Analysis of Customer Satisfaction and Internet Service Quality During the Covid 19 Pandemic in Sri Lanka

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Abstract

The tracking of Service Quality is an important consideration for a business as customers may go with an alternative service provider if they are dissatisfied with the standard. In particular we look at Internet Service Providers (ISP) and research the impact of Internet Service Quality (ISQ) on Customer Satisfaction. The prevailing COVID-19 situation in Sri Lanka reveals the importance of this study as government rules and regulations have been imposed to promote work from home, online learning and online entertainment. Previous studies have looked at the influence of ISQ on Customer Satisfaction in other countries – however to the best of our knowledge, no such evaluation has been done in Sri Lanka. Furthermore, in the context of COVID-19 the existing literature is lacking. Past research identifies the following factors which impact ISQ: Tangibility, Assurance, Empathy, Reliability, Responsiveness (Eze, et al., 2008) and Price (Joudeh & Dandis, 2018). This study was carried out as a deductive study and a quantitative method was employed. Our sample included 500 respondents obtained from the convenience sampling method by distributing a questionnaire survey among university undergraduates within Sri Lanka. The findings revealed that there is a positive relationship between Internet Service Quality and Customer Satisfaction. The study was also able to extract insights for ISP managers by highlighting the aspects of ISQ which can satisfy their customer base as well as measures which could be taken with reference to the practice gaps identified.

Keywords: Service Quality, Internet Service Quality, Customer Satisfaction, Mobile Telecommunication Industry.

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Introduction

In early 2020 the COVID-19 pandemic struck and affected the very foundations of society and economic standards around the world. Countries adopted public safety policies, in particular social distancing measures. This resulted in an increase of remote work practices, online education, video calling and digital banking (Anon, 2021).

Under this "new normal" scenario, the internet infrastructure underwent tremendous pressure. On a global scale, internet traffic rose 47%, compared to expectations of 28%. Worldwide Wi-Fi traffic also increased the loading of computers (PC) to cloud computing, while Internet traffic (IXP) in the Asia Pacific region is up 40% (Anon, 2021). Video call platforms experienced 80% growth overall with the video calling facility on Facebook experienced 100% growth. Netflix had 16 million new users. (Anon., 2021) This upsurge in traffic has brought doubt about the network's capacity and reliability. This study is carried out to understand the service quality of Internet service providers during the pandemic situation.

Past research indicates that service quality is the main function of gaining a competitive benefit and is an important factor of success for any modern service-based business (Dharmadasa & Gunawardane, 2017). There is a large body of literature on service quality measurement with applications to the finance, education, aviation, hotel and restaurant sectors. Customer satisfaction, service excellence and loyalty are among the most significant factors in affecting the retention rate, profitability and efficiency of the entire organization with research indicating a positive relationship between the variables (Parasuraman, et al., 1988).

The most well-known Quality of Service (QoS) model is the SERVQUAL model (Parasuraman, et al., 1988) expanding on their previous work (Parasuraman, et al., 1985). The original QoS mode consisted of ten service attribute dimensions (dependability, responsiveness, capability, politeness, communication, credibility, access, safety, and comprehension/ understanding customers and tangible assets). Using factor analysis, this was then reduced to five dimensions (Parasuraman, et al., 1988):

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- Tangibles: physical facilities, appearance of personnel, equipment.
- Reliability: capacity to provide the assured service reliably, accurately and dependably.
- Responsiveness: ability to serve customers and deliver prompt service
- Assurance: employees' knowledge and politeness and their capacity to inspire trust and confidence.
- Empathy: ability of the company to provide thoughtful and customized attention to its customers.

Research Problem
Empirical and Practice Gap

Internet service providers in Sri Lanka try to merge with other service providers, for example Etisalat and Hutchison (Dharmadasa & Gunawardane, 2017). In addition, internet services are integrated within the Mobile Telecommunications Industry (MTI).

There are considerable amounts of studies done worldwide on measuring service excellence of Internet Service providers with regards to customer satisfaction. There have been a few studies conducted on Internet service excellence and its impact on customer satisfaction in Sri Lanka for different service sectors like Hotels, Banking, Education institutes etc. To the best of our knowledge, there are no studies found in this area which specifically address the ISP QoS in the context of the COVID-19 situation, whereby the online behavior and usage of has increased drastically (Anon., 2021). In addition, research on ISP QoS in other countries is not applicable in the Sri Lankan context due to differences in ISP framework and practices in other countries (HaslynNausha & MohdFaiz, 2014).

Research Objectives

This paper attempts to address the impact of Internet Service Quality (ISQ) on customer satisfaction in the Sri Lankan MTI. We use the framework of the SERVQUAL model (Parasuraman, et al., 1988) and the dimensions relevant to ISQ as identified in (Eze, et al., 2008). In particular the relevant dimensions are Tangibility, Reliability,

Responsiveness, Assurance, Empathy indicators (Eze, et al., 2008) and additionally we employ the indicators of Price and Satisfaction (Joudeh & Dandis, 2018). We examine a) the impact of the five individual dimensions in the SERVQUAL model on customer satisfaction and b) the impact of prices on customer satisfaction.

Methodology

The sample for this study was obtained via the convenience sampling technique. The sample consisted of 505 university undergraduates from both state and private universities distributed throughout the 24 districts in Sri Lanka. Google questionnaires were distributed via an online platform to obtain primary data. We included a section in the questionnaire to identify

demographic details of the respondent. The remaining questions corresponded to each of the independent variables (the five dimensions of the SERVQUAL model and Price) with each variable having 4-5 questions for a total of 27 questions. The questions for the dependent variable, Customer satisfaction, consisted of 4 questions. All of these were measured via a five-point Likert Scale ranging from 1 to 5 where 1 corresponds to 'Strongly Disagree' and 5 corresponds to 'Strongly Agree'.

Table 1: Sample Survey Questions

Dimension	Indicators
Responsiveness	My ISP employees express customers precisely when services will be performed.
	Customer representatives at my ISP give quick service to customers.
	Customer representatives at my ISP are continuously willing to help customers
	Customer representatives of my ISP are not ever too busy to respond to customers' requests.

Source: Survey questions excerpted from Joudeh & Dandis (2018).

SPSS and Python was used for the data analysis. Data cleaning consisted of identifying both extreme values and missing values. These were subsequently removed for the purposes of the study. To analyze the relationships between the independent variables and customer satisfaction, we employed two different approaches: linear regression analysis and the random forest technique. Multiple linear regression analysis was selected as an appropriate model for analyzing the Likert data following the approach in (Harpe, 2015). All variables (six independent variables and the target variable) were prepared by taking the questions corresponding to the particular variable and averaging the score of the responses. This would give the final score for that variable which is the input into the regression model.

Random Forest was carried out using the scikit-learn Python library and the corresponding RandomForestClassifier algorithm (S. Madeh Piryonesi & El-Diraby, 2020; Piryonesi, et al., 2021). The first step was to normalize the feature (independent) and target variables to a score ranging between 0 and 1. We constructed a new binary target variable by taking the normalized final satisfaction target variable and defining scores between 0 and 0.5 as unsatisfied and those between 0.5 and 1 as satisfied. We seek to use the random forest technique to correctly identify whether a respondent is satisfied (unsatisfied) given the features. As per standard practices in machine learning, the dataset was split into 70%-30% for the training and test datasets respectively. We also carry out parameter tuning (Aznar, 2020) to optimize the results of the random forest via the built in GridSearchCV( ) function.

The performance of the random forest is evaluated using the confusion matrix technique along with associated metrics such as Cohen's Kappa and the AUC (ROC) score (Fawcett, 2005). These are obtained using the Python functions confusion_matrix( ), cohen_kappa_score( ), roc_auc_score( ) respectively. We also use the in-built functions to analyze the importance of the features.

Results and Discussion

We begin this section with a brief overview of the descriptive statistics. Of the 505 respondents to the survey, the gender break up was 63.8% female and 36.2% male. According to the collected data, the majority

(67.3%) of respondents were in the age range of 21 – 25 years. Gampaha was the most represented district (25%) and the Western Province was the most represented province (46.1%). For the types of internet connection, the majority (58.4%) of respondents were using wireless router connections, followed by 14.9% of respondents using ADSL cable connections.

Multiple Regression Analysis for 6 Dimensions

Table 2. Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.849[a]	0.721	0.718	0.66241

Note: [a] Predictors: (Constant), Final Price, Final Tangibility, Final Responsiveness, Final Empathy, Final Reliability, Final Assurance.

Our regression model fits a linear relationship between the final Customer Satisfaction score and the independent variable scores corresponding to Tangibility, Reliability, Responsiveness, Assurance, Empathy, and Price.

$$E(Y \mid X) = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6$$

Y = Customer Satisfaction
X_1 = Tangibility
X_2 = Reliability
X_3 = Responsiveness
X_4 = Assurance
X_5 = Empathy
X_6 = Price

We interpret our regression model as being a good fit. The R-squared coefficient of determination indicates that our model accounts for 72.1% of the variation of the final Customer Satisfaction score. In addition, the Standard Error of our model indicates that 95% of the model predicted scores are within ±0.662 of the actual final Satisfaction score. According to ANOVA the F value is 214.979 thereby validating

overall model as statistically significant.

Table 3: ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	565.974	6	94.329	214.98	.000[b]
Residual	218.514	498	0.439		
Total	784.488	504			

Note: [a]. Dependent Variable: FinalSatisfaction.
[b.] Predictors: (Constant), FinalPrice, FinalTangibility, FinalResponsiveness, FinalEmpathy, FinalReliability, FinalAssurance.

Table 4: Coefficients

Model	Unstandardized Coefficients		Standardize d Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-0.052	0.096		-0.537	0.59
Final Tangibility	-0.003	0.043	-0.002	-0.064	0.95
Final Reliability	0.192	0.047	0.186	4.068	0
Final Responsiveness	0.093	0.045	0.089	2.07	0.04
Final Assurance	0.155	0.05	0.148	3.075	0
Final Empathy	0.275	0.046	0.265	6.047	0
Final Price	0.283	0.04	0.269	7.096	0

Note: Dependent Variable: Final Satisfaction.

Apart from Tangibility, all variable coefficients are significant at the 5% significance level. At the 1% significance level, Responsiveness would also drop out. The coefficients (corresponding to β-coefficients in the model equation) represent the expected change in the Customer Satisfaction score given a change in the corresponding dimension (and keep all other dimension scores fixed).

Random Forest Analysis
GridSearchCV was used for parameter tuning to identify the best estimator values for the parameters. This is illustrated in the below table.

Table 5: Best Optimal Parameters according to GridSearchCV

No	Parameter Name	Best Estimator
1	n_estimators	20
2	max_depth	7
3	max_features	auto
4	min_samples_leaf	4
5	criterion	entropy

The overall performance of the random forest classifier is given by the confusion matrix below and summarized by the accuracy score of 90.13%. The other relevant model performance metrics include a sensitivity score of 85%, a specificity score of 92%, kappa score of 77%. and AUC (ROC) score of 88%. We can conclude that the random forest model predictions have substantial agreement level.

**Figure 1: Confusion matrix**

Source: Authors' demonstration.

Feature Importance
The random forest technique can also be used to identify which features help the algorithm make the correct prediction, i.e. which variables are most discriminating between classes. Feature importance

may be used to engineer more features by starting with the most important.

In our case we use the Mean Decrease in Impurity (MDI) score where the greater the value, the more significant the feature.

Figure 2: Feature Importance
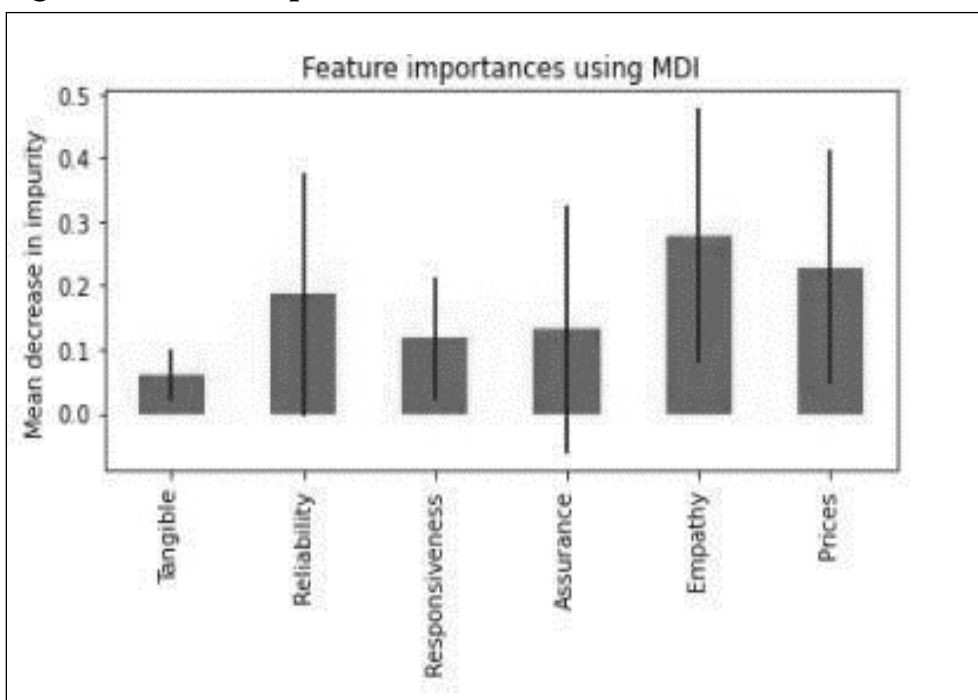
Source: Authors' demonstration.

The plot above illustrates the most relevant feature as "Empathy" which scores 0.27. Price and Reliability follow in terms of feature importance.

Conclusion

This research focused on the Impact of Internet Service Quality on Customer Satisfaction during the COVID-19 Pandemic in Sri Lanka. From our literature review we established that past research identifies the following factors which impact ISQ: Tangibility, Assurance, Empathy, Reliability, Responsiveness (Eze, et al., 2008) and Price (Joudeh & Dandis, 2018). In turn the five factors (dimensions) - Tangibility, Assurance, Empathy, Reliability, and Responsiveness -

were identified in the SERVQUAL model (Parasuraman, etal., 1988). This was a refinement of an earlier model by the same author (Parasuraman, et al., 1985). Our study focused on the impact of ISQ on Customer Satisfaction by examining the impact of the six individual components of ISQ – i.e., the five dimensions and Price. We analyzed this via two quantitative models – a) multiple linear regression and b) Random Forest technique.

The regression model statistics indicated a good overall fit. In addition, apart from the Tangibility factor, all other variables were deemed significant. In particular, there is a positive significant relationship between reliability, responsiveness, assurance, empathy and the dependent variable customer satisfaction.

Based on this dataset we have come to a conclusion that customers are not concerned about the Tangibility aspect in contrast with the study has done on ISQ conducted by (Eze, et al., 2008). We were unable to find any empirical evidence on excluding the Tangibility factor from our quantitative regression model. We propose that this factor should be examined further with a larger sample and also using qualitative analysis in order to understand any implicit relationship between the tangibility factor and customer satisfaction. Furthermore, our modification of the SERVQUAL model with the addition of the Price dimension was successful as the model indicated a significant positive relationship of the variable with Customer Satisfaction. It would therefore make sense to include this as an explanatory variable in future studies as well.

The performance metrics for the Random Forest technique indicated a good predictive capability – i.e. the model was able to predict with high degree of accuracy whether a respondent was satisfied or not based on the scores corresponding to the independent variables. Empathy, Prices and Reliability are the features deemed important to the classifier – i.e. these variables are the most significant in helping the random forest algorithm the appropriate binary satisfaction class.

Further ideas for future research stemming from this study include the use of different dependent variables such as brand loyalty, brand evangelism etc. As the telecommunication sector has not been studied thoroughly in Sri Lanka (Dharmadasa & Gunawardhana, 2017), future

research can be expanded to broader aspects of ISP while incorporating studies such as ours which are focused on Customer Satisfaction and ISQ to give a complete picture.

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