



# Service Quality Measurement in Information Systems: An Expectation and Desire Disconfirmation Approach

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## ABSTRACT

Traditionally, measurements of service quality have followed the expectation-disconfirmation approach. Further, previous studies have shown that negative disconfirmation is more influential than positive disconfirmation. This research hypothesized information systems (IS) service quality scales based on the dimensionality of the expectation-disconfirmation (ED) and desire-disconfirmation (DD) approach. Using the SERVQUAL+ instrument and data collected from 321 IS users, the authors developed ED and DD-based IS service quality scales using contemporary methods, such as LISREL-based CFA. This paper proposed and empirically validated the following two new IS service quality constructs: service adequacy (difference of expected service and perceived service) and service superiority (difference of desired service and perceived service). The results indicate that both measures have shown better predictive power than earlier scales like SERVQUAL+ and the IS ZOT scales. The authors have outlined several implications of ED and DD scales to practice and research.

## KEYWORDS

Desire-Disconfirmation, Expectation-Disconfirmation, Information Systems, Service Quality, SERVQUAL+, Zone of Tolerance

## 1. INTRODUCTION

The timely assessment of information system (IS) service quality can help the firms meet end-user requirements and instill satisfaction. Therefore, all IS firms have adopted the approaches to measure

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the IS users' perception of service quality dimensions as an integral part of their IS success evaluation. Many researchers have opined on the use of expectation disconfirmation theory (EDT) as an effective way to gauge users' satisfaction with IS usage (Hossain, 2019). The EDT theory holds that consumer satisfaction is related to the magnitude and direction (positive or negative) of the discrepancies (or disconfirmation) between prior expectations and perceived performance (Churchill and Surprenant, 1982; Gorla and Somers, 2014). Three forms of disconfirmation may occur: a) expectations are confirmed when perceived performance meets expectation, b) expectations are negatively disconfirmed when perceived performance falls short of expectations, and c) expectations are positively disconfirmed when perceived performance is better than expected performance (Rouf et al., 2019; Zamani and Pouloudi, 2020).

Studies have highlighted that expectations-based disconfirmation alone may not provide a complete picture as desires-based disconfirmation can also impact consumers' satisfaction (Gorla and Somers, 2014; Hossain, 2019). As pointed out in previous studies, the gap measures of service quality possess superior diagnostic capabilities as they are grounded in EDT, linked to user satisfaction (Hogreve et al., 2017). For example, considering the perceived services of individual users, tangibles could have the lowest performance ratings. If the perception-minus-expectation measures are considered, reliability could have the largest negative disconfirmation across individual users (Chen et al., 2018). Using perception-only scores, the company may pay more attention to tangibles than reliability with the largest shortfalls of service, thereby incorrectly diagnosing service deficiencies (Parasuraman et al. 1994). Thus, instruments that capture disconfirmation of expectations need to be different from those designed based on perception-only measures (Kettinger and Lee, 2005).

Therefore, there are several advantages of disconfirmation-based measures over alone perception-based measures: *First*, the use of performance-only based scales results in misguided diagnostics of service deficiencies, leading to wrong resource allocation decisions by managers. *Second*, the dual expectation measures of service are more realistic than single expectation measures and are being used in industry because of their importance in satisfaction research. Previous instruments in IS service quality did not capture individual users' service disconfirmations concerning expectations and desires (Chen et al., 2018). *Third*, previous research in IS service quality paid little attention to the unidimensionality property, which is the critical and basic assumption in measurement theory (Kettinger and Lee, 2005). Our study aims to address the above research gaps in IS service quality by developing IS service quality scales based on expectation-disconfirmation and desire-disconfirmation approaches.

The instruments developed using direct measures (for example, perceived service as used in Kettinger and Lee, 2005) do not reflect individual stakeholders' service gaps. Service expectations may vary among employees, across service providers, within the same employee across a period (Parasuraman et al., 1985). Each dimension depends upon the context and circumstances (Zeithaml et al., 1993). The rationales of these differences can be grounded on the varied level of service expectation and service desire levels they hold for respective service quality dimensions. Hence, the service quality dimensions' significant loadings in such instruments reflect relevance for perceived service rather than their relevance for service discrepancies. Results would be different if both components of difference score are collected and used when compared to using only one of the difference score components (Negash et al., 2003; Klein et al., 2009); thus, these two methods represent different theories. Therefore, the scales derived based on perceived service, expected service, or the desired service will differ from those based on service expectation-disconfirmation (ED) and service desire-disconfirmation (DD) measures. Service quality instruments developed based on these individual service deficiencies represent the critical service dimensions and items of importance from the IS manager's perspective compared to instruments based on the three service levels' direct and independent measurements. The greater importance and utility of difference scores is evidenced by their recent application in various industries, including railways, airlines, health, banking, hotels, and mobile service (Silvestro, 2005; Arasli et al., 2005; Cavana et al., 2007; Pakdil and Aydin, 2007;

Lemy et al., 2018; Rouf *et al.*, 2019) and. However, there were limited studies in the literature that apply expectations and desires-based disconfirmations in IS service quality.

Based on the above discussion, we seek answers to the following research questions:

1. Is there a difference exist between expectations and desires-based disconfirmations in IS service quality?
2. If yes, which dimension(s) are critical for ED and DD, respectively?

We study two key research objectives to address the above concerns of expectation (vs. desire) based disconfirmation approach. 1)To extend the previous researchers' line of investigation by developing scales for IS service quality based on expectation-disconfirmation and desire-disconfirmation theories, and; 2)To validate the proposed scale and compare it with the service quality scales developed in previous research.

Our contributions are two folds: First, our research offers new theoretical insights to ongoing theory-building efforts on information system's service quality domain. Second, these scales will enable the IS managers to assess critical service deficiencies with respect to expectations and desires, thereby resulting in useful IS service management.

The remainder of the paper is organized as follows: In section 2, a literature review is presented. Next, in section 3, the research design is explained. Results of the study are presented in section 4. In section 5, a discussion on the results is provided. Theoretical and managerial implications are discussed in section 6. Finally, the conclusion and future research opportunities are discussed in section 7 and 8 respectively.

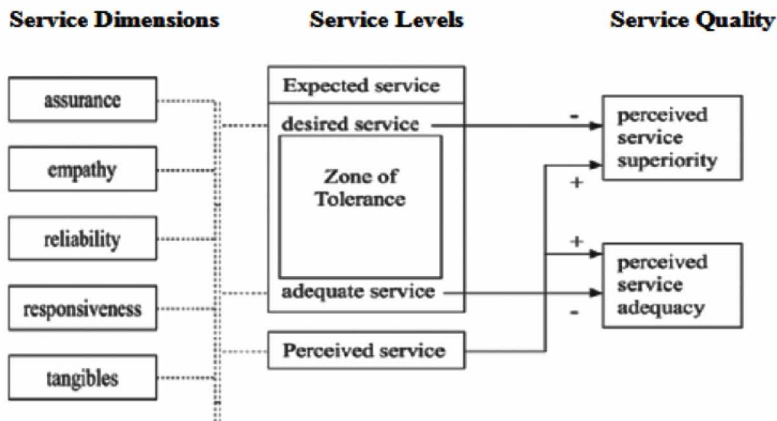
## 2. LITERATURE REVIEW

### 2.1 Service Quality Measurement: An Overview

Service quality was originally conceptualized as the extent to which perceived service meets or exceeds customer expectations. A customer's evaluation of services is a function of the distance between perceived performance and expectation (Parasuraman *et al.* 1985). Several studies have found the following discrepancies in the SERVQUAL instrument: (1) The original difference-based SERVQUAL measure was found to have a lower predictive validity than the perception-only measure (Cronin and Taylor, 1992; Babakus and Boller, 1992; Boulding *et al.* 1993). However, its superiority with respect to the predictive power of performance-only measure was agreed upon by several researchers (for example, Cronin and Taylor, 1992; Boulding *et al.* 1993; Van Dyke *et al.* 1999); and (2) Another problem with the SERVQUAL instrument is the ambiguity of the expectations construct since the expectations have been defined in various ways (such as wants, desires, normative expectations, and ideal standards).

Because of the single expectation measure's ambiguity, Zeithaml *et al.* (1993) have divided the single expectation into two levels of expectations: the desired service level and an adequate service level. The desired service level corresponds to a higher level of service, i.e., the service level a customer wants to receive. The adequate service level corresponds to the minimum level of service that meets the customer's basic needs. Adequate service is like minimum tolerable expectation or to the bottom level of performance acceptable to a consumer. The dual expectations model has been applied in several non-IS contexts, including financial services (Durvasula *et al.* 2006), university libraries (Cook *et al.* 2003), the hotel industry (Nadiri and Hussain, 2005), educational institutions (Joseph *et al.* 2005), rail services (Cavana *et al.*, 2007), and online opinions (Qazi *et al.* 2017). However, its application to the IS context is somewhat limited (Kettinger and Lee, 2005; Tsai and Lu, 2006; Gorla and Somers, 2014).

Figure 1. The dual expectation of service quality (adapted from Parasuraman et al., 1994)



A zone of tolerance is the range between the desired service level and the adequate service level within which a company's services will meet customer demands (Parasuraman *et al.*, 2005; Hogueve et al., 2017). Conceptualizing the dual expectation concept of Zeithaml *et al.* (1993), SERVQUAL+ instrument with twenty-one items in five constructs was developed (Parasuraman *et al.* 1994). Besides, two different measures were defined: a measure of service superiority (the discrepancy between perceived service and desired service) and a measure of service adequacy (the discrepancy between perceived service and adequate service). Both measures can be positive (implying that performance exceeds expectations) or negative (implying that performance is lower than expected). These difference scores are diagrammatically represented in Figure 1.

## 2.2. Service Quality Measurement: An Expectation and Desire Disconfirmation Approach

As guided by EDT, service disconfirmation is a crucial variable in IS satisfaction research. It is the magnitude and direction of disconfirmation that results in satisfaction and dissatisfaction. Positive disconfirmation results in satisfaction, while negative disconfirmation results in dissatisfaction (Venkatesh and Goel, 2010; Chen et al., 2018; Zamani and Pouloudi, 2020). The relationship between disconfirmation and satisfaction is non-symmetric. That is, negative disconfirmation on dissatisfaction is higher than positive disconfirmation on satisfaction (Venkatesh and Goel, 2010; Gorla and Somers, 2014; Nishant *et al.*, 2019). However, disconfirmation explained more variance of satisfaction compared to perceived service (Parasuraman *et al.* 1994; Premkumar and Bhattacharjee 2008; Hossain, 2019).

Under the desires-disconfirmation theory (DDT), like EDT, the desired discrepancy between performance and desired service can be positive or negative. A positive (negative) disconfirmation arises when service performance meets/exceeds (lower than) desired service, which leads to satisfaction (dissatisfaction). By not considering desires-based disconfirmations, one may arrive at illogical conclusions, such as a consumer with lower-level expectations is satisfied with low-performance levels. A consumer will be dissatisfied because of negative disconfirmation when the perceived service level is lower than the desired (wanted) service level, even though there is positive disconfirmation for the expected service level (Schaffer and Fang, 2020). Thus, expectations and desires are two separate concepts and have different effects on satisfaction (Chin and Lee 2000). While expectations may be formed by users' experience and understanding of the actual situation (or feasibility), desires are based on inner emotional needs or want (Khalifa and Liu 2003, Weitzl and Hutzinger, 2019).

Desires can be at a higher or lower level than expectations. There has been empirical evidence for the validity of desires-based disconfirmation models for their influence on satisfaction in both marketing (Parasuraman et al. 1994; Spreng et al. 1996; Schaffer and Fang, 2020) and IT (Suh *et al.* 1994; Chin and Lee, 2000; Khalifa and Liu, 2003, Weitzl and Hutzinger, 2019). Spreng *et al.* (1996) have shown that desires and expectations are empirically distinct attributes and that expectations can cause both negative and positive disconfirmations, whereas desires can only negatively affect satisfaction. There is a more significant downside risk to under-delivering on expectations than the upside reward for over-delivering (Nevo and Wade 2007). Hence, the positive and negative disconfirmations should be individually captured for building difference-based scales. In an empirical study of customers who purchased a life insurance policy from an insurance company, Durvasula *et al.* (2006) found that different service dimensions of service adequacy and service superiority had high correlations with satisfaction. These studies show that different dimensions of service quality could be important for ED and DD. Therefore, different scales would be needed for ED and DD based measures. From the discussions above, desires and expectations are different empirically as they are influenced in different ways because of different determinants (Spreng *et al.* 1996). Therefore, the scales based on expectation-disconfirmation (service adequacy) and desire-disconfirmation (service superiority) will differ.

### 2.3. Service Quality Measurement: Dimensions of ED and DD Scales

Different scales are needed to measure ED and DD because expectations and desires are different concepts and have different determinants. Customer expectations or desires are formed based on customers' experience with other companies at the time of service delivery (Zeithaml *et al.* 1993), and advertisements and salesperson communication (Spreng *et al.* 1996). It should be noted that the desired service is relatively stable compared to adequate service or expectation. Service promises made through advertising will result in enhanced reliability expectation, as IS users expect the IT service provider to keep their promises by providing services at the promised time. In user departments where timely services are critical, such as in Payroll or Accounting, there will be elevated service needs (desired service and adequate service), especially in the dimension of reliability. It is because the IS users in such departments will be pressured to report payroll and accounting information in a timely fashion because of the strict deadlines. Thus, reliability is an essential dimension of both adequate service and desired service.

A customer's desired service levels - the underlying construct for DD - are influenced by high expectations of their supervisors, customers in the service industry, and their personal needs (Parasuraman *et al.* 2005). IS users in the service industries (i.e., consulting business, hotel industry, IT services) will have higher desired service expectations from the IS service providers because such IS users are in the service business. In an empirical study involving customers of a life insurance industry, Durvasula *et al.* (2006) found that the assurance dimension is the most critical item in the service superiority scale.

The adequate service levels (an underlying construct for ED) are influenced by customers' emergencies, availability of service alternatives, and level of customer interactions (Zeithaml *et al.* 1993). Responsiveness will be a vital service dimension for the IS users who are faced with emergency technical system problems, such as hardware and software failures, especially in the timebound IS applications. In such emergencies, IS users expect a minimum level of responsiveness from the service providers.

Customer involvement is an important dimension of adequate service expectation (Bowen, 1989). User participation in system development is regarded as an essential factor for developing a successful information system. User involvement during system development raises the user expectations of the services to be delivered by the provider, as the users believe that they are doing their part in the service delivery by participation. The user and service provider coordination during system development is enhanced by the provider's understanding of the users' needs, giving high importance to users'

information requirements and individual attention. Thus, empathy is an important dimension to shape IS users' adequate service or expectation during system development. The above argument is supported by an empirical study of the life insurance industry in which empathy was determined to be the most important service dimension in service adequacy measurement (Durvasula *et al.* 2006).

Situational factors, such as malware attacks on vendor systems and high vendor IT staff turnover, can result in unreliable services as the provider cannot deliver previously promised services. As the IS users understand the emergency and consider that it is not the IT service provider's fault, they lower their adequate service expectations, especially in terms of reliability service dimension, which is an essential dimension of service adequacy. In the case of alternate delivery sources of IS services (for example, multiple outsourcing vendors or a strong internal IT department), the adequate service expectations will be high. This is because the users will estimate the minimum service level possible in terms of reliability and responsiveness. Therefore, the adequate service level will be higher because of the high expectations of reliability and responsiveness (Nishant *et al.*, 2019). In the IS functions, such as IT helpdesk or IS operations, where multiple service providers exist, high reliable service expectations with high responsiveness will prevail (Hossain, 2019).

## 2.4. Evolution of Service Quality Measurement Scales and Research Gap

The original scale to measure perception-based evaluation of service quality dimensions was given by Parasuraman *et al.* (1985) through the SERVQUAL scale. To overcome the discrepancies and measurement validity issues of the SERVQUAL scales (refer to Section 2.1 above), Kettinger and Lee (1997) have proposed an alternative IS-Adapted SERVQUAL scales. Compared to the original SERVQUAL, the authors of the IS-Adapted SERVQUAL found support for four dimensions of service qualities, namely reliability, responsiveness, assurance, and empathy. Based on EDT theory, Kettinger and Lee (2005) were the first to develop scales for IS service quality by adapting the zone of tolerance concept from marketing into IS research. The authors demonstrate the validity of perceived service and dual service expectations individually in the IS context. Service quality scales, proposed by Kettinger and Lee (2005), are useful for understanding the dynamics of perceptions and expectations and tracking the average service levels or expectation levels of a department over a period (Hossain, 2019).

Since our study aims to propose a measure based on the desire-disconfirmation approach, we follow a different approach from Kettinger and Lee (2005) 's service items of significance. We started from the original SERVQUAL instrument (Parasuraman *et al.* 1994), which is theoretically driven and tested in several contexts. In doing so, we follow Kettinger and Lee (1997, 2005) that "well-established, managerially useful measures should not be discarded until their underlying theory and practicality have been conceptually and empirically discredited" (p 898). Based on SERVQUAL+, we developed the disconfirmation measures of service adequacy, service superiority, and refined scales relevant to IS context using various statistical analyses.

Table 1 highlights the progression towards service quality measurement – starting from perception-based measurement (SERVQUAL) to the proposed desire-based disconfirmation scale.

## 3. RESEARCH DESIGN

### 3.1. Instrument Development

Following the methodologies for instrument development and validation (Segars and Grover, 1993; Segars, 1997; Gefen, 2003), a four-step approach was used to derive and validate IS service quality scales for IS service adequacy and IS service superiority. First, confirmatory factor analysis (CFA) was employed to refine the enhanced SERVQUAL+ instrument for achieving unidimensionality of these scales. Next, the model fitness was estimated, and unidimensionality was assessed using the holdout sample after the scales' refinement. Then, various reliability and validity assessments were

**Table 1. Evolution of Service Quality Measurement Scales in IS Context and (Contribution of our study)**

Scale (Study)	Major Findings
SERVQUAL (Parasuraman <i>et al.</i> 1985)	Pioneered the perception-based measurement of key service quality dimensions, namely tangibility, reliability, responsiveness, assurance, and empathy.
IS-Adapted SERVQUAL (Kettinger and Lee 1997)	Identified four dimensions of service qualities specific to the IS domain – reliability, responsiveness, assurance, and empathy
SERVQUAL+ (Kettinger and Lee 2005)	Based on EDT theory, a disconfirmation-based scale was developed to measure IS service quality by adapting the zone of tolerance concept from marketing into IS research
Service Superiority or Desire- Disconfirmation Scale (Present study)	Extend the SERVEQUAL+ scale by proposing two constructs: <i>Service Adequacy</i> (difference of expected service and perceived service), and <i>Service Superiority</i> (difference of desired service and perceived service).

performed on these instruments (Segars, 1997). After that, scales' psychometric properties were compared with those of SERVQUAL+ (Parasuraman *et al.* 1994) and IS ZOT (Kettinger and Lee, 2005). Additionally, following Carr's (2002) recommendations, the psychometric properties of component scores of the gap scales were examined for acceptable measures.

The enhanced SERVQUAL+ instrument (Parasuraman *et al.*, 1994), with dual service expectations and a 3-column format, was adapted and modified by slightly changing the wording to suit the IS context. The instrument was pre-tested with a group of academics, industry professionals, and IS department personnel, and accordingly, modifications were made. The data used in this study were collected via a nationwide mail survey drawn from the Directory of Top Computer Executives. A total of 1500 questionnaires were distributed to various organizations and various departments through their CIOs. The respondents represent different industries and functional areas in the USA. Previous studies used similar data collected from multiple organizations for analyzing IS service quality instruments (Jiang *et al.*, 2000). Respondents were asked to assess the service quality of their function or department. Overall, 337 filled responses were received, representing a 22.5% response rate. The sample data were tested for non-response bias, using the total number of employees within the organization. The chi-square test comparing the two groups did not show any significant bias, implying no concern for non-responsive bias. The weighted average of the number of employees in the company was 500 to 1000, and the respondents' departments typically contained 10 to 25 employees (mode). Out of the 337 respondents, incomplete observations (i.e., those where none of the service quality items were completed) were deleted, resulting in a net of 321 usable observations. As presented in Table 2, the respondents were from middle and upper management positions. They are knowledgeable to answer the survey, thereby confirming that there was no key informant issue.

For data analysis, the sample was divided into two parts: first, 160 observations were drawn randomly to form the first sample. Second, the remaining 161 observations were reserved as a holdout sample for retesting and or refinement. We performed CFA to assess the unidimensionality of the scales. While unidimensionality is assumed in traditional approaches, CFA provides a more accurate assessment of unidimensionality by explicitly examining different variances (Segars, 1997). If an unaccounted amount of shared variance between two measurement items is significant, there is a threat to unidimensionality (Gefen, 2003). In order to verify unidimensionality, shared residual variances are examined. The aggregate measures of threats to unidimensionality are reflected in higher values of standardized RMR and Chi-square. A significant Chi-square test statistic (p-value < 0.001) may signify a threat to unidimensionality. The above specification search should be cross-

**Table 2. Brief Profile of the Respondents**

	Frequency	Percent
<i>The department the respondent works in</i>		
Manufacturing	85	26.5%
Marketing	30	9.3%
Finance	62	19.3%
Human Resource	36	11.2%
Headquarters	38	11.8%
Accounting	48	15.0%
Others	22	6.9%
Total	321	100.0%
<i>The number of employees in the department</i>		
Less than 10	60	18.7%
10 – 25	89	27.7%
25 – 50	85	26.5%
50 – 100	55	17.1%
More than 100	32	10.0%
Total	321	100.0%
<i>Years with the Organization</i>		
1 – 2 years	64	19.9%
3 – 5 years	85	26.5%
6 – 10 years	74	23.1%
11 – 15 years	48	15.0%
More than 15 years	50	15.6%
Total	321	100.0%
<i>Age of the respondent</i>		
Below 20 years	7	2.2%
20 – 25 years	34	10.6%
26 – 35 years	110	34.3%
36 – 45 years	134	41.7%
Above 45 years	36	11.2%
Total	321	100.0%

validated through a holdout sample to validate the measuring instrument (Segars and Grover, 1993). To obtain the unidimensionality of scales, the items in the construct were deleted one at a time (Segars and Grover, 1993) until at least two of the three conditions, 1) modification indices < 5, 2) standard residuals < 3.5, and 3) non-significant chi-squared values, were met (Segars, 1997). This was done as a trade-off since satisfying all three conditions resulted in a significant reduction of items, which would have led to a threat of low content validity (Carr, 2002). This is also consistent with Gefen's (2003) suggestion that, while dropping the measurement items, care should be taken to over-fit the model. Once the conditions for unidimensionality and goodness of fit indices were satisfied, the



Table 3. Model Fit Indices of Measurement Models

Measurement Model	IS Service Adequacy		IS Service Superiority	
	Multi-factor	Single Factor	Multi-factor	Single Factor
Chi-square ( $\chi^2$ )	74.414	279.124	101.932	351.823
Degree of Freedom (df)	38	44	29	35
$\chi^2 / df$	1.958	6.344	3.515	10.052
$\Delta\chi^2$	---	204.710	---	249.891
$\Delta df$	---	6	---	6
$\Delta\chi^2 / \Delta df$	---	34.118	---	41.649

instrument was retested and refined with the holdout sample. Refinement was necessary for the service adequacy scale only, wherein the item “fulfillment of promises by IS units” had to be discarded. The refined instruments are shown in Table 4.

### 3.2. Common Method Bias and Non-Responsive Bias

Before we subject all datasets to analysis, it is always recommended to assess common method bias (CMB). CMB’s potential cause is measuring instruments using the same method/type of scale used (Podsakoff *et al.*, 2012). To assess this bias, the study followed Harman’s single factor, latent variable, and marker variable approach (Craighead *et al.*, 2011). These were the most widely used test to deal with CMB. Under this test, all variables are subject to exploratory factor analysis (EFA). CMB is assumed to exist if one factor accounts for the most variance in the variables or if one factor surfaces from unrotated factor solutions. For each information system service level (i.e., adequacy and superiority), all measures were subjected to an exploratory principal component factor analysis (EFA) with oblique rotation. This yielded a four-factor solution based on Eigenvalues and scree plot test criteria, collectively accounting for 67.5 percent of the variance. For adequacy scales, the first factor explained just 29.6 percent of the variance, considerably less than the 50 percent benchmark used in Harman’s single-factor test. Similarly, for superiority scales, the variance accounted for by the first factor was 32.2 percent. Thus, in both cases, the variance explained by the single-factor was less than the 50 percent cut-off criterion suggested by Herman (1976). Recently researchers have started executing Harman’s single factor test with CFA and finding it more robust than earlier tests (Craighead *et al.* 2011). The CFA application is more robust as CFA provides model fit statistics for both models. However, the discrepancy between the one-factor model and the multi-factor model is assessed through a chi-square difference test. If the model-fit statistics of the two models; and their differences show that the multi-factor model is better than the single-factor model across all waves, we can assume the absence of CMB in the datasets being used. Thus, a four-factor measurement model was tested ( $\chi^2 = 74.414$ ,  $df = 38$ ,  $\chi^2 / df = 1.958$ ), followed by a single factor measurement model ( $\chi^2 = 279.124$ ,  $df = 44$ ,  $\chi^2 / df = 6.344$ ). Results of the  $\chi^2$  difference test between these two models ( $\Delta\chi^2 = 204.930$ ,  $\Delta df = 6$  i.e.,  $\Delta\chi^2 / \Delta df = 34.155$ ) indicate that common method bias may not be a serious problem in our dataset (Please refer Table 3).

## 4. RESULTS

As can be seen from Table 4 below, the instrument for IS service adequacy (ED) has eleven question items representing the four constructs: tangibles, reliability, responsiveness, and empathy. The IS service superiority (DD) has ten-question items in four constructs: tangibles, reliability, assurance, and

Table 4. IS Service Quality Scales

SERVQUAL+ Items	IS Service Adequacy (ED Scale)	IS Service Superiority (DD Scale)
<b>Tangibles</b>		
1. Up-to-date hardware and software (TAN1)	----	----
2. Appeal of physical facilities (TAN2)	0.816	0.816
3. Neat appearance of IS employees (TAN3)	0.724	----
4. Physical facilities should be provided (TAN4)	0.868	0.905
5. Operating hours convenient to others (TAN5)	----	----
<b>Reliability</b>		
6. Fulfillment of promise by IS unit (REL1)	----	----
7. Interest shown by IS unit to solve user problems (REL2)	0.853	0.886
8. Dependability of IS unit (REL3)	0.891	0.886
9. Providing services at promised time (REL4)	0.837	0.849
10. Service delivery time commitment (REL5)	----	----
<b>Responsiveness</b>		
11. providing prompt service to users (RESP1)	0.911	----
12. Willingness to help users (RESP2)	0.864	----
13. Availability of IS staff to respond to user requests (RESP3)	----	----
<b>Assurance</b>		
14. IS staff install confidence in users (ASS1)	----	----
15. Users' feeling safe in transactions with IS units (ASS2)	----	0.789
16. Courteous interactions with IS users (ASS3)	----	0.853
17. Knowledgeable IS employees (ASS4)	----	0.862
<b>Empathy</b>		
18. Paying individual attention to users (EMP1)	0.904	----
19. Give personal attention to users (EMP2)	0.925	0.760
20. IS units have users' best interest (EMP3)	0.792	----
21. IS staff understand users' needs (EMP4)	----	0.902

empathy. Table 4 also shows the factor loading of service quality items on the respective constructs of the service adequacy and service superiority scales.

The instruments for IS service adequacy and IS service superiority meet all the goodness of fit criteria on both the first sample and holdout sample (Tables 5 and 6). The unidimensionality assessment shows that the ED scale exhibits the unidimensionality properties by meeting at least two of the three criteria outlined above. The scale for DD moderately satisfies unidimensionality conditions (the largest modification index of 9.22 exceeds the cut-off of 5).

The original constructs of the SERVQUAL+ instrument do not meet any of the criteria for the unidimensionality of constructs (for example, see Table 5). The chi-square value is significant at  $p < 0.000$  level, the standardized residual of 7.1 far exceeds the maximum, and the largest modification index of 76.0 far exceeds the cut-off. The IS-ZOT also does not meet the unidimensionality of

**Table 5. Unidimensionality and Goodness of Fitness for IS Service Adequacy (ED scale)**

Unidimensionality	Cut-off	1 <sup>st</sup> sample	Holdout*	#SERVQUAL+	#IS ZOT
Chi-square (df)		98.5 (48)	41.4 (38)	561 (179)	363 (129)
p-value of Chi-Sq	Non-Sig.	0.000	0.323	0.000	0.000
Largest Std. Residual	< 3.5	3.11	3.53	7.1	7.0
Largest Mod. Index	< 5.0	4.66	6.31	76.0	80.0
<b>Fit Index</b>					
Chi-square /df	<5.0	2.05	1.09	3.14	2.82
GFI	>0.90	0.906	0.955	0.749	0.798
AGFI	>0.80	0.848	0.922	0.677	0.733
CFI	>0.90	0.986	0.998	0.967	0.968
NFI	>0.90	0.973	0.995	0.952	0.951
Standardized RMR	<0.05	0.032	0.027	0.088	0.073

\*After further refinement; #with Holdout sample

**Table 6. Unidimensionality and Goodness of Fitness for IS Service Superiority (DD scale)**

Unidimensionality	Cut-off	1 <sup>st</sup> sample	Holdout*	#SERVQUAL+	#IS ZOT
Chi-square (df)		53.5 (29)	41.3 (29)	758 (179)	713 (129)
p-value of Chi-Sq	Non-Sig	0.004	0.064	0.000	0.000
Largest Std. Residual	< 3.5	2.34	3.36	8.7	8.2
Largest Mod. Index	< 5.0	5.72	9.22	101.8	87.3
<b>Fit Index</b>					
Chi-square /df	<5.0	1.82	1.42	4.24	5.52
GFI	>0.90	0.937	0.951	0.689	0.669
AGFI	>0.80	0.880	0.907	0.599	0.561
CFI	>0.90	0.998	0.993	0.939	0.920
NFI	>0.90	0.969	0.979	0.923	0.902
Standardized RMR	<0.05	0.047	0.036	0.132	0.123

\*After further refinement; #with Holdout sample

constructs criteria (chi-squared value is significant at  $p < .000$ , the standardized residual is 7.0, and the largest modification index is 80.0).

Having satisfied the conditions of unidimensionality and goodness of fit indices, the composite reliabilities and AVEs are computed based on the holdout sample (Tables 7 and 8). For the service adequacy instrument (Table 7), the composite reliabilities (the lowest is 0.8459) of all the constructs far exceed the cut-off of value of 0.80. The AVEs of the constructs (the lowest is 0.6478) is well above the suggested cut-off of 0.50, indicating that the variance accounted for by each construct's items is higher than that accounted for by the errors. Furthermore, the standardized factor loadings range from 0.724 to 0.925 (see Table 4 for the factor loadings on the holdout sample), and all are

Table 7. Scale Properties for IS Service Adequacy (ED scale)

Construct	CR	AVE	SQRT-AVE	Correlations of Constructs			
				Tangibility	Reliability	Responsiveness	Empathy
Tangibility	0.846	0.648	0.805	1			
Reliability	0.895	0.741	0.861	0.774	1		
Responsiveness	0.882	0.788	0.888	0.676	0.779	1	
Empathy	0.908	0.767	0.876	0.631	0.648	0.756	1

significant, meeting the minimum cut-off of 0.70. These results demonstrate the convergent validity of the constructs of the service adequacy instrument. The instrument also satisfies discriminant validity since the correlation coefficient between any two constructs is lower than the square-roots of the AVEs of those constructs.

The composite reliabilities of the service superiority instrument (Table 8) range from 0.819 to 0.906; the AVEs of the constructs range from 0.696 to 0.764, and the standardized indicator loadings range from 0.760 to 0.905 (Table 7). Thus, the service superiority instrument meets the minimum cut-offs for convergent validity. Except for the correlation coefficient between assurance and empathy, all the other correlation coefficients are lower than the square-root of the AVEs of the corresponding constructs. All of this demonstrates adequate support for discriminant validity.

#### 4.1. Comparison With Kettinger and Lee (2005) Study

Kettinger and Lee’s (2005) scales can be used for measuring Expectation-Disconfirmation and Desire-Disconfirmation. We applied the dimensions of Kettinger and Lee (2005) scales and examined their psychometric properties. The resulting scales did not demonstrate acceptable psychometric properties in terms of unidimensionality and goodness of fit indices (see Tables 5 and 6). Kettinger and Lee’s (2005) IS-ZOT scale for service adequacy (or expectation-disconfirmation) has GFI 0.80, AGFI 0.73, standardized RMR 0.073, and modification index 80. Similarly, Kettinger and Lee’s (2005) instrument exhibited low psychometric properties concerning service superiority (or desire-disconfirmation) – GFI 0.67, AGFI 0.56, standardized RMR 0.123, and modification index of 87. Thus, the dimensions of Kettinger and Lee (2005) scales are not suitable to measure ED or DD and should not be used for service discrepancy measures. It was noticed that the constructs of the SERVQUAL+ instrument do not satisfy either the goodness-of-fit measurement or the unidimensionality criteria. The SERVQUAL+ unidimensionality and fitness indices for service adequacy include GFI 0.749, AGFI 0.677, a standardized RMR of 0.088, modification indices 76, and a standardized residual of 7.1. Thus, neither the SERVQUAL+ instrument nor the IS ZOT scales are found to be suitable for adequate service or desired service-based discrepancy measures of IS service quality. Hence, we have

Table 8. Scale Properties for IS Service Superiority (DD scale)

Construct	CR	AVE	SQRT-AVE	Correlations of Constructs			
				Tangibility	Reliability	Assurance	Empathy
Tangibility	0.852	0.742	0.862	1			
Reliability	0.906	0.764	0.874	0.775	1		
Assurance	0.848	0.735	0.858	0.451	0.531	1	
Empathy	0.819	0.696	0.834	0.564	0.766	0.705	1

successfully shown that a different set of instruments is appropriate for assessing service discrepancies (i.e., ED and DD) of IS service quality.

The dimensional structures of our ED and DD based scales are very different from the perceived service-based factor structure of Kettinger and Lee (2005) scale in several ways. Assurance is eliminated in the service adequacy (ED) scale, and responsiveness is eliminated in the service superiority (DD) scale in the present research. However, the assurance construct is retained and combined with empathy to form the 'rapport' construct in Kettinger and Lee (2005) scale that was derived using exploratory factor analysis. Apart from this, there are other differences, as well. While all the four question items of empathy are included in the Kettinger and Lee (2005) scale, three-question empathy items are loaded in the IS service adequacy scale. Two question items are included in the IS superiority scale in the present study. Out of empathy items, our ED scale includes item #18 ("Paying individual attention to users"), and the DD scale includes item #21 ("IS staff understand users' needs"). Intuitively, item #18 reflects the basic needs and minimum expectations of IS users. Item #21 is beyond the minimum requirement, i.e., expecting the service provider to understand the users' work environment and IS users' information needs; this belongs to the DD scale. The high factor loadings of items #18 and #21 into their respective scales reflect these items' natural alignment separately.

## 5. DISCUSSION

The research objectives were to (i) hypothesize and develop scales for IS service quality based on expectation-disconfirmation and desire-disconfirmation theories, and ii) to compare our scales with the service quality scales developed in previous research. The present research has derived two constructs measuring the IS service quality: IS service adequacy (ED scale) and IS service superiority (DD scale) to meet the above objectives. The results suggested that the ED-based scale has a different dimensional structure compared to DD based scale. Both ED and DD based scales demonstrate unidimensionality and superior psychometric properties providing support for the validity of disconfirmation-based scales.

Our results highlight that the ED scale has the dimensional structure of reliability, responsiveness, and empathy. At the same time, our results show the ED scale to have a dimensional structure of tangibles, reliability, responsiveness, and empathy. The DD scale has the dimensional structure of reliability and assurance. At the same time, our results show the ED scale to have a dimensional structure of tangibles, reliability, assurance, and empathy.

Carr (2002) stipulates that gap measures can only be used if the component scores demonstrate reasonable psychometric properties. Accordingly, psychometric analysis of the components scores for each service adequacy and service superiority scale was performed using the holdout sample, all of which satisfied the required criteria. The adequate service exhibits acceptable goodness of fit (GFI 0.94, AGFI 0.88, and standardized RMR 0.023), convergent validity (factor loadings: 0.79 - 0.96; composite reliabilities > 0.87; AVEs > 0.68), and discriminant validity. The perceived service also met the criteria (GFI 0.90; AGFI 0.825; standardized RMR 0.03; factor loadings range from 0.82 to 0.96; composite reliabilities > 0.89; AVEs > 0.73; and discriminant validity). Similarly, desired service exhibited good psychometric properties (GFI 0.94; AGFI 0.88; standardized RMR 0.02; factor loadings 0.84 - 0.98; composite reliabilities > 0.86; AVEs > 0.75).

The study results show that assurance is not a significant construct in the IS service adequacy (ED) scale. Simultaneously, it is a significant factor of the IS service superiority (DD) scale. A possible explanation could be that assurance deals with "courteous interactions with users" and "provision of a safe user environment." When users are concerned about minimum service levels, these interactions may not be that important since users will be more interested in basic requirements, such as responsiveness and empathy (for example, "providing prompt service to end-users" or "give personal attention to users"). The question items of assurance ("courteous interactions" and "provision of a safe user environment") could be more critical for those who usually receive service at a level

much beyond minimum service levels. Such items may influence the desired service level expectations. Our results are in agreement with the observations of Parasuraman *et al.* (1985, 1994): customers expect basic services (not fancy services) and performance (not empty promises). The assurance appears to be a significant factor in the service superiority (DD) scale, while responsiveness is not a significant factor. The services related to responsiveness (for example, “providing prompt services to end-users”) are necessary to meet the minimum service levels and hence do not factor in the desired service-based discrepancy measure (i.e., IS service superiority). Thus, assurance is not a significant dimension in the service adequacy scale, while responsiveness is not a significant dimension in the service superiority scale.

## 6. THEORETICAL AND MANAGERIAL IMPLICATIONS

### 6.1. Theoretical Implications

This research’s primary contribution is to conceptualize and provide empirical support for IS evaluation’s desire-disconfirmation scale. The service superiority (DD) scale has been found to have outperformed the existing measures of scales such as service adequacy (ED) scale, SERVQUAL+, and IS ZOT scales. Besides, we explore the reason for the difference in structures of service adequacy, service superiority, and IS ZOT scales. As the item correlations concerning perceived service-only measure are different from the item correlations for, say, adequate service – perceived service gap. The instrument structures derived based on these criteria will be different. The service superiority scale has followed a more rigorous and robust methodological approach, including CFA and CMB assessment compared to earlier IS service quality measurement.

For customers or IS users to be satisfied, both the service adequacy and the service superiority need to be considered (Spreng *et al.* 1996). Further, negative disconfirmations have more influence than positive disconfirmations (Nevo and Wade, 2007; James, 2007). Hence, negative disconfirmations for each stakeholder’s desires and expectations should be computed and summed for each of the service adequacy and service superiority scales’ dimensions. The scale with the largest negative disconfirmation should be used and the dimensions of that scale can be considered for diagnostic purposes and corrective action.

### 6.2. Managerial Implications

Service superiority scale should be used when the user does not have any prior expectations about an IS or IT application’s performance. Churchill and Surprenant (1982) indicate a non-significant influence of service adequacy in new product innovations. However, when a consumer has used a product several times as the product meets his/her desires, expectations increase, and service adequacy may be more important (Spreng *et al.* 1996). Thus, for IS stakeholders who had prior experience with an IS or IT applications, service adequacy becomes more important and should be used.

Next, the experienced IS users may develop some desires (exceeding expectations) after using an application for some time. For example, after experiencing graphical user interfaces in the IT applications, IS users may desire even more user-friendly interfaces in future IS designs. Depending on the extent of negative disconfirmations for the dimensions of service adequacy and service superiority scales, the IS manager can allocate resources to the appropriate service dimensions, thereby allowing corrective actions. These corrective actions result in increased user satisfaction.

## 7. CONCLUSION

While assessing an IS service quality’s performance, though the desire is closer to satisfaction measure than expectation, most existing measurements are benchmarked against expectation alone. We have proposed and empirically validated the following two new IS service quality constructs to bridge

this measurement gap: *Service Adequacy* (difference of expected service and perceived service) and *Service Superiority* (difference of desired service and perceived service). Our results show that while ED (or IS service adequacy) scale contained four dimensions (tangibles, reliability, responsiveness, and empathy), DD (or IS service superiority) scale has dimensions of tangibles, reliability, assurance, and empathy. Both the ED and DD scales have exhibited superior psychometric properties compared to previous IS service quality scales like SERVQUAL+ and the IS ZOT scales. Psychometric properties include unidimensionality, the goodness of fit, convergent validity, and discriminant validity.

## 8. LIMITATIONS AND SCOPE FOR FUTURE WORK

The current research can be extended in the following directions. First, the success of the IS is often measured by the IS user satisfaction (DeLone and McLean, 2003). Present research can be extended to examine user satisfaction with IS service adequacy and IS user satisfaction separately. Such research could add insights to user satisfaction patterns, like the studies of behavioral patterns found in marketing (Parasuraman *et al.*, 2005). Second, the service adequacy and service superiority scales derived in this research that correspond to IS service adequacy and IS service superiority have about 50% of the items in the SERVQUAL+ instrument. This could pose a threat to content validity since complete service quality items are not represented. Though it is not uncommon to have two-item constructs, future research may be devoted to refining these scales to represent at least three items for each construct (Etezadi-Amoll and Farhoomand, 1991).

Next, because of globalization, there is an accelerated phenomenon of IS outsourcing or offshoring. Future studies can extend our work by developing scales for IS service adequacy and IS service superiority for IS insourcing and IS outsourcing separately. Next, future studies can also examine interdependencies between the dimensions of each IS service adequacy (ED) and IS service superiority (DD) scales. Finally, Jia *et al.* (2008) propose IT service climate variables that include service leadership, service vision, customer feedback, and customer communication. Future studies can empirically examine the impact of these four IT service climate variables on the dimensions of service adequacy and service superiority scales derived in this study. The results may lead to higher service quality and satisfaction.

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