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Article

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OPERATIONS, INFORMATION & TECHNOLOGY | RESEARCH ARTICLE

Assessing service quality of online bill payment system using extended SERVQUAL model (SERVQUAL-Butterfly model): A case study of Dhaka electric supply company limited (DESCO), Bangladesh

Mohammad Anisur Rahman^{1,2}, Xu Qi¹, Abu Naser Mohammad Saif^{2*}, Ismail Bin Ibrahim³ and Rabeya Sultana²

Abstract: The aim of this paper is to assess the service quality of Dhaka Electric Supply Company Limited's (DESCO) online bill payment system using extended SERVQUAL model termed as SERVQUAL-Butterfly Model that integrates customer expectation and perception of actual service quality, customer satisfaction, and loyalty. Using random sampling method, primary data were collected from a total of 300 customers from three operating zones of DESCO. The data were analyzed through PLS-SEM second-order hierarchical modeling approach and Importance-Performance Map Analysis (IPMA). We found that expectation on service quality has no effect on customer satisfaction; however, it influences the formation of perception about the actual quality of service. Customer satisfaction is significantly influenced by the perception of actual service quality and customer satisfaction significantly helps to make the customer loyal. For DESCO, empathy found to be a powerful indicator of both expectation and actual service quality and perception of actual service found to be the single most

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PUBLIC INTEREST STATEMENT

This paper represents the assessment of service quality of Dhaka Electric Supply Company (DESCO)'s online bill payment system by using our extended SERVQUAL model termed as SERVQUAL-Butterfly Model. By assessing DESCO data, we found that for both customers' expectation and customers' perception of actual service, genuine care for customers found to be a substantial indicator followed by responsive, safe, and esthetically designed website. Moreover, perception of actual service is found to be the single most important factor for customer satisfaction which helps to make customer loyal. Thus, DESCO must concentrate more on customer care, responsiveness, and well-designed sites to meet the customer expectations. Future researchers can use this SERVQUAL-Butterfly Model, which eliminates inherent limitations of original of SERVQUAL model, and modify it according to their specific industry, context, and culture.

important factor for customer satisfaction. Future researchers can use this SERVQUAL-Butterfly Model that eliminates inherent limitations of original SERVQUAL model and augment it according to their specific industry, context, and culture.

Subjects: Management of Technology & Innovation; Management of Technology; Innovation Management

Keywords: SERVQUAL; SERVQUAL-Butterfly model; PLS-SEM; higher order hierarchical model; formative–reflective model; DESCO; Bangladesh

1. Introduction

The worldwide dominance of Information and Communication Technology (ICT) is quite visible. As the world continues its journey in an electronic age, convergence continues to be a predominant theme. Convergence was initially a term used to explain the convergence of the various methods of telecommunication, namely telephone or television broadcasting—the separate wires for telephone and broadcast became unified. Recent convergence refers to digital convergence—hand-held devices, electronics, telecommunication, networking, etc. Both products and services are presumably more flexible and of higher value due to the occurrence of digital convergence. The number of payment system incorporating technological edge is increasing in number over the years, as there is a constant decline in the difference between paper transaction and electronic transaction (Boss, 2009).

The worldwide ICT boom has also been ignited in Bangladesh, with the total number of internet users summing to roughly around 62 million till April 2016 (BTRC, 2016). Thus, it is only natural that e-commerce is flourishing as the internet has unveiled a new dimension for trade and commerce. The Government of Bangladesh (GoB) has been encouraging the expansion of ICT through “Digital Bangladesh” initiatives. As a result, a lot of public services agencies have opened up their websites and have been sharing various information.

In line with that Dhaka Eclectic Supply Company (DESCO), an electricity distribution company formed as part of the reform in the power sector of Bangladesh, launched electronic bill payment systems through the organization’s website or the website of banks via the internet. This method has several advantages. First, it can improve the quality of service and customer satisfaction by making the bill payment process easier and faster, avoiding the long queues at the banks in the conventional system at their convenient time and from any place. Second, it enhances the bill collection process aiding in the faster collection of revenue and reducing the number of due bills every month.

As part of management’s endeavor to provide better customer service, DESCO introduced the online bill payment system in 2010. Since then, the users of this system have grown incrementally. This system, however, has a minuscule contribution in comparison to the total revenue earned by DESCO and still has a long way to go. Understanding the consumer expectation and perception of the service is a key to improving the quality of service methods.

Our study aims at identifying the service quality gap of DESCO online billing systems. By doing so, we will also identify the factors affecting the customer satisfaction and loyalty of the DESCO online billing systems.

2. Literature review

Customer satisfaction has become a prime theme in any marketing strategy in today’s dynamic business environment (Al-allak & Bekhet, 2011). Exploring customer satisfaction via various service quality studies has become a key tool in formulating market strategies. This process includes the involvement of different academic discipline and led to many service providers opting for such studies to evaluate their service quality (Azar, 2009). Service Quality is a critical parameter in establishing the service provider’s superior business performance in a highly competitive environment (Chowdhary

& Prakash, 2007). Service can be defined as actions or processes, which consists of all economic activities, whose output is intangible and supplies value to its consumers in the form of convenience, entertainment, amusement, comfort, satisfaction, etc. (Quinn, Baruch, & Paquette, 1987).

Despite service quality being a must for being superior and competitive in the market, there is no concrete definition of it (Beecham, 2009). The meaning of service quality, being multidimensional and having multi-characteristics, varies from person to person (Brady, 2001). Due to the generic nature of quality, defining it is also difficult. The standard of quality varies from case to case, culture to culture and from one period to another (Jayasundara, Ngulube, & Minishi-Majanja, 2009). Setting the quality standard is easy when characteristics are quantitative. However, setting quality standards for qualitative characteristics such as excellence, happiness, satisfaction, and luxury which are difficult to measure and control (Snoj, 1995).

Quality service can only be provided to customers by viewing the service from the customer's viewpoint and subsequently meeting their expectation (Quinn, 1997). Focusing on the quality of service usually helps an organization to team up with its customers and achieve competitive edge (Hernon & Nitecki, 2001). Various researchers have indicated that uncovering perception of the service experience of customers is the key to the success of service organizations. To retain and satisfy customers, service organizations need to examine systematically the services they provide from a customer viewpoint and enrich the design of their services and the environment in which their services are delivered (Awad, 2012).

Many governments have focused on delivering quality service to its customers/citizens in all its branches, keeping customer/citizen in focus. Like private organizations, public sector organizations such as health care, police, local government, and various government organizations have also recognized that service quality and customer satisfaction is a major strategic parameter. However, it is also more difficult to assess the service quality in such public organizations (Wisniewski, 2001).

Despite these efforts, public sector service development and delivery is still weakly developed. The various customer service tools and methods employed by the government might result in greater political inequality despite possible improvement in service (Fountain, 2001). In developing countries, access to quality public service is of utmost importance for the poor to rise from their poverty and current standard (Akter, Upal, & Hani, 2008).

To improve the public service quality, electronic media is becoming a central theme in the modernization process of various governments. However, lack of clear vision of government (Lenk, 2002) and age-related obstacles to accessing the internet (Sourbati, 2009) are two major obstacles to public service delivery over the internet. One way to overcome the obstacles is to know clearly where the service delivery problems lie and how to improve it.

To do so, Parasuraman, Zeithaml, and Berry (1985, 1988) proposed SERVQUAL model. This model takes account the customer expectation of service and perception of actual service quality of five dimensions of service quality: (1) Reliability, (2) Assurances, (3) Empathy, (4) Tangibles, and (5) Responsiveness also termed as RATER. The difference in expectation and perceived service is the gap which indicates various levels of satisfaction. A small gap indicates greater customer satisfaction and vice versa. However, some scholars later criticized SERVQUAL on the following grounds:

- Existing methods have the shortcomings in finding out holistic and actual service quality characteristics which cause customer satisfaction (Al-allak & Bekhet, 2011).
- The method of analyzing the gap between perception and satisfaction from service received to determine service quality is inaccurate since most studies have been a performance-based measure of service quality (Cronin & Taylor, 1992). Some scholars also criticized the model as being too focused on the service process and neglecting the technical factors associated (Kang & James, 2004).
- The expectation of customers changes over time (Cronin & Taylor, 1992; Hsieh & Yuan, 2011).
- SERVQUAL cannot be used in all service sectors and needs to be modified to be appropriate for that industry (Kanning & Bergmann, 2009).

As a result, different researchers such as Brady and Cronin (2001), Grönroos (1984) and Oliver, Rust, and Varki (1997) came up with different augmentations and other researchers came up with alternative methods of assessing service quality (see details in the next section).

3. Model specification

The SERVQUAL conceptual model was introduced in 1985 by Parasuraman et al. (Enríquez et al., 2016). The basic SERVQUAL model includes five service quality dimensions termed as Responsiveness, Assurance, Tangibility, Empathy, and Reliability (RATER). Using these dimensions, the model identifies the gap between perceived customer's expectation of services and customer actual experience. After identifying the average gap, the service providers try to minimize the gap to improve the service quality.

As time passed, different researchers onward tried to modify this model and used different statistical techniques to enhance SERVQUAL model. For example, Enríquez et al. (2016), Puni, Okoe, and Damnyag (2014), Albarq (2013), used average score and confidence interval to find out whether the differences are meaningful. Ali, Leifu, Yasirrafiq, and Hassan (2015), Albarq (2013), Gloria (2012) used multiple regression method to identify the SERVQUAL actual performance dimension effect on satisfaction and loyalty. Ho, Feng, and Yen (2014), Tsai, Hsu, and Lin (2011) used importance-performance matrix analysis (IPA). Wong (2014) has used the forecasting dimension of MAGAL and, fuzzy analytic hierarchy process (FAHP) to identify the most important quality dimension that customer deems important. Bodet (2008) used first-order structural equation modeling (SEM) technique to predict satisfaction and loyalty using actual service usage perception of customers of SERVQUAL dimensions.

We can identify three clear patterns from the previous researchers: (1) different statistical technique, (2) adding or removing variables from the original model, and (3) implied disagreement over the use of expectation as an indicator variable for customer satisfaction.

A major limitation of using gap analysis is the inability of linking customer satisfaction or loyalty. The basic SERVQUAL model stands on the assumption that if actual performance is better than expected one, the customer may perceive it as a better service quality or increase in service quality (Parasuraman et al., 1985, 1988). However, minimizing the expectation and actual usage perception gap may not result in customer satisfaction is a direct determining factor in customer loyalty, a central determinant of customer retention (Gerpott, Rams, & Schindler, 2001).

From the previous research pattern and limitation of SERVQUAL, it is evident that when expectation and current performance dimensions of quality are used, researchers applied average scores, confidence intervals, and when multiple regression and SEM were used they just only used actual performance dimensions to link with satisfaction and loyalty. The implied reason may lie in the methodological limitation. To cope with this limitation, we have formulated and augmented the original SERVQUAL model. The details are discussed in the following research design.

4. Hypotheses

Focused on the literature review and our model specification, we hypothesize the followings:

- H1: Perception of actual performance positively influences satisfaction of users of DESCO online bill payment system.
- H2: Expectation of the users of DESCO online bill payment system positively influences the perception of actual performance.
- H3: Expectation of the users positively influences satisfaction of the users of DESCO online bill payment system.
- H4: Satisfaction of the users of online bill payment system positively influences users' loyalty to DESCO online bill payment system.

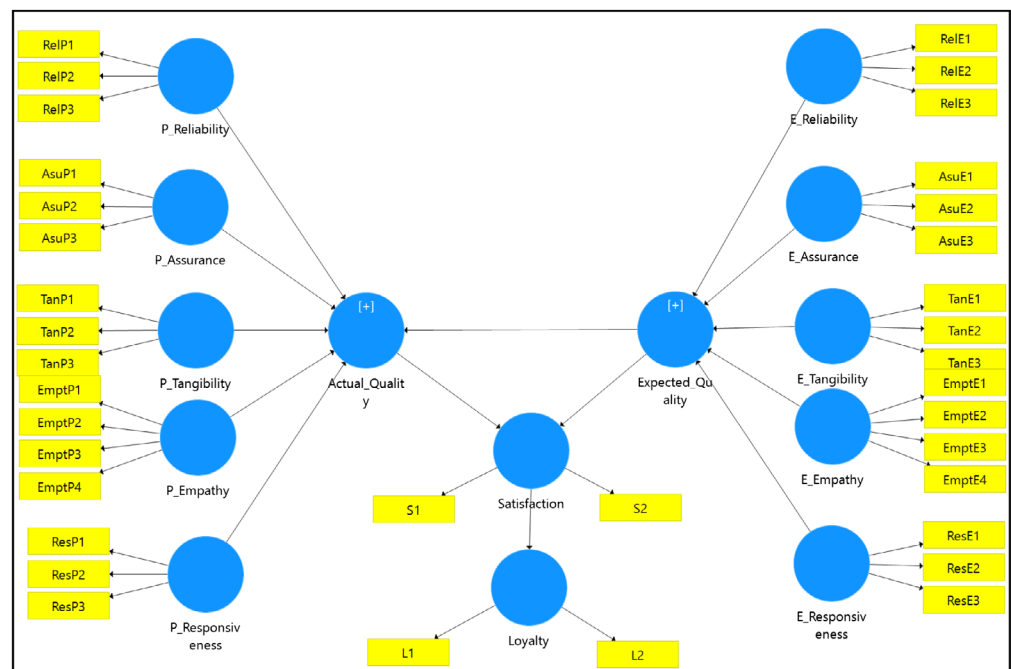
5. Research design

We will be using second-order reflective-formative construction of SEM to incorporate expectation, current quality performance dimensions as exogenous variables, and satisfaction and loyalty as endogenous variables. In our extended SERVQUAL model, both expectation and perception of actual performance are higher order formative constructs as they are formed by the first-order reflective constructs, the five quality dimensions, as suggested by the original SERVQUAL model. Following Figure 1 illustrate our extended SERVQUAL model.

A reflective indicator is an observed variable that is assumed to be an effect of a latent construct, whereas formative indicator is a variable measuring an assumed cause of or a component of a latent construct (Lowry & Gaskin, 2014). In the case of modeling reflective-formative, higher order construct is automatically to be formative construct to play a double explanation comprises reflective and formative measurement model in structural model (Asyraf & Afthanorhan, 2014).

We followed the methodology of Asyraf and Afthanorhan (2014), Lowry & Gaskin (2014), Wong (2016) and video tutorial of Gaskin (2012). The results of the data analysis of PLS-SEM are classified under measurement model and structural model. For PLS-SEM second-order reflective-formative model calculations Becker, Klein, and Wetzels (2012) found that, out of (1) the repeated indicator approach, (2) the two-stage approach, and (3) the hybrid approach, the repeated indicator approach gives better

Figure 1. Proposed extended SERVQUAL (SERVQUAL-Butterfly) model.



results. However, when the researchers are only interested in the higher level estimates (the path coefficient to and from the higher order constructs), the two-stage approach proves more useful than the repeated indicator approach (Becker et al., 2012). The two-stage approach is also preferable to repeated indicator approach to overcome the potential effect of “first-order constructs’ perfect prediction of second-order construct” (Lowry & Gaskin, 2014). Thus, we will use two-stage approach for our study.

6. Sample and instruments

Data were collected deploying face-to-face interview method with a structured questionnaire in two parts. First part included demographical questions and second part included questions on five quality dimensions (reliability, assurance, tangibles, empathy, and responsiveness) proposed by original SERVQUAL model (Parasuraman et al., 1985) using a five-point Likert scale ranging from (1) “strongly disagree” to (5) “strongly agree.” The survey questionnaire included total 16 questions for the five dimensions of SERVQUAL: 3 questions in the reliability dimension, three questions for assurance, three questions for tangibles, four questions for empathy, and three questions for responsiveness (see Table 1).

Table 1. Constructs and items used in the model

Constructs (latent variables)	Indicators	Questions
Reliability	Rel1	How well does the online bill payment system complete your bill payment transaction?
	Rel2	How is the accessibility of the DESCO’s online bill payment system when you want to pay your bill?
	Rel3	How well is your online payment reflected in your bill account summary?
Assurance	Asu1	How sophisticated is the security of DESCO’s online bill payment system?
	Asu2	How safe do you feel paying your DESCO bill online?
	Asu3	Based on the service, how skilled do you feel the operators of this system are?
Tangibility	Tan1	What is your satisfaction level from the appearance of the bill payment system’s user interface?
	Tan2	How organized is the user interface of DESCO’s online bill payment system?
	Tan3	How futuristic is the outlook of DESCO’s online bill payment system?
Empathy	Empt1	How well does DESCO’s online bill payment system provide its promised 24 h service?
	Empt2	How user-friendly is DESCO’s online bill payment system?
	Empt3	How sufficient is DESCO’s online resources to guide the first time user is through the bill payment process?
	Empt4	What is your satisfaction level regarding the option of different banks offered for bill payment?
Responsiveness	Res1	How is the speed of operation and processing of DESCO’s online bill payment system?
	Res2	How well does DESCO serve your complain regarding the online bill payment system?
	Res3	How functioning are the options offered in DESCO’s online bill payment system website?
Satisfaction	S1	How much satisfied are you with the DESCO online bill payment system?
	S2	How often do you use the DESCO online bill payment system?
Loyalty	L1	Are you going to use this billing system in the future?
	L2	Would you suggest others paying a bill with DESCO online bill payment system?

The study area includes the three zones under DESCO's jurisdiction—Mirpur zone, Gulshan Zone, and Uttara Zone. These zones include Agargaon, Shahali, Pallabi, Kafrul, Monipur Rupnagar, Gulshan, Banani Baridhara, Badda, Uttara, Khilkhet, Cantonment, Uttarkhan, Dakshinkhan, and Tongi. The users were chosen at random and surveys were conducted at the surveyor's convenience. We have distributed more than 300 surveys questionnaires with 100% returned filled.

7. Software used

Data analysis for this study is done by SmartPLS 3.0 software (Ringle, Wende, & Becker, 2015) and SPSS 21. With SPSS, we screened the data and checked its validity. For data analysis, we have used SmartPLS.

8. Data screening

After screening the data for missing values and other problems such as same values for all questions, and improper value assignment we were left with 300 questionnaires to proceed for further analysis.

9. Data validation/test for common methods bias

Since the endogenous and exogenous variables were collected at the same time using the same instrument, we tested for common methods bias (CMB) to ensure that our data are free of distortion. We have employed two approaches.

Firstly, using SPSS we tried to conduct Harman's single-factor test using exploratory, unrotated factor analysis for all of the first-order constructs. The result of our factor analysis produced 36 distinct factors, the largest of which accounted for only 46.61% of the variance of the model (see Appendix 1). The outcome is less than the threshold of 50% or above (Gaskin, 2011). This suggested that our data not be suffered from CMB. However, researchers have a dispute over using Harman's single-factor test for CMB (Podsakoff, MacKenzie, & Lee, 2003) and thus we adopted the second approach.

Secondly, we have examined a correlation matrix of the constructs (using Pearson's correlations) to test whether the formative indicators have correlation value over 0.90, which gives evidence that data have CMB (Pavlou, Liang, & Xue, 2006). In our case, all the correlation values were below 0.80, which indicate our data is less likely to have common method bias.

10. Data analysis and findings

10.1. Demographic findings

The descriptive statistics of the demographic profile (see Table 2) of the respondents are as follows.

Demographic information shows respondents were equal in number (100) from each zone. However, they are male dominated (90%) and married (77%). Most of the respondents are young—around 90% of the respondents belong to age group 20–40 years. Most of the respondents are doing service (73%) and business (17%). Around 45% of the respondents are from income level of Tk. 45,000–Tk. 60,000 and 30% of respondents are from above Tk. 60,000 income level, which means the respondents are mostly from affluent group Bangladesh.

11. Measurement model

In two-stage approach, first, the model is run for the indicators and constructs reliability and validity under the measurement model. Then the path coefficient of the second-order construct is checked under the structural model. Becker et al. (2012) suggested reporting indicator loadings, AVE, composite reliability, discriminant validity, etc. for first-order reflective constructs, and indicator weights, the significance of weights, multicollinearity of indicators, etc. for second-order formative constructs.

11.1. Construct validity of the reflective constructs

To test the construct *convergent validity* for the reflective construct, we first checked the measurement items loading with significant t-statistics and p values (Lowry & Gaskin, 2014). Table 3 shows that all of our reflective indicators: expected quality and actual performance are statistically significant (t-value > 1.96 and p-value < 0.05). These results confirm strong convergent validity in our model for the reflective constructs.

To test the discriminant validity we used the Fornell–Larcker criterion (1981) and cross-loading (Wong, 2016). Fornell and Larcker used the square root of AVE, which should be larger than the latent variable correlations (LVC). For cross-loading examination, each indicator’s loading to its latent construct should be higher than that of other constructs. Table 4 shows the square root of AVE, where each latent variable’s value is greater than other LVC. Table 5 shows the cross-loading of all indicator items with each construct. It can be observed that items loading of the construct have a higher value than loading on other constructs. Both of these findings confirm the strong discriminant validity of the reflective constructs.

Table 2. Respondents’ demographic profile

Profile	Groups	Frequency	Percent
Gender	Female	30	10.0
	Male	270	90.0
Age	10–19 years	4	1.3
	20–29 years	99	33.0
	30–40 years	175	58.3
	41–60 years	22	7.3
Marital Status	Married	230	76.7
	Single	70	23.3
Profession	Business	51	17.0
	Others	18	6.0
	Service	218	72.7
	Student	13	4.3
Income	Below 25,000 TK	20	6.7
	25,000 TK–44,999 TK	58	19.3
	45,000 TK–60,000 TK	134	44.7
	Above 60,000 TK	88	29.3
Zone	Gulshan zone	100	33.3
	Mirpur zone	100	33.3
	Uttara zone	100	33.3

Table 3. T-statistics and p-values for convergent validity of constructs

Constructs (latent variables)	Indicator	T-statistics	p-values
E_Reliability	RelE1	38.906	0.000
	RelE2	34.973	0.000
	RelE3	61.224	0.000
E_Assurance	AsuE1	60.605	0.000
	AsuE2	40.804	0.000
	AsuE3	43.790	0.000
E_Tangibility	TanE1	32.533	0.000
	TanE2	46.946	0.000
	TanE3	49.793	0.000
E_Empathy	EmptE1	43.386	0.000
	EmptE2	31.865	0.000
	EmptE3	43.163	0.000
	EmptE4	41.865	0.000
E_Responsiveness	ResE1	48.108	0.000
	ResE2	34.995	0.000
	ResE3	47.828	0.000
P_Reliability	RelP1	83.757	0.000
	RelP2	61.293	0.000
	RelP3	54.670	0.000
P_Assurance	AsuP1	54.141	0.000
	AsuP2	67.466	0.000
	AsuP3	50.584	0.000
P_Tangibility	TanP1	45.054	0.000
	TanP2	45.306	0.000
	TanP3	56.285	0.000
P_Empathy	EmptP1	29.032	0.000
	EmptP2	86.253	0.000
	EmptP3	40.959	0.000
	EmptP4	21.706	0.000
P_Responsiveness	ResP1	36.520	0.000
	ResP2	40.418	0.000
	ResP3	67.828	0.000

Notes: E = expected and P = actual performance.

11.2. Reliability of the reflective constructs

The internal reliability can be evaluated considering Cronbach's alpha and composite reliability. Cronbach's alpha is used to test the reliability of the items, and composite reliability is used to test the reliability of the construct, the latent variable (Hoque, 2016). Although Cronbach's alpha has been used extensively in social science, it provides a conservative outcome for PLS-SEM; consequently, researchers suggested composite reliability as an alternative measure (Wong, 2013). A satisfactory reliable value will be between 0.60 and 0.95 (Bagozzi & Yi, 1988; Hair, Ringle, & Sarstedt, 2013). Table 6 shows the results of the internal reliability of our reflective constructs. Here, all the reflective constructs have a value above 0.7 that confirms strong internal reliability.

Table 4. Fornell–Larcker criteria of discriminant validity

Constructs (latent variable)	1	2	3	4	5	6	7	8	9	10
E_Assurance (1)	0.894									
E_Empathy (2)	0.878	0.893								
E_Reliability (3)	0.859	0.859	0.878							
E_Responsiveness (4)	0.751	0.726	0.741	0.869						
E_Tangibility (5)	0.835	0.849	0.814	0.723	0.893					
P_Assurance (6)	0.553	0.545	0.555	0.362	0.477	0.887				
P_Empathy (7)	0.501	0.561	0.537	0.357	0.477	0.821	0.823			
P_Reliability (8)	0.605	0.636	0.684	0.490	0.591	0.727	0.780	0.910		
P_Responsiveness (9)	0.415	0.406	0.449	0.613	0.427	0.588	0.594	0.635	0.860	
P_Tangibility (10)	0.460	0.430	0.453	0.421	0.513	0.660	0.629	0.570	0.554	0.894

11.3. Construct validity for formative indicators

The construct validity for formative constructs is measured by indicator weights. When the indicator weights for formative constructs are roughly equal and significant, then the formative constructs are said to have construct validity (Lowry & Gaskin, 2014). Table 7 shows that all the indicator weights are roughly equal and significant. Thus, formative constructs are valid.

12. Structural model

After measurement model, the structural model needs to be evaluated to draw the conclusion. For formative constructs, we will evaluate three things: collinearity, coefficient of determination (R^2), and the path coefficient between the constructs.

12.1. Collinearity assessment

Collinearity is assessed by variance inflation factor (VIF), for which a value of 5 or above typically indicates problem (Hair, Ringle, & Sarstedt, 2011). However, a maximum, the VIF for formative factors should be below 10, but for a more rigorous test, they should be below 3.30 (Petter, Straub, & Rai, 2007). Collinearity assessment of our model shows that all the construct values of independent variables are below 3.30 (see Table 8).

12.2. The coefficient of determination (R^2)

R^2 is a major part of a structural model evaluation. R^2 value of 0.25, 0.50, and 0.70 are referred to as a weak, moderate, and strong coefficient of determination, respectively (Hair, Hult, Ringle, & Sarstedt, 2013). In our case, the perception of expected quality can explain 41.20% of variations of perception of actual quality performance. Actual Performance and Expected are found to jointly explain 49.00% of variances of Satisfaction and in line with that Satisfaction found to explain 68.00% variances in loyalty (see Figure 2) in this PLS-SEM model.

12.3. Path coefficient

Path coefficients in the PLS-SEM are checked for the relationship between constructs and significance level. Table 9 shows that perception about expected quality strongly affects the performance about actual quality performance ($\beta = 0.642$, $t = 9.687$, $p < 0.05$); however, perception about expected quality has no significant effect on the satisfaction ($\beta = -0.079$, $t = 1.245$, $p > 0.05$). Perception of actual quality performance has strong significant effect on the customer satisfaction ($\beta = 0.748$, $t = 12.951$, $p < 0.05$) and in turn customer satisfaction has strong effect on customer loyalty ($\beta = 0.825$, $t = 33.681$, $p < 0.05$).

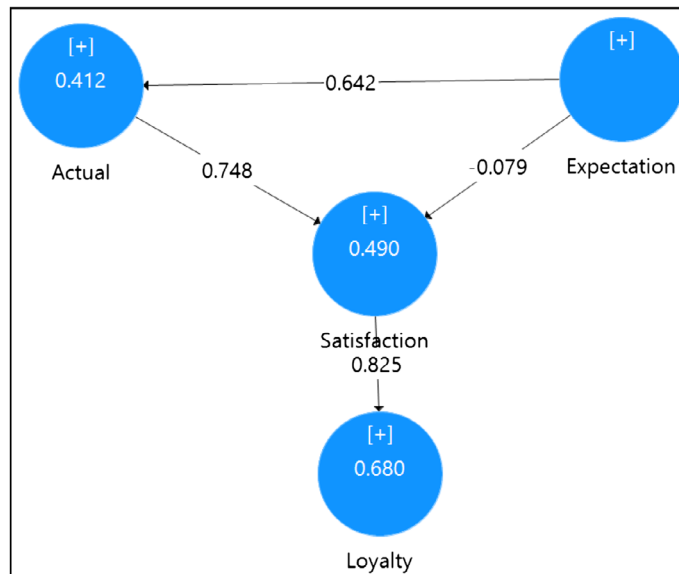
Table 5. Cross-loading of measurement items

	E_Assurance	E_Empathy	E_Reliability	E_Responsiveness	E_Tangibility	P_Assurance	P_Empathy	P_Reliability	P_Responsiveness	P_Tangibility
AsuE1	0.912	0.785	0.807	0.678	0.759	0.500	0.441	0.573	0.386	0.403
AsuE2	0.877	0.816	0.746	0.634	0.750	0.440	0.439	0.536	0.314	0.332
AsuE3	0.892	0.754	0.747	0.700	0.730	0.543	0.463	0.512	0.414	0.499
EmptE1	0.773	0.900	0.744	0.651	0.735	0.500	0.514	0.561	0.365	0.355
EmptE2	0.783	0.883	0.792	0.660	0.745	0.518	0.549	0.591	0.387	0.414
EmptE3	0.778	0.889	0.764	0.638	0.770	0.441	0.455	0.537	0.326	0.367
EmptE4	0.803	0.901	0.769	0.643	0.781	0.489	0.485	0.582	0.372	0.399
RelE1	0.724	0.732	0.872	0.560	0.658	0.498	0.469	0.604	0.338	0.376
RelE2	0.724	0.747	0.855	0.618	0.738	0.470	0.491	0.568	0.364	0.360
RelE3	0.809	0.782	0.907	0.762	0.744	0.496	0.455	0.628	0.472	0.452
ResE1	0.774	0.799	0.765	0.854	0.742	0.413	0.440	0.555	0.464	0.316
ResE2	0.543	0.485	0.517	0.859	0.519	0.225	0.191	0.301	0.576	0.360
ResE3	0.598	0.550	0.605	0.892	0.584	0.273	0.256	0.377	0.579	0.432
TonE1	0.784	0.817	0.776	0.630	0.864	0.457	0.488	0.580	0.339	0.377
TonE2	0.727	0.736	0.691	0.648	0.900	0.400	0.394	0.487	0.377	0.522
TonE3	0.722	0.715	0.709	0.659	0.915	0.418	0.390	0.512	0.429	0.479
AsuP1	0.496	0.455	0.466	0.314	0.410	0.878	0.695	0.626	0.505	0.597
AsuP2	0.509	0.520	0.523	0.360	0.456	0.903	0.773	0.646	0.570	0.637
AsuP3	0.466	0.472	0.485	0.286	0.400	0.878	0.714	0.662	0.487	0.517
EmptP1	0.511	0.559	0.544	0.424	0.469	0.666	0.812	0.753	0.561	0.451
EmptP2	0.453	0.491	0.483	0.323	0.439	0.748	0.913	0.705	0.582	0.608
EmptP3	0.381	0.435	0.400	0.305	0.362	0.695	0.849	0.593	0.493	0.548
EmptP4	0.280	0.342	0.319	0.083	0.280	0.584	0.703	0.492	0.278	0.454
RelP1	0.583	0.603	0.655	0.482	0.559	0.672	0.727	0.928	0.603	0.521
RelP2	0.484	0.512	0.553	0.362	0.478	0.695	0.745	0.904	0.566	0.553
RelP3	0.587	0.624	0.663	0.498	0.580	0.614	0.653	0.897	0.563	0.479
ResP1	0.410	0.410	0.453	0.634	0.449	0.439	0.484	0.577	0.835	0.482
ResP2	0.321	0.288	0.337	0.468	0.288	0.550	0.502	0.491	0.854	0.487
ResP3	0.344	0.352	0.371	0.486	0.368	0.528	0.546	0.571	0.891	0.463
TonP1	0.381	0.379	0.409	0.339	0.466	0.588	0.561	0.529	0.478	0.898
TonP2	0.430	0.390	0.400	0.440	0.439	0.580	0.546	0.511	0.559	0.883
TonP3	0.422	0.384	0.405	0.350	0.471	0.601	0.580	0.489	0.449	0.900

Table 6. Internal reliability measurements of reflective constructs

Constructs	Cronbach's Alpha	Composite reliability	Average variance extracted (AVE)
E_Assurance	0.874	0.922	0.799
E_Empathy	0.915	0.940	0.798
E_Reliability	0.851	0.910	0.771
E_Responsiveness	0.840	0.902	0.755
E_Tangibility	0.873	0.922	0.797
P_Assurance	0.864	0.917	0.786
P_Empathy	0.838	0.893	0.677
P_Reliability	0.896	0.935	0.828
P_Responsiveness	0.824	0.895	0.740
P_Tangibility	0.874	0.922	0.799

Figure 2. Path model estimation.



13. Importance–performance map analysis

Importance–performance map analysis (IPMA) is also known as importance–performance analysis, importance–performance matrix, impact–performance map, or priority map analysis (Table 10). It is a useful tool in PLS-SEM to identify the predecessor constructs’ relative importance in shaping a certain target construct (Ringle & Sarstedt, 2016). More specifically, for a targeting construct, the IPMA contrasts the predecessor constructs’ relative importance (total effects) and the average values of the latent variable scores (performance) to highlight significant areas of improvements for managers (Schloderer, Sarstedt, & Ringle, 2014).

For our model, we have done three IPMA; first one for the expectation of quality (second-order construct), second one for the customer perception on the actual performance and the last one for the satisfaction. The rationale for the first one is that the managers might need to know which indicator variables they should address as the expectation on quality influence the perception of actual quality performance (Parasuraman et al., 1988).

Table 7. Indicator weights for formative constructs

Formative constructs	Original sample	T-statistics	p-values
AsuE1 ← Expected_Quality	0.380	38.474	0.000
AsuE2 ← Expected_Quality	0.371	31.848	0.000
AsuE3 ← Expected_Quality	0.368	39.838	0.000
AsuP1 ← Actual_Performance	0.369	47.027	0.000
AsuP2 ← Actual_Performance	0.394	38.788	0.000
AsuP3 ← Actual_Performance	0.365	43.336	0.000
EmptE1 ← Expected_Quality	0.277	27.140	0.000
EmptE2 ← Expected_Quality	0.280	28.038	0.000
EmptE3 ← Expected_Quality	0.279	31.576	0.000
EmptE4 ← Expected_Quality	0.283	28.863	0.000
EmptP1 ← Actual_Performance	0.313	36.606	0.000
EmptP2 ← Actual_Performance	0.343	31.513	0.000
EmptP3 ← Actual_Performance	0.307	38.483	0.000
EmptP4 ← Actual_Performance	0.246	21.872	0.000
OS1 ← Satisfaction	0.361	34.126	0.000
OS2 ← Satisfaction	0.374	29.171	0.000
OS3 ← Loyalty	0.404	28.400	0.000
OS4 ← Loyalty	0.375	46.143	0.000
RelE1 ← Expected_Quality	0.377	41.335	0.000
RelE2 ← Expected_Quality	0.348	48.431	0.000
RelE3 ← Expected_Quality	0.455	19.558	0.000
RelP1 ← Actual_Performance	0.331	31.026	0.000
RelP2 ← Actual_Performance	0.366	31.566	0.000
RelP3 ← Actual_Performance	0.376	32.108	0.000
ResE1 ← Expected_Quality	0.385	32.338	0.000
ResE2 ← Expected_Quality	0.401	30.961	0.000
ResE3 ← Expected_Quality	0.386	27.449	0.000
ResP1 ← Actual_Performance	0.367	31.805	0.000
ResP2 ← Actual_Performance	0.368	33.905	0.000
ResP3 ← Actual_Performance	0.374	36.913	0.000
TanE1 ← Expected_Quality	0.375	36.186	0.000
TanE2 ← Expected_Quality	0.370	37.804	0.000
TanE3 ← Expected_Quality	0.380	38.474	0.000
TanP1 ← Actual_Performance	0.371	31.848	0.000
TanP2 ← Actual_Performance	0.368	39.838	0.000
TanP3 ← Actual_Performance	0.369	47.027	0.000

Table 8. Collinearity assessment (VIF)

Constructs	Actual performance	Expectation	Loyalty	Satisfaction
Actual performance				1.699
Expectation	1.000			1.699
Satisfaction			1.000	

Table 9. Significance testing results of the structural model path coefficients

Path	Path Coefficients (β)	T-statistics	p-values	Hypothesis
Actual Performance → Satisfaction	0.748	12.951	0.000	Accepted
Expectation → Actual Performance	0.642	9.687	0.000	Accepted
Expectation → Satisfaction	-0.079	1.245	0.214	Rejected
Satisfaction → Loyalty	0.825	33.681	0.000	Accepted

Table 10. IPMA for expectation of quality

Criterion: expectation	Total effect	Performances
E_Assurance	0.204	81.72
E_Empathy	0.271	81.32
E_Reliability	0.201	81.14
E_Responsiveness	0.149	77.11
E_Tangibility	0.174	80.41

13.1. IPMA for expectation of quality

Table 10 shows that all other indicators perform more or less higher (performance \cong 0.80). However, in terms of importance empathy (total effect = 0.271) followed by assurance (total effect = 0.204) and reliability (total effect = 0.201). The next group of importance are tangibility (total effect = 0.174) and responsiveness (total effect = 0.149). The Figure 3 shows that performance values for the indicators formed almost a straight line. However, importance varies.

13.2. IPMA for perception of actual quality

Table 11 shows that expectation variables have relatively higher performance. However, they have no importance effect (total effect = 0.00) on the perception of actual quality. Expected quality as a higher order construct of the expectation variable also performs higher but has no effect (total effect = -0.002) on perception on actual quality performance. On the contrary, actual empathy has the highest impact on the perception of actual performance, followed by second group assurance and reliability and next group responsiveness and tangibility.

Figure 3. IPMA for expectation of quality.

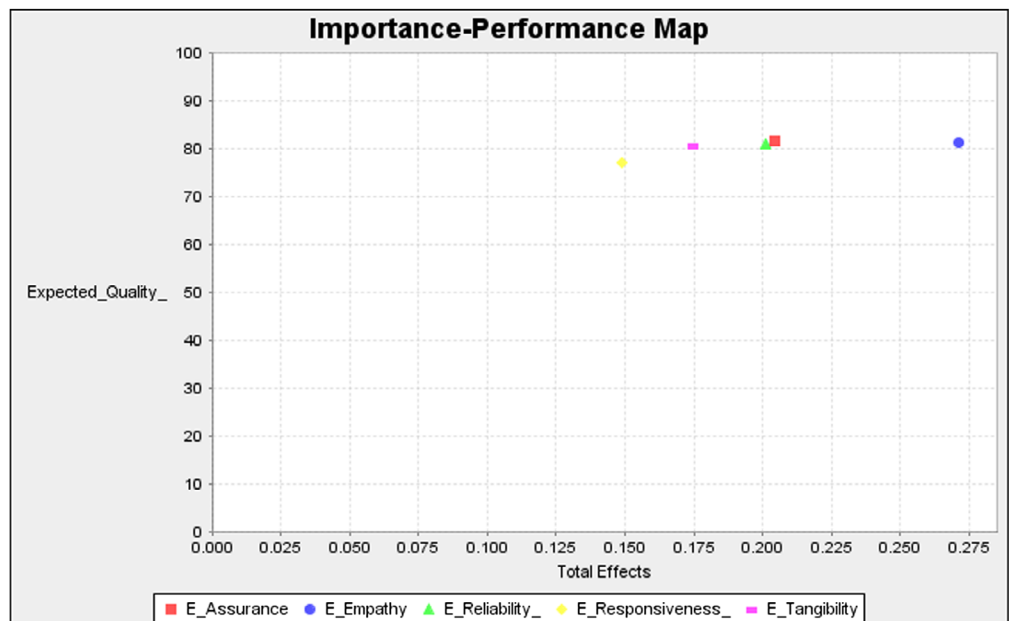


Table 11. IPMA results of actual performance

Criterion: actual performance	Total effect	Performances
E_Assurance	0.000	81.722
E_Empathy	0.000	81.323
E_Reliability	0.000	81.140
E_Responsiveness	0.000	77.111
E_Tangibility	0.000	80.412
Expected_Quality	-0.002	80.589
P_Assurance	0.217	67.696
P_Empathy	0.253	71.122
P_Reliability	0.213	79.360
P_Responsiveness	0.157	66.913
P_Tangibility	0.161	60.577

Figure 4. IPMA results of actual performance.

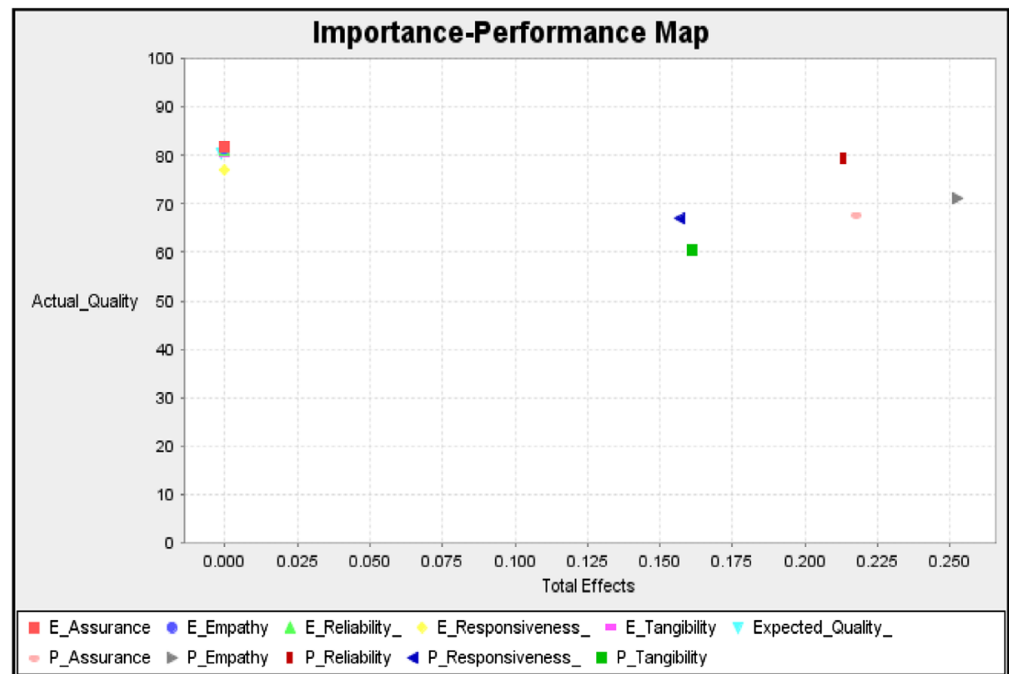


Figure 4 also shows the same output of the IPMA, where reliability has the highest performance followed by empathy, assurance, and responsiveness. However, the lowest performer is the tangibility. So, these low performing, but important indicators have room for improvements.

13.3. IPMA results for satisfaction

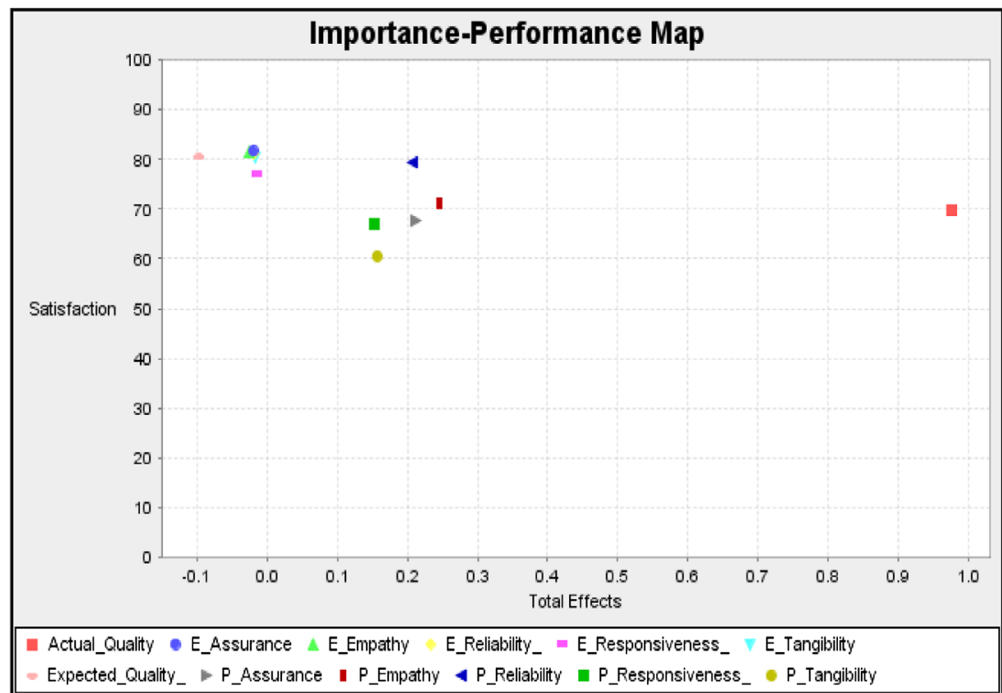
IPMA results for satisfaction in Table 12 and Figure 5 shows that indicators for expectation on quality (performance \approx 0.80) perform better than the indicators of the perception of actual quality (performance \approx 0.70). However, expectation of quality has no importance effect on satisfaction.

Table 12. IPMA results of satisfaction

Criterion: satisfaction	Total Effect*	Performances
Expected_Quality	-0.097	80.589
E_Assurance	-0.020	81.722
E_Empathy	-0.026	81.323
E_Reliability	-0.019	81.140
E_Responsiveness	-0.014	77.111
E_Tangibility	-0.017	80.412
Actual_Quality	0.975	69.690
P_Assurance	0.212	67.696
P_Empathy	0.246	71.122
P_Reliability	0.208	79.360
P_Responsiveness	0.153	66.913
P_Tangibility	0.157	60.577

*Negative signs are not significantly different from zero for total effect (Schloderer et al., 2014).

Figure 5. IPMA results of satisfaction.



As a second-order construct, perception of actual quality has the almost perfect total effect (0.975) on customer satisfaction. The effect of the indicator of perception of actual quality can be grouped into three. The highest important indicator is the empathy, followed by assurance and reliability. The last groups of important items are responsiveness and tangibility.

The reliability indicator is already performing well and at the level of customer expectation. However, there is room for improvement for tangibility, responsiveness, assurance, and empathy to meet the expectation of the customers.

14. Discussion on the findings

In this study, we augmented and extended the original SERVQUAL model termed it as SERVQUAL-Butterfly Model. In the SERVQUAL-Butterfly Model, we claimed that customers' expectation of a service quality is formed before receiving the actual service and it influences the perception of actual service quality. These prior expectations and perception of actual service quality affect customer satisfaction, and satisfaction ultimately influences customer loyalty.

Analyzing DESCO data with our SERVQUAL-Butterfly Model, we have identified four noteworthy outcomes. Firstly, the expectation of service quality significantly influences the perception of actual service quality that conforms with the study of the original SERVQUAL model developer Parasuraman et al. (1985, 1988) including Robledo (2001). Secondly, the expectation of service quality did not have any significant direct influence on customer satisfaction. Thirdly, the perception of actual service quality had a significant influence on customer satisfaction that also conforms with previous studies (Albarq, 2013; Cronin & Taylor, 1992; Iacobucci, Grayson, & Ostrom, 1994; Jun, Yang, & Kim, 2004; Wolfinbarger & Gilly, 2003). Lastly, we have also found customer satisfaction has a strong and significant influence on customer loyalty that conforms with the previous studies (Ahmad & Al-Zu'bi, 2011; Albarq, 2013; Bodet, 2008; Gerpott et al., 2001; Govindan, Shankar, & Kannan, 2016).

IPMA analysis of DESCO data shows the management of DESCO was able to generate a higher expectation of service quality among the DESCO customers. All of the indicators of customer expectation showed superior performance, however, for expectation empathy found to have single most importance for expectation formulation. Assurance and reliability of the service have the next level of importance and lastly tangibility and responsiveness. However, indicators of expectation and expectation as a whole did not found to have an important role in generating the perception of actual quality.

The reason may be that expectation of service quality formed a benchmark of service quality (evident in performance), but the perception of actual quality performance only formulates when customers encounter actual service, and hence actual service quality variables found to be important elements in forming perception of actual quality performance. Like expectation of service quality, empathy is also the most important factor that influence actual perception followed by assurance and empathy. However, unlike expectation of service quality, tangibility found to have more importance than responsiveness in the formulation of perception of actual service.

Like perception of actual quality performance, expectation did not found to have important role in satisfaction. Perception of actual quality performance found to be the single most important factor for customer satisfaction of DESCO online bill payment system. Again, empathy found to have more influence on customer satisfaction. Moreover, customer satisfaction found to significantly influence the customer loyalty of DESCO online bill payment system. The more the satisfaction, the more the customer will be loyal to the system.

Customers no more need to travel to the billing counter, wait in the long queue in front of service desk, etc. The convenience and time saving could be a good reason why customers are satisfied with the system and seem loyal to it.

15. Managerial implications

From the managerial point of view, our research suggests some guidelines to the decision-making authorities of the DESCO online bill payment system about how to improve the overall quality of the system regarding reliability, assurance, empathy, tangibility, and responsiveness. These elements reinforce perceived quality of the service and consequently help to increase customers' satisfaction with the service and later make them loyal to the system.

- Customer expectation influences the perception of experience. Customer expectation management is an essential issue for service providers to design proper customer experiences in future. Empathy is the key items with which the management could manipulate the expectation level of the customers.
- In the case of actual quality perception, only reliability seemed to achieve the expected performance level compared with the expectation indicators. Empathy, assurance, responsiveness indicators are close to expected level performance but need improvement.
- Regarding importance, management should concentrate first on empathy to give the vibe to the customers that DESCO genuinely cares for their customers. DESCO can increase empathy by the following ways:
- Creating videos tutorials on bill payment procedure and upload to their and other popular websites such as Youtube and Facebook to lessen customer frustration and confusion regarding the procedure.
- Introducing mobile apps to execute the bill payment process easily, making the system more user-friendly.
- Adding other banks and different plastic cards (VISA, Mastercard, Nexus, etc.) under the DESCO's online bill payment systems.
- Creating an exclusive and effective customer care helpline for online bill payment systems.
- DESCO needs to assure that their system is dependable and safe and highly responsive. As time passes by, the systems need to be upgraded with the state-of-art technology. Data security should be maintained by Norton's SSL certificate. The optical fiber connection in each of the bank's server can also provide sufficient physical security, avoid data hack and responsiveness. Furthermore, a password oriented log in system can be implemented in the system instead of the account number login, which is quite a weak point in this regard, to instill trust in the users regarding the security of the system.
- For tangibility, we recommend to change the design and appearance of the website can greatly uplift the satisfaction of the average users regarding the system. Since majority of the users are young, DESCO should employ young and creative people in the development of a new futuristic looking website to fulfill the user's expectation.

16. Theoretical implication

Our study has the following unique theoretical implications.

First, this study extends SERVQUAL model and develops a modified model named as SERVQUAL-Butterfly Model. With the extension and methodological changes, this study demonstrated that using PLS-SEM second-order hierarchical approach; we can still have all the benefits of SERVQUAL model while reducing the previous limitations of this model. Moreover, we were able to incorporate satisfaction and loyalty dimensions, which are the ultimate output of service quality assessment.

The second unique finding is that our study proved that expectation on service quality has no significant effect on the customer satisfaction. It merely forms a basis for the perception of actual service quality.

Third, we also showed that using IPMA with our model could specifically identify the areas of improvement, which was also the primary goal of using SERVQUAL.

17. Future research direction

Future researchers can use this model for further augmentation with other variables and methodologies that suit different context in cross-industry and cross-country environment. Researchers may incorporate moderating effects and mediating effects in this model for further augmentations.

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Appendix 1

Exploratory factor analysis for Harman's single-factor test.

Total variance explained						
Factor	Initial Eigenvalues			Extraction sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	17.486	48.572	48.572	16.781	46.613	46.613
2	4.231	11.752	60.323			
3	2.061	5.726	66.049			
4	1.491	4.141	70.190			
5	1.061	2.948	73.138			
6	0.758	2.107	75.245			
7	0.642	1.783	77.027			
8	0.607	1.687	78.715			
9	0.566	1.573	80.288			
10	0.519	1.440	81.728			
11	0.479	1.331	83.059			
12	0.451	1.253	84.313			
13	0.418	1.160	85.473			
14	0.387	1.076	86.548			
15	0.365	1.013	87.562			
16	0.352	0.978	88.540			
17	0.336	0.932	89.472			
18	0.309	0.859	90.331			
19	0.301	0.837	91.169			
20	0.280	0.778	91.947			
21	0.269	0.748	92.695			
22	0.250	0.694	93.390			
23	0.237	0.660	94.049			
24	0.220	0.611	94.661			
25	0.215	0.597	95.258			
26	0.210	0.584	95.842			
27	0.208	0.577	96.419			
28	0.192	0.534	96.953			
29	0.180	0.500	97.453			
30	0.169	0.470	97.923			
31	0.160	0.446	98.368			
32	0.138	0.384	98.753			
33	0.124	0.343	99.096			
34	0.118	0.327	99.424			
35	0.105	0.292	99.716			
36	0.102	0.284	100.000			

Note: Extraction Method: Maximum Likelihood.



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