A Study on the Factors Influencing Value-added in the Cruise Ship Value Chain Based on the DEMATEL-ISM Model

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Abstract. Cruise value chain is to take the exchange of cruise products and services as the core within a certain spatial scope, and enterprises with core advantages within the industry or between different industries establish links according to certain technical and economic conditions, so as to realise the multi-dimensional extension and value-added of the cruise value chain in both vertical and horizontal links, and finally establish a chain-network enterprise strategic alliance. This paper attempts to draw on the influencing factor analysis methods of the relevant literature - the decision making experiment and evaluation experiment method DEMATEL and the explanatory structure model method ISM - to construct a multi-level progressive structure model to analyse the value-added influencing factors of the cruise industry chain. The study shows that the innovation and scale value-added modules in the upstream of the cruise industry chain are the core modules of value-added in the whole cruise industry chain, and the value-added mainly originates from the cruise ship design and manufacturing chain. The midstream of the cruise industry chain is mainly the cruise operation enterprises. The special nature of cruise operation determines that its brand value-added is mainly accomplished through the global layout of multinational companies, and the cruise brand can drive consumer demand and has the ability to add value. The downstream value-added of the cruise industry chain is mainly achieved through the improvement of the profit of cruise tourism service products.

Keywords: Cruise ship value chain; Decision making experiment and evaluation experimental method DEMATEL; Explanatory structural modelling method ISM

1 Introduction

Cruise value chain is to take the exchange of cruise products and services as the core in a certain spatial scope, and the enterprises with core advantages within the industry or between different industries establish the association according to certain technical and economic conditions, so as to realize the multi-dimensional extension and value appreciation of the cruise value chain in the vertical and horizontal links, and finally

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establish the chain network enterprise strategic alliance. The cruise value chain covers ship design and construction, cruise financial services, cruise line development, cruise market development, cruise port services, etc., forming a top-down, back-to-back industrial chain. In the study of cruise value chain, Qiu Antelope (2015), a domestic scholar, first applied Michael Porter's value chain analysis method to divide the value-added activities of the cruise industry into basic activities consisting of cruise research and development and design, cruise production and manufacturing, cruise terminal infrastructure and cruise human resource management, and basic activities consisting of cruise market demand, cruise tourism creative planning, cruise logistics procurement, cruise operation management, cruise marketing and sales, cruise audience feedback and cruise customer service, and other supporting activities[1]. After that, Chen Lin (2020) discussed the role of cruise marketing model in promoting the development of cruise economy from the perspective of value chain management; Xu Jing (2021) constructed a cruise value chain model, analyzed the basic activities and supporting activities of cruise value chain, and analyzed the influence of cruise value chain activities on regional economic development; Yang Ming and Yi Xiaoli (2022) pointed out that R&D, design and service in the cruise value chain are and other links are the key to promote the development of Guangdong cruise industry.

From the above analysis, it can be seen that the existing studies are mainly co nducted from the perspective of the composition of cruise value chain and the inf luence of cruise value chain on regional development, while there are very few st udies related to the value-added of cruise value chain, and there is a lack of in-d epth analysis of the influence factors and the degree of influence on the value-ad ded of the value chain. In view of this, this paper tries to draw on the influence factor analysis methods of related literature - Decision Making Trial and Evaluati on Laboratory (DEMATEL) [2]and Interpretative Structural Modeling Method (IS M) (Interpretative Structural Modeling Method) [3]to construct a multi-level recursi ve structural model to analyze the value-added influencing factors of the cruise in dustry chain.

2 DEMATEL-ISM model

2.1 DEMATEL-ISM method

The DEMATEL-ISM-BN method is a combined research method that combines DEMATEL and ISM to analyze the influencing factors. DEMATEL is a quantitative analysis method based on matrix theory that analyzes the influencing relationships among factors with the help of graph theory and matrix calculation tools to identify the importance of each factor in terms of centrality and causality. ISM is a structural modeling technique that The reachable matrix is used to reflect the different categories of each factor of the system, and the interconnection between factors is identified by constructing a multi-level recursive structural model. The DEMATEL method is used to calculate the overall influence matrix, obtain the relevant indexes of the influencing factors, identify the key factors, and convert the overall influence matrix into the

reachable matrix required by the ISM method, which can analyze the hierarchical relationships of the factors.

2.2 The steps of DEMATEL-ISM model construction are as follows:

(1) Determine the set of influencing factors $U = \{u_1, u_2, \ldots u_k\}$ (k is the number of influencing factors), and construct the influence matrix E . Invite experts to determine the influence relationship between factors and get the initial direct influence matrix $E = [e_{ij}]_{k\times k}$, where e_{ij} is the degree of direct influence of the factor e_i on the factor e_j , according to the strength of the influence degree, from no influence, weak influence, strong influence, strong influence are assigned to 0-3, when $i = j$, $e_{ij} = 0$.

(2) Normalize the direct influence matrix, and normalize the direct influence m atrix E to obtain the matrix F , as in equation 1

$$F = [f_{ij}]_{k\times k} = \frac{1}{\max\limits_{1\le i\le k} \sum\limits_{j=1}^{k} e_{ij}} E \tag{1}$$

(3) Solve the combined influence matrix H , and find the key factors, such as

$$\begin{aligned} H &= [h_{ij}]_{k\times k} = F + F^2 + F^3 + \ldots + F^n \\ &= F(1 - F^{n-1}) / 1 - F = [h_{ij}]_{k\times k} \end{aligned} \tag{2}$$

That is, $H = F(I - F)^{-1}$, where I is the unit matrix.

(4) Solve for the degree of influence of each factor on other factors b_i , the de gree of being influenced c_i , the degree of centrality z_i and the degree of cause y_i .

$$b_i = \sum_{j=1}^{n} h_{ij} \qquad (i = 1, 2\ldots,\ k) \tag{3}$$

$$c_i = \sum_{j=1}^{n} h_{ji} \quad (i = 1, 2\ldots,\ k) \tag{4}$$

$$z_i = b_i + c_i \qquad (i = 1, 2\ldots,\ k) \tag{5}$$

$$y_i = f_i - e_i \qquad (i = 1, 2\ldots,\ k) \tag{6}$$

(5) The overall impact matrix $T = [t_{ij}]_{k\times k} = I + H$ is obtained by solving, the threshold $\lambda = \eta + \theta$ is determined (η, θ is the mean and standard deviation of the elements in the matrix H), and the reachable matrix S of the model ISM is constructed (the elements are s_{ij}).

$$s_{ij} = \begin{cases} 1 & t_{ij} > \lambda \\ 0 & t_{ij} \le \lambda \end{cases} \tag{7}$$

(6) If the set of all elements in row 1 of i in the reachable matrix is S P_i and the set of all elements in column 1 of i is Q_i, and $P_i = P_i \cap Q_i$ holds, then define the influence factor a as the underlying factor, eliminate the rows and columns in the reachable matrix where the factor is located, and construct a multi-level recursive structure model based on this criterion until all factors are eliminated.

3 Cruise ship value chain value-added influence factor index system construction

3.1 Literature collection

In this section, we use the refinement and coding methods of Root Theory to conduct a literature search on SCI, EI, SSCI databases and the Chinese database CNKI, with the English literature search terms "Cruise Industry Chain", "Cruise The search terms were "Cruise Industry Chain", "Cruise Supply Chain", "Cruise Value Chain", "Cruise Industry Chain", "Cruise Supply Chain" and "Cruise Value Chain". The search year was 2000-2023, and the scope of the search was core journals, which resulted in 17 English and 20 Chinese articles.

3.2 Literature coding

Drawing on the coding methodology of rooted theory, the qualitative information was coded in such a way that the analyses could be based on empirical facts. This was done as follows, following a sentence-by-sentence and paragraph-by-paragraph coding of the existing literature, a three-step process of open-ended, spindle, and selective coding was carried out. Open coding is the process of decomposing and refining the literature, i.e. conceptualising and categorising the literature; spindle coding is based on open coding, and the relationship between concepts and categories is explored through analysis and refinement, and spindle coding promotes the integration of the rootedness theory and the analytical framework of "cruise value chain, industrial chain, and value-added supply chain". Integration. The selective coding is based on the main axes

coding, and the core indicators are extracted by analysing the relationship between the main categories through induction and summary. In summary, the study coded the above 37 articles and extracted 5 core indicators and 10 sub-indicators, among which a1, a2, product innovation, cruise itineraries, and the development of passenger source markets have a higher statistical frequency, which are the key areas of concern in adding value to the cruise value chain. Table 1 Coding statistics of value-added influencing factors of the whole cruise industry chain.

Table 1. Coding statistics for value-added factors affecting the entire cruise industry chain

Core Indicators	Secondary indicators	Secondary indicators	Frequency
Cruise industry chain upstream (a)	Value-added innovation	Design Innovation	12
		Manufacturing Technology Innovation	16
	Value Added Scale	Merger and restructuring of shipyards	8
		Expansion of production scale	12
Cruise Industry Chain Midstream (b)	Brand Value Added	Brand Market Power	6
		Brand profitability	11
		Brand Growth Power	13
		Brand Loyalty	10
	Value Added Services	Cruise Hotel Services	15
		Cruise Entertainment Services	15
		Cruise ship land area services	7
Cruise industry chain downstream (c)	Channel Value Added	Expanding market share	18
		Enhance brand value	14
		Reduce channel costs	8

（Statistics from 37 relevant papers）

3.3 Analysis of factors influencing value-added cruise ship value chain based on DEMATEL-ISM

Ten experts engaged in cruise related research fields were invited to score 14 factors affecting the value-added of cruise value chain in both directions, and the expert group included five university professors specializing in cruise and five experts in cruise industry, each of whom had more than 10 years of scientific research or practice experience in the field of cruise. Based on the questionnaire results and experts' opinions, the direct influence matrix was obtained by the method of averaging, and the comprehensive influence matrix was calculated by equation (1) and equation (2), and the data were obtained as shown in Table 2.

Table 2. Cruise value chain value-added integrated impact matrix

Factors	a1	a2	a3	a4	b1	b2	b3	b4	b5	b6	b7	c1	c2	c3
a1	0.12	0.15	0.04	0.18	0.15	0.05	0.08	0.15	0.20	0.13	0.05	0.04	0.05	0.05
a2	0.08	0.19	0.09	0.17	0.21	0.08	0.11	0.05	0.19	0.08	0.08	0.09	0.08	0.09
a3	0.13	0.16	0.14	0.16	0.13	0.13	0.08	0.11	0.07	0.06	0.07	0.11	0.10	0.10
a4	0.21	0.12	0.13	0.12	0.04	0.10	0.18	0.18	0.03	0.04	0.08	0.18	0.20	0.06
b1	0.11	0.18	0.21	0.13	0.13	0.07	0.20	0.20	0.13	0.14	0.12	0.15	0.21	0.17
b2	0.20	0.09	0.11	0.09	0.10	0.06	0.18	0.21	0.13	0.10	0.16	0.20	0.13	0.12
b3	0.11	0.11	0.10	0.12	0.20	0.07	0.10	0.16	0.14	0.15	0.16	0.08	0.10	0.17
b4	0.10	0.11	0.16	0.19	0.14	0.11	0.15	0.06	0.12	0.10	0.17	0.07	0.02	0.18
b5	0.19	0.18	0.12	0.14	0.12	0.09	0.06	0.07	0.09	0.16	0.18	0.03	0.06	0.18
b6	0.08	0.12	0.10	0.16	0.09	0.06	0.16	0.05	0.19	0.21	0.21	0.10	0.06	0.20
b7	0.16	0.20	0.06	0.17	0.15	0.07	0.03	0.04	0.18	0.19	0.15	0.02	0.09	0.09
c1	0.05	0.09	0.06	0.06	0.09	0.09	0.08	0.03	0.09	0.06	0.04	0.15	0.05	0.06
c2	0.15	0.08	0.12	0.12	0.12	0.06	0.02	0.05	0.12	0.06	0.11	0.03	0.03	0.12
c3	0.10	0.16	0.17	0.16	0.08	0.08	0.14	0.14	0.12	0.12	0.13	0.14	0.14	0.13

The influence degree b_i , the influenced degree c_i , the cause degree z_i , and t he centrality degree y_i of each factor were calculated by step 4 of the DEMATE L-ISM-BN model construction, and the results were ranked in Table 3.

Table 3. Results of DEMATEL method analysis

Factors	Influencing Factors	Degree of influence	Degree of being influenced	Reason degree	Centrality	Centeredness sorting
a1	Design Innovation	2.677	1.335	1.342	4.012	3
a2	Manufacturing Technology Innovation	2.345	1.041	1.304	3.386	6
a3	Merger and restructuring of shipyards	0.978	0.856	0.122	1.834	11
a4	Expansion of production scale	0.875	0.769	0.106	1.644	14
b1	Brand Market Power	1.586	1.453	0.133	3.039	9
b2	Brand profitability	1.674	1.237	0.437	2.911	10
b3	Brand Growth Power	1.876	1.327	0.549	3.203	7
b4	Brand Loyalty	2.034	1.023	1.011	3.057	8
b5	Cruise Hotel Services	2.456	1.874	0.582	4.33	1
b6	Cruise Entertainment Services	2.132	1.296	0.836	3.428	5
b7	Cruise ship land area services	0.893	0.768	0.125	1.661	13

c1	Expanding market share	2.235	1.975	0.26	4.21	2
c2	Enhance brand value	2.653	1.221	1.432	3.874	4
c3	Reduce channel costs	0.889	0.727	0.162	1.616	12

Then, the reachable matrix S is derived from step 5, and the multi-level recurs ive structure model of value-added influence factors of cruise ship is constructed by applying the *Matlab* program to calculate step 6 and perform the hierarchy d ivision, as shown in Figure 1.

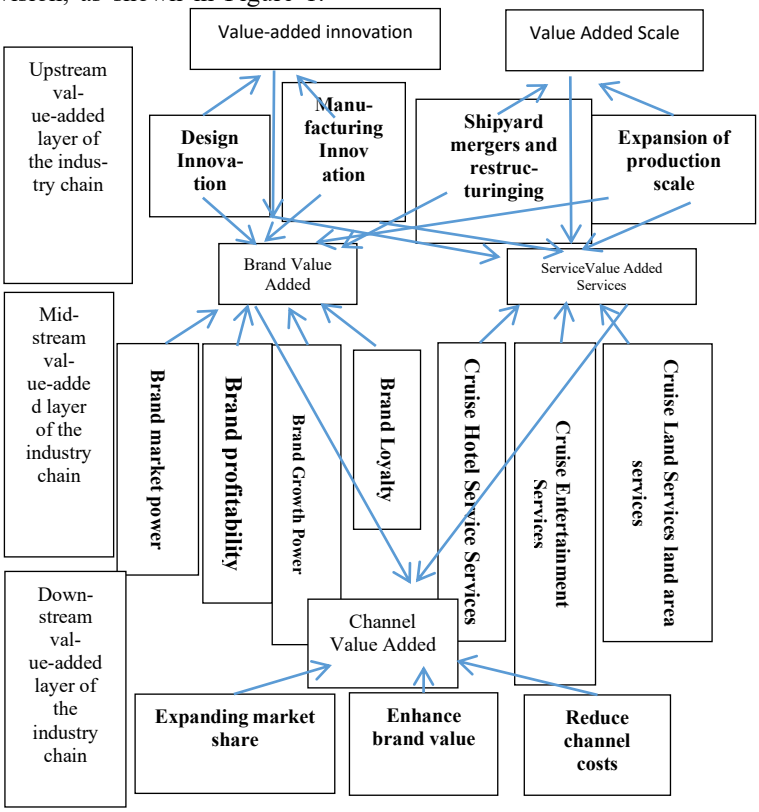

Fig. 1. Explanatory structural model of value-added influencing factors of cruise ship value chain

3.4 Comprehensive Analysis

The data obtained from Table 3 shows that the top three factors ranked by DEMATEL centrality are: cruise hotel service (b5), expanding market share (c1) and design innovation (a1) , indicating that these three factors are the most important and in the core position. The top three factors in terms of reason degree are enhancing brand value (c2), design innovation (a1) and manufacturing technology innovation (a2), indicating that these three factors will have a greater impact on other factors. The value creation process of each link in the upstream, midstream and downstream of the cruise industry constitutes the value chain, which is value-added oriented and aims at satisfying users'

needs, and the correlations of the value chain have temporal subordination and spatial directionality [4]. The core of the cruise industry chain is the value chain. Cruise enterprises and service products with broad market prospect and high technology content in the value chain ring form the chain nuclei, and these chain nuclei take technical products as the point and production factors as the line, connect backward and forward, extend up and down, and interlock to form a chain network distribution, which facilitates the sharing of resources between upstream and downstream production links of enterprises vertically and between related departments horizontally. The core competence of the cruise enterprise provides a platform for the enterprise to develop new products and launch new services, and the chain network distribution extends the business scope of the enterprise and lays the foundation for the sustainable development of the enterprise. The completeness, systemic and synergistic nature of the chain-network whole industry chain model can promote the possibility of extending the survival and development space of enterprises in both parallel and deep dimensions, enabling enterprises to realize timely information transfer and resource sharing between upstream and downstream production links in each dimension and between relevant departments in the horizontal direction. The cooperation platform in the chain network distribution provides a channel for information transfer in the whole industry chain of cruise ships, and the upstream, midstream and downstream industries of cruise ships transmit information related to product supply and demand, technological innovation and service innovation to each other through the platform, thus promoting chain extension and resource integration, and the system structure of the whole industry chain continuously promotes the technological upgrading and product replacement of enterprises with demand orientation, which in turn enhances the overall advantages of the whole industry chain and The system structure of the whole industrial chain continuously promotes the technological upgrading and product replacement of enterprises with demand orientation, thus enhancing the overall advantages and value-added capacity of the whole industrial chain.

4 Research and Recommendations

The cruise value chain operation exists in the dual drive mode of producer-driven and purchaser-driven. The cruise industry is originally a cross-regional cooperative production method, and the cruise value chain is driven by both producers and purchasers, and the spatial separation, reorganization and normal operation of its value chain are accomplished under the impetus of producers or purchasers [5]. Producer-driven, that is, cruise ship design manufacturers with technological advantages and seeking to expand the market help to form a vertical division of labor system in the local production supply chain through joint ventures and equity participation by way of investment In the producer-driven cruise ship global value chain layout, multinational cruise companies drive the production or service of cruise ships by forming global production and sales networks, which eventually form a producer-led global cruise value chain system. In the purchaser-driven global value chain, multinational cruise companies with strong brand advantages, including cruise design and manufacturing companies and cruise

operating companies, build a global cruise product distribution network through global procurement and OEM. The production link in the purchaser-driven value chain is subcontracted by multinational cruise companies to national contractors through their subsidiaries all over the world. In the producer-driven model, the high added value obtained by the value chain comes from the continuous improvement of the cruise ship design and manufacturing process and the continuous innovation of cruise products, reflecting technological innovation, and the value-added part of the cruise value chain mainly flows to the production field. In the purchaser-driven model, the high value-added in the cruise value chain comes from the marketing, service and brand promotion processes involved in developing the passenger market and expanding the sales scope, and the value-added in the cruise value chain mainly flows to the distribution field such as marketing and branding.

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