Applying the Fuzzy Delphi Method to Analyze the Evaluation Indexes for Service Quality after Railway Re-Opening – Using the Old Mountain Line Railway as an Example

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Abstract t: -The railway tourism has become a trend due to cultural heritage preservation. There have been voices calling for re-opening of the Old Mountain Line Railway. The service quality controlled by the management will have a great influence on tourists' intention to use the railway again. Therefore, the service quality after the railway re-opening is the key issue to be considered when it comes to management strategies. This study explored the indexes for service quality after railway re-opening from the viewpoints of some experts and scholars. Through literature review and interviews with experts, preliminary indexes were determined. Then the fuzzy Delphi method was applied to select proper ones from them, to discuss the key factors needed to be improved based on the current service quality. The result of this study shows that the most important factor was safety. With a safe foundation, tourists would trust the management more. The second important thing was to preserve features of scenic spots and heritage, a key factor of heritage tourism. Then with service facilities, sanitation facilities, and medical facilities, tourists' needs in comfort and emergency medical services could be satisfied, to create a service standard for the overall management. The achievement of this study helps the management to improve service quality after the railway re-opening and to facilitate future tourism management.

Key-Words: - Old Mountain Line Railway, service quality, fuzzy Delphi

1 Introduction

Since 1998, the Old Mountain Line Railway has been abandoned till now. Concerns from the Council for Cultural Affairs, ROC (CCA, ROC), the Department of Transportation and the Tourism Bureau of Taiwan Province, the Miaoli County Government, and many non-governmental organizations have brought up the issues of retrospect and preservation of railways in Taiwan. The Old Mountain Line Railway has become a popular scenic spot. After the Old Mountain Line Railway was abandoned, a series of activities to protect the Old Mountain Line Railway began, because this railway had been closely related to the development of the industries and the human environment.

In 2010, due to the preservation of the cultural relics, ecological landscapes, and the railway workmanship from the Japanese Colonial Period along the line and the needs for facilitate the local

tourism industry, the "Private Participation in the Old Mountain Line Railway" project began in accordance with the newly-revised "Old Mountain Line Railway Re-Opening Plan". The service quality after the re-opening of the Old Mountain Line Railway is closely related to the management of the Old Mountain Line Railway. If the quality of the services provided to tourists by the management cannot satisfy the tourists, their willingness to visit the Old Mountain Line Railway again would be influenced. Therefore, this study explored the indexes for the service quality after the Old Mountain Line Railway re-opening from the viewpoints of some tourism experts, tour guides, and scholars. This study first gathered information on related indexes through literature review and interviews with experts. Then the fuzzy Delphi method was applied to select proper indexes.

The fuzzy Delphi method, an integration of the fuzzy concept and the Delphi method, requires only a small survey sample to obtain an objective and reasonable result. With this method, time and costs of collecting questionnaires can be reduced, and experts' opinions can be kept as they are without being twisted [16]. This study explored the indexes for the service quality after the Old Mountain Line Railway re-opening to provide references for the related management unit. The achievements of this study would help the management unit of the re-opened Railway to improve the service quality and periodically check the service quality to come up with corresponding solutions, facilitating the management of tourism in the long run.

2. The Background of the Re-Opening of the Old Mountain Line Railway

After the Japanese Colonial Period and the Restoration of the National Government, the line between Sanyi and Houli was completed in 1908, and the Mountain Line Railway was finally completed and opened. The last train was dispatched in September, 1988. The Shengshin Station was no longer in use and had become a site with cultural meanings and values. Then, the preservation and reuse of the cultural relics of the Old Mountain Line Railway had become important local public issues

In July, 2002, the Taiwan Railways Administration instructed the Miaoli Government by correspondence that the goal of the Old Mountain Line Railway policy was to re-open it by adopting the BOT method. With the investment of non-governmental organizations and their involvement in management, this policy became the foundation of the re-opening of the Old Mountain Line Railway [15]. On June 5th, 2010, the Taiwan Railways Administration held a 3-month event to attract investments in the re-opening of the Old Mountain Line Railway in Miaoli which had not been used for almost 13 years. The event was successful with a lot of responses. The Taiwan Railways Administration also created a budget for repairing the Railway by revising the "Private Participation in the Old Mountain Line Railway". By the end of the same year, the invitation for bids was issued and the "Private Participation in the Old Mountain Line Railway" project was officially promoted [20].

3 Problem Solution

3.1 Initial Strategic Indexes for Service Quality after the Old Mountain Line Railway Re-Opening

In the first phase of this study, the scope was set to the indexes for service quality after the Old Mountain Line Railway re-opening. The methods adopted include literature analysis and interviewing experts. Based on the service quality after the Old Mountain Line Railway re-opening, the construct factors were determined according to the research features and requirements. After referencing the

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SERVQUAL scale aspects and discussions with experts, 4 aspects were included in the main frame, including (1) service reliability, (2) service convenience, (3) tourism planning, and (4) public facilities. The details are listed in table 1.

Table 1 Initial strategic indexes for service quality

Aspect	Factor	Description	Reference
Service reliability	Train safety	If tourists think it's safe to be in a train running on the repaired Old Mountain Line, then they can go on their Old Mountain Line trip with a good mood and without worries.	[2], [3], [7], [8], [13] ,[16], [18]
	Train punctuality	If trains are on schedule, tourists will trust the management more and feel satisfied.	[2], [3], [8], [13], [14], [16]
	Train comfort	Comfortable space inside trains may increase tourists' satisfaction and their willingness to come back again.	[2] , [3] , [7] , [8] ,[13], [14], [18]
	Price reasonability	Reasonable ticket prices and product prices may increase tourists' desire to make purchases while the management will not make a loss.	[2], [8], [9] , [14] , [18]
Service convenience	Convenience of transferring	Convenient transportation network connected to the Old Mountain Line makes it easier for tourists to take a train.	[2] , [3] , [7] , [13] , [14]
	Convenience of parking	Convenient parking space makes schedules of tourists with private cars more flexible.	[2] , [3] , [8] , [10]
	Guiding personnel or equipment for landscapes along the railway	Offering guiding services or equipment helps tourists to more deeply understand the historic and cultural aspects of the Old Mountain Line.	[10] ,[14]
	Tourist inquiry service	Complete tourist inquiry service helps tourists to get tourism information easily.	[3], [8], [13] , [14] , [18]
	Railway cultural relics and other products	Selling railway-related products to tourists is another way to preserve the Old Mountain Line Railway. It is also a source of income for the management.	[13] , [14]
Tourism planning	Traffic flow planning for scenic sites	Complete traffic flow planning helps tourists to understand scenic sites and obtain related information.	[9] ,[10], [14] , [18]
	Preserving features of scenic spots of historical significance	Preserving features of scenic spots of historical significance along the Old Mountain Line helps to attract tourists to take a train.	[10] , [14]
	Safety of tourism activities	Improving safety of tourism activities helps to make tourists feel safe to participate in activities and tours.	[7], [8] ,[14] , [16], [18]
	Specialty restaurants and famous foods	Combining famous Hakka foods along the Old Mountain Line helps to attract tourists from other cities/counties.	[8], [9], [14]
Public facilities	Scenic spot planning	Good scenic spot planning leads to better tourism quality for tourists.	[14] , [16]
	Allocation of public toilets	Good public toilet allocation offers tourists more convenience.	[10] , [14]
	Environmental sanitation and facilities	Good environmental sanitation helps to improve tourists' satisfaction.	[2] , [3] , [7], [8] ,[10], [13], [18]
	Medical support facilities	Medical support facilities make tourism safety more complete.	[14], [16]

3.2 The Fuzzy Delphi Method (FDM)

In the second phase of this study, the fuzzy Delphi method was applied. The disadvantages of the traditional Delphi method include low consistency of expert opinions, high enforcing cost, and modification of experts' individual opinions in order to reach consistent overall opinions. The fuzzy Delphi method was proposed by Murray et al. [15] to integrate the Delphi method and the fuzzy theory in order to improve those disadvantages. Then Ishikawa et al. [11] integrated experts' opinions with fuzzy numbers based on the concepts of cumulative frequency distribution and fuzzy integral. This process is called the fuzzy Delphi method (FDM). Now, the fuzzy Delphi method has been widely used in different fields for index selection. For example, Ma et al. [17] adopted the fuzzy Delphi method to quantify experts' attitudes toward regional road safety, urban road safety, and road safety. Kuo and Chen [12] applied the fuzzy Delphi method to create key performance indexes for the service industries offering mobile services. Cheng et al. [4-6] applied the fuzzy Delphi method to create primary criteria to evaluate supplier selection.

Generally speaking, the fuzzy Delphi method is better than the Delphi method because it has the following advantages [12]:

(1) Reducing number of surveys required
(2) By applying the fuzzy theory to clarify invertible fuzziness in interviews with experts to obtain more reasonable and proper responses
(3) Achieving higher economic effectiveness in time and costs required to conduct surveys
(4) Simple calculation process, handling multi-level, multi-attribute, and multi-solution decision problems

3.3 Research Implementation

In this study, after applying the fuzzy Delphi method, the expert evaluation values of the evaluation factors were all above "6" except for the value of "Guiding personnel or equipment for landscapes along the railway". After discussing with experts again, the criterion was set to "6" based on the common consensus of the experts. The strategic factors selection results are summarized in table 2.

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Table 2 The result of strategic index selection using the fuzzy Delphi method (selection criterion: expert common consensus value > 6)

Possible influential factors	Min value		Max value		Best value		Geometric mean			Z^i	Common consensus value > 6
	Min	Max	Min	Max	Min	Max	Min value	Max value	Best value		
Service reliability											
Train safety	5	8	7	10	6	9	6.937	9.154	8.053	1.217	8.481
Train punctuality	6	7	8	10	7	8	6.382	8.780	7.584	3.398	6.953
Train comfort	5	7	8	9	7	8	5.858	8.191	7.189	3.332	7.059
Price reasonability	5	6	7	9	6	7	5.477	7.987	6.893	3.510	6.281
Service convenience											
Convenience of transferring	4	8	7	10	6	9	5.790	8.349	7.245	1.559	7.121
Convenience of parking	4	7	6	10	5	9	5.818	7.727	6.806	0.909	6.666
Guiding personnel or equipment for landscapes along the railway	4	8	6	10	5	9	5.219	7.435	6.426	0.216	5.933
Tourist inquiry service	4	7	6	10	5	8	5.440	7.636	6.754	1.197	6.271
Railway cultural relics and other products	3	6	5	9	4	7	5.018	7.128	6.034	1.110	6.113
Tourism planning											
Traffic flow planning for scenic sites	4	7	7	9	6	8	5.835	8.275	7.065	2.440	7.583
Preserving features of scenic spots of historical significance	6	8	8	10	7	9	6.774	9.084	7.881	2.311	7.831
Safety of tourism activities	4	8	6	10	5	9	6.694	8.920	7.723	0.226	8.283
Specialty restaurants and famous foods	5	7	6	8	6	8	5.446	7.869	6.656	1.423	7.320
Public facilities											
Scenic spot planning	4	7	7	9	6	8	5.424	7.962	6.760	2.538	6.893
llocation of public toilets	4	6	7	9	6	8	5.144	7.881	6.67	3.738	6.528
Environmental sanitation and facilities	5	7	7	10	6	8	6.136	8.238	7.241	2.103	6.960
Medical support facilities	4	8	5	9	6	8	5.513	7.882	6.957	-0.630	6.875

4 Analyses and Discussions

According to the ordered results summarized in table 2, it was found that the two most important indexes for service quality after the Old Mountain Line Railway re-opening were “Train safety” (rank: 1) and “Safety of tourism activities” (rank: 2). The experts considered them as the most important factors for planning. It has been a long time since the Old Mountain Line Railway was abandoned in 1998. Although the railway was repaired and reached the standard of re-opening, tourism safety is still important and requires much attention.

In the next place were “Preserving features of scenic spots of historical significance” (rank:3) and “Traffic flow planning for scenic sites” (rank:4). The focus of a retrospective trip is on features of scenic spots. The Old Mountain Line Railway is popular because of its unique cultural landscapes and the historical sites along it. In addition, traffic flow planning for scenic sites and convenience of transferring (rank: 6) of the service convenience aspect help tourist to understand scenic sites they want to visit, obtain more tourism information, and arrange their trips with more flexibility. And specialty restaurants and famous foods (rank: 5) of the tourism planning aspect may increase tourists’ desire to visit and the economic effectiveness of the shops along the Railway and of the management.

Then, train comfort (rank: 7) of the service reliability aspect may increase tourists’ satisfaction with comfort of their trips. For rail tours, with good transportation environment, including car seats, lighting, cleanness of cars, attitude of service personnel, etc., tourists would be able to comfortably enjoy scenery along the way. During peak hours on weekends the number of tourists of the Old Mountain Line Railway tourism is very high. However, the old stations along the Old Mountain Line Railway are all small stations and outdated. The public facilities and toilets in these stations were not designed for tourism use. Therefore, with traffic flow planning for scenic sites, and environmental sanitation and facilities (rank: 8) and allocation of public toilets (rank: 13) of the public facilities aspect, filthiness caused by streams of tourists can be reduced to minimum. Thus, train comfort, environmental sanitation and facilities, and allocation of public toilets were the key factors of tourism values which tourists may percept. And compared with other railway systems such as Taiwan High Speed Rail, the train punctuality (rank: 9) of Taiwan Railways Administration has been criticized. However, the starting point of rail tours is tourism. Therefore, quality of trips should be

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controlled by numbers of tourists on trains. This way, punctuality of railway trains can be improved and arrangements of tour schedules can be assured.

Scenic spot planning (rank: 10) of the public facilities aspect is essential in tourism. However, in Taiwan, the scenic spot planning styles for many historical sites are quite out of tune with those spots. For some spots, there is even no planning at all, leading to damage to landscapes and tourists' tight schedules for there is no place to rest. These sites and the railway stations are all in the mountains. There are relatively less medical facilities in the neighborhood. Basic medical support facilities (rank: 11) are helpful in case of accident. Because the Old Mountain Line Railway goes through the mountains, nowadays many tourists visit the sites along the Railway by their own cars or motorcycles. However, parking spaces of these sites are not well-planned. Many tourists may have problems finding a parking space. Thus, the convenience of parking (rank: 12) of the service convenience aspect is one of the basic requirements of tourists who drive to those sites.

The price reasonability (rank: 14) of the service reliability aspect is another influential factor of scenic spot values tourists perceive. Therefore, a reasonable price is a win-win factor. The tourist inquiry service (rank:15) of the service convenience aspect provides nonlocal and first-time tourists a way to obtain complete information they need. Information provided may help to make up for the disadvantages caused by other service factors. The railway cultural relics and other products (rank: 16) of the service convenience aspect may help tourists to purchase meaningful products regarding the Railway during their trips. These products will, in the future, remind them of these sites. And operators' income may increase, the preservation and tourism of the Old Mountain Line Railway can go forward together, and the goal of sustainable management can be reached.

5 Conclusions

With the desire of the citizenry to re-open the Old Mountain Line Railway, this study applied the fuzzy Delphi method, based on the management philosophy of good service quality, to construct a service quality index system for the Old Mountain Line Railway Re-Opening. And this study also provided references of service quality strategy objectives to the management. The conclusions and suggestions of this study are summarized below:

This study applied the fuzzy Delphi method to select the indexes that conformed to the common consensuses of the experts. And these selected indexes were used to construct the indexes for service quality after the Railway re-opening, so that the management would be clear about the direction of the strategies to improve service quality.

According to the analyses and discussions, the experts generally believed that safety was the most important factor as the foundation. After safety was ensured, the main attractions to tourists included preserving cultural relics and fine trip arrangement planning. Then, service facilities, environment sanitation, and medical facilities for the basic needs for comfort and emergency rescue of tourists were considered as the service standards of overall management. Finally, other related industries and products were integrated to increase attraction for tourists and business opportunities in the neighborhood.

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