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Correspondence Analysis to Extract the Critical Factors of Passenger Satisfaction in Taiwan

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***Abstract*—According to Taiwan and China in cross-straits political stability and peacefully progress recently, it makes the cross-straits air traffic being warm, this research carries on passengers' perception of service quality to understand the satisfaction of airport service facilities. We employ hierarchy process to develop thirteen service quality attributes with respect to three latent factors for evaluation. We then utilize correspondence analysis to explore the subjective perception of passengers' satisfaction level and conduct some service indices from this empirical case. Through this study we successfully demonstrate that correspondence analysis is an efficiency alternative for service improvement program.**

Keywords: Correspondence Analysis, Hierarchy Process, Service Quality, Service Quality Indices.

I. INTRODUCTION

In a modern global network economy international connections are at a rising edge. This is particularly reflected in the dynamic growth pace of air transport (Button and Stough, 2000). More people tend to fly, and they travel more frequently and also over longer distances. The booming aviation industry has clearly prompted the need for huge investments in both aircraft and airports in order to accommodate the mobility drift of mounting numbers of air passengers. The operations and management of airports are handled by their administrations that view both the airline companies and passengers as consumers. Running an airport is thus the same as running any other enterprise from the perspective of corporate ethos and operational efficiency.

The deregulation and opening-up-the-sky policies of the aviation industry in Taiwan have put pressure on airports worldwide to become more competitive. Naturally airlines choose to utilize facilities that offer a more efficient and higher level of service to themselves and their passengers (Liou et. al., 2011; Oum et al., 2003). There are ten major domestic airports in Taiwan are studied for their operational performance. They are international airports (Taoyuan, Kaohsiung, Taipei and Taichung), domestic airports (Tainan, Hualien, Taitung and Magong, Chiayi and Kinmen).

Therefore, the airport managers are being confronted with fresh challengers in an era of growing commercial pressure; it is of paramount importance to provide the best service level in the most efficient manner. There is a move towards a more passenger orientated perception, which is being welcomed in today's highly competitive air transport market. Although several air transportation agencies, including the Federal Aviation Administration (FAA), Airport Council International (ACI), and Transport Canada (TC) have begun to develop methods to evaluate and improve service quality. One of the main concerns is lack of passenger input (Correia & Wirasinghe, 2004). Park (1999) also emphasized that the prime objective of the airport is to maximize user satisfaction, by aiming for high level of service as perceived by the user rather than the supplier.

II. A REVIEW ON AIRPORT SERVICE

Delivering high-quality service has become more important in this competitive environment. The most comprehensive study comparing service performance at international airports is probably that of the International Air Transport Association (IATA) Global Airport Monitor, but their results are not publicly available (Yeh & Kuo, 2003). A good review of past research on airport service was presented by Correia et al (2008). Therefore, it is imperative for airline managers to determine what their customers do and do not want.

Seneviratne and Martel (1991) developed service quality indices for several components of the airport passenger terminal. Yeh and Kuo (2003) developed a multiattribute decision making (MADM) model to

calculate a service quality index. Oum et al. (2003) compared the productivity and efficiency of 50 major airports by computing the gross total productivity factor. Tam and Lam (2004) use a quantitative measure, the visibility index, to evaluate the ease of locating various airport passenger facilities in the Hong Kong International Airport. They proposed a new set of service references for orientation based on the visibility indices of the terminal facilities.

Because of the complicated nature of airport operations, most of the previous studies have tended to simplify the problems, such as the terminal building, information visibility, and check-in or queuing time only. Barros et al. (2007) used regression analysis to evaluate the service level for transfer passengers. Their results showed that the courtesy of the security and check-in staff, and the quality of the flight information display are among the most valued by transfer passengers.

In this study we attempt to apply correspondence analysis evaluating the service quality in overall landside and departure lounge of the airports from the passengers' viewpoint, explicitly taking into account the diverse nature of airport operations. The basic concepts of the correspondence analysis and service quality improvement model for data insight are presented in the next section.

III. HIERARCHY FRAME FOR EVALUATION

Hierarchy process is a systematic technique often used to model subjective decision-making processes based on multiple attributes. Application of this approach in multiple attributes decision making environments involves defining a hierarchy frame of considered attributes, selecting appropriate method for data analysis such as AHP (Saaty 1980), grey relation analysis (Deng 1989), factor analysis etc.

In this study we develop the hierarchy frame (Fig.1) to explore the passengers' perception of service quality for the civil airport. The operation activities of airport evaluated by passengers include three parts factor considered, courtesy, comfort and convenience, with respect to thirteen critical indices.

IV. CORRESPONDENCE ANALYSIS

Correspondence analysis is developed by Benzecri (1992), the main advantages of this method is that the variables and the samples can be expressed as points in p-dimensional factor space, and the relationship between variables and samples can be shown using scatter diagrams.

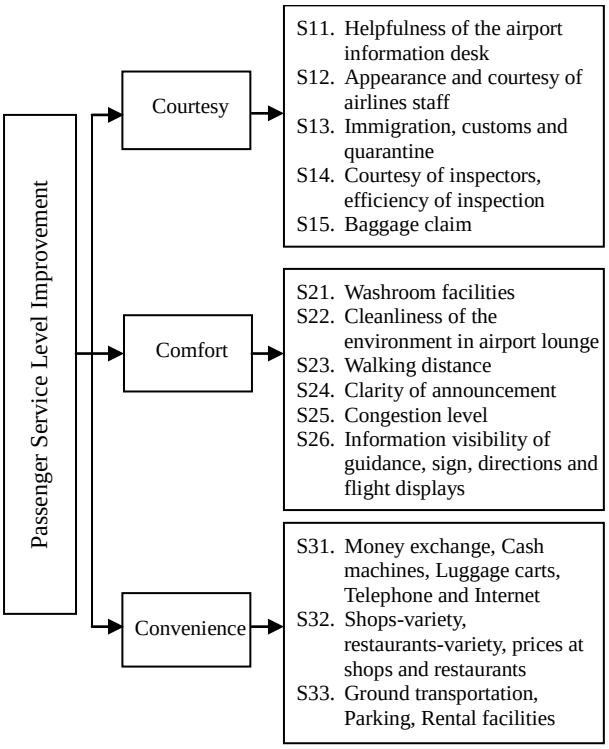

Fig.1 Hierarchy frame of service level improvement

For multivariate data exploring, correspondence analysis has several features that enable researchers to have a better understanding of the relationships among variables. The most important feature of this approach is its multivariate nature which enables multivariate treatment of multiple categorical data simultaneously. Correspondence analysis is an interdependence technique that uses the singular value decomposition to examine contingency tables from multinomial data (Thompson, 1995). The benefit of correspondence analysis is in its unique abilities for representing rows and columns in a joint space (Hair et al., 1998).

V. EMPIRICAL CASE AND DATA ANALYSIS

The prime objective of this paper is to improve user satisfaction at airports; therefore, obtaining direct perceptions from the users is the key factor for successful analysis. However, due to the airport security and air passenger time constraints there is often little time the targeted respondents to answer questions. We obtained approval from airport authorities to conduct a survey of passengers waiting

at boarding gates or lounges. We applied factor analysis to extract some important variables related to the service level of the airport. After variable extraction, the second questionnaire was administered to conduct the correspondence analysis.

There are many attributes that affect the passenger's perception about the service quality of an airport. We first drew up a list of 18 service-related elements by consulting with airport management, directors, tour guides and through a literature review (Correia et al., 2008). Then in the preliminary questionnaire survey, 60 interviewees from different backgrounds were asked to answer questions.

There were 1200 respondents to the questionnaire in the second stage. The collected data were then analyzed and the common factors extracted, principle component analysis was adopted in this study and three common factors were obtained from the results, as shown in Table 2. The total variance for the three common factors reached 62%. It is indicated that we could use these three common factors, convenience, and comfort of the environment, courtesy of staff, to represent the thirteen attributes.

Table 2. Factor analysis after varimax rotation.

Common factors	Indicators	Factor loadings			Commu-nality
Courtesy	Helpfulness of the airport information desk	.755	.286	.113	0.666
	Appearance and courtesy of airlines staff	.748	.196	.156	0.622
	Immigration, customs and quarantine	.671	.250	.208	0.556
	Courtesy of inspectors, efficiency of inspection	.652	.286	.169	0.536
	Baggage claim	.596	.212	.191	0.437
Comfort	Washroom facilities	.154	.795	.258	0.723
	Cleanliness of the environment	.243	.786	.202	0.718
	Walking distance	.304	.697	-.010	0.577
	Clarity of announcement	.374	.658	.012	0.573
	Congestion level	.553	.328	.224	0.463
	Information visibility of guidance, sign, directions and flight displays	.438	.592	.062	0.546
Convenience	Money exchange, Cash machines, Luggage carts, Telephone and Internet.	.497	.371	.339	0.499
	Shops-variety, restaurants-variety, prices at shops and restaurants	.179	.173	.843	0.773
	Ground transportation, Parking, Rental facilities	.287	.042	.784	0.699
Eigenvalue		3.534	3.105	1.747	
Variance interpreted (%)		25.24%	22.18%	12.48%	
Accumulated variance (%)		25.24%	47.43%	59.91%	

Table 3. Passenger service level perception

	Importance	Rank	Satisfaction	Rank
S11	3.72	5	4.41	2
S12	3.20	6	4.49	1
S13	2.43	9	4.38	3
S14	2.18	11	4.37	4
S15	1.00	14	4.30	6
S21	4.40	2	4.27	10
S22	4.35	3	4.33	5
S23	2.67	7	4.12	11
S24	2.62	8	3.76	14
S25	1.32	13	4.27	9
S26	2.30	10	4.28	8
S31	1.75	12	4.11	12
S32	5.00	1	4.29	7
S33	4.12	4	4.05	13

According to the correspondence analysis, we explore the passenger service quality improvement program from two aspects, the importance of attribute evaluated by passengers' perception and the satisfaction expressed the service level. The overall centroid magnitude of average perception scores in importance vs. satisfaction with respect to all considered indicators is (2.93, 4.25). We briefly summarize the implications of critical indicators on each quadrant (Table 3 and Fig. 2):

First, there are five critical indicators including in quadrant Q1: S11, S12, S21, S22 and S32, it's called agreement area, the service provider should improve their service quality deeply in these indicators.

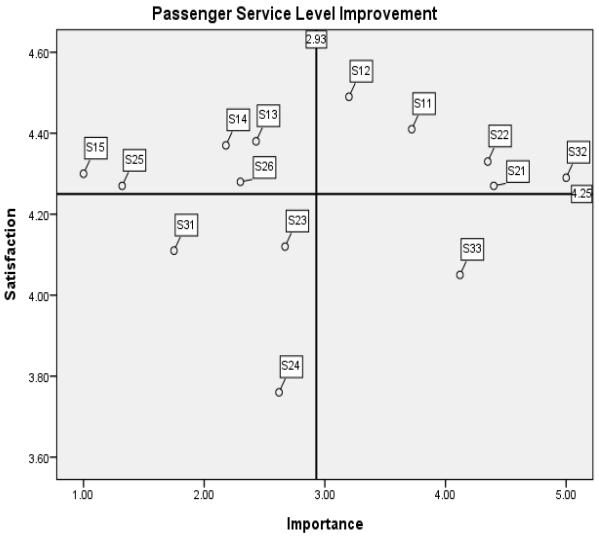

Fig.2 IS Graph of Service Level Improvement

Second, there are five critical indicators including in quadrant Q2: S13, S14, S15, S25 and S26, the service provider need look over the amount of input to enhance the efficient.

Third, there are two critical indicators including in quadrant Q3: S23, S24 and S31, it's called disagreement area, the service provider should enhance their service quality or consider to adjust or shift the amount of input in these indicators.

Fourth, there is only one critical indicators including in quadrant Q4: S33, the service provider should enhance the training program to improve their service quality.

VI. CONCLUSIONS

The aviation industry has become very diverse and competitive in today's globalized market. Airport managers are eager to provide superior service level to attract more customers. This research utilizes a novel data visualization technique, correspondence analysis, to evaluate ways to improve service quality. In contrast to the classic statistical techniques, correspondence analysis is an exploratory visualization technique designed to analyze simple two-way tables containing some measure of correspondence between the rows and columns. The empirical results confirm that correspondence analysis is an appropriate method to apply to mine knowledge directly from the passengers' perceptions.

Human perception is very complicated, and sometimes unreasonable. To consider all of the condition factors relative to service level that can influence the decision of a passenger is neither easy nor practical. We therefore applied factor analysis to extract some independent common factors, combining those that had high interdependence. We extracted three common factors, which were used to conduct a second survey. With the help of factor analysis, we not only needed to use fewer factors to represent complex systems, but we could also avoid generating too many rules in the following analysis. This study demonstrates passenger perception of airport service quality in Taiwan, through this study, correspondence analysis highlights what is interesting, and indicates the direction in which further inquiry should be done for service provider.

From the results of our survey, the first important indicators are S32 (Shops-variety, restaurants-variety, prices at shops and restaurants) S21 (Washroom facilities) and S22 (Cleanliness of the environment). The first three high service level indicators are on S12 (Appearance and courtesy of airlines staff), S11 (Helpfulness of the airport information desk) and S13 (Immigration, customs and quarantine), these information is really useful for service provider to improve their service level.

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