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A Hierarchical Model of Service Quality in the Prepaid Mobile Telecommunications Industry

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Abstract

This research models the service quality in the prepaid mobile services given by the telecommunications industry in the Philippines. The study is divided into four phases: (1) identification of an initial set of quality variables; (2) pilot testing with 30 respondents and gathering of 321 responses during the full-scale survey; (3) exploratory and confirmatory factor analyses; and, (4) statistical analyses concluding that the model established uni-dimensionality, reliability, and convergent and discriminant validity. The output model defines the prepaid mobile telecommunications service quality. It has three (3) primary dimensions: Interaction, Environment, Outcome; thirteen (13) factors, and thirty-six (36) variables.

Keywords: Philippine telecommunication industry, service quality and management, structural equation modeling, factor analysis

Introduction

A literature search on service quality models for the mobile service industry in the Philippines has not yielded any result. Elsewhere though, there are six quality models specifically developed for the mobile service industry. These are Eshghi Model (Eshgi, Roy, and Ganguli 2008), MBS-Quality (Lu, Zhang, and Wang 2009), MS-Qual (Hosseini, Zadeh, and Bideh 2013), Ozer Model (Ozer, Argan, and Argan 2013), M-Service Quality (Stiakakis and Petridis 2014), and M-S-Qual (Huang, Lin, and Fan 2015). However, these models are deemed not applicable to the Philippine mobile telecommunications industry for several reasons. First, the models presented above were developed using postpaid users as respondents while the Filipino mobile users are mostly prepaid users. As of December 2015, it is reported that 96% of the Filipino users are prepaid subscribers (Intelligence, 2014). Second, the models were developed from other countries which have cultures different from the Filipinos'. Cultural differences among countries affect customers' perception and expectation of quality. Nguyen, Cao and Phan (2015) stated that people with different cultural values evaluate service quality diversely. Furrer, Liu, and Sudharshan (2000) also proved that the relative importance of service quality dimension vary from one culture to another. These studies support the argument of Hosseini, Zadeh, and Bideh (2013) that a specific model that is developed for a specific country may not be applicable to other countries because of differences in cultural context. Finally, another big difference to highlight is the Filipino's unique economic environment, which affects their spending pattern, price sensitivity, and daily priorities especially in availing the services provided by the telecommunication companies. This much is evidenced by the fact that majority of Filipino users are prepaid subscribers.

Problem & Solution

The Philippine Telecommunications Industry (PTI) lacks an assessment tool that measures the quality of services provided by telecommunication companies. Primary data gathered shows that the PTI does not have a current assessment tool for service quality. What PTI has are feedback questionnaires asking how satisfied their customers are. Moreover, PTI only has customer service hotlines to address issues or problems or complaints. Hence, a model that would represent the prepaid mobile telecommunications quality must first be developed to serve as foundation for the tool that will be used to measure the quality of mobile telecommunications services. Conforming the products and services according to consumers' wants and needs would definitely strengthen a company's competitive advantage. Thus, there is a need to create a model that is specifically developed for the assessment of service quality in the Philippine prepaid mobile telecommunications industry.

Exploratory Analysis

Item Generation

From the existing six models reviewed, items were consolidated which resulted in an initial set of 68 quality variables. A similar approach was conducted by Wu and Cheng (2013) in developing a service quality model for the airline industry. Hosseini, Zadeh, and Bideh (2013) also conducted a similar approach in generating items, whereby variables were consolidated from four existing models.

Survey Questionnaire Development

The items from the initial scale model were used to develop the questionnaire that would later be used in the pilot test and full scale survey. The pilot test questionnaire has three parts. The first part states a brief description about the survey; the second part asks for some personal information about the respondent such as name, age and gender; and, the last part, which is the survey proper, asks the respondent to rate the importance of each item using a five-point Likert scale.

Expert Panel Consultation

The questionnaire was subjected to expert panel consultation. This was conducted to ask for inputs regarding the initial 68 variables and to content-validate the initial questionnaire. A similar approach was conducted by Isip and Li (2017). The first member of the panel is a 44-year old Certified Public Accountant who currently works in an automobile company. He previously worked for two and a half years in a telecommunications company as part of the Product and Service Labeling Team. The second member is a 40-year old Registered Electronics and Communications Engineer. She is currently a faculty member in a known university. She has been teaching for ten years in the university's engineering department. The last member is a 25-year old Development Communications graduate. She currently works as a researcher in the Department of Science and Technology (DOST). She was previously exposed to a similar study as part of her work.

Data

Pilot Testing

The initial scale was tested to thirty (30) mobile telecommunications service users and yielded a Cronbach alpha of 0.96, which is above the threshold of 0.7. This implies that the initial scale is reliable enough for the study to proceed to a full scale survey. The pilot test approach is also used by several researchers in developing industry-specific models (Hosseini, Zadeh, & Bideh, 2013; Isip & Li 2017; Lau et al., 2013; and Wu and Cheng, 2013).

Full Scale Survey

Both online and physical surveys were conducted in this study. Upon combining the responses from online and physical surveys, a total of 321 responses were gathered, wherein 270 responses were from physical surveys and 51 responses were from online surveys. From a

Table 1. Descriptive data of the sample population (sex, age, region)

Sex	Count	%	Age	Count	%	Region	Count	%
Female	135	57.94	<16	0	0	III	27	8.41
			16-18	108	33.64	IV	219	68.22
Male	186	42.06	19-24	178	55.45	NCR	58	18.06
			25-32	35	10.90	Others	20	5.30

Table 2. Descriptive data of the sample population (years of use and provider)

Years of Use	Count	%	Provider	Count	%
1	2	0.62	Globe	112	34.89
2-4	31	9.66	TM	87	27.10
5-7	90	28.04	Sun	41	12.77
>8	198	61.68	Smart	81	25.23

total of 321 responses gathered in the full-scale survey, a total of 314 usable responses remained after data screening. Descriptive statistics of the sample population are summarized as shown in Table 1 and Table 2. More female respondents participated in the survey, with 57.94% females and 42.06% males. Moreover, it is shown in the table that the bulk of the respondents are aged 19-24 years old, which is 55.45% of the total respondents. Lastly, Table 1 shows that most respondents are from Region IV and NCR, with 68.22%, and 18.06%, respectively.

Table 2 shows distribution of the respondents according to the number of years that they have been using mobile services. Majority, or 61.68%, are users for more than 8 years, while 28.04%, for 5-7 years.

Sampling Adequacy Test

To determine if the number of responses gathered were adequate, the Kaiser-Meyer-Olkin (KMO) Test was conducted using the Stata 12® Software, and yielded a KMO value of 0.7870. This implies that the sample data is fit for Factor Analysis, as the KMO Test is the measure of how suited the gathered data is for factor analysis. Field (2013) pointed out that a KMO value that is close to one (1) indicates that the patterns of correlations in the data are relatively compact that factor analysis should therefore result in distinct and reliable factors. Moreover, Kaiser (1974) suggested that KMO values greater than 0.5 (KMO > 0.5) are already acceptable. If values were below 0.5, more data should be collected.

Factor Analysis

Exploratory Factor Analysis

A series of Exploratory Factor Analyses (EFA) was conducted which served the following purposes: (1) to purify the scale through the removal of insignificant items (quality variables) in the model, and (2) to identify the key factors (quality dimension) in mobile telecommunications service industry. Quality dimensions were formed when the significant quality variables are grouped together to form a construct upon conducting exploratory factor analysis.

The Principal Factor with Orthogonal Varimax Rotation using Stata 12 was performed as an Exploratory Factor Analysis method, having been used by numerous researchers in developing other industry-specific models (Huang, Lin, & Fan, 2015; Lau et al., 2013; and Wu & Cheng 2013). Also, factors with eigenvalues > 1 were retained. The pattern matrix of the EFA using Stata 12 shows identified 14 factors. However, one factor is omitted due to poor loading, thus 13 factors and 54 variables remained. The results are shown in Table 3. The resulting model from the EFA provided a "conceptual" or "a priori"

model which will be further tested for validity through confirmatory factor analysis (CFA).

Table 3. Factors names resulting from the EFA

FACTOR	NAME
1	Billing System
2	Entertainment
3	Customer Service
4	Information
5	Network Quality
6	Privacy
7	Context
8	Satisfaction
9	Availability
10	Convenience
11	Efficiency
12	Reliability
13	Tangibles

Grouping of Factors

In order to identify which factors belong to which primary grouping, another exploratory analysis was conducted. However, in this step, the remaining 54 variables were further grouped into three, which will be termed in this study as "dimension."

Efficiency (EF), Availability (AV), Billing System (BS), and Privacy (PR) were grouped in Dimension 1. This dimension was assumed to be Environment Quality. It is also shown that Customer Service (CS), Context (CX), Convenience (CV), Network Quality (NQ), Reliability (RE), and Satisfaction (ST) were grouped in Dimension 2. This dimension was assumed to be Interaction Quality. And lastly, Information (IN), Tangibles (TN), and Entertainment (EN) were grouped in Dimension 3. This dimension was assumed to be Outcome Quality.

Figure 1 presents the a priori model with three primary dimensions, 13 factors and 54 variables that resulted from the exploratory factor analyses.

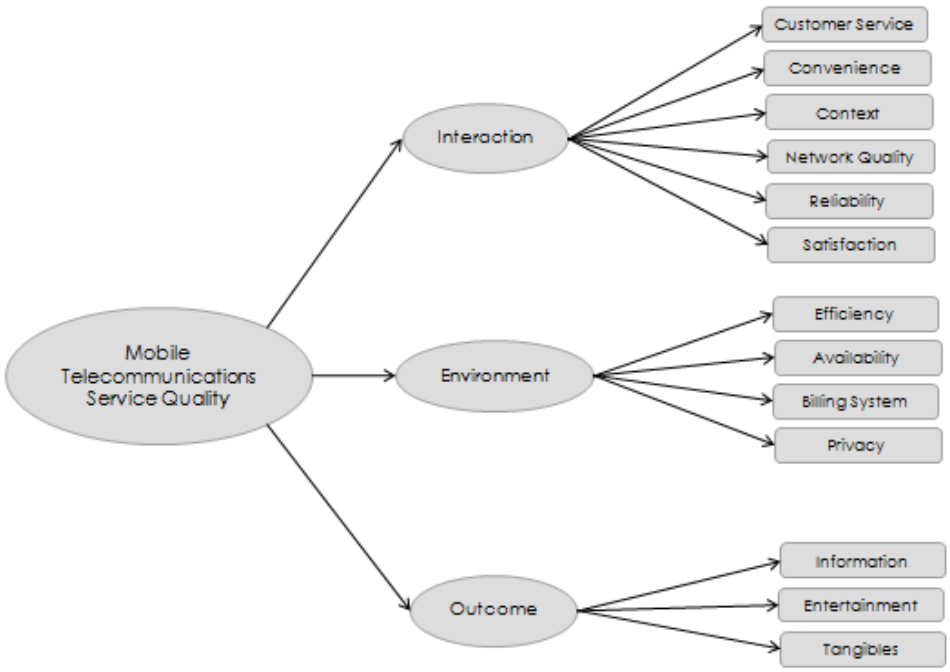

Figure 1. A priori model of the study

Confirmatory Factor Analysis

The Confirmatory Factor Analysis (CFA) was also conducted. It is a common practice in hierarchical models to evaluate the primary dimensions first before evaluating the whole model. In this study, the "a priori" or "conceptual" model used for the CFA was the resulting model from the Exploratory Factor Analysis (EFA). The confirmatory factor analysis was done through the Structural Equation Modeling technique just like the methodology conducted by Isip and Li (2017) and Wu and Cheng (2013) in their studies creating a hierarchical model of service quality. In this case, Interaction Quality, Outcome Quality and Environment Quality were evaluated separately.

Interaction Quality

From the Exploratory Factor Analysis (EFA), it was identified that the Interaction Quality dimension is composed of six factors: Customer Service, Satisfaction, Context, Convenience, Network Quality and Reliability. After four (4) runs for Interaction Quality, the final outcome is presented in Figure 2. Table 4 shows the ratio between chi-square and degrees of freedom RMSEA, both CFI and TFI, and SRMR values are within the bounds/thresholds. It can be concluded that the Interaction Quality Dimension has good model fit. This implies that the dimension establishes uni-dimensionality.

Environment Quality

The Environment Quality Dimension has four factors: Efficiency, Availability, Billing System and Privacy. The second run provided the model with estimates within the bounds. Figure 3 shows that all the standard estimates are greater than 0.7, indicating a good fit. Table 5 shows that the RMSEA, CFI, TLI and SRMR values are within their respective thresholds with values equal to 0.083, 0.949, 0.932 and 0.049, respectively. As all the indices are within their

Table 4. Model fit test of the Interaction Quality Dimension

Fit statistic	Value	Description
Likelihood ratio		
chi2_ms(75)	282.838	model vs. saturated
p > chi2	0.000	
chi2_bs(105)	2973.306	baseline vs. saturated
p > chi2	0.000	
Population error		
RMSEA	0.094	Root mean squared error of approximation
90% CI, lower bound	0.082	
upper bound	0.106	
pclose	0.000	Probability RMSEA <= 0.05
Information criteria		
AIC	7300.201	Akaike's information criterion
BIC	7525.164	Bayesian information criterion
Baseline comparison		
CFI	0.928	Comparative fit index
TLI	0.900	Tucker-Lewis index
Size of residuals		
SRMR	0.046	Standardized root mean squared residual
CD	1.000	Coefficient of determination

Table 5. Model fit test of the Environment Quality Dimension

Fit statistic	Value	Description
Likelihood ratio		
chi2_ms(59)	187.654	model vs. saturated
p > chi2	0.000	
chi2_bs(78)	2587.036	baseline vs. saturated
p > chi2	0.000	
Population error		
RMSEA	0.083	Root mean squared error of approximation
90% CI, lower bound	0.070	
upper bound	0.097	
pclose	0.000	Probability RMSEA <= 0.05
Information criteria		
AIC	5536.632	Akaike's information criterion
BIC	5705.355	Bayesian information criterion
Baseline comparison		
CFI	0.949	Comparative fit index
TLI	0.932	Tucker-Lewis index
Size of residuals		
SRMR	0.049	Standardized root mean squared residual
CD	1.000	Coefficient of determination

Table 6. Model fit test of the Outcome Quality Dimension

Fit statistic	Value	Description
Likelihood ratio		
chi2_ms(17)	21.012	model vs. saturated
p > chi2	0.226	
chi2_bs(28)	1702.293	baseline vs. saturated
p > chi2	0.000	
Population error		
RMSEA	0.027	Root mean squared error of approximation
90% CI, lower bound	0.000	
upper bound	0.061	
pclose	0.844	Probability RMSEA <= 0.05
Information criteria		
AIC	4677.103	Akaike's information criterion
BIC	4778.336	Bayesian information criterion
Baseline comparison		
CFI	0.998	Comparative fit index
TLI	0.996	Tucker-Lewis index
Size of residuals		
SRMR	0.013	Standardized root mean squared residual
CD	0.999	Coefficient of determination

respective thresholds, it can be concluded that the Environment Quality dimension has good model fit. Therefore, it is safe to conclude that the current model represents well the Environment Quality Dimension.

Outcome Quality

The exploratory factor analysis identified that the Outcome Quality Dimension has three factors: Tangibles, Entertainment and Information; see Figure 4. After two runs, the chi-square-degrees of freedom ratio is 1.236, which is less than the threshold value of 5. RMSEA, CFI, TLI and SRMR values are all within their respective thresholds with values 0.027, 0.998, 0.996 and 0.013, respectively (Table 6). This indicates the model represents well the Outcome Quality Dimension.

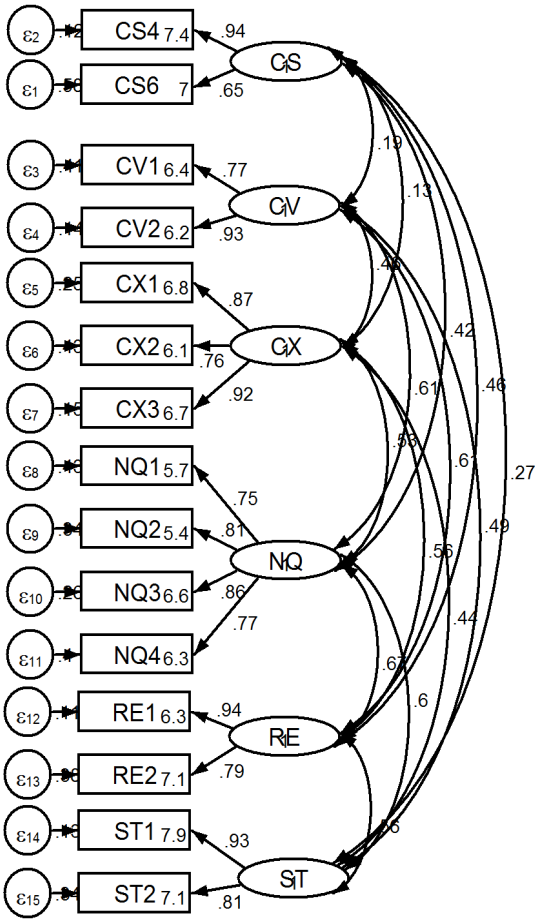

Figure 2. Interaction quality dimension (Run 4)

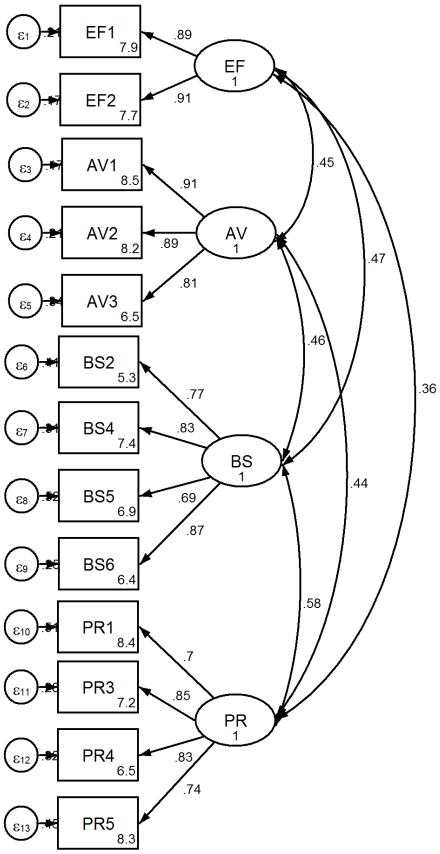

Figure 3. Environment quality dimension (Run 2)

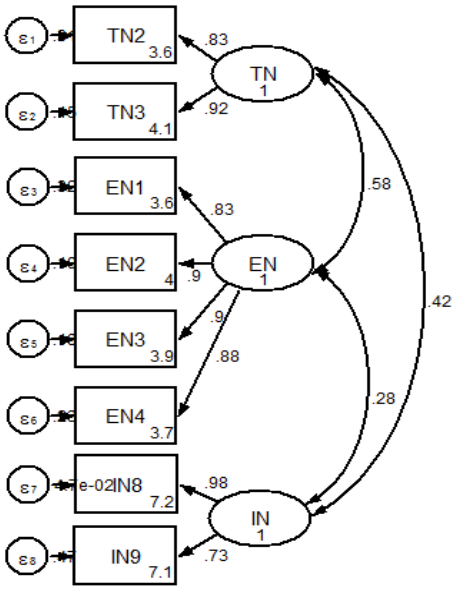

Figure 4. Outcome quality dimension (Run 2)

Unidimensionality of the Overall Model

Tests for uni-dimensionality, reliability, and validity (content and construct) were conducted. Moreover, as part of the test for uni-dimensionality, incremental and absolute fit indices were computed and compared with the threshold indices values as provided by Hooper et al. (2008).

The R Studio software was used to measure the goodness of fit of the overall model. The results of the model fit tests are presented in Table 7. All indices of the overall model are within their respective thresholds, which indicate that the overall model has good fit. This generally indicates that the overall model represents well the concept of mobile telecommunications service quality.

Table 7. Model fit test results of the overall model

Parameter	Threshold	Value
Chisquare	-	2291.652
Df	-	613
Chisquare/df	< 5.0	3.74
CFI	>=0.9	0.907
TLI	>=0.9	0.917
RMSEA	< 0.10	0.093
SRMR	<0.08	0.075

Reliability of the Overall Model

The test for reliability was done by observing the alpha value as recommended by Cronbach (1951). Table 8 shows the Cronbach alpha of each dimension and the overall model. All dimensions has a Cronbach alpha greater than 0.7, which implies good internal reliability.

Table 8. Cronbach alpha values of the overall model

FACTORS	CRONBACH ALPHA
Availability	0.902
Billing System	0.866
Context	0.884
Convenience	0.833
Customer Service	0.797
Efficiency	0.896
Entertainment	0.93
Information	0.832
Network Quality	0.874
Privacy	0.86
Reliability	0.85
Satisfaction	0.863
Tangibles	0.87
Overall	0.931

Convergent Validity of the Overall Model

Convergent validity is a measure of how correlated the variables are to form a factor (Abdullah, 2005). According to Hosseini, Zadeh, and Bideh (2013), the convergent validity could be determined through the computation of the Average Variance Extracted (AVE) and Composite Reliability (CR). Hair et al. (2010) also mentioned that the values of AVE should be greater than 0.5 while CR values must be greater than 0.7. Table 9 shows the CR values and AVE values of each factor, whereby CR values are greater than 0.7 and AVE values are greater than 0.5. Therefore, it is safe to say that the overall model has good convergent validity. This indicates that variables in a particular factor are correlated enough to represent that factor.

Table 9. CR and AVE values of each factor

FACTORS	CR	AVE
Availability	0.939	0.837
Billing System	0.909	0.715
Context	0.928	0.812
Convenience	0.923	0.857
Customer Service	0.881	0.711
Efficiency	0.951	0.906
Entertainment	0.95	0.826
Information	0.922	0.856
Network Quality	0.914	0.727
Privacy	0.905	0.705
Reliability	0.93	0.869
Satisfaction	0.936	0.879
Tangibles	0.939	0.885

Discriminant Validity of the Overall Model

Farrell and Rudd (2009) stated that CFA is not enough to validate a particular model; thus, discriminant validity should also be established. Discriminant validity can be interpreted as the degree to which a factor discriminates from other factors in the assessment tool. Discriminant validity could be tested through the Fronell and Larcker Criterion, which states that the square root of a factor's AVE must be greater than its correlation to any other factors.

The values presented in the diagonal is the square root of AVEs of each factor while the values below it and the values on its left are its correlations in each factor. As shown in Table 10, all AVEs are greater than their correlations in each factor. Therefore, discriminant validity was established. This indicates that each factor is unique from any other factor and that it represents a construct that is entirely different from any other construct.

Assessment Tool Development

The resulting model was further put into good use by translating it into a useable assessment tool, which can be used by the telecommunications companies in the Philippines for self-evaluation of the quality of services provided to their customers.

Developed Hierarchical Model and Assessment Tool

The final and confirmed overall model of the service quality is presented in Figure 5. The model will be named MTSQ Model. This was further translated into a working assessment tool (named MTQAT) that the telecommunication companies can use for self-evaluation (see Appendix A).

Table 10. Fronell and Larcker table.

	AV	BS	CX	CV	CS	EF	EN	IN	NQ	PR	RE	ST	TN
Availability	**0.915**												
Billing	0.427	**0.845**											
Context	0.314	0.265	**0.901**										
Convenience	0.242	0.262	0.39	**0.926**									
CustServ	0.173	0.29	0.134	0.248	**0.897**								
Efficiency	0.417	0.415	0.135	0.304	0.201	**0.952**							
Entertainment	0.011	0.172	0.127	0.153	0.084	0.036	**0.909**						
Information	0.199	0.309	0.394	0.251	0.297	0.241	0.243	**0.925**					
Network Quality	0.199	0.466	0.478	0.56	0.35	0.337	0.212	0.369	**0.852**				
Privacy	0.405	0.514	0.4	0.323	0.263	0.315	0.193	0.432	0.29	**0.84**			
Reliability	0.359	0.48	0.541	0.494	0.387	0.343	0.173	0.46	0.6	0.416	**0.932**		
Satisfaction	0.22	0.392	0.416	0.424	0.206	0.389	0.1	0.413	0.528	0.287	0.47	**0.938**	
Tangibles	0.103	0.128	0.255	0.396	0.166	0.053	0.53	0.365	0.374	0.266	0.4	0.252	**0.941**

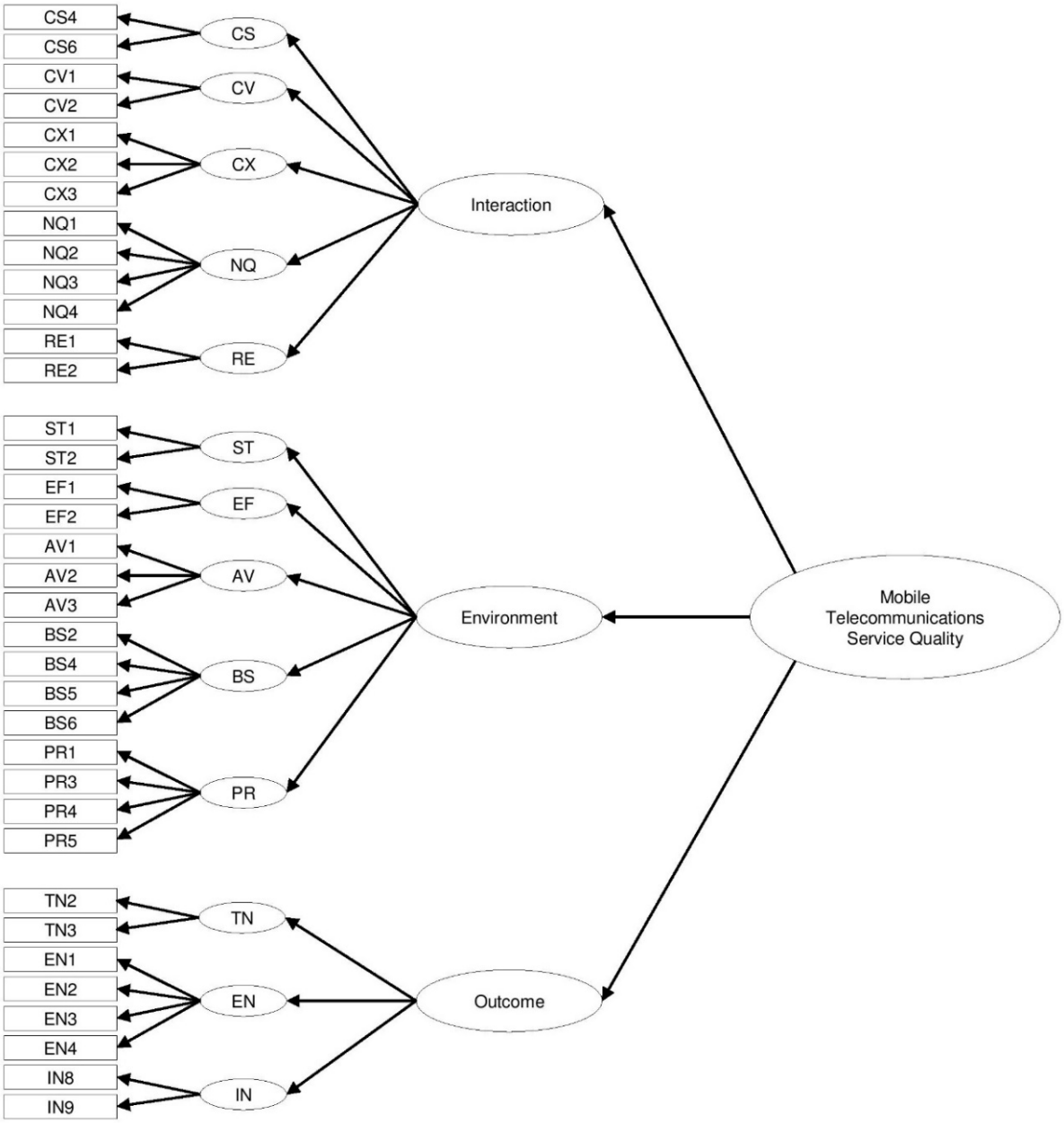

Figure 5. The mobile telecommunications service quality model (MTSQ model).

The MTQAT is composed of two parts. The first part asks for the profile of the respondent while the second part contains the survey proper. The tool is composed of 36 questions/items. The assessment tool works by measuring the company's performance in each dimension of quality and also in each specific quality variable. This is done by computing the mean score of each variable. Likewise, in determining the score of the factor, the average of the mean scores of the variables in a particular factor is determined.

Implications To Management

The MTSQ is a model of service quality for the prepaid mobile telecommunication industry in the Philippines. It comprises 36 variables grouped further into 13 factors, and further into three quality dimensions. The model was further translated into a working assessment tool that can be of used for the telecommunications industry for self-evaluation. The 36-item tool is hierarchical, which makes it favorable for three levels of development and management: strategic, tactical, and operational.

Upon using the tool, companies can use the feedback from their customers as valuable input for the assessment of their telecommunication services. It is very timely considering that the Philippine government has currently responded to the call of many stakeholders for a drastic improvement in the services provided by the telecommunications companies.

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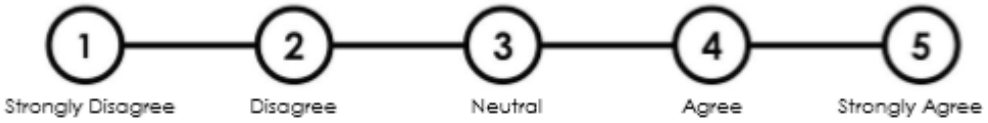
Appendix A
The Mobile Telecommunications Quality Assessment Test (MTQAT)

MOBILE TELECOMMUNICATIONS QUALITY ASSESSMENT TEST

Name (optional): _____ **Age:** _____ **Sex:** _____
Province (Origin): _____ **Region:** _____ **Nationality:** _____
Civil Status: ▫ Single ▫ Married

Instructions:
Rate the following items according to the performance of your current network provider. Use the ratings below



1	The mobile network representatives are able to help with problems.	① ② ③ ④ ⑤
2	The mobile network representatives show that they understand the customer's specific needs.	① ② ③ ④ ⑤
3	The mobile network has numerous loading stations and payment centers.	① ② ③ ④ ⑤
4	The loading stations and payment centers are near the customers.	① ② ③ ④ ⑤
5	Mobile services still work even if I'm within confined environments (e.g. elevators, basements, walled rooms, etc)	① ② ③ ④ ⑤
6	The mobile network understands my need to use mobile services in confined environments	① ② ③ ④ ⑤
7	Mobile services still work even with unstable weather conditions	① ② ③ ④ ⑤
8	The frequency of dropped calls (involuntary terminated calls) is low.	① ② ③ ④ ⑤
9	There is a good voice quality during phone calls.	① ② ③ ④ ⑤
10	The mobile network always provides stable connections. There is always good service coverage	① ② ③ ④ ⑤
11	The mobile network can provide the same service with different devices.	① ② ③ ④ ⑤
12	Mobile services (e.g. delivery of messages, promo subscriptions, etc) are completed on the expected time.	① ② ③ ④ ⑤
13	The users are notified of potential delays in the service delivery.	① ② ③ ④ ⑤
14	The user had a good experience and is satisfied in using the mobile network's mobile services.	① ② ③ ④ ⑤
15	The mobile network tries to give its users a good experience	① ② ③ ④ ⑤
16	The mobile network enables me to complete transactions (calls, texts, mobile internet, subscription, etc) quickly	① ② ③ ④ ⑤
17	The mobile network delivers transactions (calls, texts, etc) quickly.	① ② ③ ④ ⑤
18	I can reach mobile services (e.g. calls, texts, internet, etc) anytime.	① ② ③ ④ ⑤
19	I can reach mobile services anywhere.	① ② ③ ④ ⑤

20	Mobile services (calls, texts, internet, etc) works right the first time.	① ② ③ ④ ⑤
21	The mobile network offers a variety of price plans (e.g. promos and monthly plans)	① ② ③ ④ ⑤
22	The prices of the mobile services offered by the mobile network are economical. The services are worth their price.	① ② ③ ④ ⑤
23	The mobile network provides convenient payment procedures.	① ② ③ ④ ⑤
24	It is easy to understand and resolve billing issues	① ② ③ ④ ⑤
25	The mobile network protects the user's sensitive information	① ② ③ ④ ⑤
26	The transactions made with the mobile network are secured.	① ② ③ ④ ⑤
27	The mobile network owns a proper security certificate.	① ② ③ ④ ⑤
28	The user's personal data are used only after the user's consent.	① ② ③ ④ ⑤
29	The mobile networks' website provides important content.	① ② ③ ④ ⑤
30	The mobile network's website provides updated content.	① ② ③ ④ ⑤
31	The mobile network provide various entertainment features	① ② ③ ④ ⑤
32	It is easy to download music, games and videos.	① ② ③ ④ ⑤
33	Downloadable features (music, games, videos. etc) are up to date	① ② ③ ④ ⑤
34	High quality downloadable features (music, games, videos, etc)	① ② ③ ④ ⑤
35	The mobile network's facilities (payment centers, loading stations, offices) are visually appealing	① ② ③ ④ ⑤
36	The mobile network's employees at payment centers offices are neat and clean.	① ② ③ ④ ⑤