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Measuring Customer Satisfaction Index (CSI) in Iranian Tile Industry Using Pls Path Modeling Technique

[1]Ahmad Jafari Samimi and [2]Roohollah Mohammadi

[1]Department of Economics, Firoozkooh Branch, Islamic Azad University, Firoozkooh, Iran
[2]Holds M.S in Economic and Social Systems Engineering,
Science and Technology, University of Babol, Iran

Abstract: In this paper, first we have used a contrastive study of customer satisfaction index models in some countries and interviewed with experts in order to identify customer satisfaction index model variables in Iranian tile industry. Then based on the results of a questionnaire, variables and indicators of the developed model were inquired from the population and the collected data was analyzed using PLS method. Our findings indicate, the latent variables "image" and "perceived quality" played a significant role in customer satisfaction index in the Iranian tile industry. However, customer satisfaction index was mostly influenced by "perceived quality" factor with a coefficient of 0.531%. On the other hand, other independent variables such as "customer expectations" and "perceived value" bore little impact on customer satisfaction index.

Key words: Customer Satisfaction Index (CSI) · Partial Least Square (PLS) · National Customer Satisfaction Index Model · Latent Variable (LV) · Manifest Variable (MV)

INTRODUCTION

From the mid 1970s, in the developed countries, marketing and consumer behavior researchers such as Oliver (1977), Churchill and Suprenant (1982), Olshavsky (1993) began comprehensive studies on customer satisfaction[1]. In 1982, Professor Fornell together with his colleagues at the University of Michigan conducted the first customer satisfaction index measurement system at the national level and introduced American Customer Satisfaction Index (ACSI) in 1996. This model includes independent variables such as customer expectations, customer perception of quality and perceived value, as well as customer loyalty and complaints as the responses of customer satisfaction[2] [1, 2].

Among the applications of this model are measurement of customer satisfaction index at an industry level and using it as one of the most important tools of TQM for studying purpose within a given industry or across industries [2].

So far, many countries have attempted to prepare their own national and local models among which are Germany, USA, Switzerland, Finland, Greece, Denmark, Russia, Portugal, Iceland, Norway, Ireland, England, South Africa, Austria, South Korea, Malaysia, Turkey, Brazil, Argentina, Mexico, Canada, Australia, Hong Kong, Taiwan, Singapore, New Zealand and Japan, to mention a few.

PLS Path Modeling Technique was introduced by Herman Wold (1985) and then gradually developed by researchers such Lohmoller (1989), Fornell and Cha (1994) and Tenenhaus (1999). Fornell for the first time used this technique for estimating a national customer satisfaction index model [5].

PLS Path Modeling Technique in most national customer satisfaction index models is used for estimating model parameters, helping in measuring the validity and reliability of the models and finally calculating the customer satisfaction index.

[1] For More Information, see: [3]Fasanghari, Mehdi, Farzad Habibipour Roudsari,. "The Fuzzy Evaluation of E-Commerce Customer Satisfaction", World Applied Sciences Journal 4 (2): 164-168, 2008.

[2] For More Information, see: [4]Sadeghi, Tooraj, Sahel Farokhian,. The Role of Customer Satisfaction in Product Planning, Middle-East Journal of Scientific Research, 7 (1): 39-45, 2011.

Corresponding Author: Dr. Ahmad Jafari Samimi, Department of Economics, Firoozkooh Branch, Islamic Azad University, Firoozkooh, Iran.

This research is composed of two parts. In the first part a model for measuring customer satisfaction index in the Iranian tile industry is designed and in the second part, using the model devised in part 1 and PLS PM method, customer satisfaction index in Iranian tile industry is calculated.

Literature Review: So far, many countries have attempted to prepare their own national and local models. Although these models are fundamentally similar, some of them have obvious advantages in structures or variable selection. In other words, each country tries to devise its native model consistent with its national specifications and characteristics [6].

So, comparing and analyzing some of these existing models with the aim to design a local model are something necessary and valuable.

Therefore, at the beginning of this study four most celebrated models namely ACSI, European Customer Satisfaction Index (ECSI), Norwegian Customer Satisfaction Barometer (NCSB) and Swiss Index of Customer Satisfaction (SWICS) that are frequently used in the formation of other models are discussed.

The Comparison Is Twofold:

- Selection of variables in each customer satisfaction index model.
- Communication and interaction among variables [7].

For example, in SCSB the two variables customer perception of quality and customer perceived value are merged and converted to perceived value. In ECSI model the variable customer perception of quality is dismantled into two variables customer perception of the quality of product (hardware) and customer perception of the quality of service (software). NCSB model introduces a new instrument called SERVQUAL to evaluate quality. In other words, different models measure similar latent variables using various manifest variables. For example, SCSB and ACSI models measure customer perception using different manifest variables.

As of 1996 ACSI model in choosing manifest variables has introduced a new index called consistency of information while ECSI, SCSB and SWICS models, although have reflected the effects of this index in some manifest variables, have not pointed it out directly.

In many cases, empirical evidences[3] suggest little effect of customer expectation on customer satisfaction. Therefore, NCSB eliminates this variable and replaces it with a new variable called global image [8].

In studies on customer satisfaction, researchers have found that most customer, even if dissatisfied with products or services, do not complain and consequently, this causes loss of data needed in this area while dissatisfied customers, like other customers, care much about complaint addressing procedure. Due to the same reason in NCSB customer complaint is replaced with complaint addressing [11].

In recent years, customer loyalty is emphasized by marketing researchers and organizational directors to be the only consequence of customer satisfaction. In this context two issues are focused zealously:

- Defining customer loyalty.
- The relationship between loyalty and satisfaction in different contexts.

Most modern researchers hold that any attempt to define loyalty should include both behavioral and tendency elements and define customer loyalty using the two elements. In ACSI model customer loyalty is defined as the customer's willingness to repurchase. Willingness to recommend has been added to ECSI model. In this model both behavioral and tendency elements are addressed simultaneously and completely using customer relations variable [8]

It is worth mentioning that customer satisfaction index model is based on a set of latent and manifest variables and its validity depends on the definition of variables and their interactions. Thus, Manifest variables should reflect various aspects of their latent variables.

ACSI and SCSB models emphasize the positive effect of customer expectations on customer perception of quality and perceived value. However there is much evidence on the limited effect of expectations in other customer satisfaction models. Thus, ECSI and SWICS models neglect it altogether.

[3] For More Information, see: [9]Taj, Ali Asghar., Shojaee, F., Badami, R., Kaman, S., Relation Between Job Satisfaction and Personal Traits of Female Managers in Professional Sports, World Applied Sciences Journal, 9 (8): 918-921, 2010. Also:[10] Liao, Z., & Cheung, M. T., Measuring consumer satisfaction in Internet banking: a core framework. Communications of the ACM, 51(4): 47-51,2008.

The variable global image/reputation was first introduced in NCSB as a latent independent variable. In early experiences of ECSI model scholars held that this variable directed affected customer expectations, satisfaction and loyalty. But subsequent experiences in Denmark showed that it only affected customer expectations and satisfaction not loyalty. But NCSB model assumes that reputation is due to satisfaction, having a positive effect on loyalty. The battle over the role of reputation of the organization in customer satisfaction index model in fact roots in the difference of the definition of terms [12].

In early attempts to produce ECSI model, image was supposed to be a variable not only representing the global image of the company, but also including individual's knowledge and information about the products and brand of the company. Therefore, image was connected to customer expectations and perceptions. It was held that in terms of good images the customer had high presupposed expectations leading him to a higher understanding. In the development cycle of ECSI, image replaced organization's reputation. Reputation relates to the organization's performance in all aspects of the society not to its performance in the marketplace; in other words, reputation not only includes the reports on the organization's success in the market, but also consists of the customers' evaluations of the organization as an actor in the society including its ethics and values. Another important point in ECSI is the existence of different beliefs about the structure of mutual relations of European countries despite employing very similar models [11].

Consequently, the four customer satisfaction index models have different endogenous and exogenous variables as mentioned in Table 1.

Customer Satisfaction Index Model in the Iranian Tile Industry: After a comparative study and reviewing models, for naturalizing the identified indices, the researchers interviewed 10 experts. At this stage the variable customer dialogue replaced customer complaints because there are not suitable official customer complaints in Iran and the experience of Switzerland in this case has proved to be successful.

So, ultimately, a customer satisfaction index model with seven latent variables as shown in Figure 1 was confirmed.

Table 1: Comparison of endogenous and exogenous variables

Models	Exogenous variables	Endogenous variables
ACSI	Customer expectations	Customer perception of quality, perceived value, customer satisfaction, customer complaints, customer loyalty
ECSI	Overall image, perceived product quality, perceived service quality	Customer expectations, perceived value, customer satisfaction, customer complaints, customer loyalty
NCSB	5 quality stimuli: tangibility, reliability, compatibility, warranty, suggestibility	Customer satisfaction, organization's reputation, customer loyalty
SWICS	Expectation, efficiency, customer-orientation	Perceived value, customer satisfaction, communication or relations with customer, customer loyalty

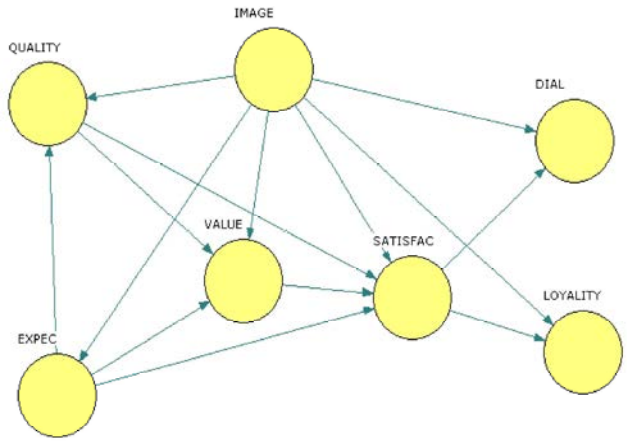

Fig. 1: Final Customer Satisfaction Index Model for Iranian Tile Industry

Table 2: Output of SPSS after Data Analysis

	One-Sample Statistics			
	N	Mean	Std. Deviation	Std. Error Mean
Customer sat	240	7.1082	1.40300	.22183
Percieived quality	240	8.3895	.93216	.14739
Perceived value	240	7.0312	1.35271	.21388
Cus expectations	240	7.5420	1.29798	.20523
Cus dialogue	240	8.0198	1.12501	.17788
Cus loyality	240	8.0564	1.03202	.16318
Image	240	8.3755	1.36240	.21541

This model is a causal model including seven latent variables. In this model “customer satisfaction” stimuli include four latent variables: "perceived quality", "perceived value", "customer expectations" and "image". Meanwhile, customer satisfaction outcomes include two latent variables: "customer loyalty" and "customer dialogue".

Each of these seven latent variables can be measured by the number of measurable variables. Measurable variables, in turn, are directly measured through some questions asked from the customers.

Population: Population included Iranian tile industry customers including consumers, contractors and distributors. Survey questionnaires designed for assessing customer satisfaction index model indices were distributed among the population. Number of samples for filling out the questionnaires was determined 240.

In the questionnaire each of the seven variables was measured through three to eight other variables measured through surveying and questioning customers. The significance of each question was measured using a one to ten scale, one being the lease significant and 10 being the most significant.

Table (2) shows a descriptive analysis of the data related to the questionnaire.

Evaluation of the Model: In this section the model presented in the previous section is evaluated in terms of validity using PLS Path Modeling Technique [13].

In the questionnaire, all indices (questions) were evacuated using a one to 10 scale (1 being the least significant and 10 being the most significant); thus, after extracting responses, the values were normalized first. Supposing that y_i be the variable related to question i in the questionnaire, then the normal variable will be calculated as follows:

$$X_i = \frac{100}{9} \times (Y_i - 1)$$

Accordingly minimum and maximum values of X_i will be zero and 100 respectively. Unanswered questions were replaced with the mean of ΣX_i.

Explanation of PLS Path Modeling Technique: Partial least square method, which is among conceptual approaches, is one of the multivariate statistical techniques using which, despite some limitations such as unknown response variable distribution, low number of observations and existence of serious correlation between independent variables, one can model one to several dependant variables simultaneously using several independent variables [13].

This method determines coefficients in such a way that the resulting model enjoys maximum interpretation and explanation power. In addition, PLS technique assesses all the mutual effects among latent variables (endogenous coefficients) and the weight of all measurable indices related to latent variables per case (exogenous coefficients) [13].

According to Chin’s theory, in PLS technique, parameter estimation is based on minimizing residual variance of independent variables. The first step to analyze the Structural Equation Model (SEM) is clearly defining a model that is a combination of a structural model and a measurement model [14]. For this purpose it is necessary to define the relations among model variables:

Relations of Manifest Variables and Their Respective Latent Variable: Each latent variable μ_{jh} is indirectly describable by a set of manifest variables X_{jh} and each manifest variable relates to its respective latent variable through a simple regression [15].

$$X_{jh} = \alpha_{jh}0 + \alpha_{jh}.\mu jh + \varepsilon_{jh}$$

μ_{jh} has a standard deviation of one.

Relations among Latent Variables: The model is a set composed by linear equations among latent variables. The overall form of the equations is as follows [15]:

$$\mu_j = \beta_{j0} + \beta_{ji}.\mu_j + \varepsilon_j$$

Considering the above formula, the linear equations among latent variables of the model will be as follows:

$Customer\ Expectation = \beta_{20} + \beta_{21}$ Image $+ \varepsilon_{20}$
$Percieved\ Quality = \beta_{30} + \beta_{31}$ Image $+ \beta_{32} Customer\ Expectation + \varepsilon_{30}$
$Percieved\ Value = \beta_{40} + \beta_{41}$ Image $+ \beta_{42}\ Customer\ Expectation$

$+\beta_{43}\ Percieved\ Quality + \varepsilon_{40}$
$ICSI = \beta_{50} + \beta_{51}$ Image $+ \beta_{52}\ Customer\ Expectation +$
$\beta_{53}\ Percieved\ Quality + \beta_{54}\ Percieved\ Value + \varepsilon_{50}$
$Customer\ Loyalty = \beta_{60} + \beta_{61}$ Image $+ \beta_{62}\ ICSI + \varepsilon_{60}$
$Customer\ Dialogue = \varepsilon_{70} + \beta_{71}$ Image $+ \beta_{72}\ ICSI + \varepsilon_{70}$

Having identified the above equations, using PLS Path Modeling Technique, all the coefficients and parameters can be estimated. For this purpose, many software applications such as LVPLS, VisualPLS, SmartPLS, PLS-GUI, PLS-Graph, SPAD-PLS and XLSTAT are developed [16]. In this study VisualPLS (vpls 1.4) was used to estimate the relations among latent variables.

The causal model depicted in Figure (2) shows the structural regressions of the model.

Model Validity: Diagnosis and validating a PLS Path Model entails two stages [14]:

- Validity or accuracy of structural model.
- Validity or accuracy of measurement model.
- Validity of structural model.

According to Chin's theory, R^2, that is just measured for endogenous variables and shows the variance of endogenous latent variables, can be interpreted as noticeable, average and weak for values of 0.67, 0.67-0.33 and less that 0.19 respectively. Also, in a specific model including endogenous latent variables with only one or two exogenous latent variable(s), average amount of R^2 is acceptable. In this study R^2 value ranged from 0.39 to 0.5 and its mean was 0.4954. Since the model is a combination of endogenous latent variable with only one exogenous latent variable the value of R^2 is acceptable [12].

Average redundancy of the model was estimated to be 0.18 that is equal to the output of some ECSI models [12].

Goodness of Fit (GOF) index of the model can be calculated as follows:

$$GOF = \sqrt{\overline{communality}} \times \sqrt{\overline{R^2}} = \sqrt{0.506} \times \sqrt{0.4954} = 0.4999$$

Since Q^2 of all endogenous latent variables are positive, it can be concluded that on average basis the indices of all the latent variables have been chosen correctly [17].

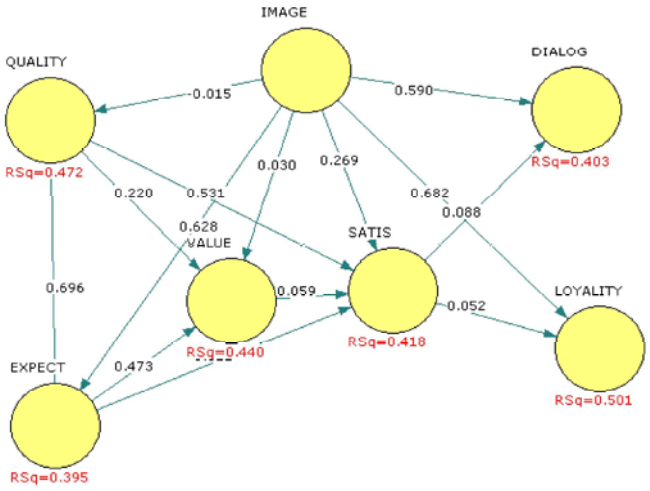

Fig. 2: ICSI causal model for Tile Industry

Table 3: Correlation Coefficients of Manifest and Latent Variables of the Model

Loyalty	Dialogue	Customer Satisfaction	Perceived Quality	Perceived Value	Customer Expectation	Image	
0.5627	0.4330	0.4563	0.2888	0.2981	0.4896	0.7497	Image1
0.5157	0.2645	0.3942	0.2184	0.0629	0.3341	0.7613	Image2
0.5667	0.5395	0.1642	0.1618	0.1959	0.3851	0.7621	Image3
0.2776	0.4179	0.2899	0.2986	0.4492	0.3406	0.5733	Image4
0.5031	0.4566	0.2985	0.3085	0.2743	0.6052	0.7444	Image5
0.6472	0.6021	0.3829	0.4277	0.4309	0.5366	0.7938	Image6
0.3668	0.4227	0.4786	0.5679	0.4846	0.8256	0.5005	Cus-Exp1
0.5957	0.4851	0.4264	0.6044	0.5900	0.8560	0.6183	Cus-Exp2
0.5280	0.5512	0.3246	0.5742	0.4757	0.8746	0.4757	Cus-Exp3
0.3271	0.1916	0.7596	0.8363	0.3867	0.5210	0.3596	Per-qua1
0.2274	0.2112	0.6442	0.8178	0.3594	0.4981	0.1877	Per-qua2
0.2249	0.2774	0.5205	0.7992	0.3234	0.4771	0.1959	Per-qua3
0.2688	0.1796	0.1766	0.5713	0.4093	0.3708	0.1734	Per-qua4
0.3014	0.3758	0.2333	0.4386	0.4076	0.2582	0.4428	Per-qua5
0.4534	0.2701	0.0518	0.4850	0.2366	0.4313	0.3003	Per-qua6
0.2538	0.1315	0.1475	0.5916	0.4836	0.6080	0.3024	Per-qua7
0.0107-	0.2247	0.3185	0.3933	0.6607	0.2500	0.0668	Per-val1
0.2422	0.3088	0.2477	0.3462	0.7247	0.2778	0.2976	Per-val2
0.1666	0.1912	0.3012	0.5161	0.7662	0.4830	0.1665	Per-val3
0.2223	0.3770	0.1584	0.3236	0.7729	0.6216	0.3327	Per-val4
0.5238	0.4916	0.2254	0.4042	0.7110	0.5978	0.5374	Per-val5
0.3713	0.3303	0.7408	0.3713	0.1975	0.2665	0.3444	Cus-sat1
0.4925	0.2664	0.8281	0.4925	0.4063	0.4341	0.4174	Cus-sat2
0.6212	0.2525	0.8574	0.6212	0.2150	0.4602	0.3487	Cus-sat3
0.3190	0.7054	0.1265	0.0963	0.0937	0.2779	0.2509	Dialogue1
0.2757	0.7484	0.1977	0.1668	0.1777	0.2786	0.3017	Dialogue2
0.3475	0.6820	0.0852	0.3089	0.2188	0.3796	0.2526	Dialogue3
0.3164	0.6262	0.3557	0.3130	0.2855	0.4782	0.4445	Dialogue4
0.2712	0.4975	0.3371	0.1736	0.3179	0.1033	0.4338	Dialogue5
0.5858	0.7716	0.2458	0.1180	0.3102	0.4745	0.4975	Dialogue6
0.4948	0.7295	0.1585	0.2771	0.4818	0.5212	0.6068	Dialogue7
0.3887	0.5839	0.2468	0.2681	0.2747	0.4113	0.3017	Dialogue8
0.8958	0.5101	0.3359	0.3746	0.2559	0.5061	0.6866	Loyalty1
0.2953	0.1944	0.2280	0.1276	0.0712	0.0471	0.1514	Loyalty2
0.7412	0.4423	0.1393	0.2888	0.3232	0.5311	0.4665	Loyalty3
0.0406-	0.0554	0.1551	0.0368	0.0216	-0.2436-	0.0489	Loyalty4

Validity of Measurement Model: In this Section, Three Categories Were Evaluated

1.Single Dimensionality of Indices: Single-dimensionality of indices was measured using Cronbach's alpha coefficient. Cronbach's α coefficient is a measure for internal consistency. If the coefficient is more than 0.7 the reliability of the model is high and if the coefficient is smaller than 0.6 the model has low reliability. Although Cronbach's alpha coefficient for loyalty index is less than 0.6, but the average of Cronbach's á coefficients of the model is higher than 0.7, showing that the reliability of the model is confirmed in general. Also, considering the low correlation of Loyalty with its respective variable, that is less than 0.4 (Table (3)), this index should be excluded from the model [17].

2.Controlling explanation power of indices by their respective latent variables: In this Study All the Three Indicators of Explanation Power of Latent Variables Were Estimated.

A:Communality: The average of communality that describes the power of explanation of an index by its latent variable was estimated to be 0.5046 in this research. If communality value exceeds residual variance, high explanation power is confirmed [12]. With regard to the output of the model the power of explanation is confirmed.

B:Composite Reliability: Composite Reliability, also called Composite Reliability Criterion, is the criterion of the reliability of the model. If the value is less than 0.6 the model lacks reliability. The value of this criterion related to the model estimated in this study is much higher than 0.6, which shows the high reliability of the model [17].

C:AVE: To calculate the convergent validity, Fornell and Larcker suggested AVE. If in AVE the least amount equals 0.5, the indices enjoy good convergent validity. This means that a latent variable is able to explain more than half of its parameter variances (manifest variables) on an average basis. The AVE of the model is higher than 0.5; so the convergent validity of the model is confirmed [17].

Evaluation of Distinction of Latent Variables: In order to evaluate the distinction of latent variables or divergent validity of the model there are two criteria: Fornell-Larcker and Cross Loading. In this study Cross Loading criterion was used. Based on this criterion, correlation coefficient of an index (manifest variable) with its respective latent variable is to be larger than that of the index with other latent variables. With regard to Table (3) it was found that three indices Per-qua5, Per-qua7 and Loyalty4 lack the necessary standard and therefore should be excluded from the model. But in other cases divergent validity of the model is confirmed [17].

On the other hand, regarding the foreign model table in Appendix 1, considering that the weights of the manifest variables of the model are all positive, all measurement indices correctly explain their respective latent variables.

Also, according to Figure (2) it can be observed that the variables image and perceived quality have high impact on customer satisfaction index in Iranian tile industry. However, customer satisfaction has been mostly affected by perceived quality (0.531). Image variable (0.296) followed perceived quality in affecting customer satisfaction. Customer expectation and perceived value had not much effect on customer satisfaction.

Customer loyalty is an important factor in tile industry and is mostly affected by image (0.682).

Customer dialogue is affected by customer satisfaction and image, but the share of "image" is much noticeable (0.59). Yet, customer dialogue has no direct effect on customer loyalty.

Concluding Remarks: In recent years, customer satisfaction index has been evaluated and measured in different countries across organizations, industries and even at national level. Unfortunately, this index has not been seriously studied in Iran so far. In this research first of all the most valid and significant models were studied and then a suitable model was devised for measuring customer satisfaction index in Iranian tile industry. Finally, customer satisfaction index in Iranian tile industry was measured 54%.

Also, for the first time in Iran, PLS Path Modeling was used in this research for measuring customer satisfaction index. PLS is a statistical method to analyze latent variables of structural models. Unlike methods such as LISREL, PLS aims at finding latent variables to predict the desired goals using measurable indices. Given the various indices offered for controlling the model, PLS is one of the best methods for measuring structural models including customer satisfaction index models.

Given the importance of customer satisfaction index, the model presented in this study can be used as a basic model adoptable by governmental and private institutions and organizations in this industry after due researches.

Appendix 1: Latent and Manifest Variables of the Model

Row	Latent variables	Manifest variables
1	Image	Does the industry seem to be innovative and progressive?
		Is the industry flexible enough to offer newer services?
		Are customers important for the organizations?
		Whether the status of warranty, guarantee and after sales services of suppliers are satisfactory?
		Are the suppliers and organizations active in tile industry reliable in terms of reputation and sustainability?
		Are supplying organizations in tile industry basically bound by their moral obligations?
2	Perceived quality (including both software and hardware parts)	Do the performance and functionality of goods and services consistent with your demands?
		Do the performance and functionality of goods and services enjoy the demanded reliability and precision?
		Do the goods or services conform to the determined quality standards?
		Are the services associated with the products including technical documentation, behavior of sales staff, etc. appropriate?
		Do most of the time the delivery of goods or services match your needs?
		Does the product range offered by the supplier meet your demands?
		Are you satisfied with information procedure of suppliers' organizations in tile industry including advertisement, training courses, technical meetings, etc.?

Appendix 1:Continued

3	Perceived value	Are the current prices of goods and services satisfactory?
		Do the payment terms for goods and services satisfy you?
		Are the percentages of discount of goods and services satisfactory?
		Assuming that your ordered product had enjoyed the expected quality, was the price suitable?
		Assuming you had purchased products proportionate with your budget, was you satisfied with the quality of products?
4	Customer expectations	Are your personal expectations from the purchased goods or services generally fulfilled?
		Has the supplier of goods met your quality expectation to make you a loyal customer?
		Has your expectation of goodness of supplied products or services been satisfied?
5	Customer Satisfaction	Does the current state of Iranian tile industry satisfy you?
		Are customers' quality expectations addressed?
		Does your purchased service or product match your ideal service or product?
6	Customer Relationship	If you need to complain, how much do you follow up your complaint through the supplier's staff?
		If you need to complain, how much do you follow up your complaint through supplier's management?
		If you need to complain, how much do you submit your complaints to the supplier?
		If you ever made a complaint to your supplier, were you satisfied with the supplier's responding procedure?
		Is there a reliable and easy channel to inquire customers' remarks in the organizations active in tile industry?
		Suppose you intend to lodge your complaint with your supplier, how much do you think the supplier shall notice your complaint?
		Are you satisfied with your communication with your suppliers?
		Basically, how much are you inclined to communicate with your suppliers?
7	Customer Loyalty	If you need to buy an item similar to the previous one, how much do you want to purchase it from your previous supplier?
		Imagine your supplier decides to increase prices, while other suppliers are not to do so. What is your tolerance of price difference for changing your supplier?
		Do you recommend purchased goods or services to others? Regarding the goods and services, do you feel inclined to change your supplier?

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