DEVELOPING CITY BUS SERVICE QUALITY DIMENSIONS--TAIPEI AS AN EXAMPLE

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Abstract: Previous studies on the level of city-bus service mostly focus on the tangible, actual and quantifiable dimensions, such as vehicle equipment, bus frequency, loading factor and travel time. Passengers' perception of service quality is less taken into consideration. This study built up and analyzed the dimensions of service quality from the viewpoint of passengers' perception. We discussed the characteristics of bus and service in the first place. According to the SERVQUAL model, a questionnaire was designed to investigate volunteers' perception and expectation toward service. We converted the raw data of each service quality item into crisp number by fuzzy linguistic conversion scale of fuzzy theory. Then, we used factor analysis and the process of questionnaire condensing to come up with five dimensions on bus service. The five dimensions include "interaction with passengers", "tangible service equipment", "operating management support", "handiness of service" and "offering correct service information". Finally, what these five dimensions means to bus managers was discussed.

1. INTRODUCTION

Among the mass transportation systems, the bus plays an important role in the cities. It not only satisfies citizens' needs but also offers action powers for social and economic activities. In addition, it lends the connection to other inter-city transportation systems, like trains and airplanes as well as other rail transportation in the cities, like Rapid Transit System and light rail. It other words, it can improve the accessibility of entire mass transit systems. It follows that the use of private cars and the problems of traffic jam can be reduced.

Most of the previous studies on the level of bus service and performance are focused on the tangible, actual, quantifiable dimensions, like the bus frequency, loading factor, travel time and vehicle equipment (Bakker, 1976; Alter, 1976; Metropolitan Transit Authority of Harris Country, 1984; Fielding, 1985). In contrast, passengers' perception of service quality is less taken into account. If we severely define these dimensions mentioned above, vehicle equipment and bus frequency should be classified as level of service, not service quality. In spite of the importance of level of service, the service quality should be the indicator to passengers' perception of the bus service. After all, the passengers' perception on service quality should not be neglected at all.

Parasuraman, Zeithaml, and Berry (PZB) ever came up with ten basic dimensions about service quality and designed an inventory to conduct investigations. They concluded an inventory -- SERVQUAL (PZB, 1990) with five dimensions and 22 items from several

experiments. The inventory is believed to be workable on all kinds of service business. However, conclusions from much research (Carman, 1990; Finn and Lamb, 1991; Babakus and Boller, 1992; Cronin Jr. and Taylor, 1992; Triplett, et al., 1994) found that the five basic dimensions can not be applied to all kinds of service business. Instead, they suggested new studies had to be conducted from the viewpoints of the original ten dimensions. The purpose of this research is to develop dimensions of bus service quality based on the ten dimensions and to discuss what the implication from these dimensions is for bus managers.

2. LITERATURE REVIEW

2.1 The Characteristics of City Bus Service

The activity flow of bus taking roughly can be divided into several steps. The passenger has to go to the bus stop from the start point. When the bus stops, the passenger gets on it. Then, the bus runs on its route. When he arrives at his intended stop, the passenger gets off the bus. Finally, he walks to his destination (see Figure 1). Passengers' will to take a bus is affected by the disturbing flows of other cars on the road, the control of traffic signs, the pavements, and even the weather. These factors result from the reason that bus service is not restricted in the closed environment, but offered in the changing open space.

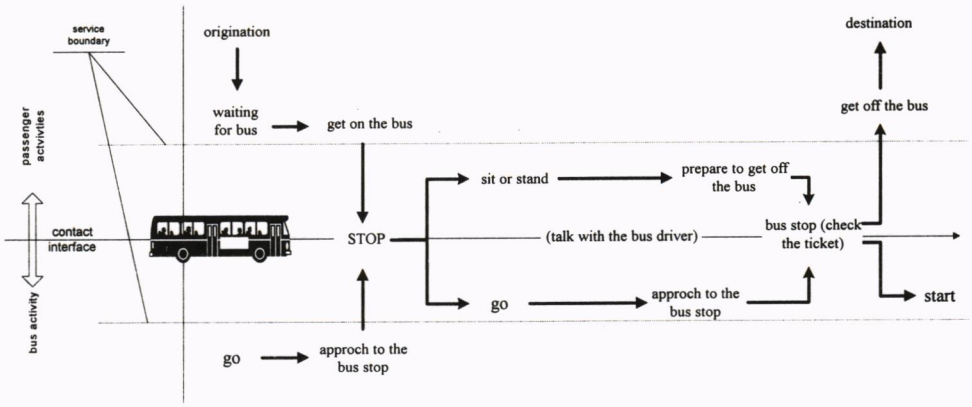

Figure 1. One Passenger's Activity Flow

Generally speaking, there are four characteristics for service industry: intangibility, inseparability, variability, perishability (Kolter, 1991). It is hard to judge service quality because service industry is lack of the characteristic of endurance as general products (PZB, 1985).

From the conclusions of other related studies (Gronroos, 1978; PSB, 1985; Murdick, 1990; Lovelock, 1996; Fitzsimmons et al., 1998), we conclude ten characteristics of mass transit service: (1) the service act is tangible actions, (2) services directed at people's bodies, (3) no formal relationship between service organization and its customers, (4) service characteristics are low customized, (5) low extent of equal service, (6) each transaction recorded and charged separately, (7) less repetition of service units (ex. bus vehicle), (8)

customer goes to service outlets, (9) multiple service outlets (ex. bus stops), (10) peak demand regularly exceeds capacity.

2.2 The Indicators of Bus Service

Botzow (1974) evaluated the service performance of mass transit at first. He came up with nine indicators, such as schedule delay and average space for individuals. Alter (1976), Bakker (1976), Fielding & Anderson (1983), Metropolitan Transit Authority of Harris Country (1984), Fielding, Babitsky & Brenner (1985), Carter & Lomax (1992), Fielding (1992) and Wipper (1994) ever developed indicators to bus service but they were scarcely concerned about passengers' perception on service quality. Lambert (1993) came up with 99 factors of service. He held that the best policy to win was to define service level based on customers' needs, to have good cost management, and to realize the goal of providing customer with good service.

PZB's (1985) concept toward service quality is that service quality (SQ) should be the distance between the users' perception (P) and their expectation (E). That is, SQ = P - E. When the perceived service is lower than the expected one, the service quality is negative. On the contrary, when the perceived is higher than the expected service, the service quality is positive. PZB discussed the ten dimensions of passengers' perception and conducted experiments on each dimension (Berry, et al., 1990; Parasuraman, et al., 1991; Parasuraman, et al., 1988; Zeithmal, et al., 1990). The following is the ten dimensions:

- *Tangibles*: Appearance of physical facilities, equipment, personal and communication materials.
- *Reliability*: Ability to perform the promised service dependably and accurately.
- *Responsibility*: Willingness to help customers and to provide prompt service.
- *Competence*: Possession of the required skills and knowledge to perform the service.
- *Courtesy*: Contact personnel's politeness, respect, consideration, and friendliness.
- *Credibility*: Service providers' trustworthiness, believability, and honesty.
- *Security*: Freedom form danger, risk, or doubt.
- *Access*: Approachability, and ease of contact.
- *Communication*: Keeping customers informed in language they can understand and listening to them.
- *Understanding/Knowing Customer*: Making the effort to know customers and their needs.

According to the ten dimensions and other factors (word of mouth, personal needs, past experiences, external communications), PZB conducted research on five kinds of industry (bank, credit card company, fixing company, long-distance telephone company and stock firms) and structured a model of customer assessment service quality. The model is presented in Figure 2.

After that, PZB conducted experimental research on different industry and found five dimensions of service quality. The five dimensions are applicable to all kinds of service industry. They briefly converted the original figure into a scale of service quality -- SERVQUAL (PZB, 1988). SERVQUAL is made up of five cognitive dimensions and 22 items. The five dimensions include tangibles, reliability, responsiveness, assurance and empathy. However, the results from Babakus and Boller (1992), Carman (1990), Finn and

Lamb (1991), Cronin Jr. and Taylor (1992), Triplett et al. (1994), where SERVQUAL serves as the scale, showed that their resulting dimensions of service quality were not the same. Carman suggested that to get reliable results, questionnaires should be redesigned based on the original ten dimensions.

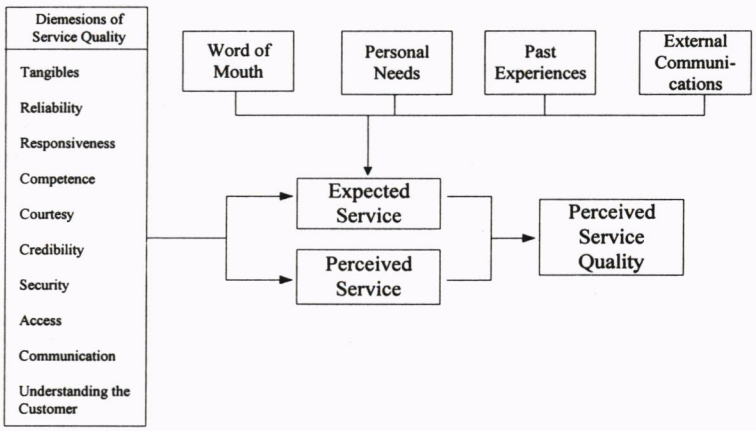

Figure 2. PZB's Customer Assessment of Service Quality (PZB, 1990)

3. METHODOLOGY

3.1 The Design of Questionnaire

We agree with PZB's point of view that customers' perception should be considered to test service quality. However, many researchers stated above found that the five dimensions and 22 items of SERVQUAL could not be applicable to various industries. Therefore, we adopt Carman's suggestion that the questionnaires should be designed based on the ten dimensions of service quality come up with by PZB. The questions were formed based on the ten dimensions serving as the skeleton of the questionnaires. On the top of that, they were designed according to the characteristics of city buses and the activity flow of passengers.

This study aims to test the amount of passengers' perception toward bus service and their expectation on that. To facilitate passengers' answering, the questions of perception and expectation are separated into two sections. The questions of the two sections mean the same but their descriptions are different. For example, questions of perception are to ask how much the service has been offered and perceived. Those of expectation are to ask passengers whether certain service should be provided in city buses. Then, we could obtain service quality by computing the difference between perception and expectation. We also designed a blank column on the back of the questionnaires. Subjects can freely release their opinions about the design of the questionnaires or how to improve the service quality. All answers are given in the form of Likert 7-scale. They include "much agree", "agree", "a little bit agree", "no comments", "somewhat disagree", "disagree", "much disagree".

3.2 Pretest

Before the formal testing, the pretest with small samples was conducted in order to get subjects' opinions. Then, we canceled the improper, unrepresentative questions, revised fuzzy and repetitive ones according to the conclusion from many discussions.

3.3 The Formal Test

There are one public and thirteen private bus companies in Taipei City. Three thousand buses are going on three hundred routes and stop at more than two thousand stops. They ride 1,900,000 trips of passengers every day. Since each of the four newer private companies has less than five routes, this research didn't include them.

To understand the bus service, Taipei City Government (TCG) had recruited 1000 bus passengers to be "volunteers" to record a questionnaire designed by TCG at least four times every week. Because the volunteers, who are enthusiastic, have rich experience on riding a bus, we chose them as our sampling frame. Therefore, in the formal test, we selected 500 subjects at random from the volunteers. Then, we sent the questionnaires by mail and asked subjects to finish them in three weeks.

3.4 The Conversion of Fuzzy Linguistic Terms

The answers on the questionnaires are not absolute numbers but are continuous numbers in a scale. Subjects selected a number from the scale according to their perception. That is, the answers are fuzzy in their meanings. The numbers from 1 to 7 on the agreement scale are not well representative of individual subject's perception, which results in the uncertainty of the data. For example, the answer of "much agree" is 6 grades by Likert 7-scale. But not every subject's answer of "much agree" is 6. Some may be 6.5 grades and some 5.8. To compensate for the disadvantage of the scale, Chen and Hwang (1992) proposed an 8-degree scale of fuzzy linguistic terms conversion. The scale can reflect the different meanings of a term in different occasions. Chen and Hwang suggested researchers could build up their own fuzzy linguistic terms conversion set according to the needs of certain studies. Besides, the fuzzy numbers can be converted into crisp numbers to facilitate the analysis latter on. By employing the fuzzy linguistic terms conversion to design a proper scale, we changed the fuzzy answers into crisp numbers from 0 to 1.

3.5 Factor Analysis and Reliability Analysis

We conducted the reliability analysis on the answers to confirm the reliability of the questionnaires. Then, according to PZB's logic flow, we had the iterative reliability analysis and factor analysis on the items about service quality. Finally, inappropriate questions were kicked off and the dimensions of service quality were extracted out, which we gave proper names. Figure 3 represents the analyzing flow.

3.6 Hierarchical Cluster Analysis

To understand the relationship between each dimension and individual items, we performed hierarchical cluster analysis and discussed its implication.

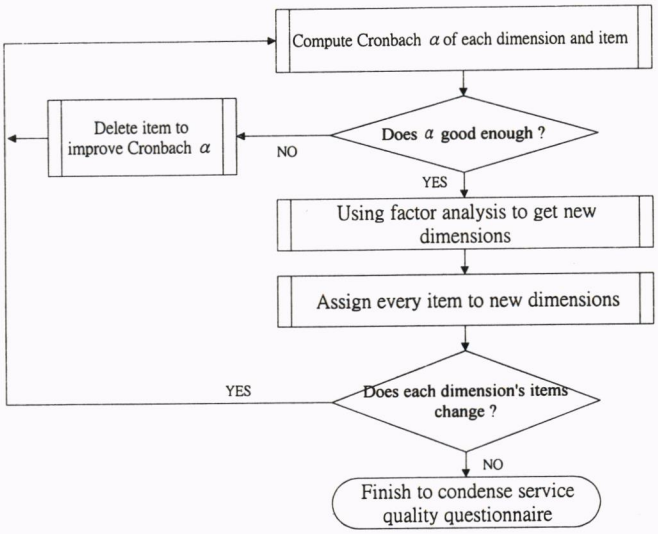

Figure 3. Process of Questionnaire Condensing

4. RESULTS

4.1 The Revise of Questionnaire

From the ten dimensions of PZB, we designed 64 questions. According to the pretest, we canceled the inappropriate items and 50 questions were left in total.

4.2 Description of Sample

500 questionnaires were sent out and 326 questionnaires came back. The response rate is 65.2 %. After rejecting 82 invalid questionnaires, the valid rate is 74.8% (= 244 / 326). Because the questionnaire was sent to the volunteer by mail, it was difficult to improve the response rate and valid rate. We believe that a response rate of 65.2% and a valid rate of 74.8% are reasonable for this kind of research.

In the 244 questionnaires, most of the subjects are 15 to 35 years old who are students or work in companies. The number of females is more than that of males. Their education levels are above colleges in most cases (see Table 1). Except the education levels, our sample structure is very similar to two previous studies in Taiwan (Hu, 1994; Chou, 1998). We also took a series of statistic analysis to test the effect of samples' characteristic variables on their perception of service quality. With the consistency of the samples' responses, we believe the sampling is appropriate. However, we will be aware of the limitations in generalizing the conclusion.

4.3 Fuzzy Linguistic Terms Conversion

We built up one fuzzy linguistic terms conversion set according to Chen and Hwang's

suggestions. The set includes the degrees of 1, 2, 4 and 6. Table 2 in the following describes the definite numbers after the calculation. To get the definite numbers, we converted the linguistic terms in the expectation section and the perception section in different degrees. Then, numbers in the perception section minus those in the expectation section. The distance is the actual service quality.

Table 1. Frequency Table of Age, Occupation, Education, Sex

		Frequency	Percent(%)
Age	16-25	79	32.4
	26-35	60	24.6
	36-45	48	19.7
	46-55	36	14.8
	56-65	9	3.7
	Above 66	12	4.9
	Total	244	100.0
Occupation	Student	61	25.0
	Teacher	10	4.1
	Soldier & police	2	0.8
	Office worker	130	53.3
	Self-employed	9	3.7
	Housewife	2	0.8
	Others	30	12.3
	Total	244	100.0
Education	Junior high school & under	3	1.2
	Senior high school	32	13.1
	College & above	209	85.7
	Total	244	100.0
Sex	Male	62	25.4
	Female	182	74.6
	Total	244	100.0

Table 2. Summary of Conversion of Linguistic Terms to Crisp Numbers

Chan & Hwang's Scale	1	2	4	6
Number of linguistic terms that been used	2	3	5	7
Strongly disagree				0.0910
Disagree		0.166	0.115	0.2275
More or less disagree			0.300	0.3645
Medium	0.583	0.500	0.500	0.5000
Morel and less agree			0.700	0.6355
Agree	0.750	0.833	0.885	0.7725
Strongly agree				0.9090

In the 244 samples, there were only 3 questionnaires where the five linguistic terms were used --- agree, a little bit agree, no comments, a little bit disagree, and disagree. Therefore, these three samples were converted by scale 4. In the other samples, all of the linguistic terms were used, so they were converted by scale 6. After the conversion, the definite numbers representing the service quality were undergone analysis.

4.4 Reliability Analysis

The items in the questionnaire are aimed to test the same attitude. They should show some agreement in reliability. In this study, we tested the reliability in Cronbach α. The original dimensions and Cronbach α are presented in Table 3. The questionnaire shows that the reliability in most of the dimensions is above 0.6. Only the dimension of credibility shows the low alpha --- 0.3948. Nevertheless, it is not rejected according Cronbach because rejected alpha should be lower than 0.35. The total Conbach α reaches to the number of 0.9518, which means that the questionnaire is of high credibility.

Table 3. Reliability of the Questionnaire and Dimensions

Initial dimensions	Cronbach α
Tangibles	0.8583
Reliability	0.7556
Responsiveness	0.7754
Competence	0.6772
Courtesy	0.7629
Credibility	0.3948
Security	0.7959
Access	0.6799
Communication	0.8477
Understanding the customer	0.6673
The questionnaire	0.9518

4.5 Analysis and Naming of the Dimensions

After the conversion and analysis of credibility, we extracted out the dimensions of bus service quality. First, Bartlett value is 3587.636 and its p-value is 0.000. So factor analysis is applicable. KMO value is 0.914, very close to 1, which means that the samples are random and appropriate. Second, we performed the main factor analysis. According to Kaiser (1974), the common factor with the eigenvalue > 1 should be reserved. Because there is no obvious factor loading on these main factors, the orthogonal rotation is performed in varimax rotation to get factor loading. By the process of questionnaire condensing and iterative factor analysis, we got a questionnaire with 30 items about service quality. Their eigenvalues and percentage explained variances are presented in Table 4.

Finishing the process of questionnaire condensing, we could select a factor pattern. First, we extract out 6 dimensions whose eigenvalue>1. We assigned each item to the dimension. But we found that those 6 dimensions didn't mean anything, and there are a lot differences among the items in those dimensions. Therefore, we used SCREE test. The SCREE test was used to identify the appropriate number of factors. The eigenvalue plot for the SCREE test is shown in Figure 4. The SCREE test indicates that the appropriate number of factors is five, the point at which the eigenvalue curve levels off. Because the pattern is meaningful, we could extract 5 dimensions. Although its percentage explained variance of these dimensions is only 57.213%, we believe that the pattern is more appropriate. The items' factor loadings are shown in Table 5. The following is the result of each

dimension's name:

Dimension 1: "*Interaction with passengers*". Customers feel respected and concerned when interacting with servers. Bus drivers lend friendly and reasonable response to passengers' questions.

Dimension 2: "*Tangible service equipment*". The equipment and service offered by bus companies can make passengers feel cozy.

Dimension 3: "*Operating management support*". The planning of schedule, the dispatch of buses and servers, and the support from managers can satisfy customers' needs.

Dimension 4: "*Handiness of service*". The access to information and equipment can help passengers reach bus service.

Dimension 5: "*Correct service information*". The bus companies can remind passengers of the changing of service environment and provide the correct information.

Table 4. Eigenvalue and Percentage Explained Variance

Component	Eig.	% of Variance	Cumulative %	Component	Eig.	% of Variance	Cumulative %
1	10.413	34.711	34.711	16	0.517	1.724	84.064
2	2.623	8.745	43.455	17	0.503	1.677	85.741
3	1.595	5.316	48.772	18	0.482	1.606	87.347
4	1.344	4.481	53.252	19	0.458	1.527	88.874
5	1.187	3.958	57.210	20	0.424	1.413	90.287
6	1.036	3.454	60.664	21	0.389	1.297	91.584
7	0.931	3.103	63.767	22	0.373	1.244	92.827
8	0.833	2.775	66.542	23	0.345	1.151	93.978
9	0.761	2.536	69.079	24	0.320	1.067	95.045
10	0.753	2.510	71.589	25	0.292	0.974	96.019
11	0.726	2.419	74.008	26	0.269	0.896	96.915
12	0.714	2.380	76.388	27	0.249	0.830	97.745
13	0.654	2.181	78.569	28	0.241	0.802	98.547
14	0.581	1.937	80.506	29	0.222	0.740	99.287
15	0.550	1.834	82.340	30	0.214	0.713	100.000

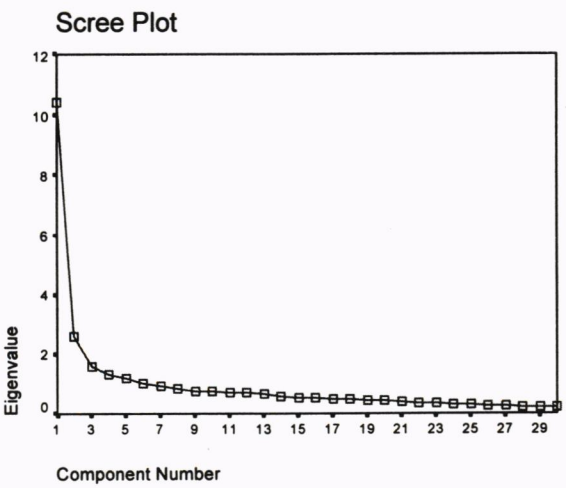

Figure 4. Scree Test Eigenvalue Plot

Table 5. Five Dimensions Component and Factor Loadings

Dimension 1 : Interaction with Passengers							
items	code	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	h^2
Drivers can answer passengers' questions in short time.	3	**0.670**	0.141	0.134	0.118	0.053	0.425
Drivers help passengers automatically.	3	**0.715**	0.083	0.072	0.297	0.004	0.545
Drivers are polite and friendly to passengers.	5	**0.781**	0.216	0.134	0.089	0.000	0.521
Drivers are glad to communicate with passengers.	5	**0.681**	0.179	0.137	0.148	-0.177	0.484
Drivers release reliability for passengers.	6	**0.642**	0.215	0.162	0.353	-0.082	0.461
Drivers drive buses smoothly.	7	**0.516**	0.248	0.039	0.347	0.185	0.612
Companies deal with accidents quickly and reasonably.	3	**0.730**	0.072	0.004	0.086	0.262	0.517
Bus companies solve passengers' problems sincerely.	2	**0.630**	0.237	0.142	0.131	0.220	0.401
Bus companies response completely and reasonably to passengers' complaint.	9	**0.668**	0.086	0.104	-0.048	0.302	0.421
Bus companies deal with passengers' opinions sufficiently.	9	**0.734**	0.132	0.150	0.086	0.182	0.716
Bus companies have easy access to allegation for passengers.	9	**0.678**	0.179	0.002	0.109	0.242	0.785
Bus companies communicate sincerely with passengers.	9	**0.770**	0.085	0.111	0.062	0.214	0.586
Dimension 2 : Tangible Service Equipment							
items	code	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	h^2
Bus companies provide brand-new buses	1	0.065	**0.709**	0.184	0.010	0.066	0.540
Vehicles shouldn't set forth smoke and pollute the environment.	1	0.285	**0.607**	0.072	0.234	0.086	0.708
Vehicles are clean inside.	1	0.393	**0.589**	0.091	0.097	0.048	0.641
The light on the bus is enough and proper.	1	0.074	**0.644**	0.105	0.182	0.141	0.611
Noise on the car isn't too loud.	1	0.161	**0.615**	-0.011	0.235	0.047	0.614
The chairs are spacious and cozy.	1	0.275	**0.682**	0.247	-0.025	0.097	0.683
The air conditioning is very comfortable.	1	0.081	**0.490**	0.252	0.208	0.260	0.567
Dimension 3 : Operating Management Support							
Items	code	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	h^2
I don't have to worry that there is no bus.	2	0.076	0.123	**0.826**	0.084	0.081	0.515
It's not good if I have to wait for a long time.	2	0.098	0.230	**0.823**	0.163	0.136	0.617
Bus companies dispatch buses according to the schedule.	2	0.192	0.224	**0.650**	0.119	0.251	0.484
The office hour every day satisfies passengers' needs.	10	0.280	0.117	**0.600**	0.256	0.109	0.630
Dimension 4 : Handiness of service							
Items	code	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	h^2
The equipment at stops satisfies passengers' needs.	1	0.151	0.305	0.206	**0.485**	-0.090	0.645
The information about bus routes is marked clearly.	1	0.104	0.242	0.156	**0.536**	0.209	0.558
The places of bus stops are proper and convenient for taking a bus.	8	0.166	0.078	0.172	**0.741**	0.132	0.619
The places where buses stop are proper; it is convenient to get on and off the buses.	8	0.245	0.150	0.069	**0.728**	0.165	0.563
Dimension 5 : Offering Correct Information							
items	code	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	h^2
Bus companies can correct the information in short time when the routes and bus schedule are changed.	3	0.286	0.237	0.207	0.064	**0.723**	0.662
The companies have to inform customers in short time when the routes and bus schedule are changed.	3	0.277	0.233	0.145	0.163	**0.680**	0.530
Information at stops is correct.	6	0.137	0.044	0.270	0.325	**0.561**	0.504

Code: 1.tangibles 2.reliability 3.responsiveness 4.competence 5.coutesy 6.credibility 7.security 8.access 9.communication 10.understanding/knowing customer (PZB, 1990)

To make further classification, we performed cluster analysis. In Euclidean distance, we calculated the distance of each dimension in factor loading and in group-average method. The result is presented in Figure 5, where individual questions are not listed because of the triviality. The analysis shows that the perceived service quality mainly relies on the accessible external service. The "service members" is viewed as the most important

(coefficient of determination is 34.711%). The "service functions" is the second one (coefficient of determination is 13.266%). The results reveal that the servers' attitude and response when offering service much affect passengers' perception. Passengers take the basic service of satisfying the need of transportation as one of the significant services. Therefore, the "basic service" is very important to passengers' perception (cumulative coefficient of determination is 47.937%).

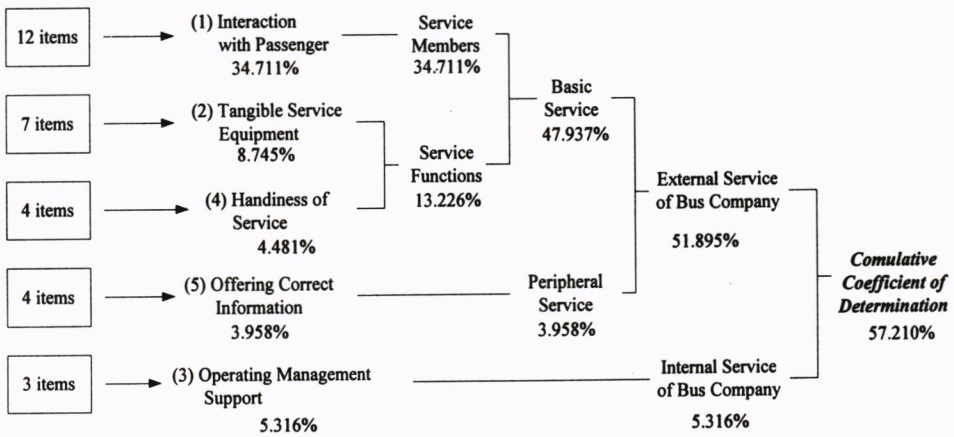

Figure 5. Dendrogram for Bus Service Quality Dimensions

5. DISCUSSIONS

5.1 The Discussion on the Dimensions and Items of Service Quality

In Table 5, dimension 1 is mainly about servers' attitude and response to passengers when they interact with each other. It also includes the friendly and reasonable answers from bus companies to passengers' questions. Therefore, dimension 1 is labeled as the interaction with passengers. Dimension 2, tangible service equipment, is about the vehicle equipment and its influence to passengers' perception. Dimension 3 includes the bus schedule and its planning as well as managers' support. It is named operating management support. Dimension 4, handiness of service, is about the ease of access to transportation equipment and information, together with facilities for waiting. Dimension 5, correct service information, means that bus companies can correctly inform passengers of the changing of schedule and routes in short time. The former two dimensions are the common features for general service industry while the others three ones are specific to bus industry.

Examining each item, we found that the five dimensions of the service quality in this study are not the same as those of SERVQUAL. The relation to the original ten dimensions of PZB is as revealed in Table 6. Dimension 2 is the original tangibles while dimension 3 contains the original reliability and empathy. Dimension 4 is of tangibles and access. Dimension 5 is response and credibility. Only dimension 1 implies a wider range since these perceived service qualities come from the interaction between passengers and drivers or servers. The reliability of the simplified questionnaire is presented in Table 6, which reveals that the Cronbach α in every dimension is over 0.65. The lowest is 0.6983. The

results indicate that the reliability is much higher than that in the original questionnaire. The total reliability is greater than 0.9306. Therefore, the questionnaire and the analyzed dimensions in this study are reliable. It shows that PZB's structure can help us to develop an appropriate inventory and dimensions suitable for bus industry.

Table 6. Relationship between New Dimensions and Original Dimensions

New dimensions / Original dimensions	Interactive with passengers	Tangible service equipment	Operating management support	Handiness of service	offering correct service information
Tangibles		▨		▨	
Reliability	▨		▨		▨
Responsiveness	▨				
Competence					
Courtesy	▨				▨
Credibility	▨				
Security	▨				
Access				▨	
Communication	▨				
Understanding the customer			▨		
Cronbach α	0.9207	0.8138	0.817	0.6983	0.7371

Reliability of new questionnaire (Cronbach α)=0.9306

5.2 The Implication for Bus Companies

Questionnaires of service qualities are aimed to help bus companies make improvement. While the opinions between the responded volunteers and bus passengers have no significant difference, as we believe, the analyzed dimensions should be helpful to the management and the achievement of higher ridership.

The five dimensions proposed in this study cover each step of passengers' activities when taking a bus (Figure 6). First, offering correct information will define whether passengers, before taking a bus, can understand the offered information and take the right one. Second, handiness of service and operating management support will affect the convenience and bus schedule when passengers decide to take one. Finally, interactions with passengers and tangible service equipment are represented on the bus. These two service dimensions are perceived more and thus have greater influence on passengers' perception.

From Figure 5, we can find the relation between dimensions and the management of bus companies. The service quality of bus companies can be divided into two kinds: external service and internal service.

The external service means the equipment and measures bus companies offer to customers. It can be classified into two types: basic service and cooperating service. Basic service is meant to satisfy passengers' needs on transportation. It includes people performing the service. Servers and drivers should keep good interaction with passengers because their attitude and behaviors have greater effects on customers' perception on service quality. In addition to the basic transportation equipment, the service should be easily accessible to passengers. The right stops, proper planning of routes, clear information and convenient facilities for waiting are elements affecting the handiness of service. On the other hand, bus

companies should take the responsibility of offering cooperating service, like providing and correcting information. The cooperating service will reduce the misunderstanding between passengers and companies.

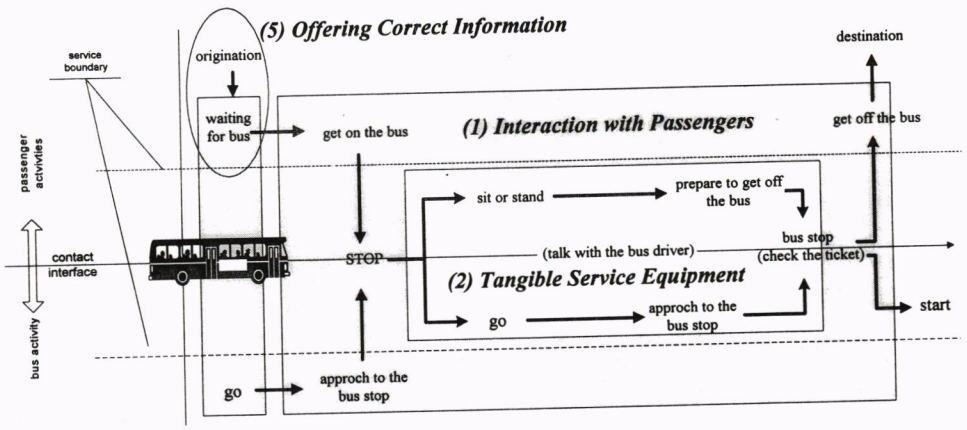

Figure 6. Relationship between New Dimensions and Passenger's Activity Process

The internal service means the planning in advance, controlling in companies and preparation of supporting to achieve the goal of satisfying customers' needs. For example, companies have to make a schedule of servers as well as buses, keep the regularity of bus frequency and the service standard.

6. CONCLUSION

Starting from PZB's ten dimensions, we developed service quality dimensions of bus industry. With Taipei City as an example, this study was conducted by asking the bus volunteers who are frequency bus passengers to record the questionnaires. Although the sample is a little concentrated and not perfect, we believe it was still an available method for constructing a study set. And by using statistics tests, we found that this sample is appropriate. After proper statistic analysis, confirmation on the typification of data and questionnaire condensing, we got five reliable dimensions of service quality. The dimensions are given the names from the viewpoint of bus management. They are interaction with passengers, tangible service equipment, operating management support, handiness of service and offering correct information. By cluster analysis, the five dimensions are further classified. The results indicate that the passengers' perception to the service quality is mainly focused on the external service, especially on the servers' service and facility next.

Since the reliability of the questionnaire condensing and the five dimensions reach the level of acceptance and the items of service quality are representative, they are indicators to the service quality of city buses. With the five dimensions and the activity flows, bus

companies are offered reference about how to improve their service quality by our study.

Although this study is aimed to establish and discuss the dimensions of service qualities, yet passengers also high value the quantifying level of service. Combining dimensions developed by our investigation with quantifying indicators to service levels, the future studies could make the more detail and thorough investigation and assessment on the entire service of bus companies.

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