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An Extended Zone of Tolerance Method to Measure Service Quality

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Abstract: SERVQUAL has been widely applied in the domain of service quality measurement, but there have also been some arguments raised. However, an issue is less proposed to discuss, that is, the gap score only calculated by central tendency, i.e. mean, but variation tendency is not involved, i.e. standard deviation. Such variation concepts have been applied widely to the quality management of manufactory industries, and demonstrate fully its' essentiality and effectiveness. Hence, this paper proposes an extended ZOT analysis method, it involve the variation tendency into SERVQUAL to measure service quality, and via the integrate with the concept of Zone of Tolerance, then adopt process capability index to replace the traditional ZOT analysis which is mean based, therefore increase the measuring precision. Furthermore, through a case study to compare the traditional ZOT analysis with the Extended ZOT analysis, thus demonstrate its' validity.

1. Introduction

The measurement of service quality acts an irreplaceable key part of an enterprise because only correct and accurate measurement results can guide the enterprise to implement correct and appropriate decisions, thereby increasing efficiency and increasing profits. SERVQUAL, a quality of service measurement model, has been widely used in various fields since it was developed by three scholars of Parasuraman, Zeithaml and Berry (PZB). In order to more clearly define customers' expectations for service quality, they put forward the concept of "Zone of Tolerance" (ZOT) in 1991 and 1993 [3,4], which distinguishes customer expectations of service into "desired service level" and "adequate service level", and the "ZOT" between them. It summarizes that in addition to customers' different perceptions of the five-dimensional attributes of service, the main factors that affect ZOT are the price of service (products) and the consumption experience accumulated by customers themselves. The more the price the customer pays and the more experience he has accumulated, the wider the ZOT becomes (the greater the gap between the desired and the adequate service level), the more difficult it is for the customer to be satisfied. In recent few years, the scale of research and literature on ZOT has gradually expanded. Many scholars at home and abroad begin to verify the theoretical framework of ZOT through empirical research, and explain its opportunities and advantages, and some scholars have even included ZOT in service quality evaluation and management for many different service organizations [5-7].

SERVQUAL model has been controversial all the time, but only one item has been rarely

discussed, that is, the calculation of gap score only takes into account the concentrated trend and is measured by the average, because the central tendency is not enough for the description and collation of sample data, the variation tendency, even skewness and kurtosis should also be taken into account. The average is an excellent central tendency quantity, but it is easily affected by extreme values, and the distribution of service quality and customer satisfaction survey data is often accompanied by skewness. Previous scholars play down the degree of skewness by increasing the Likert's scale[9], but it often makes it difficult for interviewees to answer correctly and mislead researchers to face a situation that is difficult to analyze, and the variation tendency has not been taken into account.

Variation inevitably exists in the system, and the current measurement and management of service quality only focus on the concept of central tendency, without considering the variation tendency. Therefore, this research proposes a conceptual method that incorporates the variation tendency into SERVQUAL's measurement of service quality. Subsequently, we replaced the traditional ZOT analysis method based only on averages with process capability index values through the combination with the ZOT concept, which greatly improved the accuracy of service quality measurement. Finally, we use a case to compare the difference between the traditional ZOT analysis method and the extended ZOT analysis method, and the effectiveness of this method is proven.

2. Introduction and Discussion of Zot

The Zone of Tolerance (ZOT) theory mainly divides the customer's expectations of service into desired service level and appropriate service level, and the ZOT in between.It is worth noting that the ZOT formed by customers' service expectations is unstable and easy to change because their service expectations are subjective, diverse and dynamic. PZB describes in detail the two different service levels that affect the formation of ZOT, as well as the factors of ZOT itself:

(1).Desired service level: customers hold that in the process of consumption, the service they want to get is also the service level that the enterprise can provide or should provide under ideal conditions.

(2).Adequate service level: customers predict the general basic service level that the enterprise can provide before consumption, and the change of customer expectation for adequate service level is often greater than the desired service level.

Parasuraman and Berry (1997)[10] have verified the effectiveness of the ZOT architecture through examples. It puts forward two examples to illustrate the blind spot of traditional single point measurement and highlights the application advantages and value of ZOT. In the first example, customers' actual feelings about each service dimension of the company are between 6-8. This data may allow the company's managers to judge that the current service is accepted and satisfied by customers, but when the expected data is added, it can clearly show that except for Empathy, the perceived service level of all other dimensions is lower than adequate service level, indicating that customers are not satisfied with these four dimensions, suggesting that the company must immediately engage in improvement work (Fig. 1, left). In the second example, the customer's actual feeling about each service dimension is also about 6-8, which is satisfactory and acceptable when shown by the traditional single point and ZOT evaluation. At this time, if the traditional single point method is used as the basis for service quality improvement, managers may give priority to improving Assurance dimension according to the order of scale, but ZOT can clearly show that the perceived service level of Tangibles dimension is closest to adequate service level. This implies that for customers, the Tangibles dimension is in a low degree of satisfaction and needs to be improved first (Fig. 1, right).

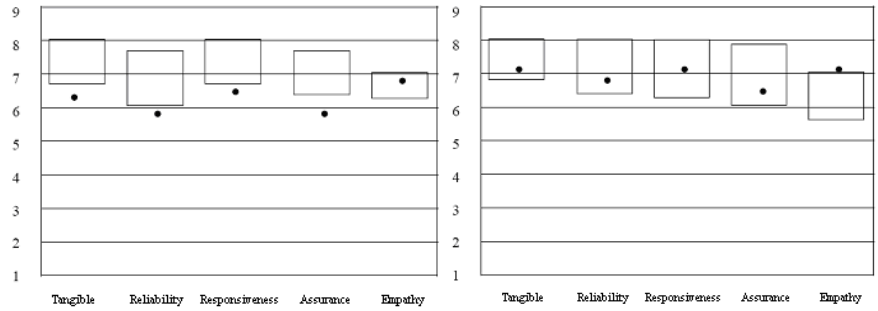

Fig.2 Two Examples from Parasuraman and Berry (1997)

This measurement based solely on concentrated trends may result in a lack of accuracy, as illustrated by a few examples in Fig. 2:

(1).In item 1 of Fig. 4, if the performed service level of any two dimensions is lower than the appropriate service level and the distance from the appropriate service level is the same, which one should be improved first? It seems impossible to determine. Choose the dimension on the left because its performed service level is lower? Why? Isn't the service quality determined by the gap between perception and exception? Similarly, in item 2 of Fig. 4, if the perceived service level of any two dimensions is higher than that of adequate service level and the distance from adequate service level is the same, which service quality is better? The right dimension?

(2).In item 3 of Fig. 4, if the perceived service level of any two dimensions is lower than the desired service level and the distance from the desired service level is the same, which one has the better service quality? The left dimension is better, because its perceived service level is higher? It is higher than the adequate service level? What does the desired service level mean? Similarly, in item 4 of Fig. 4, if the perceived service level of any two dimensions is higher than the desired service level and the distance from the desired service level is the same, which one has the better service quality? Left dimension?

(3).In item 5 of Fig. 4, if the perceived service level of the left dimension of the two dimensions is higher than the appropriate service level, it is less but closer to the desired service level; while the dimension on the right is higher than the appropriate service level but farther away from the desired service level. Which one has the better service quality? Can it not be determined because the perceived service levels are the same? Or is the dimension on the right side better because of its larger forward gap? Do not need to consider the gap from the desired service level? Similarly, in item 6 of Fig. 4, if the perceived service level of the left dimension of the two dimensions is less than the desired service level and less than the desired service level; while the dimension on the right is lower than the desired service level but higher than the appropriate service level. Which one has the better service quality? The dimension on the right?

(4).In item 5 of Fig. 4, if the two dimensions have the received service level in the middle of the ZOT, which one is better? Because the received service level is the same, the left dimension is better? Because the positive gap is higher? But is it far from the desired service level?

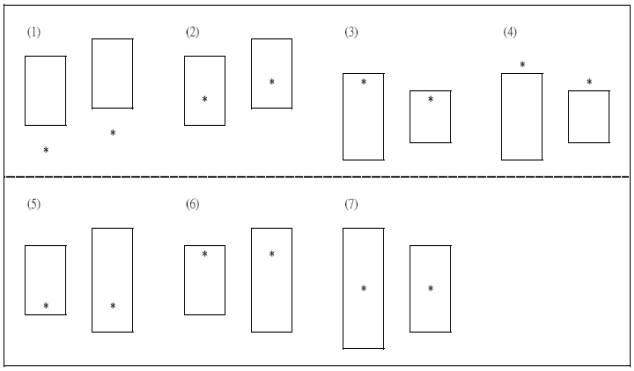

Fig.2 Discussion Example

None of the above questions is easy to answer because only concentrated trends are considered and measured only by averages. First of all, regardless of the difference in the real response concentration of the influence of extreme values on the average due to the skewness of the data, it is necessary to take the variation tendency of perceived service level into consideration.

3. Extended Zot Analysis Method

(1) Graphical representation

Box plot, also known as box-and-whisker plot or Schematic plot, does not plot the actual observations, but displays the summary-statistics of the distribution, which can be used to test the extreme quantities of data and the type of distribution. Box plot mainly draws the median, that is, the 50th percentile, the 25th percentile, the 75th percentile, etc. The lower bound B is the 25th percentile (25% quartile QL, the lower quartile), and the upper bound D is the 75th percentile (75% Q3, that is, the upper quartile). The length of the box represents the inter-qrartierange, which is the difference between the 75th percentile and the 25th percentile (IQR=Q3-Q1). The straight line C in the box represents the median. Typically, the box contains observations of 50% variables, so the larger the box, the greater the dispersion of the observation body. The line extending from the upper and lower boundary of the box, called whiisker, is used to connect the maximum value E and the minimum value A of the observer, and the dot F represents its average. This information can be used to show the distribution pattern of the data. In the case of left-skewed distribution, the average will be less than the median; in the case of right-skewed distribution, the average will be greater than the median.

Using Box plot instead of point representation has many advantages, which can tell not only where the average is, but also where the median is. The median is less affected by the extreme value than the average, so it is an excellent concentrated trend quantity. In addition, the concentration of 50% of the data and the skewness trend of the data can be seen from the box, which can provide researchers with more accurate information. However, the discrimination by graphics alone is still not accurate enough, so the comparison of quantitative indicators is very necessary. The next section introduces the methods of quantitative index construction.

(2) Quantitative indicators

Since Charbonneau and Webster (1978) [11] first put forward the first process capability index, it has aroused the interest of the industry. Then Kane (1986) [12] puts forward the process capability index C_p; C_{pl}; C_{pu} and C_{pk} according to the unilateral and bilateral specifications and whether or not to consider the process target value. Chan et al. (1988) [13] proposed another process capability index C_{pm} based on Taguchi's loss function to make up for the lack of C_p and C_{pk}. It is an outstanding means to quantify the quality level and process capability indicators. If the

appropriate service level is regarded as the Lower limit specification, while the desired service level is regarded as the Upper limit specification, and it is regarded as the target value, and the Perceived service level is an allocation, the graph is shown in Fig. 3:

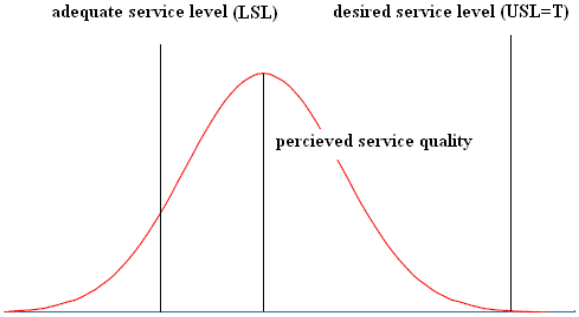

Fig.3 Perceived Service Distribution

Therefore, the process capability index C_{pm} is an excellent index to measure the quality level. However, perceived service level is not necessarily a normal distribution, so in this study, the percentile distance method is used to calculate the $C_{p(q)}$ and $C_{pk(q)}$ index of any shape distribution based on percentile . Its main advantage is that there is no need for complex curve fitting. The formula of the new index $C_{pmk(q)}$ is as follows:

$$C_{pmk(q)} = \min\{\frac{USL - x_{50}}{3\times\sqrt{(\frac{x_{99.865} - x_{50}}{3})^2 + (x_{50} - T)^2}}, \frac{x_{50} - LSL}{3\times\sqrt{(\frac{x_{50} - x_{0.135}}{3})^2 + (x_{50} - T)^2}}\} \quad (1)$$

Where in:

USL: Upper limit of the specification, replaced by appropriate service level;

LSL: Lower limit of specification, replaced by desired service level;

T: The target value of the specification, replaced by desired service level;

x_p: The pth percentile of x.

Therefore, the *Cpmk(q)* index not only considers the concentrated trend quantity but also includes the variation tendency quantity, which can reinforce the deficiency of graph discrimination and provide a clear and accurate judgment standard for researchers when comparing each dimension.

4. Case Study

(1) Research framework

Taking the outpatient office of a hospital in Taiwan as an actual case, the adequate service level; desired service level and perceived service level of the outpatient department of a hospital were evaluated with a 3-column SERVQUAL questionnaire, and then the MSS and MSA were calculated. In addition, the $C_{pm(q)}$ index is calculated by formula 1, and then the differences of the service quality measurement results of the traditional ZOT analysis method and the Extended ZOT analysis method in the outpatient department of this hospital are compared.

(2) Research and design.

In this study, a questionnaire survey was conducted with five dimension21 items in the SERVQUAL scale revised by PZB (1994) and a nine-point scale in the form of three columns. The data were collected by random sampling interview, a total of 272 people were investigated, of which 13 were invalid questionnaires, and the recovery rate of effective questionnaires was 95.22%. SPSS 10.0 statistical software was used as the analysis tool. Results: the value of Cronbach's α was 0.8342, which was reliable enough.

(3) ZOT analysis

After the questionnaire was collected, the average numbers of perceived service level; adequate service level and desired service level were calculated, and then MSA and MSS were calculated. The results are shown in Table 1 and graphically shown in Fig. 4. Among them, the MSA of Reliability and Responsiveness dimensions was positive, while that of the other three dimensions was negative, and the performance of Responsiveness was the best, followed by Reliability. The Empathy dimension is -0.04, the worst performance, which is the priority improvement project; while the MSA of Tangibles and Assurance is the same, both are -0.03. According to the traditional ZOT analysis method, these two dimensions are regarded as the same service level, and Tangibles dimension may also be selected for priority improvement.

Table 1 Mss and Msa

	Adequate service level	Desired service level	Perceived service level	Measure of service adequacy MSA	Measure of service superiority MSS
Tangibles	0.64	0.76	0.61	-0.03	-0.15
Reliability	0.62	0.79	0.65	0.03	-0.14
Responsiveness	0.60	0.78	0.67	0.07	-0.11
Assurance	0.65	0.80	0.62	-0.03	-0.18
Empathy	0.67	0.82	0.63	-0.04	-0.19

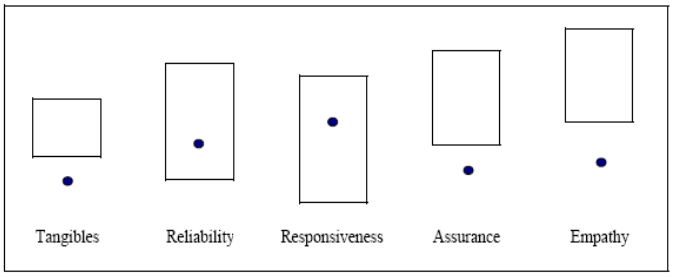

Fig.4 Zot Analysis

(4) Extended ZOT analysis

If it is replaced with a Boxplot chart, after calculating the quantiles of x_{25}; x_{50} and x_{75} (as shown in Table 2), draw a new ZOT diagram (as shown in Fig. 5), showing that the Tangibles dimension is assigned to the right, and the other four dimensions are assigned to the left. According to this chart, although the concentration trend of Responsiveness is higher than that of Reliability dimension, the degree of dispersion of dimension is also higher than that of Reliability dimension, so it is difficult to determine which dimension performs poorly, while Empathy dimension shows a very right deviation distribution, with a median much higher than the average, reaching desired service level. In addition, the Assurance also shows a very right-leaning distribution, with the median much higher than the average or even higher than the desired service level; while the Tangibles dimension is slightly left-leaning, with the median lower than the average. In this case, it is difficult to judge the advantages and disadvantages of this 3dimension, so we further calculate its $C_{pmk(q)}$ index to compare. After the quantiles of $x_{0.135}$and $x_{99.865}$of each dimension are calculated, the v index is obtained instead of formula (1).

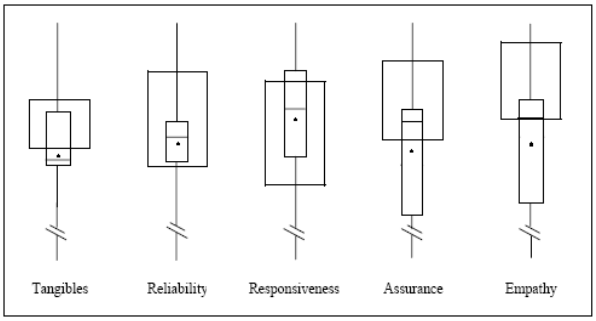

Fig.5 Box Plot Analysis

Table 2 $C_{pmk(Q)}$ Analysis

	$x_{0.135}$	x_{25}	x_{50}	x_{75}	$x_{99.865}$	$C_{pmk(q)}$
Tangibles	0.50	0.57	0.60	0.70	1.0	-0.23
Reliability	0.55	0.61	0.67	0.72	1.0	0.31
Responsiveness	0.54	0.63	0.71	0.79	1.0	0.23
Assurance	0.46	0.54	0.67	0.71	1.0	-0.12
Empathy	0.50	0.57	0.67	0.73	1.0	-0.09

According to the results of the $C_{pmk(q)}$ indicator, the Reliability dimension performs the best; the Responsiveness dimension is the next best; the worst performance is the Tangibles dimension, which is the dimension that needs to be improved first; followed by the Assurance and the Empathy dimension.

(5) Discussion

1).Which dimension performs better, Reliability or Responsiveness? The $C_{pmk(q)}$ pointer shows that the result is different from that of the traditional ZOT analysis method. The reason is that although the concentrated trend of Responsiveness dimension is higher than that of desired service level either in average or median, its variation tendency is easy to be larger, so the Reliability dimension is better from the viewpoint of robustness (Robust).

2).For Assurance and Empathy dimension, although the average of these two dimensions is lower than the desired service level, but the median is higher than or equal to the desired service level, so it performs better than the Tangibles dimension.

3).Although the MSA of the Tangibles dimension is equal to or lower than the Assessment and Empathy dimensions, the median is lower than the average, so its performance is worse than that of the Assessment and Empathy dimensions, even though its variation tendency is smaller.

5. Conclusion

There is no doubt about the importance of accurately measuring the quality of service, but the traditional way of measurement is obviously insufficient only in terms of concentrated trend, not to mention that the average is easily affected by extreme values. The amount of variation tendency should be included in the measurement of service quality, so that more accurate information can be obtained for researchers to make correct decisions. Based on this, this work proposes a conceptual method that incorporates the measurement of variation tendency into SERVQUAL's measurement of service quality, and replaces the traditional ZOT method with Box plot by combining with the ZOT concept, which can provide more sufficient information. Subsequently, the process capability

index $C_{pmk(q)}$ value is used to replace the traditional ZOT analysis method based only on the average, which improves the accuracy of service quality measurement. Finally, the comparison and discussion of examples in the outpatient department of this hospital proves that this method is superior to the traditional ZOT analysis method, and it can indeed provide researchers with more accurate information.

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