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Applying ANP in Establishing a Decision-Making Model for the Destination Selection of Large-scale Exhibitions

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Abstract

This study investigates the decision-making issues in the selection of destinations for large-scale exhibitions by the cultural and creative industry. We use the Rubber Duck China Tour by the Dutch artist *Florentijn Hofman* as an example and adopt the analytic network process technique to evaluate destination options for the exhibition, as well as to explore the impacts of the evaluation of destination feasibilities on exhibition investment. The results show that power, a high benefit-cost ratio, first-tier cities, integration with local communities, and a rich and interesting theme are the top five factors that curators should consider when planning exhibitions. Considering the priority among cities of various tiers, first-tier cities are the most favorable, followed by fourth-tier, third-tier, and second-tier cities. The decision-making model provides curators with a reliable reference for selecting destinations for future exhibitions.

Keyword: Cultural and creative industry, Network analysis, Public art, Decision analysis, Curator

1. Introduction

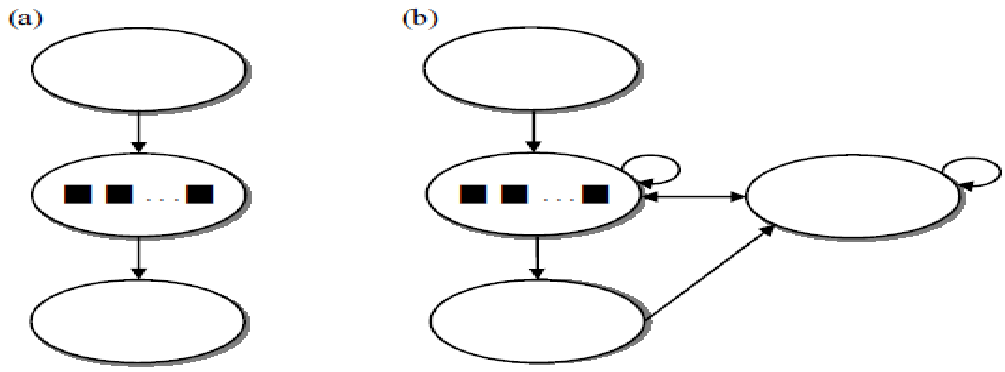
This study attempts to apply a network analysis method to establish a decision-making model for selecting destinations for large-scale exhibitions, using the Rubber Duck touring exhibition in China by the Dutch artist Florentijn Hofman as an example. In 2007, the "Rubber Duck China Tour" created by Mr. Hofman began its world tour, from Europe to Asia, and was exhibited in Japan, Hong Kong, Taiwan, and mainland China. The Rubber Duck China Tour project was a part of the global touring exhibition. The purpose of the project was to introduce Mr. Hoffman's contemporary artwork to China. By displaying the piece in a public area, the exhibit intended to facilitate a dialogue between public space and art. The Duck was created by the artist to summon sentimental memories of childhood, soothe the minds of children, and foster happiness in everyone, which resulted in a competition among cities to host the exhibition. This study attempts to focus on destination selection strategies for large-scale exhibitions using the network analysis method. Many cities have built complex indoor and outdoor venues for conferences and exhibitions, as it is widely believed that attractive facilities can entice high-end art exhibitions. However, the degree of cultural literacy and development of the destination often affect the number of visitors (Whitfield, Dioko, Webber, & Zhang, 2014). Selecting destinations for large-scale, independent exhibitions is not an easy task, as the evaluation criteria tend to depend on each other. Traditional analytic hierarchy processes (AHP) are not effective in structuring complex problems during decision-making processes; hence, they are not suitable for exhibition destination selection processes. This study adopted an analytic network process (ANP) approach, which is a modified version of the AHP, and utilized Kotler's (1986) 6Ps (Product, Price, Place, Promotion, Power, and Public Relations) as criteria to evaluate destination options for exhibitions. Previous studies have applied net present value (NPV) to measure the *static investment environment* for project options (De Reyck, Degraeve, &Vandenborre, 2008). However, given the potential risks from a multitude of sources, which are not covered by NPV, a *dynamic environment evaluation* model is needed. Therefore, this study employs an ANP method to construct an optimal decision-making model to be used in selecting destinations for large-scale exhibitions. This model aims to assist curators to evaluate the investment environment of cities of various tiers; analyze the advantages and disadvantages of each city; and estimate prospective values, number of potential visitors, and probable risks, to devise different hedging strategies to select the most profitable cities as destinations for exhibitions. This study utilizes the 6Ps—product, price, place, promotion, power, and public relations—as the evaluation criteria, since economic benefits are the most suitable measurement in selecting investing cities for art exhibitions. First, the potential values of destination options were evaluated, and then, the computed values were utilized to construct a mathematical model for evaluation of future destinations. The purpose of this study is to provide exhibition curators and investors with a reference for selection of future exhibition destinations.

2. Literature Review

There are currently many exhibition agencies in Taiwan; however, most exhibitions are outsourced to Media Sphere Communications Ltd. and United Daily News Group. The themes of these exhibitions are typically mainstream art, contemporary art, and well-known animations. In the summer of 2014, Media Sphere Communications Ltd. hosted the exhibition of One Piece (*Wan Pīsu*, a Japanese *manga* series) at Huashan 1914 Creative Park in Taipei City, which attracted three hundred thousand visitors and achieved astoundingly high revenue from derived products. A successful example of a contemporary art exhibition was organized by the Japanese artist and writer Yayoi Kusama at the Shanghai Museum of Contemporary Art, which attracted a million visitors. In 2013 and 2014, Hofman's Yellow Duck conquered the world with its "cuteness." The exhibition was particularly successful in China, as it attracted a stunningly large number of visitors. It can be concluded that with the evolution of society, life and art have grown closer together, becoming an inseparable entity and leading to the rise of the cultural and creative industry. The stakeholders behind the scene are artists, exhibition agencies, and investors, who help to lay the foundation of a constantly innovating industry. However, decision-making models for the destination selection of large-scale exhibitions have seldom been studied and most scholars tend to apply traditional financial investment evaluation methods, such as NPV, to measure the static investment environment (De Reyck et al., 2008). Lin, Huh, and Yen (2011) adopted a modified Delphi method (MDM) and proposed a five-dimensional model to evaluate the competitiveness of Taipei city and five other major Asian destination cities for international exhibitions. Ho, Chiu, Feng, & Tai (2011) applied ANP and the decision-making trial and evaluation laboratory (DEMATEL) to assess the importance of service-quality attributes of international conferences and exhibitions, and established a weighted evaluation system to examine the service quality of international conferences and exhibitions. Saaty (2009) also adopted the ANP to investigate decision-making processes for the location selection of the new Disneyland in China. Yang (2015) used the Dingfan region of Lukang Town in Changhua County (Taiwan) as an example to investigate the key factors for successful Lantern Festival activities, and proposed a three-fold framework with twelve evaluation criteria. The findings revealed that the environmental identity is the most important aspect, local cultural identity and educational value are the most critical items in the success of activities, execution ability is the key to marketing implementation, while strategic planning and explicit themes are the most important items in event planning. Boateng, Chen, and Ogunlana (2015) pointed out that the ANP is a commonly used decision-making model in both academic and practical fields. Therefore, the ANP was also employed by the present study in the analyses of destination selection for large-scale exhibitions.

The AHP is a decision-making model proposed by Saaty in 1971, and is mainly applied to decision-making with uncertain criteria, or multiple evaluation criteria. The AHP is able to systematize complex problems so that they are easily evaluated. Although the AHP can be used to address problems with multiple criteria and with a multi-leveled structure, it is only effective based on the assumption that the decision criteria, on all levels, are independent of one another, and when the criteria and alternatives are independent of one another. Previous research in the social sciences has shown that real-life decision making is characterized with internal complexity, and there is usually a certain degree of dependence and interaction between various criteria. In other words, the relationship between criteria presents a network, rather than a linear structure (Saaty & Takizawa, 1986; Saaty, 1996; Zeng, 2005). Subsequently, Saaty (1996) further improved the AHP and developed the ANP, which overcomes the restrictions of the AHP, taking into consideration interdependent relationships between scenarios and criteria when solving real-life problems, and allowing for analyses and assessments of decision-making scenarios that involve complex interdependent relationships (Saaty, 1996; Meade and Sarkis, 1999; Wu And Lee, 2007). The ANP can be used to build hierarchical or network-structured models, depending on the types of issues involved (Büyüközkan, Kahraman, & Ruan, 2004). Satty's (1996) ANP featured dependency and feedback, which can assist in making decisions when there is dependency among criteria. Meade and Sarkis (1999) suggested that the traditional AHP model could be regarded as a special and simplified version of the ANP model.

The ANP is a comprehensive decision-making technique that encapsulates external independence, as well as inner and outer dependence of decision criteria. An ANP model consists of two parts: the first part is composed of control clusters (or dependent criteria and sub-criteria), while the second is a network of interdependent clusters and elements (Saaty, 1996). Therefore, ANP can be used to establish various structural models according to the type of problems. As shown in Figure 2-1 "(a)" illustrates a hierarchical structure and "(b)" illustrates a network structure. A network system is a complex structure of clusters (Momoh and Zhu, 2003). Saaty (1996) employed circles to indicate the dependent relationships between clusters and elements, and arrows to signify the relationship and interaction points between clusters. In Figure 2-2, a "→"indicates the influential relationships between clusters, "↔" designates the interaction between clusters, and a loop represents the inner dependency of elements within a cluster. In addition, in a network structure, the importance of criteria determines that of the corresponding alternatives and; the importance of alternatives influences that of relevant criteria.



(a) Hierarchical Structure (b) Network Structure

A Cluster A Criteria Indicates a one-way influential relation

Indicates dependent relationships between clusters

Indicates inner dependence of criteria within a cluster

Fig1. Hierarchical and Network Structures

Data source: Saaty (1980, 1996)

The ANP utilizes a supermatrix to represent the relationships between elements, as well as the strength of such relationships. Figure 2-3 illustrates how items form several matrices, and the matrices further form a supermatrix. In other words, a supermatrix is composed of several sub-matrices, while each sub-matrix is composed of the criteria and the eigenvectors acquired upon comparing the stated criteria. In figure 2-3, the values w11, w12, ⋯; wij are the eigenvalues calculated following a pairwise comparison. In addition, the values in the columns of a supermatrix are stochastic, and the total sum of the column valuesis 1. An empty spot or “0” in the supermatrix indicates that the clusters or elements are independent of each other. One of the greatest advantage of a supermatrix is that it can be used to assess both outer and inner dependent relationships. Outer dependence refers to the relationship between clusters, while inner dependence is the interrelationship between criteria within the same cluster. In summary, an ANP model utilizes the concept of network processes to improve restrictions (requiring independent relationships among items) of an AHP model. Since applying the ANP technique to compare alternatives involves the examination of actual interdependent relationships between various scenarios and criteria, the selected scenario is more likely to meet the project objectives and requirements. Therefore, this study adopts the ANP technique to compute consistent and objective weights for each criterion, and then establishes a model based on these criteria to compare destination options, thereby extracting optimal alternatives, according to the evaluation results.

$$W = \begin{array}{cc} & \begin{array}{cccc} C_1 & C_2 & \cdots & C_i \\ e_{11}e_{12}\cdots e_{1j} & e_{21}e_{22}\cdots e_{2j} & \cdots & e_{i1}e_{i2}\cdots e_{ij} \end{array} \\ \begin{array}{cc} C_1 & \begin{array}{c} e_{11} \\ e_{12} \\ \vdots \\ e_{1j} \end{array} \\ C_2 & \begin{array}{c} e_{21} \\ e_{22} \\ \vdots \\ e_{2j} \end{array} \\ \vdots & \vdots \\ C_i & \begin{array}{c} e_{i1} \\ e_{i2} \\ \vdots \\ e_{ij} \end{array} \end{array} & \begin{bmatrix} w_{11} & w_{12} & \cdots & w_{1j} \\ w_{21} & w_{22} & \cdots & w_{2j} \\ \vdots & \vdots & \ddots & \vdots \\ w_{i1} & w_{i2} & \cdots & w_{ij} \end{bmatrix} \end{array}$$

Figure 2. Super Matrix

3. The Decision-making Environment for Exhibition Destination Selection

This study adopted Hofman’s Rubber Duck public art exhibition as an example to investigate decision-making issues involved in destination selection strategies for large-scale exhibitions in the cultural and creative industry. The theoretical foundations of the decision-making environment setting is constructed using Kotler’s (1986) Mega marketing Theory, which was developed based on the 4Ps (product, price, place, and promotion) theory, adding political power and public relations as factors to become the 6Ps. Subsequently, key evaluation items for each dimension in the six-dimension framework (6Ps) were further defined, with reference to Lee’s (2004) study on integrated marketing of the cultural and creative Industry, and were screened by experts in exhibition administration. The final framework is exhibited in Figure 3.

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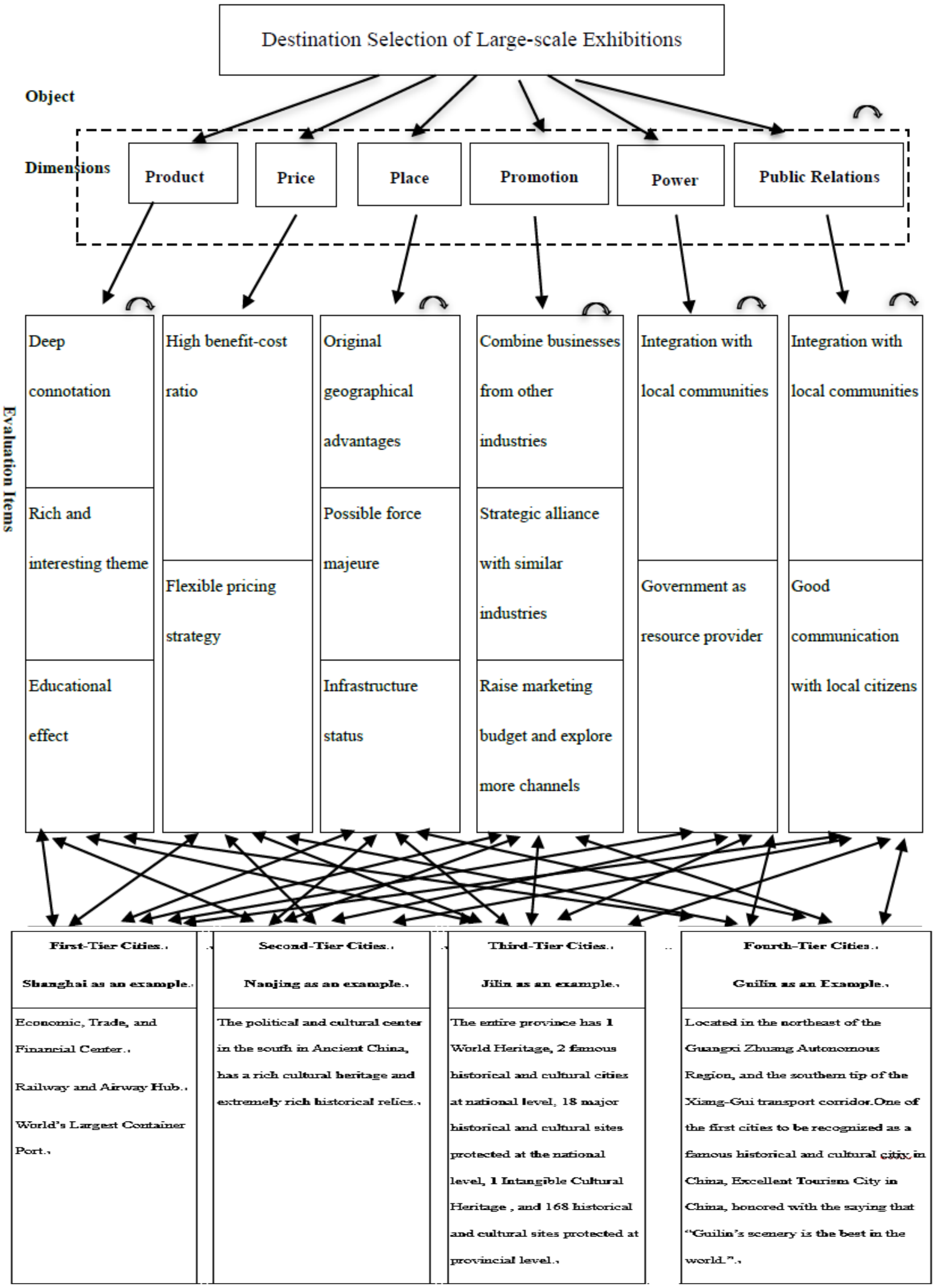

Figure 3. Evaluation Framework

The questionnaire in this study was based on the formation ofIntegrated Marketing of the Cultural and Creative Industry: A Case Study of YiLan County (Lee, 2004). And that were modified from NGT expert groups to familiarize themselves with the experts in curatorial activities of Rubber Duck TourChina.The membershipas shown in Table 1, there were 4 males and 3 females, and the list of NGT experts

Table 1. list of NGT experts

Service Uni.	Gender	Position	Seniority
FPG International co., Ltd.	Male	President	10
FPG International co., Ltd.	Male	Manager	10
Airglow CO. LTD.	Male	President	15
Chinese Economic & Cultural Development Unionist Association	Male	President	20
Inspiration Development Company Limited	Female	President	3
Inspiration Development Company Limited	Female	Manager	3
Inspiration Development Company Limited	Female	Manager	3

There are 30 important criteria for evaluation, and the integration of scholars and experts is made on the basis of three-point scales of “1 = common, 2 = important, 3 = extremely important” (Liberalore, 1987; Liberatore et al., 1992; Tam and Rao, 2003). That is, the average value is calculated $\bar{M}_i = \frac{\sum_{q=1}^{7} x_i q}{7}$, where $x_i q$ is the mean value of the q-th expert gives the score for the i-th item, i = 1, 2,……, 38; q=1, 2,…… , 7, in order to simplify the evaluation model and evaluation process, the same attribute criteria integration steps to achieve the goal, and the purpose of the questionnaire at this stage is to select important evaluation criteria. $\bar{M}_i \leq 2.275$ will be deleted, and finally sort out the 6 constructs and 15 sub-criteria as shown in Table 2.

Table 2. EvaluationCriterion

Criteria	
C_1Product	C_{11}Deep connotation
	C_{12}Rich and interesting theme
	C_{13}Educational effect
C_2Price	C_{21}High benefit-cost ratio
	C_{21}Flexible pricing strategy
C_3Place	C_{31}Original geographical advantages
	C_{32}Possible force majeure
	C_{33}Infrastructure status
C_4Promotion	C_{41}Combine businesses from other industries
	C_{42}Strategic alliance with similar industries
	C_{43}Raise marketing budget and explore more channels
C_5Power	C_{51}Integration with local communities
	C_{52}Government as resource provider
C_6Public relationship	C_{61}Integration with local communities
	C_{62}Good communication with local citizens

This section of the statistical data from the ANP questionnaire data, and sampling by Big Duck China Tour team members. According to the survey of 10 large-scale exhibition exhibits, there were 5 males (50%) and 5 females (50%). The age distribution ranged from 30-65 years old. All thequestionnaire's inconsistency score are ≤ 0.1.

4. Analysis Results

The present study utilized the software 'Super Decision' to analyze the result data. First, we input the geometric mean of the data obtained through the questionnaire into the software to obtain a stable, limiting supermatrix and a weighted matrix. Then, the obtained limiting supermatrix and weighted matrix were utilized to rank the dimensions evaluation criteria within each dimension according to the calculated weights. Lastly, the ranking results were adopted to help assess and decide the most favorable destinations for the exhibition. The weights of the matrices and ranking results are listed in Table 3.

Table 3. Priority of Criteria

Dimensions	EvaluationItems	Normallized by Cluster	Limiting	Global Rank
Product	Deep connotation	0.16285	0.013271	17
	Rich and interesting theme	0.59659	0.048616	8
	Educational effect	0.24056	0.019603	14
	High benefit-cost ratio	0.80745	0.037599	9
Price	Flexible pricing strategy	0.19255	0.008966	18
	Original geographical advantages	0.15654	0.025513	12
	Possible force majeure	0.6591	0.10742	2
Place	Infrastructure status	0.18436	0.030047	11
	Cooperation with businesses from other industries	0.37729	0.018447	15
Promotion	Strategic alliance with similar industries	0.15538	0.007597	19
	Raises marketing budget and explores more channels	0.46734	0.02285	13
Power Public Relations	Independent Organization	0.19463	0.063443	5
	Government as resource provider	0.80537	0.262517	1
	Integration with local communities	0.62867	0.030739	10
	Good communication with local citizens	0.37133	0.018156	16

Table 4. Importance of destinations for future exhibitions

	Level of Cites	Sample Cities	Rank
City Options	First-tier Cities	Shanghai	1
	Second-tier Cities	Nanjing	4
	Third-tier Cities	Jilin	3
	Fourth-tier Cities	Guilin	2

It can be seen from Table 1 that within the “Product” dimension, the weight of “Rich and interesting theme,” Educational effect,” and “Deep connotation” were 0.59659, 0.24056, and 0.16285 respectively. Within the “Price” dimension, the weight of “High benefit-cost ratio” (0.80745) was higher than that of “Flexible pricing strategy” (0.19255). Within the “Place” dimension, “Possible force majeure” had the highest weight (0.6591), followed by that of “Infrastructure status” (0.18436), and “Original geographical advantages” (0.15654). Within the “Promotions” dimension, the weight of “Raises marketing budget and explores more channels” was the highest (0.46734), followed by that of “Cooperation with businesses from other industries” (0.37729) and “Strategic alliance with similar industries” (0.15538). Within the “Power” dimension, the weight of “Government as resource provider” (0.80537) was higher than that of "Independent Organization" (0.19463). Within the "Public relations" dimension, "Integration with local communities" had a higher weight (0.62867) than "Good communication with local citizens" (0.37133). "Rich and interesting theme," "high benefit-cost ratio," "possible force majeure," "raises marketing budget and explores more channels," "government as resource provider," and "integration with local communities," were the most important items within the six dimensions respectively. However, it is insufficient to merely consider the most important criteria within each dimension, as some dimensions are less significant than others. Adopting only the most important criteria within each dimension is likely to lead to the possibility of overlooking relatively important items from other dimensions. It is therefore necessary to remove the constraints of each dimension, and identify the overall priorities among the fifteen items. A further analysis revealed that "government as resource provider," "possible force majeure," "fist-tier cities," "integration with local communities," and "rich and interesting theme" are the top five items in the global rank. In cases where the rank from within each dimension was not consistent with the global rank, the global rank was adopted.

The priority among cities of various tiers, first-tier cities are the most favorable, followed by fourth-tier, third-tier, and second-tier cities. The decision-making model provides curators with a reliable reference for selecting destinations for future exhibitions.

5. Conclusion

In this study, Hofman's exhibition was introduced as an example to test the model. The exhibition was present in the following cities in mainland China: Beijing (first-tier), Hangzhou (quasi-first-tier), Qingdao (quasi-first-tier) Guiyang (third-tier), Harbin (third-tier), Shanghai (first-tier), and Nanjing (second-tier). Given that mainland China is a huge market, each city has its own distinctive economic, social, and geographical conditions; therefore, the weights of the items for each of the six dimensions may be different in each city. After analyzing the data and information collected by the present study, the following criteria are suggested:

1) The Government as a resource provider: In mainland China, all exhibitions should apply for approval from relevant departments, such as the Ministry of Public Security, and the Ministry of Culture. When the government acts as a resource provider for a project, the application process is likely to be more efficient, and will have a greater probability of being approved. In addition, with the participation and support of the local government, the risks for exhibition holders such as bad debt or violation of property rights by manufacturers, as well as the uncertainty of being approved, are typically reduced.

2) High benefit-cost ratio: There is a large gap between urban and rural areas in China, therefore, absolute ticket value as a measure is not applicable. Moreover, due to rapid economic development, China's consumption tendency has seamlessly converged to the same level as the rest of the world. The emerging middle class is highly sensitive towards price and attaches great significance to cheap luxury, high quality at lower prices, and value beyond money. Therefore, only by putting an emphasis on affordable high-quality products and services can an exhibition be successful. It is therefore suggested that

exhibition organizers consider "affordable high-quality" when designing their pricing strategy.

3) Possible force majeure: The focus of this item is to investigate the local climate scenarios, and possible infectious diseases occurring within the destination. In 2016, the opening of the "Rubber Duck China Tour" exhibition in Xiamen was canceled due to a typhoon. Therefore, local climate is very important.

4) First-tier cities: First-tier cities typically have a larger population, greater consumption capacity, and better infrastructure compared with other cities. Therefore, they should be the priority for curators. The second priority destinations should be fourth-tier cities. Although fourth-tier cities (such as Guilin) are less populated and have insufficient infrastructure, their unique landscape and good climate compensates for their shortcomings.

5) Integration with local communities: Working with local communities can bring the following benefits: (1) the ability to motivate citizens to attend the exhibition, (2) support from the local government through favorable policies can be acquired, (3) leading participants are easier to find, and (4) the local cultural resources and work force are utilized.

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Appendix

Table 5. Unweighted Super Matrix

Cluster		C_1			C_2		C_3			C_4			C_5		C_6		City Options			
Node Labels		C_{11}	C_{12}	C_{13}	C_{21}	C_{22}	C_{31}	C_{32}	C_{33}	C_{41}	C_{42}	C_{43}	C_{51}	C_{52}	C_{61}	C_{62}	First-tier Cities	Second-tier Cities	Third-tier Cities	Fourth-tier Cities
C_1	C_{11}	0.104729	0.084144	0.117221	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.4442	0.14240	0.142857	0.1297
	C_{12}	0.636986	0.704936	0.61441	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0836	0.67817	0.714286	0.7324
	C_{13}	0.258285	0.210920	0.268369	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.4721	0.17942	0.142857	0.1378
C_2	C_{21}	0.0000	0.0000	0.0000	0.5000	0.5000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.8000	0.83333	0.875000	0.9000
	C_{22}	0.0000	0.0000	0.0000	0.5000	0.5000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2000	0.16666	0.125000	0.1000
C_3	C_{31}	0.0000	0.0000	0.0000	0.0000	0.0000	0.112524	0.0880	0.14883	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1786	0.20812	0.287203	0.5469
	C_{32}	0.0000	0.0000	0.0000	0.0000	0.0000	0708856	071723	0.69083	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.7088	0.66076	0.634839	0.1082
	C_{33}	0.0000	0.0000	0.0000	0.0000	0.0000	0.178620	0.1946	0.16032	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1125	0.07795	0.131112	0.3445
C_4	C_{41}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.15498	0.32748	0.16032	0.0000	0.0000	0.0000	0.0000	0.1840	0.19192	0.636986	0.0786
	C_{42}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.13538	0.41259	0.14883	0.0000	0.0000	0.0000	0.0000	0.2318	0.17431	0.104729	0.0786
	C_{43}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.70963	0.25992	0.69083	0.0000	0.0000	0.0000	0.0000	0.5841	0.63370	0.258258	0.2627
C_5	C_{51}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.25000	0.142857	0.0000	0.0000	0.1666	0.87500	0.166667	0.5000
	C_{52}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.7500	0.857143	0.0000	0.0000	0.83333	0.125000	0.833333	0.5000
C_6	C_{61}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.8000	0.3333	0.5000	0.8000	0.857143	0.50000
	C_{62}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.200	0.6666	0.50000	0.2000	0.142857	0.50000
City Options	First-tier Cities	0.503924	0.354778	0.590315	0.055926	0.556456	0.059893	0.05744	0.059575	0.611130	0.057445	0.651708	0.053310	0.047307	0.597026	0.556474	1	0.0000	0.0000	0.0000
	Second-tier Cities	0.176898	0.443646	0.266971	0.126555	0.280840	0.108183	0.09355	0.097149	0.249238	0.093557	0.212370	0.120761	0.123855	0.261190	0.296219	0.0000	1	0.0000	0.0000
	Third-tier Cities	0.062148	0.144443	0.1000372	0.269950	0.108513	0.296256	0.25478	0.281222	0.083081	0.254789	0.080798	0.449052	0.316316	0.054973	0.097683	0.0000	0.0000	1	0.0000
	Fourth-tier Cities	0.257050	0.057133	0.042342	0.547569	0.054192	0.535668	0.59420	0.562054	0.056550	0.594209	0.055124	0.376877	0.512523	0.086811	0.049624	0.0000	0.0000	0.0000	1

Table 6. Weighted Super Matrix

Cluster		C_1			C_2		C_3			C_4			C_5		C_6		City Options			
Node Labels		C_{11}	C_{12}	C_{13}	C_{21}	C_{22}	C_{31}	C_{32}	C_{33}	C_{41}	C_{42}	C_{43}	C_{51}	C_{52}	C_{61}	C_{62}	First-tier Cities	First-tier Cities	First-tier Cities	First-tier Cities
C_1	C_{11}	0.052365	0.042072	0.058610	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.444274	0.142407	0.142857	0.129721
	C_{12}	0.318493	0.352468	0.307205	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.083616	0.678171	0.714286	0.732430
	C_{13}	0.129143	0.105460	0.134184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.472111	0.179422	0.142857	0.137849
C_2	C_{21}	0.0000	0.0000	0.0000	0.06250	0.06250	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.800000	0.83333	0.8750000	0.900000
	C_{22}	0.0000	0.0000	0.0000	0.06250	0.06250	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.200000	0.166667	0.125000	0.100000
C_3	C_{31}	0.0000	0.0000	0.0000	0.0000	0.0000	0.084393	0.066058	0.111627	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.178620	0.208127	0.287203	0.546931
	C_{32}	0.0000	0.0000	0.0000	0.0000	0.0000	0.531642	0.537926	0.518127	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.708856	0.660761	0.634839	0.10825
	C_{33}	0.0000	0.0000	0.0000	0.0000	0.0000	0.133965	0.146016	0.120247	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.112524	0.077959	0.131112	0.344545
C_4	C_{41}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.025830	0.054580	0.026721	0.0000	0.0000	0.0000	0.0000	0.184002	0.191921	0.636986	0.078617
	C_{42}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.022565	0.068766	0.024806	0.0000	0.0000	0.0000	0.0000	0.231823	0.174317	0.104729	0.078617
	C_{43}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.118272	0.043320	0.115139	0.0000	0.0000	0.0000	0.0000	0.584170	0.633708	0.258258	0.262753
C_5	C_{51}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.218750	0.12500	0.0000	0.0000	0.166667	0.875000	0.166667	0.50000
	C_{52}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.656250	0.7500	0.0000	0.0000	0.83333	0.125000	0.8333333	0.50000
C_6	C_{61}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.13333	0.055556	0.5000	0.8000	0.857143	0.50000
	C_{62}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.033333	0.111111	0.50000	0.2000	0.142857	0.50000
City Options	First-tier Cities	0.503924	0.354778	0.590315	0.055926	0.556456	0.059893	0.057445	0.059575	0.611130	0.057445	0.651708	0.053310	0.047307	0.597026	0.556474	1	0.0000	0.0000	0.0000
	Second-tier Cities	0.176898	0.443646	0.266971	0.126555	0.280840	0.108183	0.093557	0.097149	0.249238	0.093557	0.212370	0.120761	0.123855	0.261190	0.296219	0.0000	1	0.0000	0.0000
	Third-tier Cities	0.062148	0.144443	0.1000372	0.269950	0.108513	0.296256	0.254789	0.281222	0.083081	0.254789	0.080798	0.449052	0.316316	0.054973	0.097683	0.0000	0.0000	1	0.0000
	Fourth-tier Cities	0.257050	0.057133	0.042342	0.547569	0.054192	0.535668	0.594209	0.562054	0.056550	0.594209	0.055124	0.376877	0.512523	0.086811	0.049624	0.0000	0.0000	0.0000	1

Table 7. Limiting Matrix

Cluster		C_1			C_2		C_3			C_4			C_5		C_6		City Options			
Node Labels		C_{11}	C_{12}	C_{13}	C_{21}	C_{22}	C_{31}	C_{32}	C_{33}	C_{41}	C_{42}	C_{43}	C_{51}	C_{52}	C_{61}	C_{62}	First-tier Cities	First-tier Cities	First-tier Cities	First-tier Cities
C_1	C11	0.013271	0.013271	0.013271	0.013271	0.013271	0.013271	0.013271	0.013271	0.013271	0.013271	0.013271	0.013271	0.013271	0.013271	0.013271	0.013271	0.013271	0.013271	0.013271
	C_{12}	0.048616	0.048616	0.048616	0.048616	0.048616	0.048616	0.048616	0.048616	0.048616	0.048616	0.048616	0.048616	0.048616	0.048616	0.048616	0.048616	0.048616	0.048616	0.048616
	C_{13}	0.019603	0.019603	0.019603	0.019603	0.019603	0.019603	0.019603	0.019603	0.019603	0.019603	0.019603	0.019603	0.019603	0.019603	0.019603	0.019603	0.019603	0.019603	0.019603
C_2	C_{21}	0.037599	0.037599	0.037599	0.037599	0.037599	0.037599	0.037599	0.037599	0.037599	0.037599	0.037599	0.037599	0.037599	0.037599	0.037599	0.037599	0.037599	0.037599	0.037599
	C_{22}	0.008966	0.008966	0.008966	0.008966	0.008966	0.008966	0.008966	0.008966	0.008966	0.008966	0.008966	0.008966	0.008966	0.008966	0.008966	0.008966	0.008966	0.008966	0.008966
C_3	C_{31}	0.025513	0.025513	0.025513	0.025513	0.025513	0.025513	0.025513	0.025513	0.025513	0.025513	0.025513	0.025513	0.025513	0.025513	0.025513	0.025513	0.025513	0.025513	0.025513
	C_{32}	0.107420	0.107420	0.107420	0.107420	0.107420	0.107420	0.107420	0.107420	0.107420	0.107420	0.107420	0.107420	0.107420	0.107420	0.107420	0.107420	0.107420	0.107420	0.107420
	C_{33}	0.030047	0.030047	0.030047	0.030047	0.030047	0.030047	0.030047	0.030047	0.030047	0.030047	0.030047	0.030047	0.030047	0.030047	0.030047	0.030047	0.030047	0.030047	0.030047
C_4	C_{41}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.166667**	**0.174371**	**0.327480**	0.0000	0.0000	0.0000	0.0000	0.184002	0.191921	0.636986	0.078617
	C_{42}	0.018447	0.018447	0.018447	0.018447	0.018447	0.018447	0.018447	0.018447	0.018447	0.018447	0.018447	0.018447	0.018447	0.018447	0.018447	0.018447	0.018447	0.018447	0.018447
	C_{43}	0.022850	0.022850	0.022850	0.022850	0.022850	0.022850	0.022850	0.022850	0.022850	0.022850	0.022850	0.022850	0.022850	0.022850	0.022850	0.022850	0.022850	0.022850	0.022850
C_5	C_{51}	0.063443	0.063443	0.063443	0.063443	0.063443	0.063443	0.063443	0.063443	0.063443	0.063443	0.063443	0.063443	0.063443	0.063443	0.063443	0.063443	0.063443	0.063443	0.063443
	C_{52}	0.262517	0.262517	0.262517	0.262517	0.262517	0.262517	0.262517	0.262517	0.262517	0.262517	0.262517	0.262517	0.262517	0.262517	0.262517	0.262517	0.262517	0.262517	0.262517
C_6	C_{61}	0.030739	0.030739	0.030739	0.030739	0.030739	0.030739	0.030739	0.030739	0.030739	0.030739	0.030739	0.030739	0.030739	0.030739	0.030739	0.030739	0.030739	0.030739	0.030739
	C_{62}	0.018156	0.018156	0.018156	0.018156	0.018156	0.018156	0.018156	0.018156	0.018156	0.018156	0.018156	0.018156	0.018156	0.018156	0.018156	0.018156	0.018156	0.018156	0.018156
City Options	First-tier Cities	0.086551	0.086551	0.086551	0.086551	0.086551	0.086551	0.086551	0.086551	0.086551	0.086551	0.086551	0.086551	0.086551	0.086551	0.086551	0.086551	0.086551	0.086551	0.086551
	Second-tier Cities	0.057791	0.057791	0.057791	0.057791	0.057791	0.057791	0.057791	0.057791	0.057791	0.057791	0.057791	0.057791	0.057791	0.057791	0.057791	0.057791	0.057791	0.057791	0.057791
	Third-tier Cities	0.054530	0.054530	0.054530	0.054530	0.054530	0.054530	0.054530	0.054530	0.054530	0.054530	0.054530	0.054530	0.054530	0.054530	0.054530	0.054530	0.054530	0.054530	0.054530
	Fourth-tier Cities	0.086343	0.086343	0.086343	0.086343	0.086343	0.086343	0.086343	0.086343	0.086343	0.086343	0.086343	0.086343	0.086343	0.086343	0.086343	0.086343	0.086343	0.086343	0.086343