CHAPTER VI
DEVELOPED SQM-ME MODEL BY FACTOR ANALYSIS AND MULTIPLE REGRESSIONS

Confirmatory Factor Analysis (CFA) is selected to refine and validate the measurement scales. CFA is identified as an appropriate statistical test particularly for the number of SQM factors that are required to explain the inter-correlations among the variables. The result of previous chapter identifies five SQM dimensions of service quality (SQM-ME) that customers rely on to form their judgment of perceived service quality, which are:

1. Facility: The physical facilities at excellent shops will be visually appealing and good condition.
2. Speed: time consumption for service delivery process.
3. Reliability: ability to perform the promised service dependably and accurately.
4. Professional Competence: Capability of service agent to serve customer as promise.
5. Agent Utilization: The effectiveness of staffs/employees utilization.
6. Responsiveness: willingness to help customers and provide prompt service.

This chapter shows the result of confirmatory factor analysis, which is designed to test specific hypotheses about the factor structure for a set of variables. The final part of this chapter provides the formula resulting from multiple regressions analysis.

6.1 DESCRIPTION OF THE STUDY SAMPLES

Fifteen-thousand questionnaires were distributed to mobile service shop customers in Bangkok metropolitan area. A total of 1,121 questionnaires were returned (74.73 % response rate). Of the returned questionnaires, 121 were not used for data analysis because all items in the questionnaire were allocated the same responsive values of all items. Therefore, 1,000 usable questionnaires (66.67%) were used for data analysis. The average age of the respondents from the studied sample was 27.25±5.26 [range 17-56] years. Their average income per month was 10,589.12±1994.41 [3,000 - 100,000] Baht. The majority of the respondents were female (62.7%). A total of 72.9 % of the questionnaires were self-administered. For the remaining 27.1%, fieldworkers read out the questionnaires to them. According to a thousand of data samples, the result shows the average value and the standard deviation of 28 factors such as Location (the average value is equal to 5.49, standard deviation (SD) is equal to 1.18) and Cleanliness (the average value is equal to 2.87 and the SD is 0.59).

According to table 6.1, the label for each variable is shown in the first column of the descriptive statistics table with the mean and standard deviation for each variable. This provides the initial summary of each of the variables.

Table 6.1 Descriptive Statistics

Attributes	Mean	Std. Deviation
Queuing Speed	5.49	1.18
Accuracy in billing	5.42	1.24
Problem Solving Employee	5.40	1.18
Ambient Condition/Layout	5.37	1.17
Friendliness	5.34	1.18
Ease of Use	5.18	1.16
Service Handling Speed	5.31	1.16
Cleanliness	2.88	0.59
Short Process	5.32	1.19
Location	3.08	0.66
Sign/Symbol	5.17	1.21
Use of Technology	5.42	1.25
Queuing Fairness	5.34	1.25
Material and Document	5.29	1.16
Perform Service as promise	5.13	1.20
Technical Knowledge	5.04	1.28
Prompt Service	5.26	1.08
Handling complaints	5.34	1.14
Emotional Control	5.10	1.37
Agent Availability	5.28	1.23
Tone of voice	5.16	1.23
Knowledge	5.46	1.19
Resource Allocation	3.17	0.74
Communication Skill	5.30	1.29
Politeness	3.24	0.67
Attitude	5.14	1.24
Agent Appearance	5.17	1.22
Perform right at the first time	5.29	1.25

6.2 KMO AND BARTLETT'S TEST OF SPHERICITY

Before conducting a factor analysis, it is essential to check the sampling adequacy and sphericity to see if it is worth proceeding with the analysis. The data is tested by Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity. For KMO, it reveals the sampling adequacy by comparing the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients. The KMO is calculated by using correlations and partial correlations to test the variables in the sample. It calculates whether variables are so highly correlated and difficult to distinguish between them. A general rule of thumb is that a KMO value should be greater than 0.5 for a satisfactory factor analysis to proceed.

The Kaiser-Meyer-Olkin measure of sampling adequacy is greater than .90. As table 6.2, the "KMO and Bartlett's Test" is utilized to measure the data adequacy. The result is 0.933 which more than 0.90. The degree of common variance among the eleven variables is "Marvelous "so it can be concluded that the most effective way to measure the data is factors analysis technique.

Table 6.2 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.933
Bartlett's Test of Sphericity	Approx. Chi-Square	1.268E4
	df	406
	Sig.	.000

Another indicator of the strength of the relationship among variables is Bartlett's test of sphericity. As a result, the analysis used the Bartlett's Test of Sphericity to test an assumption of factors.

The researcher determines:

H 0: variables in the population correlation matrix are uncorrelated.

H 1: There has been a relation of each factor.

Bartlett's Test of Sphericity reveals a relationship between the variables. If no relationship is found then there is no point in proceeding with the factor analysis. The testing statistics will enumerate by using Chi-Square equal to 1.268E4 which produces the significance value equal to .000 which is less than 0.05 leading to H 0 excision. It is concluded that the strength of the relationship among variables is strong. Consequently, it indicates that it makes sense to continue with the factor analysis. Since it is found that $p < 0.001$, it can be concluded that there are relationships between the variables.

6.3 COMMUNALITIES

At the beginning, the software assumes that 100 percent of the variance of each variable is common variance, so each variable is given a communality of 1.000. However, when it has extracted the factors it works out how much of the variability of each variable really can be explained by the extracted factors, and gives an updated value of communality.

It is discovered that each factor indicates initial communalities and Extraction communalities value as a proportion of standard deviation for common factors (all Factors: F 1, F 2... F m), or the Multiple Correlation 2 of factors which can be explained. From table 6.3, each factor relates to the others and elucidates the deviation of all factors by using initial communality data table from Principal Component method (Under defining condition the initial communality of all factors is equal to 1). Extraction Communality is the communality value of factor after extracting influences. The results manifest the Extraction communality value X3 equal to 0.227 which is the lowest value therefore it is unable to classify this part in any factor explicitly. According to table 6.4, it shows that all the variance of "queuing speed" is initially given a communality value of 1.000, but after extracting the factors, the communality is 0.870. This indicates that 87 percent of its variability is explainable by the factors.

Table 6.3 Communalities

Attributes	Initial	Extraction
Queuing Speed	1.000	.870
Accuracy in billing	1.000	.832
Problem Solving Employee	1.000	.827
Ambient Condition/Layout	1.000	.817
Friendliness	1.000	.825
Ease of Use	1.000	.546
Service Handling Speed	1.000	.607
Cleanliness	0.000	.002
Short Process	1.000	.655
Location	0.000	.006
Sign/Symbol	1.000	.672
Use of Technology	1.000	.498
Queuing Fairness	1.000	.419
Material and Document	1.000	.586
Perform Service as promise	1.000	.628
Technical Knowledge	1.000	.664
Prompt Service	1.000	.580
Handling complaints	1.000	.639
Emotional Control	1.000	.598
Agent Availability	1.000	.605
Tone of voice	1.000	.460
Product/Service Knowledge	1.000	.369
Resource Allocation	0.000	.002
Communication Skill	1.000	.569
Politeness	0.000	.007
Attitude	1.000	.107
Agent Appearance	1.000	.057
Perform right at the first time	1.000	.761
Overall Service Perception	1.000	.629

6.4 EIGEN VALUES

Eigen values contain a particular set of scalars associated with a linear system of equations. The percent of Variance column shows how much variance each individual factor can explain. The factors that accounted for more than 5 percent of variance are selected. The Cumulative percent column shows the amount of variance accounted for by each consecutive factor added together. Table 6.4 shows the Eigen values, which reveal the number of factors to be retained for rotation; a majority uses the Kaiser criterion (all factors with Eigen values are greater than one. According to Costello (2005), the default in most statistical software packages is to keep all factors with Eigen values greater than 1.0. Only five factors have Eigen values greater than 1. The result presents the factor X1(Speed). X2(Accuracy), X3(Employee Competency), X4(Ambient Condition) and X5 (Friendliness) having Eigen values more than 1. The author determines the most significant factors and agrees that the crucial one is the first factor which demonstrates the clearest picture of standard deviation.

Table 6.4 Eigen values

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Queuing Speed	9.067	31.267	31.267	9.067	31.267	31.267	5.380	18.552	18.552
Accuracy in billing	2.915	10.052	41.319	2.915	10.052	41.319	4.621	15.933	34.485
Employee Competency	1.710	5.898	47.217	1.710	5.898	47.217	2.873	9.907	44.392
Ambient Condition/Layout	1.488	5.133	52.349	1.488	5.133	52.349	2.222	7.662	52.054
Friendliness	1.111	3.831	56.181	1.111	3.831	56.181	1.197	4.126	56.181
Ease of Use	.969	3.342	59.522						
Service Handling Speed	.943	3.252	62.775						
Cleanliness	.908	3.130	65.904						
Short Process	.852	2.938	68.842						
Location	.770	2.656	71.498						
Sign/Symbol	.674	2.325	73.823						
Use of Technology	.622	2.145	75.968						
Queuing Fairness	.598	2.063	78.031						
Material and Document	.577	1.990	80.021						
Perform Service as promise	.564	1.946	81.967						
Technical Knowledge	.528	1.822	83.790						
Prompt Service	.477	1.644	85.434						
Handling complaints	.465	1.602	87.036						
Emotional Control	.416	1.433	88.469						
Agent Availability	.407	1.402	89.871						
Tone of voice	.394	1.359	91.230						
Knowledge	.387	1.335	92.565						
Resource Allocation	.373	1.285	93.851						
Communication Skill	.360	1.242	95.092						
Politeness	.327	1.129	96.221						
Attitude	.310	1.068	97.289						
Agent Appearance	.299	1.030	98.318						

6.5 SCREE PLOT

Another way to determine the number of factors to extract in the final solution is Cattell's scree plot. The scree test involves examining the graph of the Eigen values (available via every software package) and looking for the natural bend or break point in the data where the curve flattens out. The factors are the X-axis and the Eigen values are the Y-axis. The factor with the highest Eigen value is the first component and the second component has the second highest Eigen value.

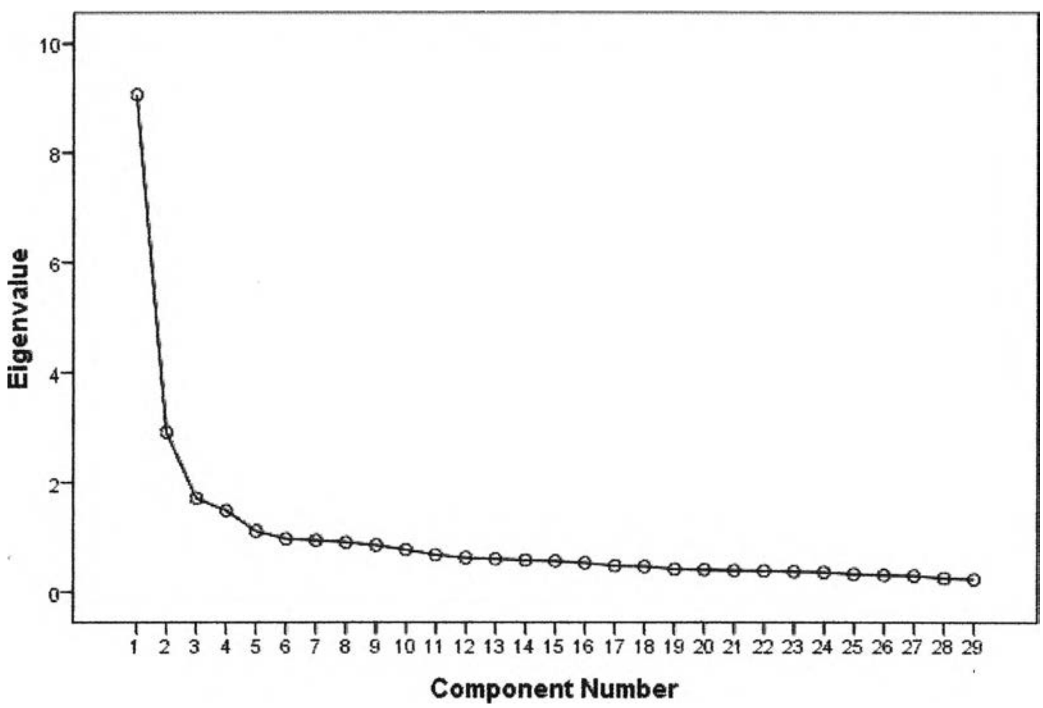

Figure 6.1 Cattell's scree plot.

This is a plot of the Eigen values associated with each of the factors extracted, against each factor. At the point that the plot begins to level off, the additional factors explain less variance than a single variable. The result shows that the variables can be grouped into five main factors that indicate the Eigen value more than 1, which are Queuing Speed, Accuracy, Employee capability, Ambient Condition/Layout and Friendliness.

6.6 COMPONENT MATRIX

A principal components analysis looks at the two-factor solution. Specifically, the correlations between the variables and the two factors (or "new" variables), as they are extracted by default; these correlations are also called factor loadings.

The un-rotated component matrix indicates the correlation of each variable with each factor. The first factor is generally more highly correlated with the variables than the second factor. This is to be expected because, as previously described, these factors are extracted successively and will be accounted for less and less variance overall.

To determine which variables should be addressed on which factors, it is set from the factors loading value. If the factor loading in factors variable has considerable value (close to 1 or -1) when the other factors have low factor loading (close to zero), its variable will be set on high potential factors loading. For example, the multi - relation coefficient between X 11 (Process) variables and the first factor is 0.690, while the multi - relation coefficient between X 11 (Process) variables and the second factor has less than minus value. For this reason, the exact value cannot be shown. As a result, it can be concluded that the X11 (Process) Variable strongly relates to the first factor then the factors at the first rank are provided. However, if the factor loading value from others factors is not distinct explicitly, the variable is unable to be set on and the factors axis is needed to be rotated.

Table 6.5 Component Matrix[a]

	Component				
	Queuing Speed	Accuracy in billing	Employee Competency	Ambient Condition	Friendliness
Short Process	.690	-.427			
Ease of Use	.684	-.439		-.294	
Service Handling Speed	.674	-.429			
Perform right at the first time	-.241	.431	.502		
Use of Technology	-.137	.387	-.206	.360	
Prompt Service	.634	-.349	-.494		
Queuing Fairness	.615	-.394			
Technical Knowledge	-.215		.455		
Location					
Material and Document	-.308	.402		.352	
Sign/Symbol	-.199	-.393	-.510	.213	
Ambient Condition/Layout	-.296	-.367		.332	
Accuracy in billing	-.193	.433			-.266
Problem Solving Employee	-.203	-.103	.331		
Perform Service as promise	-.591		-.571		
Product/Service Knowledge	-.590	.312	.396		
Communication Skill	-.568	.430	.372		.312
Emotional Control	-.531	-.398			.343
Agent Availability	-.526	-.170	.213		
Resource Allocation					
Agent Appearance	-.587	.289	.220		
Tone of voice	-.607	-.213	-.211		.298
Attitude	-.522	-.335	-.188	-.289	.356
Handling complaints	-.490	-.390	.453	-.568	
Politeness					
Cleanliness					
Friendliness	-.203		-.315	-.206	.588

Extraction Method: Principal Component Analysis. a. 5 components extracted.

6.7 ROTATING THE FACTOR ANALYSIS

A factor analysis prior to rotation provides an explanation of how many factors underlie the variables. The goal of this step is to obtain a clear pattern of loadings, that is, factors that are somehow clearly marked by high loadings for some variables and low loadings for others. This section is designed to obtain a pattern of loadings on each factor that is as diverse as possible, lending itself to easier interpretation. Below is the table of rotated factor.

There are various methods that can be used in factor rotation but this study utilizes Varimax Rotation, which attempts to achieve loadings of ones and zeros in the columns of the component matrix (1.0 & 0.0). According to the rotated component matrix in table 6.6, the variables can be grouped into five main factors below:

Factor 1 (Queuing Speed) consists of 5 variables, which are Short Process, Ease of Use, Service Handling Speed, Prompt Service, and Queuing Fairness.

Factor 2 (Accuracy) consists of 6 variables, which are Perform right at the first time, Use of Technology, Accuracy in billing, Material and Document, Product Knowledge and Communication Skill.

Factor 3 (Employee Capability) consists of 8 variables, which are Perform right at the first time, Technical Knowledge, Problem Solving Employee, Product/Service Knowledge, Communication Skill, Agent Availability, Agent Appearance and Handling complaints.

Factor 4 (Ambient Condition/Facility) consists of 5 variables, which are Sign/Symbol, Use of Technology, Material and Document and Ambient Condition/Layout

Factor 5 (Friendliness) consists of 3 variables, which are Emotional Control, Tone of voice and Attitude

Table 6.6 Rotated Component Matrix[a]

	Component				
	Queuing Speed	Accuracy	Employee Capability	Ambient Condition/Facility	Friendliness
Short Process	0.778				
Ease of Use	0.775				
Service Handling	.7640				
Perform right at the first time		0.731	0.702		
Use of Technology		0.687		0.76	
Prompt Service	0.712				
Queuing Fairness	0.693				
Technical Knowledge			0.755		
Material and Document		0.602		0.506	
Sign/Symbol				0.693	
Ambient Condition/Layout				0.732	
Accuracy in billing		0.733			
Problem Solving Employee			0.831		
Perform Service as promise					
Product/Service Knowledge		0.725	0.696		
Communication Skill		0.653	0.672		
Emotional Control					0.743
Agent Availability			0.713		
Agent Appearance			0.62		
Tone of voice				0.582	
Attitude				0.677	
Handling complaints			0.718		
Friendliness					0.788
Queuing Speed	0.786				

Extraction Method: Principal Component Analysis.

a. Rotation converged in 5 iterations.

6.8 FACTOR PLOT IN ROTATED FACTOR SPACE

Table 6.7 is the matrix received by multiplying the un-rotated factor matrix to get the rotated factor matrix. According to the component transformation matrix, the value in the table is the new factor loading value as a result of rotation matrix by Varimax method. According to the component plot in rotated space which displays loading value of each factor, if factor loading value has numerous amounts and can be substituted well, the factor position should be the end of line. In addition, if the factor is situated close to the Intersection point ((0,0,0)), it means those factors are not related to any factors at the end of the line.Therefore, it is set in any other factors.

Table 6.7 Component Transformation Matrix

Component	1	2	3	4	5
1	.642	.575	.393	.311	.082
2	-.733	.647	.156	.133	-.051
3	.160	.381	-.905	.101	.033
4	-.149	-.320	-.052	.896	.264
5	-.059	.060	.020	-.269	.959

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

In the plot of factor loadings above, 28 variables are grouped to five specific factors: Queuing Speed, Accuracy, Employee capability, Ambient Condition, and Friendliness factor.

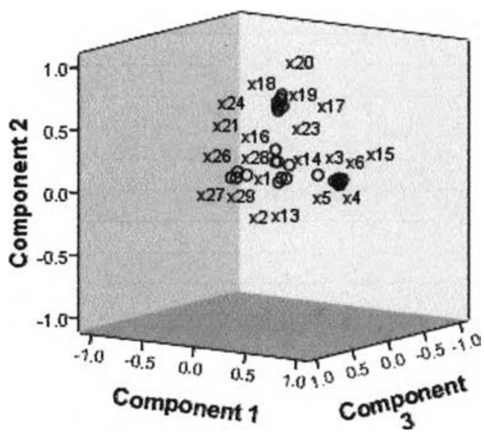

Figure 6.2 the Plot of Factor Loadings

6.9 MULTIPLE REGRESSIONS RESULT

To determine the extent to which each SQM dimension contributes to the overall service quality, multiple regression analysis is conducted with the five factors as independent variables. The technical outcome variables of overall service quality are treated as dependent variables. Summary results of the regression analysis are listed in Table6.9 Results show that all the five factors have significant positive effects on overall service quality.

Table 6.8 Model Summary[e]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.802	0.751	0.87	1.08184	1.98

Table 6.8 shows that the coefficient of multiple determinations (R) value is 0.802, *therefore, about 80.2% of the variation. It describes strong relationship between variables* and the coefficient of determinant (R2) value describes that overall satisfaction will vary around 75.1% for variation in each of those five independent variables. The regression equation appears to be very useful for making predictions since the value of R2 is close to 1. Table 6.9 shows the value of constant and coefficient value of each attributes for satisfaction model.

TABLE 6.9 Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1 (Constant)	4.014	.160		25.133	.000		
X1	1.673	.029	.976	8.589	.000	1.000	1.000
X2	1.252	.029	.855	3.521	.000	.989	1.012
X3	.796	.036	.499	2.675	.008	.669	1.494
X4	.431	.036	.234	2.307	.002	.653	1.531
X5	.268	.031	.171	2.179	.030	.873	1.146

These are the values for the regression equation for predicting the dependent variable from the independent variable. The regression equation is presented in many different ways. The column of estimates provides the values for b0, b1, b2, b3, b4 and b5 for this equation. Thus, the service quality equation is described as below:

Y (Overall Service Quality) = 4.041+.268 X(Friendliness) +.431X (Ambient condition) +.796X (Employee Capability) +1.252X (Accuracy) +1.673X (Queuing Speed)

Friendliness - The coefficient for Friendliness is 0.268. So for every unit increase in friendliness, a 0.268 unit increase in overall service quality is predicted, holding all other variables constant.

Ambient Condition - For every unit increase in ambient condition, a 0.431 unit increase in the ambient condition score is expected, holding all other variables constant.

Employee Capability - The coefficient for employee capability is 0.796. So for every unit increase in employee capability, an approximately 0.796 point increase in the overall service quality score is expected, holding all other variables constant.

Accuracy - The coefficient for accuracy is 1.252. So for every unit increase in accuracy, a 1.252 point increase in the overall service quality score is forcasted.

Queuing Speed - The coefficient for accuracy is 1.673. So for every unit increase in queuing speed, a 1.673 point increase in the overall service quality score is forcasted .

6.10 CONCLUSIONS

The SQM-ME model from Delphi study in previous chapter is developed and refined by using confirmatory factor analysis and multiple regressions. It can be summarized that overall service quality of mobile service shop depends on five distinct service quality attributes.

Factor 1 (Queuing Speed) consists of 5 variables, which are Short Process, Ease of Use, Service Handling Speed, Prompt Service, and Queuing Fairness.

Factor 2 (Accuracy) consists of 6 variables, which are Perform right at the first time, Use of Technology, Accuracy in billing, Material and Document, Product Knowledge and Communication Skill.

Factor 3 (Employee Capability) consists of 8 variables, which are Perform right at the first time, Technical Knowledge, Problem Solving Employee, Product/Service Knowledge, Communication Skill, Agent Availability, Agent Appearance and Handling complaints.

Factor 4 (Ambient Condition/Facility) consists of 5 variables, which are Sign/Symbol, Use of Technology, Material and Document and Ambient Condition/Layout

Factor 5 (Friendliness) consists of 3 variables, which are Emotional Control, Tone of voice and Attitude

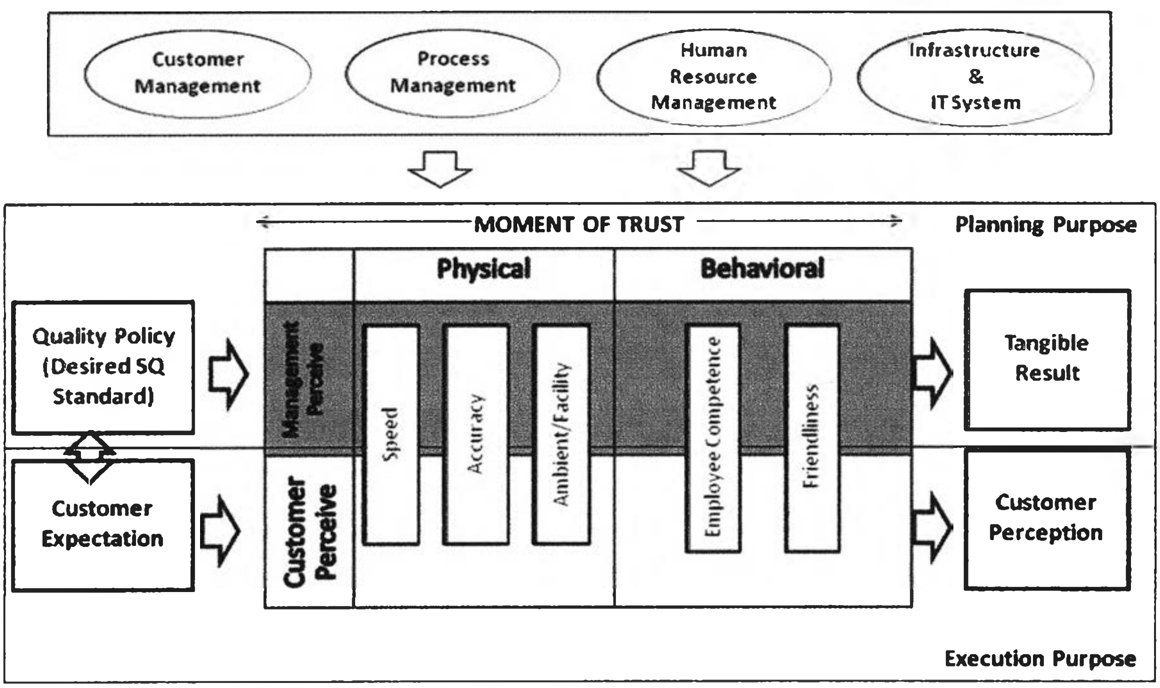

Figure 6.3 A refined SQM-ME model

The relation between overall SQ attributes is stated earlier through a SQM-ME model. From this model, it is observed that the overall SQ depends on five distinct SQ attributes. It can be summarized that the queuing speed is the most important factor among those because the coefficient of the speed get high value which implies the service satisfaction is mostly dominated by the quality of this service attribute. Also accuracy is found close to condition as same as queuing speed, because both attributes get high value of coefficient value. Problem solving is found with moderate impact. Layout and friendliness are found with lower coefficient value than others which implies that these two have less domination in overall service quality. The customers give much importance in queuing speed because it is common that most customers mostly come to the mobile service shop for bill payment. They expect to finish payment as soon as possible. The long period of waiting time is the main problems of many branches of mobile service shops. It means that if the company can improve queuing management, the overall service quality will improve significantly. In addition, the accuracy in bill payment is also important. The nature of mobile telecom industry is complicated because of the marketing proposition and price plan. Today, a billing statement combines various services transaction in one bill. Consequently, it leads to confusion in many cases. The result of this chapter implies that if the company can measure service quality of these five factors, the overall service quality can be forecasted and effectively managed by executives/managers. The service quality equation is described as below:

Y (Overall Service Quality) = 4.041+.268 X(Friendliness) +.431X (Ambient condition) +.796X (Employee Capability) +1.252X (Accuracy) +1.673X (Queuing Speed)

The input for SQ equation requires the system that capable to collect the data from mobile service shops. The SQM-ME model can be considered as the foundation for new product development process of SQM-ME system, which is explained in the next chapter.