{11}/t_D^1 & \cdots & t_D^{1j}/t_D^1 & \cdots & t_D^{1m}/t_D^1 \\ \vdots & & \vdots & & \vdots \\ t_D^{i1}/t_D^1 & \cdots & t_D^{ij}/t_D^1 & \cdots & t_D^{im}/t_D^1 \\ \vdots & & \vdots & & \vdots \\ t_D^{m1}/t_D^1 & \cdots & t_D^{mj}/t_D^1 & \cdots & t_D^{mm}/t_D^1 \end{bmatrix} = \begin{bmatrix} t_D^{nor_{11}} & \cdots & t_D^{nor_{1j}} & \cdots & t_D^{nor_{1m}} \\ \vdots & & \vdots & & \vdots \\ t_D^{nor_{i1}} & \cdots & t_D^{nor_{ij}} & \cdots & t_D^{nor_{im}} \\ \vdots & & \vdots & & \vdots \\ t_D^{nor_{m1}} & \cdots & t_D^{nor_{mj}} & \cdots & t_D^{nor_{mm}} \end{bmatrix} \quad (7)$$

Step6: The normalized total influence relationship matrix TNC is transferred to the establishment criterion unweighted super matrix (W_C), and the unweighted super matrix (W_C) is multiplied by the dimension normalized total influence relationship matrix T_D^{nor} to obtain the weighted super matrix W_C^*, Such as formula (8). And the weighted super matrix is multiplied by itself to achieve convergence and stability, that is, take the limit super matrix $lim\ W_w^t$ to obtain the DANP weight of a criterion factor.

$$W_C^* = W_C T_C^{nor} = \begin{bmatrix} t_C^{nor_{11}} \times W_C^{11} & \cdots & t_C^{nor_{1j}} \times W_C^{1j} & \cdots & t_C^{nor_{1m}} \times W_C^{1m} \\ \vdots & & \vdots & & \vdots \\ t_C^{nor_{i1}} \times W_C^{i1} & \cdots & t_C^{nor_{ij}} \times W_C^{ij} & \cdots & t_C^{nor_{im}} \times W_C^{im} \\ \vdots & & \vdots & & \vdots \\ t_C^{nor_{m1}} \times W_C^{m1} & \cdots & t_C^{nor_{mj}} \times W_C^{mj} & \cdots & t_C^{nor_{mm}} \times W_C^{mm} \end{bmatrix} \quad (8)$$

3.3. VIKOR Method

Step7: Determine the ideal solution f_i^* and negative ideal solution f_i^- of all evaluation criteria. j is the alternatives, i is the evaluation criteria; f_{ij} is the performance evaluation value of the i evaluation criteria of the alternatives, which is obtained through questionnaires; I1 is the set of benefit evaluation criteria, and I2 is the set of cost evaluation criteria; f_i^* is the positive ideal solution, as in formula (9), f_i^- is the negative ideal solution, as in formula (10).

$$f_i^* = \left[< Max_j f_{ij} | i \epsilon I_1 >, < Min_j f_{ij} | i \epsilon I_2 > \right] \forall i \quad (9)$$

$$f_i^- = \left[< Min_j f_{ij} | i \epsilon I_1 >, < Max_j f_{ij} | i \epsilon I_2 > \right] \forall i \quad (10)$$

Step8: Calculate the value of group utility S_j and individual regret R_j. Use formulas (11) and (12) to calculate S_j and R_j, and w_i is the weight value of each evaluation criterion derived by DANP.

$$S_j = \sum_{i=1}^{n} w_i \left(f_i^* - f_{ij} \right) / \left(f_i^* - f_i^- \right) \forall j \quad (11)$$

$$R_j = Max_i \left[w_i \left(f_i^* - f_{ij} \right) \left(f_i^* - f_i^- \right) \right] \forall j \quad (12)$$

Step9: Calculate as the benefit ratio Q_j that can be generated by the j scheme. In the formula (13) $S^* = Min_j S_j \ ; S^- = Max_j S_j \ ; R^* = Min_j R_j \ ; R^- = Max_j R_j$ The value of $Min_j S_j$ is the majority rule of the group, and the value of $Min_j R_j$ is the minimum individual regret. In this study, v is set to 0.5 to pursue maximization of group utility and minimization of individual regrets at the same time.

$$Q_j = \frac{v(S_j - S^*)}{(S^- - S^*)} + \frac{(1-v)(R_j - R^*)}{(R^- - R^*)} \forall j \quad (13)$$

Step10: Sort schemes according to the relational conditions of Q_j, S_j and R_j. When the two conditions are satisfied, the order can be based on the size of Q_j, and the smaller Q_j is the better.

Condition 1: Threshold conditions for acceptable benefits in the formula (14).

$$Q^{"} - Q' \geq 1 / (J - 1) \tag{14}$$

Q' represents the Q value of the plan ranked first according to the Q value; Q" represents the Q value of the plan ranked second according to the Q value; J represents the number of all evaluated plans. This formula means that the ranking is only one bit worse Only when the difference between the benefit ratio (Q_j) of the two schemes of the company must exceed the threshold of $1 / (J - 1)$, can it be determined that the first-ranked scheme is significantly better than the second-ranked scheme. When there are several schemes, then compare in order whether the ranked first plan and ranked second, third, fourth and other plans meet condition one.

Condition 2: Acceptable decision-making reliability.

The S value (S') of the first solution ranked according to the Q value must also perform better than the S value (S") of the second solution, or after sorting according to the Q value, the R(R') value of the first-ranked scheme must also perform better than the R value (R") of the second-ranked scheme. When there are several plans, compare the first ranked plan and the ranked second, third, fourth and other plans in order to see if they meet the second condition.

After investigating relevant studies and documents, we come up with 20 evaluation criteria in 5 dimensions. And as shown in Table 1, then define the various dimensions and criteria, and integrate them for questionnaire design and analysis.

Table 1: The dimensions of influence and criteria

Dimension	**Definition**	**Criteria**
Security (D1)	The process of commodity distribution and payment shall be safe.	Contactless payment (C1)
		Intelligent epidemic prevention (C2)
		Food hygiene and safety (C3)
		Equipment cleaning and maintenance (C4)
Delivery (D2)	The time scale between ordering products and arrival of products.	GPS positioning (C5)
		Automatic driving technology (C6)
		Distribution range (C7)
		Road conditions in transit (C8)
		Climate factors (C9)
Convenience (D3)	Various pick-up modes for different consumers.	Home delivery (C10)
		Designated place (C11)
		Immediate use (C12)
		User interface (C13)
Competitive condition (D4)	Enterprises launch good competitive strategies to strengthen their advantages and maintain their competitive position.	Service range (C14)
		Marketing Strategy (C15)
		Product penetration (C16)
		User experience (C17)
Temperature control (D5)	Maintain the required temperature of the product during the distribution route.	Low temperature preservation efficiency (C18)
		Heat insulation (C19)
		Freshness management (C20)

4. Experimental Example

This section uses an example to illustrate the questionnaire design, measurement and result analysis using the proposed method. A total of 55 questionnaires were collected in this questionnaire, of which 30 were valid questionnaires and 25 were invalid questionnaires. They were mainly aimed at the influence of consumers on various factors of contactless delivery. The above 30 valid questionnaires were used for analysis and consistency verification. The following is an explanation.

4.1. Verification of Consistency between Dimension and Evaluation Criteria

In order to avoid too many criteria to affect the response effect, this research intends to delete the criteria with lower weights, and then conduct a pre-test within the group, and multiply the dimension weight of the response results by the criteria weight to obtain the weight of the filterable criteria, the threshold value Set to 0.05, the original 20 criteria will be screened out and 12 criteria will remain as shown in Table 2.

Table 2: The weight of the filterable criteria

Dimension	**sort**	**Criteria**	**The relative weight of the pretest**	**The overall weight of the pretest**
Security (D1)	4	~~Contactless payment (C1)~~	0.215	~~0.041~~
		Intelligent epidemic prevention (C2)	0.259	0.050
		Food hygiene and safety (C3)	0.318	0.061
		~~Equipment cleaning and maintenance (C4)~~	0.208	~~0.040~~
Delivery (D2)	1	~~GPS positioning (C5)~~	0.201	~~0.044~~
		Automatic driving technology (C6)	0.239	0.052
		Distribution range (C7)	0.256	0.056
		~~Road conditions in transit (C8)~~	0.187	~~0.041~~
		~~Climate factors (C9)~~	0.117	~~0.025~~
Convenience (D3)	2	Home delivery (C10)	0.252	0.053
		Designated place (C11)	0.303	0.063
		Immediate use (C12)	0.323	0.067
		~~User interface (C13)~~	0.122	~~0.026~~
Competitive condition (D4)	3	~~Service range (C14)~~	0.221	~~0.046~~
		Marketing Strategy (C15)	0.298	0.062
		Product penetration (C16)	0.270	0.056
		~~User experience (C17)~~	0.211	~~0.044~~
Temperature control (D5)	5	Low temperature preservation efficiency (C18)	0.297	0.051
		Heat insulation (C19)	0.311	0.053
		Freshness management (C20)	0.392	0.067

The questionnaire is issued for the deleted content. The following uses the dimension data from the questionnaire to be used as the step of consistency verification. There are a total of 1 dimension and 5 sets of criteria, and a total of 6 consistency index (C.I.) verification procedures.

Step 1. Calculate the average of n and n-1 questionnaire values: take the values of 30 questionnaires and calculate the average value AV30, and calculate the average value of 29 questions. Number AV29.

Step 2. The average is subtracted, and the data in the table is converted into an absolute value, that is, the average AV30 minus the average AV29, and the absolute value of the data is obtained.

Step3. Combine the formula to obtain the C.I. value: Divide the absolute value obtained in the above steps with the average AV30 to obtain the value, as shown in Table 4.2. After adding up all the values in the table, use the formula sum/(n*n-1) to calculate the C.I. value, as shown in Table 3.

Table 3: The C.I. value after summation

SUM	**sum/(n*n-1)**
0.217	0.011

The judgment result C.I. value ≤ 0.1, which means that the degree of consistency meets the demand. The C.I. value>0.1 indicates that it does not meet the consistency test and will be excluded in the subsequent analysis.

Through the above calculations, the CI value of the dimension is 0.011, the CI value of the security dimension (D1) is 0.014, the CI value of the delivery face t(D2) is 0.007, and the CI value of the convenience dimension (D3) is 0.015, which constitutes the CI value of the competitive condition (D4) is 0.012, and the CI value under the temperature control (D5) dimension is 0.009. The above six kinds of demand tests are all in line with this research and are determined to be valid questionnaires. The summary table of CI values is shown in Table 4.

Table 4: The summary of the C.I. value

	Dimension	D1	D2	D3	D4	D6
C.I. value	0.011	0.014	0.007	0.015	0.012	0.009

The aspects of this research and various evaluation criteria are calculated after the questionnaire is collected and the consistency check is calculated. C.I. $\leq$ 0.1, it means that although it is not completely consistent before and after, it is an acceptable difference. C.I. $\leq$ 0.1 means that the degree of consistency meets the requirements. In the consistency test, the test results are relatively unrelated and fail the consistency test, so they will be excluded in the subsequent analysis.

4.2. Holistic Analysis

Establish the direct relationship matrix of each respondent to form the DEMATEL matrix. After comparing each dimension in pairs, perform normalization, and calculate the total influence relationship matrix, and then calculate the result based on each variable, through the causal interaction between the dimensions relationship, analyze the strength of the relationship between the dimensions (centrality) and the strength of the influence or influence of the dimensions (cause degree) to clarify the causal relationship and importance between the dimensions in an influence network relationship map (INRM), as shown in Fig. 1.

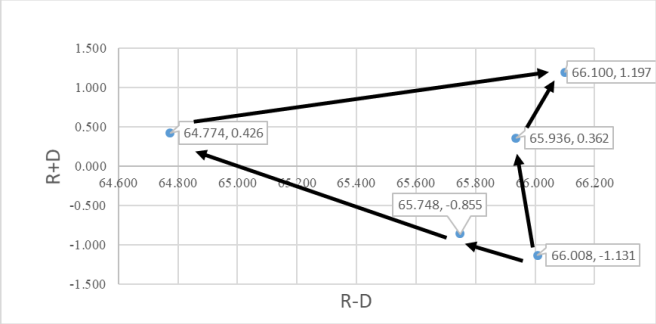

Fig. 1. Influence network relationship map (INRM) of the dimension.

Then multiply the unweighted super matrix with the total influence relationship of the dimension and criterion normalized matrix to obtain the weighted super matrix. After the weighted super matrix is multiplied by itself to converge and stabilize, a pole that does not change is obtained.

According to the above calculation, the dimension of the case of contactless distribution scheme selection are sorted as convenience (0.204, D3), competitive condition (0.203, D4), security (0.200, D1), delivery (0.198, D2), and temperature control (0.196, D5) as shown in Table 5.

Table 5: The weight ordering of the dimension

Dimension	D3	D4	D1	D2	D5
Weight	0.204	0.203	0.200	0.198	0.196
Sort	1	2	3	4	5

After the value converges in the limit super matrix, the relative weight of each evaluation criterion can be obtained. The following table shows weights and the order of each dimension and criterion as shown in Table 6. Based on the numbers selected by the respondents for the third-level evaluation indicators, the geometric average is used to calculate the integrated value. The overall ranking is "marketing strategy", the second is "product penetration", and the third is "intelligent epidemic prevention", as shown in Table 6.

4.3. VIKOR for the Solution Selection

The study then uses the VIKOR compromise ranking method to conduct a questionnaire survey for consumers in the post-epidemic era. Based on literature reviews and the discussion from relevant experts, this study proposes 5 contactless solution alternatives, namely i-mailbox, instant meal cabinet, unmanned vehicle, unmanned store, and delivery platform, and gives each alternative a rating of 1 to 5 among various criteria.

Table 6: The overall weight ordering of the dimension and criteria

First level	Second level			Third level			
Target level	**Dimension**	**Sort**	**Criteria**	**Local Weights**	**Sort**	**Global Weights**	**Sort**
The Study of DANP and VIKOR Multiple Criteria Decision Making in the Post Pandemic Era Logistics: A Case of Contactless Distribution Scheme Selection	Security (D1)	3	Intelligent epidemic prevention (C2)	0.506	1	0.101	3
			Food hygiene and safety (C3)	0.494	2	0.099	5
	Delivery (D2)	4	Automatic driving technology (C6)	0.505	1	0.100	4
			Distribution range (C7)	0.495	2	0.098	6
	Convenience (D3)	1	Immediate use (C12)	0.340	1	0.069	7
			Home delivery (C10)	0.333	2	0.068	8
			Designated place (C11)	0.328	3	0.067	10
	Competitive condition (D4)	2	Marketing Strategy (C15)	0.501	1	0.102	1
			Product penetration (C16)	0.499	2	0.101	2
	Temperature control (D5)	5	Freshness management (C20)	0.343	1	0.067	9
			Heat insulation (C19)	0.330	2	0.065	11
			Low temperature preservation efficiency (C18)	0.327	3	0.064	12

According to the calculation steps of the compromise ranking method, 30 valid questionnaire results are analyzed, the ranking relationship between each alternative and the 12 criteria is studied, and the data of the positive ideal solution and the negative ideal solution are obtained through formulas (9) and (10), And the weight is derived from the DANP analysis results in the second section.

Then use formulas (11) and (12) to calculate the distance S_j value of each contactless solution alternative and the positive ideal solution, and the distance R_j value of each contactless solution alternative and the negative ideal solution, as shown in Table 7.

Table 7: S_j value and R_j value of each solution alternative

	I-mailbox	**Instant meal cabinet**	**Unmanned vehicle**	**Unmanned shop**	**Delivery platform**
S_j	0.687	0.549	0.662	0.485	0.339
R_j	0.102	0.089	0.101	0.100	0.090

In this study, the decision-making mechanism coefficient v is set to 0.5, according to the comprehensive index Q_j value calculated by formula (13), to prioritize the importance of contactless schemes. When the value of Q_j is closer to 0, it means that it is closer to the positive ideal solution; on the contrary, the value of Q_j is closer to 1, which means that it is closer to the negative ideal solution, and the order of the most suitable solution alternatives can be obtained, as shown in Table 8.

According to Table 8, the preference order of consumers' choices in the post-epidemic era is as follows: delivery platform > instant meal cabinet > unmanned store > unmanned vehicle > i-mailbox. The Q_j value of first-ranked delivery platform is 0.019, which is a numerical value, the closest to 0. The second is the instant meal cabinet, and the third is the unmanned store.

Table 8: Q_j value and the ranking of each solution alternative

Contactless solution alternative	Q_j	Sort
I-mailbox	1.000	5
Instant meal cabinet	0.301	2
Unmanned vehicle	0.925	4
Unmanned shop	0.631	3
Delivery platform	0.019	1

5. Conclusion and Remarks

This research uses a hybrid MCDM model combined with DANP and VIKOR for weight analysis and selection of contactless distribution solutions. The selection element structure of the contactless distribution scheme has been established, and the five major dimensions have been summarized with a total of 20 criteria. The five dimensions of contactless distribution scheme selection are "convenience", "competitive condition", "security", "delivery time", and "temperature control". The results show that "convenience" is the most important component for the respondents, and "marketing strategy" is the most important evaluation criterion for the whole. From this, it can be seen that most respondents believe that, under the balance of convenience, competitors' marketing strategies are the main factors affecting consumer buying behavior.

According to Q_j values analyzed by VIKOR, five contactless distribution alternatives to choose priority for the delivery platform, instant meal cabinet, unmanned shop, unmanned vehicle and i-mailbox. It can be seen that the delivery platform is the best contactless solution considered by consumers in the post-epidemic era. At present, the logistics industry combined with the catering industry to develop a new industrial form, not only across the limitations of dining space, but mainly benefit from the convenience of mobile devices. The effective application of data analysis to understand consumers' buying behavior and optimize it to existing business models enables accurate and rapid response to consumer demand and revenue performance.

In the results of the study and analysis, we can see that consumers attach importance to convenience, competitive condition, security, etc., enterprises can focus on these projects to strengthen the function of contactless distribution. In addition, the enterprise can intelligentize the distribution to avoid the spread of the epidemic, so that consumers can rest assured that the choice and use of contactless distribution options. For example, it can be suggested that the delivery platform optimize the user interface, increase icons and add enlarged page function, so that consumers with poor vision can see more clearly, use smoothly, and increase the number of users. In addition, the delivery platform repeatedly appeared the sender to steal food and other food security problems, this is recommended to send the platform to regulate the delivery of food delivery staff to take meals need to shoot good commodity status to consumers. This approach allows consumers to reduce their safety concerns, while also protecting the rights of stores.

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