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Study on Risk Evaluation of Online Smart Tourism Supply Chain

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Abstract: *Based on the theoretical study on the smart tourism, tourism supply chain, and risk evaluation, this paper sorts out the dynamic structure of the online tourism supply chain and the main body cooperation mechanism under the background of smart tourism. On the basis of the traditional supply chain model, it takes the engagement in the online network platform into consideration, rebuilds the new supply chain model of smart tourism with online travel service providers as the core, and combines the characteristics of the new model to establish a basic framework of the supply chain risk evaluation indicator system by using the production process method. With comprehensively taking the relevant factors affecting the supply chain risk into account, it summarizes 25 measurement factors. By adopting the weight factor judgment table method and the expert evaluation method to assign the weights to each indicator, the fuzzy comprehensive evaluation method is used to make quantitative analysis and empirical research on the qualitative indicators in the three-level indicators.*

Keywords: *smart tourism; supply chain; risk evaluation*

1. Introduction

The development of the Internet has driven great changes in the social economy. With a wide variety of intelligent technology systems arising, the tourism industry has been continuously transformed in the great change, and the tourism enterprises start to transform and integrate into the new e-commerce industry. The China National Tourism Administration designated the theme of tourism development in 2014 as the "Year of Smart Tourism", which was a magnificent beginning to smart tourism in China, as well as guiding the development and construction of my country's smart tourism to a new climax.

Practice has proved that the smart tourism is not just an extension of tourism informatization, nor is it achieved overnight, but can only be realized after long-term accumulation. Such kind of process can be called tourism intelligence. Smart tourism will become a leading trend of tourism development. It should not only rely on the wisdom of people in the industry, but also be driven and guided by the wisdom of the related industries [1]. Therefore, it is necessary to fully grasp the opportunity, make full use of the opportunity, and develop the model of wisdom for the transforming and upgrading of the tourism industry in China.

2. Relevant Theoretical Basis

2.1. Online Tourism

Traditional tourism services rely on people, while the modern tourism services rely on the combination of humans and machines. With the development of the tourism and the increase of tourists, the manual services cannot meet the requirements of modern tourists any more, and the online tourism arises in time. Based on the first principle of enabling the user to experience comfortably, the online travel companies regularly analyze the user's needs in the product design and development, and keep optimizing the travel products. Tourists can freely choose the products online on their mobile phones, which enhances the service experience, such as electronic navigation, and VR reality experience. Such kind of experiences arouse the tourists' interest and offers guidance for their consumption, which shows that the service of smart tourism is an information service focusing on the tourist's experience. And the tourist are no longer limited to the traditional face-to-face consultation and transactions, but they can freely inquire, consult and book the items they are interested in with the help of customer service. This

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method will effectively save the user's time and improve the user's work efficiency. The promotion of smart tourism has changed the way of smart tourist to obtain the travel information, thereby helping them make the travel decisions.

2.2. Supply Chain Risk

Currently, there are two perspectives of risk research, one is the perspective of uncertainty, and the other is the perspective of loss. In Merriam-Webster Advanced Learner's English-Chinese Dictionary, risk refers to the possibility of loss or damage, the possibility and consequences of dangerous situations. The scholars have studied for a long time on the supply chain risk abroad and at home, and there are also some comprehensive study reviews. Xia Xinyue et al. proposed a classification method combining supply chain and fault tree to track the risks to the suppliers, manufacturers and distributors according to their sources. Ma Lin proposed a division method based on the supply chain operation reference model, and classified the risks into five sections: planning, procurement, manufacturing, distribution and return. Ma Shihua divides the supply chain risk into two types: endogenous risk and exogenous risk. He believes that the endogenous risk arises from the moral hazard, information distortion and individual rationality, while the exogenous risk mainly results from the politics, economy, law and technology.

In summary, as an independent market subject, each enterprise in the supply chain has different interests and carries out the interactive game and cooperation in maximizing its own interests. Information hiding among the enterprises will cause the information asymmetry in different sections, the bullwhip effect and the slow response of the supply chain, which also reflects the dynamics, complexity and diversity, hierarchy and risk transmission of the supply chain risk.

3. The Structure of Online Tourism Supply Chain

3.1. The Connotation of Tourism Supply Chain

The tourism supply chain consists of tourists, agents, travel agencies and tourism suppliers, each of which plays a specific role in the labor division of the supply chain. The tourism suppliers produce the products and provide the corresponding services according to the needs of tourists; the operators are the organizations or systems that are engaged in tourism services, showing the tourism specialization; the suppliers are the basic elements and the necessary basis to the purchase, food, housing and transportation of the tourism industry; the tourism consumers are the core elements to realize the tourism value [2]. In a word, the online tourism supply chain has got rid of the constraints of time and space, and has re-created the value of the tourism value chain with flexibility and interactivity, which helps the emerging tourism industry boost and upgrade, brings great changes to the supply chain structure and management and finally promotes the transformation and development of the tourism industry.

3.2. Evolution of the tourism supply chain

3.2.1. Supply Chain Structure Taking the Travel Agency as the Core

The traditional tourism supply chain takes the travel agencies as the core, integrates the entertainment supply factors such as food, accommodation, shopping and tourism, and serves the tourists by cooperating with the tourism agents. As shown in Figure 1, when taking the travel agency as the core, it can connect with the tourism agents, tourists, upstream suppliers or even the general provider of suppliers. In such a structure, the whole chain from the supplier to the customer is the service flow from the upstream to the downstream. The spanning of each level of service will be accompanied by the capital flow and information flow. In this structural mode, the travel agencies are responsible for the organization and allocation of resource. The direct communication with consumers allows them to fully understand the individual needs of consumers, which helps to design more reasonable products or services. The travel agencies are placed in the core in this mode, but when meeting the needs of consumers, they will ignore the direct communication and feedback between subjects at different levels, resulting in the information asymmetry or information delay between the service providers and consumers. As a result, it will cause the bullwhip effect, and affect the circulation of tourism information and customer value. And it is hard for them to gain the economic benefits in the service supply chain.

ISSN 2616-5902 Vol. 4, Issue 12: 27-36, DOI: 10.25236/AJBM.2022.041206

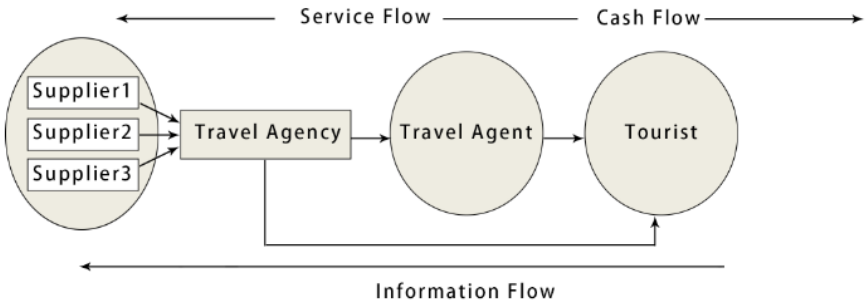

Figure 1: Supply chain model with travel agency as the core

3.2.2. Reconstruct a new model with online service providers as the core

Online travel websites can act as both the travel operators and intermediary agents. Even if they are the same supplier or the same consumer, there are multiple connections between them. Therefore, the tourism supply chain is a multi-channel parallel network structure, rather than a chain structure. The tourism companies can collect the cross-level flow information of tourism products and services as well as the tourism evaluation feedback in the tourists' purchase behavior[3]. So the smart tourism supply chain is more suitable for the development needs in the current tourism, which is of great significance to promote the sustainable development of tourism. And the specific model is shown in Figure 2.

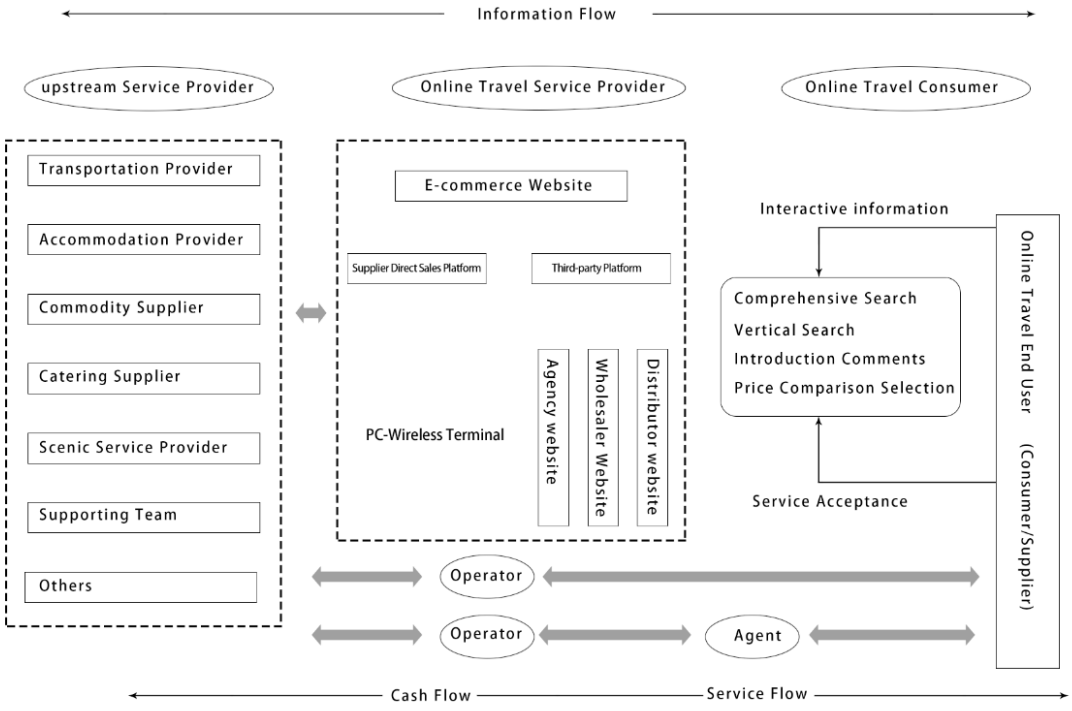

Figure 2: The New Tourism Supply Chain of Smart Tourism

Compared with the previous supply chain, the biggest difference of smart tourism supply chain lies in the comprehensive sharing of information and the high transmission efficiency [4]. The online tourism supply chain conducts the online sales for self-service tourists with the aid of the Internet and mobile networks for market positioning. It aims to maximize the tourists' happiness, allowing the consumers to experience the efficient services in information inquiry, reservation, payment and evaluation, and meet the consumers' differentiated, customized and dynamic needs. Through this model, the tourists will be provided with more choices, and the tourism services are open and comparable in price. It is a supply chain that is completely dominated by the tourists.

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4. Risk Management And Evaluation of Online Tourism Supply Chain

4.1. Construction of Supply Chain Risk Evaluation Indicator System

This paper sorts out all the members and macroeconomic factors in the online tourism supply chain, mainly analyzes the relationship among the various entities in the supply chain, and classifies them on the basis of the causes of risks. It is believed that the production process method is more suitable to explore the risk challenges brought by the supply chain. Therefore, the supply chain risk evaluation indicator system is established according to the actual operation of the supply chain, as shown in Table 1.

Table 1: Evaluation Factors of Supply Chain Risk

First-level Indicator	Second-level Indicator	Third-level Indicator
A1Production Organizational Risk	A11Supply Risk	A111 Order Completion Rate A112 Supply Service Flexibility
	A12Service Reliability	A121 Customer Satisfaction A122 Customer Retention Rate
	A13Benefit Allocation Risk	-
	A14Enterprise Cooperation Risk	-
A2System Operational Risk	A21Information System Risk	A211 Computer network failure A212 Timely rate of information communication A213 data transfer distortion rate
	A22Third-Party Payment Platform	A221 Data Confidentiality A222 technical support A223 Operational Risk
	A23 Financial Risk	A231 Asset Turnover Ratio A232 Return on Assets A233 Profit Growth Rate
	A24 Competitive Risk	A241 Peer Price Advantage A242 Peer Service Advantage
	A25 Feasibility of Scientific Research Project	-
	A26 Management Decision Risk	-
A3Customer Perceived Risk	A31 Complaint risk	-
	A32 Customer Requirements	A321 Demand Response Speed A322 Evaluation Feedback
A4Other Risks	A41 Natural Disasters	-
	A42 Legal Policy	-
	A43 War	-

The production organization risk occurs when providing the final online tourism services to the consumers. Production risk refers to whether the service products can be provided to the consumers normally according to the requirements and whether the services can meet the consumers' requirement, which involves the reliability of supply and service. The supply risk is mainly determined by the order completion rate and the supply service flexibility, while the service reliability is measured by the customer satisfaction and customer retention rate[5]. Secondly, the interest distribution and enterprise cooperation risks may arise in the process of organization, which refers to the respective commission shares obtained in upstream and platform cooperation and the reliability of enterprise cooperation. Any changes arisen in a section of the enterprise will affect the whole supply structure.

The system operation risk refers to the collection of various factors that will affect the operation of the whole system, including the information flow, capital flow, business flow, company management and market competition[6]. Thus, it can be divided into five parts: information system risk, third-party payment platform risk, internal financial risk, management decision risk and market competition risk. The different quantitative calculations are set in each indicator. The information system risk lies in the customer's payment on the third-party platform. Since a large amount of customer information and transaction data is stored in the third-party platform, once disclosed, it may cause other potential risks.

The customer perceived risk is affected by the customer's needs, including the response speed of

ISSN 2616-5902 Vol. 4, Issue 12: 27-36, DOI: 10.25236/AJBM.2022.041206

customer's demand and the feedback of customer's evaluation. The first step to do a good job in marketing is to get the hang of the customer's needs, which determines the integration of corporate marketing activities, promotional activities, and sales activities[7]. It will help the enterprises to respond quickly, make better production plans, reduce the management and circulation costs and provide better services to the customers by meeting the requirements in the market.

Other risks which include natural disasters, laws, policies and wars are uncontrollable. It is difficult to predict these factors in the tourism supply chain. The risk study in this paper is more suitable for the evaluation based on quantification. Such kind of risks can only be effectively managed by preparing for crisis handling and reducing losses in advance.

Therefore, according to the indicator system designed in the above table, let the first-level indicators $A=\{A:A_1,A_2,A_3,A_4\}$ of the risk evaluation system of the supply chain, set each of the first-level indicators $A_i\ (i=1,2,3,4)$ with Q_i second-level indicators, which are respectively denoted as $A_i=\{A_i:A_{i1},A_{i2},A_{iQ}\}(i=1,2,3,4)$, among which A_{ij} refers to the j second second-level indicator of A_i, such as A_1 refers to the production organization risk, A_{11} refers to the supply risk, and A_{111} refers to the order complete rate.

The second-level indicators are as follows:

$A_1=\{A_{11},\ A_{12},\ A_{13},\ A_{14}\}$

$A_2=\{A_{21},\ A_{22},\ A_{23},\ A_{24},\ A_{25},\ A_{26}\}$

……

The third-level indicators are as follows:

$A_{11}=\{A_{111},\ A_{112}\}$

$A_{12}=\{A_{121},\ A_{122}\}$

……

$A_{32}=\{A_{321},\ A_{322}\}$

4.2. Establish the Weight Coefficient Matrix

The weight factor judgment table method is to form an evaluation team by inviting the experts, prepare and fill in the weight factor judgment table, and finally determine the weight value according to the weight factor judgment table filled in by the experts. It is a weight determination method of qualitative evaluation, which is easy and convenient to operate.

Let the weight of the indicator A be $W(i=1,2,3,4)$, the first-level indicators $W=\{W_1,W_2,W_3,W_4\},(0<W<1)$, and the weight coefficient $W_{ij}=(W_{ij}\mid i=1,2;j=1,2...Q_i)$ of the second-level indicators A_{ij}.

The second-level indicators are as follows:

$W_1=\{W_{11},\ W_{12},\ W_{13},\ W_{14}\}$

$W_2=\{W_{21},\ W_{22},\ W_{23},\ W_{24}\}$

……

The third-level indicators are as follows:

ISSN 2616-5902 Vol. 4, Issue 12: 27-36, DOI: 10.25236/AJBM.2022.041206

$W_{11} = \{W_{111}, \ W_{112}\}$

$W_{12} = \{W_{121}, \ W_{122}\}$

……

$W_{32} = \{W_{321}, \ W_{322}\}$

The specific process is as follows:

Step 1: Set up an evaluation expert group by inviting the experts from the tourism industry, Internet industry and supply chain management, and score according to each indicator.

Step 2: Prepare the evaluation indicator factor judgment table. The five-point system is used to measure the importance of each indicator. When the score expressed as 5 refers to very important, 4 refers to more important, 3 refers to important, 2 refers to less important, and 1 refers to not important, as shown in Table 2.

Table 2: Evaluation Indicator Judgment Table

Importance	Description
5	Refers to that the former is extremely more important than the latter when compared with the two factors
4	Refers to that the former is significantly more important than the latter when compared with the two factors
3	Refers to that the former is more important than the latter when compared with the two factors
2	Refers to that the former is less important than the latter when compared with the two factors
1	Refers to that the former is not as important as the latter when compared with the two factors

Step 3: Experts compare the factors in each row with the factors in each column according to the evaluation indicator judgment table, and score according to the importance scale without comparing the same indicators.

Step 4: Figure out the score.

a) Calculate the total score for each row, see Equation 1.

$$D = \sum_{m=1,n=1}^{T_m} a_{mn} (m \neq n) \tag{1}$$

T_m --The number of evaluation indicators

a_{mn} --The indicator score when the evaluation indicator m is compared with the evaluation indicator n

R --Expert serial number

b) Calculate the average score of the evaluation indicator, see Equation 2.

$$P_M = \sum_{R=1}^{N} \frac{D_{MR}}{N} \tag{2}$$

N—Total number of experts

c) Calculate the evaluation indicator weights, see Equation 3.

$$W_M = \frac{P_M}{\sum_{M=1}^{T} P_M} \tag{3}$$

ISSN 2616-5902 Vol. 4, Issue 12: 27-36, DOI: 10.25236/AJBM.2022.041206

4.3. Fuzzy Comprehensive Evaluation

Fuzzy comprehensive evaluation is an evaluation method based on the fuzzy mathematics, which is widely used in various fields of social life. It mainly quantifies the factors with unclear boundaries or difficult to quantify [8]. The online tourism supply chain is a multi-level complex system [9]. Therefore, this paper first establishes the hierarchical structure of the operation risk of supply chain, and then adopts the weight factor judgment method to determine the weight. Finally, the fuzzy comprehensive evaluation method is applied to quantitatively analyze the operation risk of service chain .

(1) Determine the comment set

The evaluation results of each indicator in the risk evaluation system of the online tourism supply chain are divided into five levels: slight risk, low risk, general risk, great risk and significant risk.

(2) Establish the evaluation matrix

① Single factor fuzzy evaluation

Let the k th element A_k in the evaluation factor set be evaluated, the membership of the j_{th} element S_j in the evaluation set is R_{ij}. The matrix composed of each single factor evaluation set, that is, the fuzzy relationship matrix R_i from the factor set A_i to the evaluation set S. The evaluation matrix of the evaluation factor set A_k is R_K, which is multiplied by the weight coefficient vector W_K to obtain the fuzzy evaluation matrix Equation 4:

$$Y_K = W_K \cdot R_K \tag{4}$$

② Multi-factor fuzzy evaluation

The fuzzy evaluation results Y_{ij} of each single factor are combined to form a higher-level evaluation matrix R_i, and the same method is used to multiply R_i with the weight coefficient matrix W_i to obtain the comprehensive evaluation result Y_i of the i th evaluation factor set. Then, a higher-level matrix R is formed by Y_i, and finally the comprehensive evaluation matrix Y is obtained, see Equation 5:

$$\mathrm{Y} = \mathrm{W} \cdot \mathrm{R} \tag{5}$$

(3)Comprehensive scoring matrix Equation 6:

$$\mathrm{F} = \mathrm{Y} \cdot S^T \tag{6}$$

Where: F is the comprehensive score value of risk, Y is the final comprehensive evaluation matrix, S is the row vector of evaluation level, S^T is the transposed matrix of S, and the value F shows the risk level of different evaluation indicators.

4.4. Validation Analysis

This paper investigates and analyzes the consumers' experience feelings of a tourism platform company. Since the evaluation indicators of the company, such as financial information, information system and third-party payment data should be output according to the actual statements, this paper will only give an example of fuzzy comprehensive evaluation for several qualitative indicators. The specific investigation and calculation results are shown in the table below.

(1) Establish the Weight

Firstly, an evaluation team is established according to the fuzzy comprehensive evaluation. A total of 100 regular consumers are selected. The members of the evaluation team should understand the evaluation content; Secondly, the evaluation weight factor judgment table is prepared on the basis of the selected five indicators: customer demand response speed, customer satisfaction, supply chain flexibility,

ISSN 2616-5902 Vol. 4, Issue 12: 27-36, DOI: 10.25236/AJBM.2022.041206

peer price advantage and peer service advantage; Then, according to the score of the evaluation team, the total score and average score are calculated respectively by the five-point method mentioned above for the indicator weight of each factor. Later readjust the weight of each factor according to the special cases. Finally, the weight of the evaluation indicator is obtained and the specific calculation results are shown in Table 3 and Table 4.

Table 3: Score Statistics of Evaluation Indicators

No.	Evaluation Indicators	Scorers (10 people in groups)										Total Score	Average Score	Weight	Adjusted Weight
		1	2	3	4	5	6	7	8	9	10				
1	Response Speed of Customer's Demand	16	15	11	12	10	8	9	11	11	11	116	14.50	0.202	0.185
2	Customer Satisfaction	10	12	8	13	11	12	11	13	10	10	110	13.75	0.192	0.20
3	Supply Chain Flexible Service	12	9	12	8	11	7	10	12	8	8	96	12.01	0.168	0.165
4	Peer Price Advantage	13	12	15	15	11	12	13	14	13	13	128	16.01	0.223	0.23
5	Peer Service Advantage	9	10	13	14	12	11	12	16	11	11	123	15.38	0.215	0.22
Total		60	59	59	62	55	50	55	66	53	53	573	71.65	1.00	1.00

Table 4: Evaluation Indicator Weight

Evaluation Indicator	Response Speed of Customer's Demand	Customer Satisfaction	Supply Chain Flexible Service	Peer Price Advantage	Peer Service Advantage
Weight	18.5%	20.0%	16.5%	23.0%	22.0%

$W = (0.185, 0.2, 0.165, 0.23, 0.22)$

(2) Determine the comment set, as shown in Table 5

According to the degree of the risk, the risks are divided into 5 levels: slight risk, low risk, general risk, great risk and significant risk.

Table 5: Risk Evaluation Levels

Safety Level	Slight Risk	Low Risk	General Risk	Great Risk	Significant Risk
Score	20	40	60	80	100

Table 6: Risk Score of Each Indicator

Evaluation Indicator	Weight	Number of Scorers (rounded to ten)					Total Number
		Slight Risk	Low Risk	General Risk	Great Risk	Significant Risk	
Response Speed of Customer's Demand	0.185	32	28	23	8	9	100
Customer Satisfaction	0.20	23	27	29	19	2	100
Supply Chain Flexible Service	0.165	20	36	22	12	10	100
Peer Price Advantage	0.23	38	21	18	21	2	100
Peer Service Advantage	0.22	48	11	28	12	1	100

(3) Establish a fuzzy judgment matrix

After the weight is determined by the weight factor judgment table, the fuzzy comprehensive

ISSN 2616-5902 Vol. 4, Issue 12: 27-36, DOI: 10.25236/AJBM.2022.041206

evaluation is applied to the indicator. Experts who get the hang of the supply chain, online tourism, and risk evaluation are invited to score the five indicators according to the membership principle, and obtain a judgment matrix, as shown in Table 6.

$R_1 = (0.3,0.3,0.2,0.1,0.1)$

$R_2 = (0.2,0.3,0.3,0.2,0)$

$R3 = (0.2,0.4,0.2,0.1,0.1)$

$R4 = (0.4,0.2,0.2,0.2,0)$

$R5 = (0.5,0.1,0.3,0.1,0)$

So the matrix $R = \begin{bmatrix} 0.3 & 0.3 & 0.2 & 0.1 & 0.1 \\ 0.2 & 0.3 & 0.3 & 0.2 & 0 \\ 0.2 & 0.4 & 0.2 & 0.1 & 0.1 \\ 0.4 & 0.2 & 0.2 & 0.2 & 0 \\ 0.5 & 0.1 & 0.3 & 0.1 & 0 \end{bmatrix}$

The fuzzy judgment matrix is:

$$Y = W \cdot R=(0.23,0.2,0.22,0.2,0.1)$$

(4) Fuzzy Comprehensive Score

According to the maximum membership principle, it is concluded that the maximum membership principle of 0.23 is a slight risk. Since the first few data are nearly close, it fails to reflect the difference accurately. We can assign a value to the risk level and further quantify it with the comment set, and obtain:

$$F = Y \cdot S^T =(0.23,0.2,0.22,0.2,0.1)[20,40,60,80,100]T=51.8$$

(5) Comprehensive Score

According to the fuzzy comprehensive evaluation model, a comprehensive score is obtained, if $F>100$, which means that the indicator factor has caused significant risks in the supply chain, and it must take some measures to reduce the losses immediately, or establish a preventive mechanism. If $80<F<100$, it means that the indicator factor has caused great risk in the supply chain. It is necessary to respond in time and take emergent measures. If $60<F<80$, it means that the indicator factor has caused the general risk in the supply chain, which can be controlled. If $40<F<60$, it means that the indicator factor has caused the low risk in the supply chain; if $20<F<40$, it means that the indicator factors has caused a slight risk in the supply chain, which can be reasonably controlled by taking measures. If $F<20$, it means that the indicator factor has little impact on the supply chain, which can be regarded as a relatively safe risk.

5. Conclusions

The above analysis shows that the supply chain risk of the online tourism platform is low, and the tourism platform can focus on the rational allocation of resources and grasp the main problems. Therefore, the tourism website has a good reputation in the peer price advantage, peer service advantage and customer satisfaction. The evaluation results of customer demand response speed and supply chain flexible service are average. This paper believes that the evaluation results of the tourism platform are consistent with the reality as well as being reliable, which shows that it is effective to adopt the evaluation system and methods in this paper.

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