

## Cross National Study for Potential Consumers' Expected Quality Attributes of Smart Home Products

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### *Abstract*

*Predicting potential consumers' expected quality attributes is essential for any business to know the level of their customer expectations in order to set and improve the products and service based on customer need. The purpose of this study is to research on the factors that affect the expectation of customers for quality from a smart-home products. The data had been collected from 450 people of the students in Taiwan and Thailand and analyzed by 1-way ANOVA and Multiple linear regression in Statistica 10. The results indicate that the differences of nationality and age lead to the different results of customer expectation in quality of smart home products. This results will provide useful guidelines for planning and setting future strategies for improving business plans of Smart home products to fit customers' demands.*

**Key Words:** *Smart Home, Service Quality, Customer Behavior.*

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### **Introduction**

Technology has a crucial role in people's daily life. People have adapted various technologies to make their life easier and more comfortable. For example, people have recently changed their perception of smart homes. They once thought that smart-home systems are extravagant and unnecessary. However, the target market for smart-home systems has shifted from high-class to middle-class consumers because of the growing demand for comfortable and secure lifestyles. To meet this demand, smart-home systems have become compact to facilitate installation and decrease cost.

The concept of a "home automation system" or smart home has become popular since its introduction (Li, Hathaipontaluk, and Luo, 2009). A smart home is a kind of accommodation that can be automatically controlled from any location. The integration of technology into a dwelling can be divided into two types (Pullen, 2015). The first type is application based, which is characterized by usage function, for example, the installation of systems for lighting control, security, and temperature control. The second type is technology based, which is characterized by the installation of wired or wireless control systems such as Wi-Fi and Bluetooth. Each device will be connected and controlled via the Internet or other networks. For example, the user can open or close doors by using a mobile phone. Owing to its friendly interface, this

system can provide many solution modes, such as energy saving mode, scenario mode, security mode, to increase the comfort and security of the residents (Lia and Yu, 2011).

The whole world is currently in the era of Internet connection. As proven by the rapid increase in the number of electronic devices, many customers have shown increased interest in technology (Zickuhr and Smith, 2012). Smart-home businesses have become one of the most popular business models of present and future technology. The market for smart homes has expanded because the prices of smart-home devices have decreased, thus engaging middle- and lower-class customers. Furthermore, the adoption of Big Data has stabilized and secured information storage. In 2016, more than 80 million smart-home devices were installed all over the world (Olick, 2017). Kay (2017) claimed that the market for smart homes in Asia is expected to reach \$115 billion by 2030.

Smart-home businesses sell smart-home products and provide installation and maintenance services for these products. Smart-home businesses provide services throughout the entirety of the smart-home product's lifetime. Therefore, studying customer behavior is necessary because each customer has different demands. Providing accurate information to the customer will help them decide what product they exactly need. Therefore, this study aimed to investigate the factors that affect customers' demands for smart homes.

## Literature Review

### Service Quality

Service quality is important to marketers because the expectation and evaluation of service quality reflects the satisfaction of a customer for a product or service (Emel, 2014). Satisfaction consequently encourages repurchasing. In other words, service quality can be used as an indicator of business success (Iacobucci and Ostrom, 1995).

Parasuraman, Zeithaml, and Berry (1985) stated that a service quality model (SERVQUAL) is based on customer recognition, which occurs when customers compare their expectations and the reality they earn from products or services. The SERVQUAL is measure in five components which are tangibility, reliability, responsiveness, assurance, and empathy

The SERVQUAL model is widely used not only for research purposes or academic literature but also for practical marketing research in many industries (Ladhari, 2009). Therefore, by identifying the service quality factors prioritized by customers, SERVQUAL is the key to developing service strategies that meet customers' expectations. Businesses today cannot survive without delivering excellent service quality (Saravanan and Rao, 2007).

### Customer Behavior

Customer behavior indicates activities that one performs while consuming and purchasing goods and services (Belch and Belch, 1990); (Blackwell, Miniard, and Engel, 2001). Consumer behavior is about how people buy, what, where, when, and why they buy each product or service. Consumer behavior can help the better understanding about buyer decision making process, and buyer decision processes (Sultana, Siddique, and Islam, 2015).

### Factors that Affect Customers' Behavior

The factors that affect customers' behavior are indicative of the various needs of customers. To motivate target customers effectively, businesses should present marketing stimulations or other stimuli to customers that make them think about their exact needs. The seller and marketer have to identify specific stimuli for

different customers. However, stimulators are difficult to predict. Schiffman and Kanuk (2007) confirmed that identifying stimulators can help the seller or marketer attract customers from a target market. Kotler (2005) and Lautiainen (2015) claimed that nationality, sex, age, educational background, and income considerably influence the customer's decision-making process.

## Hypothesis

Taiwan is a developed country with numerous high-technology industries (Chan, 2009). Moreover, the freedom of mass communication, economic, public health, education, and human resource development of Taiwan are highly ranked (Yao, Cheng, and Cheng, 2008). Lands and residential areas in Taiwan are costly given that it is smaller with fewer national resources than Thailand. Thus, the Taiwanese people have to manage their residential areas as effectively as possible. The Taiwanese people emphasize products and services for their accommodations. In the same way, Min and Khoon (2013) suggested that the differences of nationality can motivate the different evaluation of service quality among individual. Thus, the following hypothesis was formulated:

Hypothesis 1: The expectations of Taiwanese people for service quality (SERVQUAL) are higher than those of Thai people.

Physical differences among males and females result in the belief that males and females are different in other aspects, such as knowledge, skills, abilities, mindsets, and emotions (Mokhlis and Salleh, 2009). Carpenter, Nathanson, and Kim (2009) claimed that males and females have highly different mentalities and attitudes. Females are more susceptible and are more easily persuaded than males. Males are more rational and have better memories than females. Kadjevich (2000); Li and Kirkup (2007) stated that males prefer new technology, which they understand faster than females. Thus, the following hypothesis was formulated:

Hypothesis 2: The expectations of males for the service quality (SERVQUAL) provided by a smart-home company are higher than those of females.

Age is a factor that causes variations in human thought, attitude, and product or service selection through different life experiences (Vipul, 2010; Sharma and Antil, 2013). Young people prefer trying new technology and use more technology compared with the old people (Chris and Binhui, 2011). They do not prioritize product and service quality and more likely to choose cheap products (Dotson, 2001). By contrast, older people prefer high-quality products that are safe and user-friendly. They are happy to pay more for excellent service (Moschis, Sneath, and Mathur, 1995). Thus, the following hypothesis was formulated:

Hypothesis 3: The expectations of older people for the service quality (SERVQUAL) of a smart-home company are higher than those of younger people.

People from different educational backgrounds will also have different expectations for products and services (Felder and Brent, 2005). Civil engineers who have better knowledge and understanding of smart-home devices will require smart-home products and services with high quality compared with people in other careers who select smart-home devices on the basis of comfort. Thus, the following hypothesis was formulated:

Hypothesis 4: The expectations of Engineer students for the service quality (SERVQUAL) of a smart-home company are higher than those of Management students.

Individual income influences one's buying decision. The level of income affects buying ability and perspective among customers (Solomon, 2004). People who can earn lower income tend to be more interested in essential product for their living rather than luxury brands (Ioană and Stoica, 2014). Individuals with high income tend to choose products and services with higher quality than those selected by individuals with lower income, who focus on price and quantity (Mihic and Čulina, 2006). Thus, the following hypothesis was formulated:

Hypothesis 5: The expectations of high-income individuals for the service quality (SERVQUAL) of a smart-home company are higher than those of low-income individuals.

## Methodology

This research studied all of the related literature about customer behavior in order to develop and create a questionnaire which will be used to gather data from samples. The samples were from distributing the questionnaires directly to the students in Universities in Thailand and Taiwan due to enhancing the internal validity and reliability. The questionnaire is made in 3 languages which are English, Mandarin and Thai. The questionnaire consists of 2 parts. The first part is service quality (SERVQUAL) which is the widely acceptable theory in order to evaluate the quality of service show in table1. There are 40 questions in this questionnaire which are 8 questions of tangible (Q1-Q8), 8 questions of reliability (Q9-Q16), 8 questions of responsiveness (Q17-Q24), 8 questions of assurance (Q25-Q32) and 8 questions of empathy (Q33-Q40). In part 2 is the personal information which are sex, age, nationality, occupation, faculty, year and income.

### Multiple Linear Regression

Multiple linear regression is the relationship between one Dependent variable and more than one Independent variables according to the equation.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5$$

Y	Service quality
X <sub>1</sub>	Nationality
X <sub>2</sub>	Age
X <sub>3</sub>	Gender
X <sub>4</sub>	Major
X <sub>5</sub>	Income
β <sub>0</sub>	Coefficient

### Sample

The questionnaires were distributed to 450 samples and received a total of 446 questionnaires which are 99.1%. The questionnaire has been created by the criteria based on personal factors which are nationality, gender, age, education and income.

### Analysis and Results

The experiment of hypothesis of this study are analyzed by 1-way ANOVA and Multiple linear regression in Statistica 10 based on samples which consists of nationality, gender, age, education and income. If they occur the value of differences, this value will be test pair by pair by the method of Scheffé and Pearson Correlation Coefficient (alpha) at 95%. The values will be accepted when their significant (p) are less than 0.05.

Hypothesis 1: The expectations of Taiwanese people about service quality (SERVQUAL) are higher than Thai people.

Table 1: the comparison between nationality and the expectations of service quality in smart home.

	SS	DF	MS	F	p
Intercept	8068.730	1	8068.730	97012.860	0.000*
Nationality	0.941	1	0.941	11.310	0.001*
Error	36.928	444	0.083		

\*p < 0.05

Table 2: the number of samples, mean, standard deviation and standard error of the expectations of service quality in smart home based on nationality.

Nationality	N	Mean	Std. Dev.	Std.Err
Thailand	243	4.224	0.227	0.014
Taiwan	203	4.317	0.348	0.024
Total	446	4.266	0.292	0.014

Table 1 depicts the comparison between nationality and the expectations of service quality in smart home demonstrates that the difference of nationalities can lead to the difference of expectations of service quality in smart home. The expectation of Taiwan students is 4.317 higher than the expectation of Thai students which is 4.224 shown in table 2.

Hypothesis 2: The expectations of male people about service quality (SERVQUAL) in smart home company are higher than female.

Table 3: the comparison between gender and the expectations of service quality in smart home.

	SS	DF	MS	F	p
Intercept	8089.523	1	8089.523	95036.810	0.000
Gender	0.076	1	0.076	0.890	0.346
Error	37.793	444	0.085		

Table 4: the number of samples, mean, standard deviation and standard error of the expectations of service quality in smart home based on gender.

Gender	N	Mean	Std. Dev.	Std.Err
Male	237	4.254	0.295	0.019
Female	209	4.280	0.288	0.020
Total	446	4.266	0.292	0.014

According to the table 3 and 4, it shows that there is no significant value between the expectations of service quality in smart home between male and female. The expectations of service quality in smart home of male is 4.254 and 4.280 for female.

Hypothesis 3: The expectations of older people about service quality (SERVQUAL) in smart home company are higher than younger people.

Table 5: the comparison between age and the expectations of service quality in smart home.

	SS	DF	MS	F	p
Intercept	1602.781	1	1602.781	19079.890	0.000*
Age	0.655	2	0.328	3.900	0.021*
Error	37.214	443	0.084		

\*p < 0.05

Table 6: the number of samples, mean, standard deviation and standard error of the expectations of service quality in smart home based on age.

Age	N	Mean	Std. Dev.	Std.Err
Less than 20 years old	39	4.234	0.380	0.061
20 – 25 years old	394	4.262	0.276	0.014
More than 30 years old	13	4.483	0.374	0.104
Total	446	4.266	0.292	0.014

According to the table 5 and 6, the comparison of ages that affect the expectation of service quality in smart home shows that different ages significantly lead to different service quality in smart home expectation at 0.05 statistic point. Then the researcher finds the value of differences by pairing of Scheffé method shown in the following table.

Table 7: the result of paring by the method of Scheffé divided by age.

Age	Mean	{1}	{2}	{3}
Less than 20 years old {1}	4.234	-		
20 – 25 years old {2}	4.262	0.834	-	
More than 30 years old {3}	4.483	0.028*	0.027*	-

\*p < 0.05

From table 7 the result of paring by the method of Scheffé divided by age show that the expectation of older people higher than the expectation of younger people. The expectation value of the samples who are older than 30 years old is at 4.294, while the samples are between 20 to 25 years old is at 4.262 and the samples whose ages are less than 20 years old is at 4.234.

Hypothesis 4: The expectations of Engineer students about service quality (SERVQUAL) in smart home company are higher than Management students.

Table 8: the comparison between education background and the expectations of service quality in smart home.

	SS	DF	MS	F	p
Intercept	165.745	1	165.745	1957.696	0.000
Major	0.363	2	0.182	2.144	0.118
Error	37.506	443	0.0847		

Table 9: the number of samples, mean, standard deviation and standard error of the expectations of service quality in smart home based on education background.

Major	N	Mean	Std. Dev.	Std.Err
Construction Engineer	221	4.238	0.284	0.019
Management	224	4.294	0.298	0.020
Others	1	4.400	-	-
Total	446	4.266	0.292	0.014

Table 8 shows the comparison of samples which have different educational background. There is no significant value of the expectations of service quality in smart home between construction engineering students and management students. In this case, the researcher didn't count another student from the different faculty because the amount of this sample is too less to evaluation.

Table 9 shows the expectation of service quality in smart home. The expectation value of management students is at 4.294, while construction engineering students' come closely at 4.238. In the other word, there is only 0.056 differences between these two groups of samples.

Hypothesis 5: The expectations of higher income people about the quality of service (SERVQUAL) in smart home company are higher than lower income people.

Table 10: the comparison is between income and the expectations of service quality in smart home.

	SS	DF	MS	F	p
Intercept	4000.690	1	4000.690	46857.440	0.000
Income	0.216	4	0.054	0.630	0.639
Error	37.653	441	0.085		

Table 11: the number of samples, mean, standard deviation and standard error of the expectations of service quality in smart home based on income per month.

Major	N	Mean	Std. Dev.	Std.Err
Less than 300\$	250	4.258	0.292	0.018
300\$ - 450\$	66	4.269	0.271	0.033
451\$ - 600\$	38	4.239	0.215	0.035
601\$ - 990\$	74	4.286	0.310	0.036
More than 990\$	18	4.354	0.418	0.098
Total	446	4.266	0.292	0.014

From table 10 and 11 found that there is no significant value between income and the expectations of service quality in smart home.

Table 11 demonstrates that the expectation about service quality in smart home of samples which have more than \$990 income comes in the first place at the value of 4.354. Following samples closely by those who earn \$601-\$990, \$300-\$450, those who can earn less than \$300, and those who can earn \$451-\$600 at the statistic value of 4.286, 4.269, 4.258, and 4.239 respectively.

**Multiple Linear Regression**

Table 12: the  $R^2$ -value of multiple linear regression analysis test with relationship between customer behavior and service quality

	R	$R^2$	Adjusted $R^2$	p
Result	0.193	0.037	0.026	0.005*

Table 13: the result of multiple linear regression analysis test with relationship between customer behavior and service quality

	B	Std.Err.	Beta	t	p
Intercept	4.216	0.023	-	183.675	0.000*
Nationality	0.076	0.030	0.131	2.541	0.011*
Age	0.212	0.010	0.122	2.128	0.034*
Gender	0.007	0.028	0.012	0.248	0.804
Major	0.017	0.030	0.030	0.584	0.559
Income	-0.061	0.086	-0.041	-0.708	0.479

According to table 12, customer behavior has significant relationship with service quality at the 0.05 statistic points which R,  $R^2$ , and Adjusted  $R^2$  equal to 0.193, 0.037, and 0.026 respectively.

From table 13, nationality and age have relationship with service quality at 0.05 statistic points which the values of p are 0.011 and 0.034. The test result by the method of Multiple linear regression analysis is as exactly same as the results from 1-way ANOVA which can be written down into the flowing equation

$$Y = 4.216 + 0.076X_1 + 0.212X_2 + 0.007X_3 + 0.017X_4 - 0.061X_5$$

- Y Service quality
- $X_1$  Nationality
- $X_2$  Age
- $X_3$  Gender
- $X_4$  Major
- $X_5$  Income

**The Conclusion of the Hypothesis**

Table 14: the result of hypothesis

Hypothesis	Result
<b>H1:</b> The expectations of Taiwanese people about service quality (SERVQUAL) are higher than Thai people.	Accept
<b>H2:</b> The expectations of male people about service quality (SERVQUAL) in smart home company are higher than female.	Reject
<b>H3:</b> The expectations of older people about service quality (SERVQUAL) in smart home company are higher than younger people.	Accept
<b>H4:</b> The expectations of Engineer students about service quality (SERVQUAL) in smart home company are higher than Management students.	Reject
<b>H5:</b> The expectations of higher income people about the quality of service (SERVQUAL) in smart home company are higher than lower income people.	Reject



## Conclusion and Discussion

The differences of nationality lead to the different results of customer expectation in service quality of smart home business. The results from hypothesis 1 demonstrated that the expectation rate of service quality among Taiwanese is higher than Thais, due to the higher price of lands and residential area in Taiwan. In the other words, Taiwan has fewer national resources compared to Thais, that's the reason why they have to manage their residential areas as effectively as possible. Taiwanese usually expect high quality product and professional service in order to maximize the benefit of building a house within the limited land. In the other hands, Thai people prefer living their life based on the model of sufficiency which make them concern more about the benefit of products and the value of money spent on them, rather than service quality the company provide. Min and Khoon (2013) agreed with this statement and claimed that the differences of nationality can motivate the different evaluation of service quality among individual. That make the expectation of service quality among Taiwanese is higher than Thai.

According to hypothesis 2, the difference of gender has no significant to the results of customer expectation in service quality of smart home business. Due to smart home is considered to be one of the accommodation types which are mandatory for human being. That's why there has no significant difference between men and women. They both need the best products and service for their home. While Carpenter, Nathanson, and Kim (2009) argued different genders bring highly different in their attitude and the way they think. However, some researchers such as Brady and Cromn, (2001) and Oluseye (2009) agree with this result of hypothesis. They claimed that there is no significant about the expectation of service quality among different genders.

The differences of ages lead to the different results of customer expectation in service quality of smart home business. According to the hypothesis 3, the results demonstrated that samples who are older than 30 years old have higher expectation rate of service quality. People who are older than 30 years old need their house to be more comfortable and safe. They are willing to pay more for better products, services, and maintenances (Moschis, Sneath, and Mathur, 1995).

While younger people prefers new technology to quality or service. They know more about technology, and also, they are able to learn them faster (Chris and Binhui 2011). Dotson, (2001) concluded the point that younger generation is more likely to select the cheaper and newer product to try something new. That's why the expectation about service quality of older people is higher than younger's.

According to results about the hypothesis 4, the educational background has no significant differences for customer expectation in service quality of smart home business. The research of Gibbs, (2010) argued that people who have different an education background will also have the different of expectation on products and services. But in the results of this research, civil engineering students who can understand more about smart home system have the same expectation rate as business management students who lack of technical knowledge. Both groups wish for better product quality and service.

According to the hypothesis 5, the difference of income has no significant results of customer expectation in service quality of smart home business. Owing to this survey was taken by the groups of students, which most of their income are from their parents not their salaries. People have lower salary yet expected to have more income in the future tends not to worry about the factor of money spending for service quality. This result conflicts with the statements of Mihić and Čulina, (2006). They predicted that individual who can earn more income tend to select the higher quality product and services compared to those who can earn less who will be more consider on cost and quantity.

## Recommendations

### Recommendation for Companies

The research demonstrated that the average value of service quality equals 4.266 which are considered in the high level. It means the sample need good quality service. Due to smart home company doesn't provide only smart home products, but it also provides the service of installation, and maintenance. If only the company have good products, but lack of the proper service, the company will not definitely be success. Therefore, the emphasizing of service quality since the process of being a consultant, installing, inspecting, to maintaining is essential. This research also found that the differences of nationalities and ages affect the expectation on service quality differently. The company needs to consider these factors in order to effectively reach and engage more customers.

### Recommendation for Future Research

Owing to the limited time and human resource, most samples of this study never have experiences of choosing home products and services because they never buy a house by themselves. Therefore, the research results can show only the expectation of the customer in the future. The research will be more tangible if it has more samples have direct experiences of choosing home products and services. For the future study, it will be better if the researcher can study more specifically in each factor that affects the customer buying decision, such as price, quality, customers' need, in order to adapt the result for the business.

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