# A Study on Consumer Perception towards Adoption of 4G Mobile Technologies in Rwanda

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**Abstract**

Consumer adoption process affects the success or failure of products in service industry. Though 4G technology is gaining an increasing importance in developed countries, there are various factors that will affect the acceptance of 4G technology in developing country like Rwanda. Over 2G technologies, 3G technology is well accepted by the Rwandan youths and service sector employees for its benefits like speed, price, and service availability etc. This study is conducted to understand to understand the interplay of factors involved in the adoption process of 4G technologies in Rwanda. This study was conducted on 150 consumers, who are 3G technology users, a cross sectional data was collected through structured questionnaire using interview method. Data collected was analysed using SPSS17 revealed the underlying factors like perceived benefits, perceived usefulness & perceived ease of handling, affects the adoption of 4G technology in Rwanda consumers.

*Keywords:* 4G technology; Convenience; Service Quality; Perceived Value; TAM.

## 1. Introduction

Mobile & internet has become the integral part of human life style. The development of smart phones and progressive development of internet technology & social media is resulting is development of dependency on mobile. Not only the teenagers or working class employees/servicemen, housewives, children & even the oldies are not rescued from this condition.

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The dependency on mobile is so high, that users can't control/tolerate their selves away from smart mobile phones as well a minute without internet data. Such situations are now a day termed as "NoMoPhobia", an addiction on mobile & internet usage.

The internet & mobile technologies were the technology development for improved communication, which has achieved, but the disadvantages are also growing along the technological development. Since this study is conducted on adoption of 4G technology, the disadvantage part is not included in study.

## 1.1 Internet & Communication Technology Development

Mobile communications systems are uniquely identified by its "generation" designations. First generation (1G) was introduced in the early 1980's, & second generation (2G) wireless communications systems was introduced in late 1980's, both the technologies were used mainly for voice transmission and reception.

General Packet Radio Services (GPRS) technology fuelled 2.5 & 3G technology in 2002, which was predominantly used for voice and paging services, as well as for teleconferencing, internet access, and other services. The 3G wireless systems provide only WAN coverage ranging from 144 kbps (for vehicle mobility applications) to 2 Mbps (for indoor static applications). The 4G wireless uses Orthogonal Frequency Division Multiplexing (OFDM), Ultra Wide Radio Band (UWB), ranging speed from 21mbps to 42 mbps. This higher speed allows the users to experience high speed internet browsing, hassle free online video streaming & gaming experience etc. 4G technologies are significant because users joining the network add mobile routers because the users carries much of the network with them, network capacity and coverage which can be dynamically shifted/shared to accommodate more number of users to access the data.

## 1.2 ICT Development in Rwanda:

Rwanda is the country situated at the heart of Africa, which is commonly known as "The Land of a Thousand Hills", has a population over 10 million. Rwanda's history of mobile telecommunication companies was pioneered by MTN Rwandacell which received a license in 1998 to provide GSM services for both post and prepaid consumers.

MTN's monopoly in Rwanda lasted for around 10 years, until when Rwandatel (80% owned by LAP Green networks of Libya) joined the Rwandan mobile market. Rwandatel's introduction of 3G networks before MTN could do; has quickly attracted subscribers reaching over 100,000 in less than 2 months of its introduction. By this time, revolution into Rwanda's mobile communication had just begun, with faster data communications and internet through handheld PCs and mobile phones [1].

Tigo was the telecommunication company 3rd to enter in the mobile communications market (owned by Luxembourg) which was licensed to carry operations by late 2009. Tigo did an intensive marketing (public transport buses & motorbikes, were promoted Tigo colors with overwhelmingly cheap call costs of 300Rwf per 24 hours) and rapid coverage of networks countrywide, Tigo could secured 1,523,825 as of November 2011.

**Table 1:** Rwanda Internet Usage and Population Statistics

| YEAR | Users | Population | % Penetration | GDP |
|------|-------|-----------|---------------|-----|
| 2000 | 5,000 | 10,400,000 | 0.50% | US$ 280 |
| 2011 | 818,048 | 11,689,696 | 7.00% | US$ 300 |
| 2014 | 1,110,043 | 12,337,138 | 9.00% | US$ 620 |
| 2015 | 3,216,080 | 12,661,733 | 25.40% | n/a |

**Source:** United Nations Department of Economic and Social Affairs.

As of 11 November 2014 Rwanda became the newest country to begin introducing 4G LTE services in its capital Kigali after months of testing. In April 2011, Rwandatel failed to meet licensee obligations such as coverage, planned investment targets and quality of service, its license was revoked by Rwanda's telecom regulator RURA. Late 2011 Bharti Airtel (Indian origin) secured a license to provide 2G and 3G cellular services.

## 2. Literature Review

Now since there is a good number of 3G subscribers, which is increasing significantly (Table No. 1), which indicates that the consumers' are willingness to adopt advance wireless technology which can provide them with more comprehensive utility than any other wireless services.

Reference [2] has conducted a study to identify the determinants of adoption of 3G mobile multimedia services and found that perceived usefulness, ease of use, price, and speed of use are the most important determinants of adoption of 3G multimedia mobile services. The importance of determinants differs by age groups or segments to some extent.

Reference [3] identified various other factors were like "Performance Expectancy", "Facilitating Conditions", "Social Influence", Attitude towards Technology Change & adoption, of 3G mobile telecommunication services, has positive influence towards "Behavioral Intention" and "User behavior",. Technology Acceptance Model (TAM), has been considered the most useful for predicting the usage of such technology.

This model provides the insight into those factors influencing acceptance of new technology in the context of consumers, as the described by reference [4], is based on construct and relationships in the Theory of Reasoned Action (TRA) [5, 6].

### 2.1 *Convenience*

Reference [7] mentions that 3G has brought higher mobility to the working people, enabling problem solving at anytime, anyplace. Ng-Kruelle defined convenience as 'how technology has made certain activities as easier'. Convenience also includes *mobility*, which refers to having access to real time information and communications.

## 2.2 Service Quality

Reference [8] studied that SERVQUAL has been widely used for evaluation of consumer services expectations & delivery. SERVQUAL, based on the disconfirmation paradigm, helps perform a gap analysis of an organization's service quality performance against customer service quality expectations.
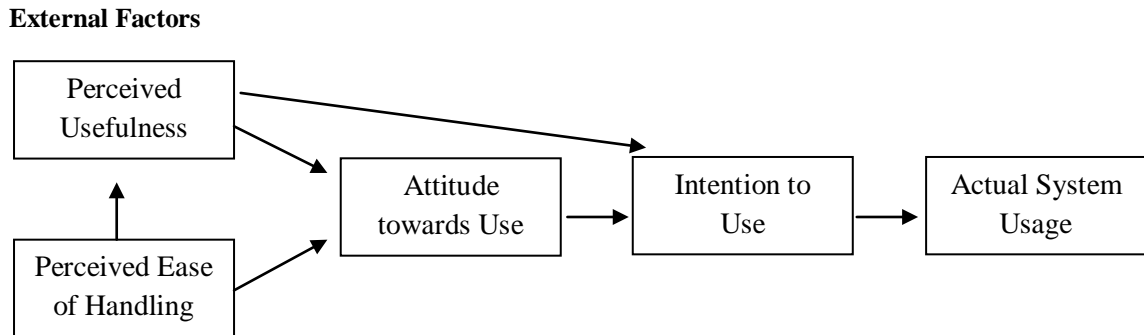
**External Factors**



**Figure 1:** Technology Acceptance Model (TAM)

## 2.3 Value

In the marketing research literature, perceived value has been suggested as one of the most important measures contributing to consumer purchase intention as per reference [9, 10]. Reference [9] proposed to consider consumer value to be regarded as a source of competitive advantages because it is a better way to increase profitability than quality and satisfaction management.

## 2.4 Price

Objective price and perceived price are the two types of price most commonly used in the literature [11, 12]. Perceived price is the comparison between objective price and reference price. It is the customer's perceptual representation or subjective perception of the objective price of the product or service [12]. Studies suggest that use of perceived price is more suitable in marketing research than objective price [13].

## 2.5 Perceived Usefulness (PU)

 In reference [14], the author hypothesized that behavioral intention (BI) of using a particular technology depends on the two factors, which are perceived usefulness and perceived ease of use (handling). The empirical findings of the study supported his hypothesis that there is a strong relationship between perceived usefulness and intention to use. Reference [15] authors studied two measurements (PU and PEOU), and found PU had a direct effect on usage behavior employing structural equation modeling (SEM), and not the PEOU.

## 2.6 Perceived Ease of Use (PEOU)

In reference [16], perceived ease of use has also been found to influence behavioral intention to use indirectly through perceived usefulness.

## 2.7 Attitude (ATD)

Most customers may have an attitude towards using newer technologies, which may be ranging from a very favorable to very unfavorable conditions. Many consumers today are likely to have been exposed to 3G mobile phones and have attitude to buy it. Many studies have shown the existence of such attitude and its influences on the using & trying of new technology [17, 18].
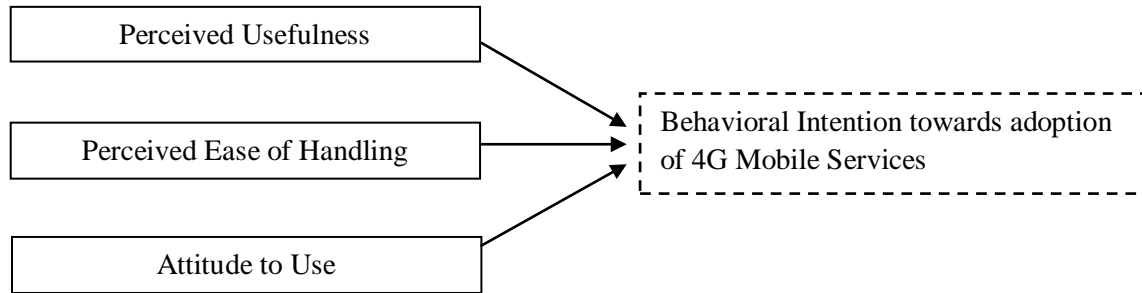


**Figure 2:** Conceptual Model

## 2.8 Behavioral Intention (BI)

Behavioral Intention is a measure to understand, if a person will adopt the service or not, while TAM represent a self-report measure of time or frequency of adopting the service. Some empirical studies also found to have a strong correlation between intention to engage in a behavior and actual behavior.

## 3. Research Methodology

The research was conducted in Kigali, Capital city of Rwanda on the samples aging between 20 years (College Students) to 35 years (service sector employees). A non probability method of sampling was used to select samples included for the study. A cross sectional data were collected through a structured questionnaire using interview method and analyzed by factor analysis, correlation and regression analysis using Statistical Package for Social Sciences (SPSS) version 17.

### 3.1 Objectives of the Study:

1)    To study awareness of 4G technology in mobiles & internet users in Rwanda

2)    To study the perception of mobile & internet users towards adoption of 4G technology in Rwanda

3)    To study the factors affecting behavioral intentions (BI) of mobile & internet users in Rwanda towards adoption of 4G technology

### 3.2 Hypothesis of the Study:

$H_1$: There is a significant relationship between Perceived Usefulness (PU) and Behavioral Intention (BI) towards adoption of 4G technology in Rwandan Consumers

**H$_2$**: There is a significant relationship between Perceived Ease of Handling (PEH) and Behavioral Intention (BI) towards adoption of 4G technology in Rwandan Consumers

**H$_3$:** There is a significant relationship between Attitude (ATD) and Behavioral Intention (BI) towards adoption of 4G technology in Rwandan Consumers

**H$_4$:** Price has no direct impact on Behavioral Intention (BI) towards adoption of 4G technology in Rwandan Consumers

## 4. Result & Discussion

The data collected from the respondents includes both demographic profile as well as the opinions related to behavior intentions to adopt 4G technology in Rwanda. The demographic profile of respondents is as shown in the following table.

**Table 2:** Demographic Profile of the Respondents

| Male | Female | Average Age | Students | Working | UG | PG | Others | Average period |
|------|--------|-------------|----------|---------|-----|-----|--------|----------------|
| 107 | 43 | 25.49 | 47 | 103 | 63 | 59 | 28 | Use of Mobile |
| 71% | 29% | | 31% | 69% | 42% | 39% | 19% | 4.3 years |

The demographic details of respondents reveal higher percentage (71%) of males & 69% of working class, with an average age of 25.49 years, having graduation and above educations. Some of the respondents (students) were having less than 1 years of mobile handling and use of internet technology while majority of the respondents were using mobile and internet technology from more than 2 years, the average period of use of mobile found to be 4.3 years.

### 4.1 Reliability of Data

Statistical outcome of study depends upon its collected data, to affirm the output of data analysis; a reliability test is required to be conducted. Cronbach's Alpha test gives the reliability of the data, where alpha coefficient value ranges between 0 & 1. If the alpha value is more than 0.8, the data is said to be reliable. Here in this study the data obtained from the survey found to have alpha value more than 0.7, hence we can consider that the data collected was reliable.

**Table 3:** Reliability of Data (Cronbach's Alpha Value)

| Factors under Study | No. of Items | Mean | Min. | Max. | Cronbach's Alpha |
|---------------------|--------------|------|------|------|------------------|
| Perceived Usefulness | | 3.224 | 1.46 | 4.231 | 0.822 |
| Perceived Ease of Handling | 150 | 2.967 | 1.56 | 3.983 | 0.801 |
| Behavioral Intentions | | 3.024 | 1.73 | 4.032 | 0.792 |
| Attitude | | 2.848 | 1.49 | 3.862 | 0.776 |

### *4.2 Factor Analysis*

The data obtained from the respondents on 4 factors under study were analysed using factor analysis method. The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy indicates the normality of the collected data. Kaiser recommends accepting values greater than 0.5, values in between 0.5 to 0.7 are mediocre, 0.7 to 0.8 are good, 0.8 to 0.9 are great & above 0.9 is superb. All the factors included in the study scored more than 0.5 of KMO value, hence all the factors included in the study. Eigen values obtained for Perceived Usage was (3.286) with 78.35% of variance, for PEH (3.096 & 69.648), BI (2.864 & 74.274) & for ATD was (3.266 & 63.458).

The statements included in the study under the four factors of the study obtained values more than 0.6 as can be seen from the table. The factor loading values obtained for the statements under Perceived Usage **(PU)** were Convenience of Use (8.22), Effectiveness of Use (7.84) & Connectivity (7.37). The factor loading values obtained for the statements under Perceived Ease of Handling **(PEH)** were Easy to Understand (0.814), Easy to Learn (0.793) & for Easy to Use (0.688). The factor loading values obtained for the statements under Behavioral Intentions **(BI)** are Willingness of use (0.841), Interested to use (0.811) & for Recommendation to others was (0.773). The factor loading values obtained for the statements under Attitude **(ATD)** were Status Showoff (0.756) & for To Test the Services (0.732).

### *4.3 Correlation Analysis of Variables*

Pearson correlations analysis was done with the factors under study to find the correlations between the variables and to identify the relationship between the dependent variables and the outcome of the study. The average score of the statements under the factors of study was used for correlation analysis and regression analysis. If the correlation coefficient value (r) ranges from 0.10 to 0.29 is considered weak, from 0.30 to 0.49 is considered medium and from 0.50 to 1.0 is considered strong. In this study the highest correlation coefficient value obtained was 0.488 which is less than 0.8, there is no multi-co-linearity problem in this research.

### *4.4 Multiple Regression Analysis*

Multiple Regression analysis was performed to test the hypothesis relationship between independent and dependent variables. Four hypotheses were proposed and results were enumerated in Table 4. The F-statistics produced (F = 31.487) was significant at 5 per cent level (Sig. F<0.05), thus confirming the fitness for the model.

**Table 5:** Model Summary

| R | R Square | Adjusted R Square | SE | F |
|---|---|---|---|---|
| 0.762 | 0.5807 | 0.578 | 5.6804 | 31.487 |
| F @ (4, 95) = 31.487, is Significant | | | | |

**Source**: Primary Data

Therefore, there is a statistically significant relationship between the four factors (Perceived Usefulness, Perceived Ease of Handling, and Attitude) and Behavior Intention towards adoption of 4G mobile technology.

The coefficient of determination $R^2$ was 58.07 per cent. Thus, the four factors can significantly account for 58.07 per cent towards adoption of 4G Mobile Technologies in Rwanda. (Table No. 5)

**Table 6:** Coefficients

| Factors under Study | UnStandardized Coefficient | | Standardized Coefficient | t | Sig. |
|---|---|---|---|---|---|
| | b | Std. Error | Beta (β) | | |
| Perceived Usefulness | 1.350 | 0.154 | 0.286 | 5.501 | 0.000* |
| Perceived Ease of Handling | 0.838 | 0.364 | 0.332 | (-) 1.697 | 0.0240 |
| Attitude | (-) 0.762 | 0.308 | (-) 0.250 | 2.574 | 0.000* |

**Source**: Primary Data

**Table 4:** Factor Analysis on variables under study

| Factors under Study | PU | PEH | BI | ATD |
|---|---|---|---|---|
| **Perceived Usefulness** | | | | |
| Convenience of Use | 0.822 | | | |
| Effectiveness of Use | 0.784 | | | |
| Connectivity | 0.737 | | | |
| **Perceived Ease of Handling** | | | | |
| Easy to Understand | | 0.814 | | |
| Easy to Learn | | 0.793 | | |
| Easy to Use | | 0.688 | | |
| **Behavioral Intentions** | | | | |
| Willingness of use | | | 0.841 | |
| Interested to use | | | 0.811 | |
| Recommendation to others | | | 0.773 | |
| **Attitude** | | | | |
| Status Showoff | | | | 0.756 |
| To Test the Services | | | | 0.732 |
| Kaiser-Meyer-Olkin (KMO) | 0.82 | 0.764 | 0.793 | 0.788 |
| Eigenvalues | 3.286 | 3.096 | 2.864 | 3.266 |
| Percentage of Variance Explained | 78.354 | 69.648 | 74.274 | 63.458 |
| Cumulative Percentage | 78.354 | 69.648 | 74.274 | 63.458 |

**Source:** Primary Data

### 4.5 Hypothesis Testing

**H[1]:** The first hypothesis stated was "There is a significant relationship between Perceived Usefulness (PU) and Behavioral Intention (BI) towards adoption of 4G technology in Rwandan Consumers", the data analysis (Table No. 6) revealed significant result ( $\beta$= 0.286; t = 5.501; p = 0.000*). Since at 5% level of significance, the p value obtained is 0.000*, which is < 0.05, this supports that, the adoption of 4G technology in Rwandan consumers has a significant relationship with the perceived usage of the technology.

**H[2]:** The Second hypothesis stated was "There is a significant relationship between Perceived Ease of Handling (PEH) and Behavioral Intention (BI) towards adoption of 4G technology in Rwandan Consumers", the data analysis (Table No. 6) revealed significant result ( $\beta$= 0.332; t = -1.697; p = 0.0240). Since at 5% level of significance, the p value obtained is 0.0240*, which is < 0.05, this supports that, the adoption of 4G technology in Rwandan consumers has a significant relationship with the perceived ease of Handling of the technology.

**H[3]:** The Third hypothesis stated was "There is a significant relationship between Attitude (ATD) and Behavioral Intention (BI) towards adoption of 4G technology in Rwandan Consumers", the data analysis (Table No. 6) revealed significant result ( $\beta$= - 0.250; t = 2.574; p = 0.000*). Since at 5% level of significance, the p value obtained is 0.000*, which is < 0.05, this supports that, the adoption of 4G technology in Rwandan consumers has a significant relationship with the Attitude of consumers of consumers towards the 4G technology.

**H[4]:** The Fourth hypothesis stated was "Price has no direct impact on Behavioral Intention (BI) towards adoption of 4G technology in Rwandan Consumers", the data analysis after t test obtained is as shown in Table No. 8, revealed significant result ( t= 33.707; df = 149; p = 0.000*). Since at 5% level of significance, the p value obtained is 0.000*, which is < 0.05, thus we can reject the null hypothesis & supports that, there is a direct impact of price on Behavioral Intention (BI) towards adoption of 4G technology in Rwandan Consumers.

**Table 7:** One Sample Statistics on Impact of Price on BI

| One-Sample Statistics | | | | |
|---|---|---|---|---|
| | N | Mean | Std. Deviation | Std. Error Mean |
| Price | 150 | 3.1467 | 1.14333 | .09335 |

**Table 8:** One Sample Test

| | Test Value = 4 | | | | | |
|---|---|---|---|---|---|---|
| | t | df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference | |
| | | | | | Lower | Upper |
| Price | 33.707 | 149 | .000 | 3.14667 | 2.9622 | 3.3311 |

**Source**: Primary Data

## 5. Findings of the Study

The research data was collected from 150 respondents of age group ranging between 20-35 years including students and service group of respondents revealed significant results on Behavior Intention (BI) of respondents towards adoption of 4G services in Rwanda.

1)      Since all the respondents are already using & enjoying 3G technologies, they were aware of 4G technology introduced in Kigali, Capital city of Rwanda.

2)      4G technology is considered to be a better option to present 3G technology, as the speed of internet, web browsing is not satisfactory to most of the respondents

3)      Irrespective of age & class of respondents, the factors under study i.e. PU, PEH, ATD & Price has shown a significant impact on Intention (BI) of respondents towards adoption of 4G services in Rwanda.

4)      Price has a major impact on adoption of 4G technology in Kigali city, as most of the respondents are students & as compare to 3G, they are expecting the new 4G technology will be not an economical affair for them.

## 6.   Recommendations

Since the factors under study found to have significant impact on Behavior Intention (BI) of respondents towards adoption of 4G services in Rwanda, the researcher suggests following recommendations to 4G services providers.

1)      The 4G service providers should provide more diverse and entertaining ways of communicating, which are at the same time easily accessible and convenient to use.

2)      A trial package should be provided with a limited data may be up to  1-2GB to the interested consumers as a demonstration of the 4G technology, which can create interest in the customers, looking in to speed & quality of network.

3)      The satisfied trial of the 4G technology may lead to word of mouth in Kigali for easy penetration in the market.

4)      Initially companies can provide some free bundle volume along with the weekly/monthly package to early bird consumers to attract large customer base.

5)      Consistency in the band width will improve the satisfaction of the customer, which will retain new old customers as well can attract more 3G users to join 4G technology.

## References

[1]     Sara Hennessy, Brown Onguko and Leonard Wamakote, "Developing the Use of Information and Communication Technology to Enhance Teaching and Learning in East African Schools: Review of the Literature", Centre for Commonwealth Education & Aga Khan University Institute for Educational Development – Eastern Africa Research Report No. 1, May 2010.

[2]     Pagani, M, (2004), *"Determinants of adoption of Third Generation mobile multimedia services"*, Journal of Interactive Marketing, 18(3).

[3]     Y. L. Wu, Y. Tao, and P. C. Yang, *"The use of unified theory of acceptance and use of technology to confer the behavioral model of 3G mobile telecommunication users"*, Journal of Statistics and Management Systems, Vol. 11, No. 5, pp. 919–949, October 2010.

[4]     Davis, Bagozzi, and Warshaw, "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models", Management Science Vol. 35, No. 8, pp. 982-1003, 1989.

[5]     Adams, D.A, Nelson, R.R & Todd, P.A., PU, ease of use and usage of information technology are application, MIS Quarterly, June 1992.

[6]     Dishaw and Strong, "Extending the Task Technology Fit Model with Self Efficiency Construct", Eighth Americas Conference on Information System, pp. 1021-1027, 2002.

[7]     Margherita Pagani, *"Determinants of adoption of Third Generation mobile multimedia services"*, Journal of Interactive Marketing, Vol. 18, No. 3, pp. 46-59, Summer 2004.

[8]     A. Parasuraman,  V. A. Zeithaml, and L. L. Berry, "A conceptual model of service quality and implications for future research",  Journal of Marketing , Vol. 49, pp. 41-50, Fall 1985.

[9]     Woodruff and Robert B, "Customer Value: The Next Source of Competitive Advantage" The Journal of Academy of Marketing Science, Vol.25, No. 2, pp.139-153, 1997.

[10]     A Parsuraman and Dhruv Grewal, "The Impact of Technology on the Quality-Value-Loyalty Chain: A Research Agenda", The Journal of Academy of Marketing Science, Vol. 28, No. 1, pp. 168-174, 2000.

[11]     Zeithmal and A. Valerie, "Consumer Perception of Price-Quality-Value: A Means End Model an Synthesis of Evidence", ournal of Marketing, Vol. 52, No. 3, pp. 2-22, January 1988.

[12]     J. Jacoby and J. C. Olson, "Consumer Response to Price: An Attitudinal Information Processing", in Moving Ahead with Attitude Research, Wind Yand Greenberg M (Eds), American Marketing Association, Chicago, pp. 73-86, 1977.

[13]     Dickson P. R. and A. G. Sawyer (1990), The Price Knowledge and Search of Supermarket Shoppers. Journal of Marketing, 54 (July), 42–53.

[14]     Chau, P.Y.K., & Hu, P.J. Information Technology Acceptance by Individual Professionals: A Model Comparison Approach, *Decision Sciences*, Vol. 32, No. 4, pp. 699-719, 2001

[15]     Subramanian, *"A Replication of Perceived Usefulness and Perceived Ease of Use Measurement"*, Decision Sciences, Vol. 25, No. 5-6, pp. 863-74. June 1994.

[16]     M.S. Norazah, T. Ramayah, and M. S. Norbayah, "Internet shopping acceptance: examining the influence of intrinsic versus extrinsic motivations", Direct Marketing: An International Journal, Vol. 2 No. 2, pp. 97-110, 2008.

[17]     J. Moon, and Y. Kim, "Extending the TAM for a World-Wide-Web context", Information and Management, Vol. 38, pp. 217-230, 2001.

[18]     L. R. Vijayasarathy, "Predicting Consumer Intentions to Use On-line Shopping: The Case for an Augmented Technology Acceptance Model", Information & Management, Vol. 41, No. 6, pp. 747-762, 2004.