
# Diagnosing TAM Using Factor Analysis

Zurena @ Rena Shahril[1], Mohd Salehuddin Mohd Zahari[1], Ida Rosmini Othman[2]

[1] Faculty of Hotel and Tourism Management,
[2] Faculty of Computer and Mathematical Sciences,
Universiti Teknologi MARA, 40450, Shah Alam, Selangor, Malaysia

zurenashahril@yahoo.com

## Abstract

Factor analysis using Principal Axis Factoring (PAF) extraction method and oblique rotation conducted to confirm the factor structure and unidimensionality of the constructs by extending the Technology Acceptance Model (TAM). This study examines responsiveness towards the actual usage of Malaysia's "Touch 'n Go" smart card amongst restaurant customers. Results discovered that two factors extracted from the three core determinants of customer responsiveness, in which dimensions such as awareness, brand Image, attitude and actual usage of the smart card remained due to the significant factor loadings. Replication of this factor analysis through further research is significant to customize the research framework.

Keywords: technology acceptance model, responsiveness, smart card, restaurants


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## 1.0 Introduction

Driven by advances and support of creative technologies, the range of payment products and services in the market is expanding in response to diverse market demands and shift to a completely new level of competency. The volumes and estimate of U.S. consumers' that use cash in payment transactions continually declining from year to year (Aite Group, 2011). It predicted four to seventeen percents of consumers using cash slightly drop more than USD 1 trillion per year between the year 2010 to 2015. Similar to the country known as "Land of the Rising Sun", the electronic payment market in Japan has grown rapidly from $6 billion to $22 trillion between year 2007 to 2012 (Nomura Research Institute, 2008).

Malaysia makes no exception in embarking on the electronic payments and this has become a part of the national agenda to increase the efficiency of the nation's payment systems which would ultimately improve the competitiveness of the economy. The Bank Negara Malaysia Governor, Tan Sri Dr Zeti Akhtar Aziz targets to raise the number of e-payment transactions per capita from 44 transactions in 2010 to 200 transactions by the end of 2020, which is comparable to the e-payment transactions per capita in the developed countries (Bank Negara, 2011).

Despite the tremendous amount of financial resources spent, government, bank institutions and non-commercial banks offered the e-payment services, the success rate of it has not commemorated with operators and the customer's awareness and actual usage. Smart card technologies and its level of acceptance have not been at its peak particularly in the Malaysia restaurant industry (Bank Negara, 2011).

It may be said that the future of smart card seems to be very bright, even more so in the case of Malaysia which is slightly lagging behind and has not yet reached saturation point, which is slowly being approached. Therefore, the Government, service providers and restaurant operators need to work together on an international platform to ensure specific standards are set, to truly level the smart cards playing field.

This study extends and empirically validate the Technology Acceptance Model (TAM) in predicting proposed "perceived trust", "perceived usefulness" and "perceived ease of use" as part of customer responsiveness towards the actual usage of Malaysia's "Touch 'n Go" smart card among the restaurant customers. The rational efficacy of TAM stems from the fact that electronic commerce through smart card is technology-driven as it contributes to the overall effort aimed at finding the most appropriate base for explaining the responsiveness of payment technologies in the restaurant industry.

## 2.0 Literature Review

### 1. Technology Acceptance Model

Adoption of novel technologies has been examined through the prism of numerous theoretical models, of which the widely supported technology acceptance model (Davis, 1989) stands out as the most appropriate (Huh, Kim, & Law, 2009; C. H. Lin, Shih, & Sher, 2007). Using the TAM as a theoretical foundation, this study's primary purpose is to examine the factors that impact the customers' actual usage of smart card in restaurants. As the

original TAM was designed to predict technology adoption in work-related settings (Davis, 1989), the model were revised and extended in this study to capture the context of customer responsiveness of smart card in restaurants.

**2. Perceived Trust**

Trust is the customer confidence that their money and personal information will not use against their personal interest. Even if we use an imperfect system, consumers want to believe that vendors, banks and credit card companies will not misuse their personal information (Abrazhevich, 2004). The other aspect is that customers should trust the payment system adopted by the other user. The existing literature points out that high level of user confidence and trust in EPS is a contributing factor for the successful adoption of e-payment systems (Kurnia and Benjamin, 2007). The higher the levels of consumer trust, the higher the degree of purchase intentions of consumers, and the easier it is to retain consumers.

**3. Perceived Usefulness**

Users' intention to use an information technology is predicated, to a large degree, on their perceived usefulness of the system (Davis et al., 1989). There is also a certain amount of empirical evidence in the mobile technology literature regarding users' intention to use mobile technology (Au & Kauffman, 2008; Mallat, 2007). Users will use m-payment systems when they find the system to be useful for their transaction needs or financial issues. Mozeik et al. (2009) found and concluded that the adoption of e-services in restaurants namely the conventional computing devices (i.e., desktop and laptop computers) was driven by perceived usefulness.

**4. Perceived Ease of Use**

Cooper (1997) identifies "ease of use" as one of the three important characteristics from the customer's perspective for adoption of innovative service. The adoption of e-services in restaurants such as mobile computing devices (i.e., BlackBerry Smartphones, Palm Pilots) was driven by perceived ease of use confirmed by Mozeik et al. (2009).

**5. Brand Image**

Brand image is important because it contributes to the consumer's deciding whether or not the brand is the one for him/her and it influences consumers' subsequent buying behavior (Johnson and Puto, 1987). A well-communicated brand image should help to establish a brand's position, insulate the brand from the competition, and enhance the brand's market performance (Keller, 1993; Feldwick, 1996; Park and Srinivasan, 1994).

**6. Awareness**

Adoption can be defined as the acceptance and continued use of a product, service or an idea. Consumers go through "a series of process in knowledge, conviction, decision and confirmation" before they are ready to adopt a new product or service and once the adoption or rejection of an innovation begins; the consumer becomes aware of the innovation (Rogers

and Shoemaker, 1971). Howard and Moore (1982) emphasized that adoption "consumers must become aware of the new brand."

## 3.0 Methodology

A self reported questionnaire derived the data information from 100 restaurant customers in the Klang Valley, Malaysia. Data was collected from the "Touch 'n Go" stipulated restaurants in the Klang Valley, Malaysia, namely Baskin Robins, Burger King, Dunkin Donuts, Starbucks and The Chicken Rice Shop. A 100 % response rate of the pilot was obtained for analysis. Factor analysis using Principal Axis Factoring (PAF) extraction method and oblique rotation conducted to confirm the factor structure and the unidimensionality of the constructs within the TAM.

## 4.0 Results and Discussions

### 1. Customer's Background Information

The respondents were customers from five participating restaurants namely Baskin Robins, Burger King, Dunkin Donuts, Starbucks, and The Chicken Rice Shop which consisted of 49 males (49.0%) and 51 females (51.0%). The majority of the customers (85.0%) were Malays and about half of them (52.0%) aged between 19 to 30 years of age. Most of the customers aware in terms of "Touch 'n Go" usage only in three outlets such as Highway Toll (88.0%), Parking (65.0%) and Public Transport (49.0%). They were only 22% of the customers had used "Touch 'n Go" card at Starbucks while for other restaurants, the usage were very minimum which was less than 10%.

### 2. Factor Analyses for Independent, Moderating, Mediating and Dependent Variables

The Kaiser-Meyer-Olkin (KMO) indexes of sampling adequacy for all factor analyses were explored to ensure the sufficiency of covariance in the scale items to warrant factor analysis. The Bartlett's test of sphericity was applied to each analysis to guarantee that the correlation matrix was not an identity matrix. KMO indices for all analyses were > .80, while almost all KMO values of individual items were > .52, which is above the acceptable limit of .50 (Field, 2009), except for one item independent variable. This item was then removed from the analysis. Bartlett's tests of sphericity for all analyses were sufficiently large with $p < .001$, indicating that the correlation matrices were not identity matrices.

A number of factors for each variable were accessed through parallel analysis where the eigenvalues from factor analysis were compared with the eigenvalues from Monte Carlo simulation. The number of factors was retained if the eigenvalues from factor analysis exceeded the simulated eigenvalues (Watkins, 2006). Results from parallel analysis in Table 2 indicate that three factors (Perceived Usefulness, Perceived Ease of Use and Perceived Trust) under customer responsiveness (independent variable) should be collapsed into two factors while for other variables (dependent, moderating and mediating), the structure maintain as they were.

Based on results from parallel analysis, factor analyses were then rerun using the constrained factors with oblique rotation. The results are presented in Table 3.

Table 1: Customer's Background Information

| Background Information | *n* | % |
|---|---|---|
| Gender | | |
| Male | 49 | 49.0 |
| Female | 51 | 51.0 |
| Age group | | |
| 19 – 30 | 52 | 52.0 |
| 31 – 40 | 31 | 31.0 |
| 41 – 50 | 11 | 11.0 |
| 50 and above | 6 | 6.0 |
| Race | | |
| Malay | 85 | 85.0 |
| Chinese | 9 | 9.0 |
| Indian | 4 | 4.0 |
| Others | 2 | 2.0 |
| *Aware of the Touch 'n Go usage in these outlets | | |
| Highway Toll | 88 | 88.0 |
| Theme Park | 2 | 2.0 |
| Movie | 16 | 16.0 |
| Medical and Healthcare | 1 | 1.0 |
| Public Transport | 49 | 49.0 |
| Parking | 65 | 65.0 |
| Restaurant | 26 | 26.0 |
| Retail | 9 | 9.0 |
| *Have experience using Touch 'n Go card at the following restaurants | | |
| Baskin Robins | 6 | 6.0 |
| Burger King | 5 | 5.0 |
| A & W | 2 | 2.0 |
| Dunkin Donuts | 1 | 1.0 |
| Pancake House | 1 | 1.0 |
| Starbucks | 22 | 22.0 |
| Station 1 | 2 | 2.0 |
| The Chicken Rice Shop | 6 | 6.0 |

*Note: This is multiple response questions. The percentage is based on the number of customers.

After rotation, customer responsiveness (independent variable) which had been constrained to a 2-factor solution, explained 47.8% of the variance with 13 out of 18 items exceeds the minimum cutoff load off .55 required for a sample of 100 hence, statistical significance. The two factor structures under customer responsiveness are named *Perceived Trust* and *Perceived Usefulness.* Factor loadings loaded in the second factor seems to contrast the first factor with correlation between factors was, $r$ = -.423.

On the other hand, different scenario happened to a moderating variable where the structure remains as two factors with 15 out of 17 items loaded to their original factors (i.e., brand image and awareness). The other two items were dropped from the analysis due to insignificant factor loadings. These two factors explained 48.5% of the variance with correlation between factors was, $r$ = .262.

Table 2: Result from parallel analysis

| Variable | Component Number | Actual eigenvalue from factor analysis | Criterion value from parallel analysis | Decision |
|---|---|---|---|---|
| Independent | 1 | 7.751 | 1.826 | ***Accept*** |
| | 2 | 1.890 | 1.649 | ***Accept*** |
| | 3 | 1.201 | 1.509 | Reject |
| | 4 | 1.139 | 1.403 | Reject |
| | 5 | .835 | 1.308 | Reject |
| Dependent | 1 | 3.161 | 1.283 | ***Accept*** |
| | 2 | .958 | 1.116 | Reject |
| Moderating | 1 | 6.483 | 1.805 | ***Accept*** |
| | 2 | 2.759 | 1.613 | ***Accept*** |
| | 3 | 1.473 | 1.492 | Reject |
| | 4 | .969 | 1.376 | Reject |
| Mediating | 1 | 5.973 | 1.562 | ***Accept*** |
| | 2 | 1.176 | 1.394 | Reject |
| | 3 | .732 | 1.271 | Reject |

Table 3: Factor analyses for Independent, Dependent, Moderating and Mediating Variables

| Variable | Factors and Items Included | Original Factor | Factor Loading |
|---|---|---|---|
| Customer's Responsiveness *(Independent)*<br><br>Correlation between factors, *r* = -.423 | *Perceived Trust* | | |
| | This card would instill the confidence in me when purchasing food | Perceived Trust | .730 |
| | This card would make me feel great to have one and able to enjoy its benefits | Perceived Trust | .675 |
| | This card would mean that I do not have to worry about taking too much cash with me | Perceived Ease of Use | .674 |
| | This card would be trustworthy in purchasing food | Perceived Trust | .641 |
| | This card would be easy for me to become skillful in purchasing food | Perceived Ease of Use | .635 |
| | This card would make purchasing food easier for me | Perceived Ease of Use | .602 |
| | This card would convince me the reliability in purchasing food | Perceived Trust | .578 |
| | This card would convince me the technology used in purchasing food | Perceived Trust | .551 |
| | ***Cronbach's alpha = .883, % variance explained = 40.4, Eigenvalue = 7.27*** | | |
| | *Perceived Usefulness* | | |
| | This card would make it easier for me to conduct cashless transactions | Perceived Usefulness | -.715 |
| | This card would enhance my effectiveness in purchasing food | Perceived Usefulness | -.714 |
| | This card would enable me to purchase more food quickly | Perceived Usefulness | -.704 |
| | This card would avoid the queue for payment at the counter | Perceived Usefulness | -.650 |
| | This card would be an alternate method of purchasing food | Perceived Ease of Use | -.615 |
| | ***Cronbach's alpha = .844, % variance explained = 7.45, Eigenvalue = 1.34*** | | |

| | | | |
|---|---|---|---|
| Post Purchase Behavior *(Dependent)* | *Post Purchase Behavior (PPB)* | | |
| | I will keep continue using this card in purchasing food | PPB | .946 |
| | I will use this card whenever available in purchasing food | PPB | .878 |
| | I am planning to use this card in purchasing food | PPB | .781 |
| | I would recommend the use of this card in purchasing food | PPB | .740 |
| | ***Cronbach's alpha = .902, % variance explained = 57.4, Eigenvalue = 2.87*** | | |
| Brand Image and Awareness *(Moderating)*<br><br>Correlation between factors, *r* = .262 | *Brand Image* | | |
| | This card would be a prestige symbol in purchasing food | Brand Image | .815 |
| | This card would be a brand that is keeping with my lifestyle | Brand Image | .813 |
| | This card would be a reputed brand in purchasing food | Brand Image | .786 |
| | This card would be a leading brand in purchasing food | Brand Image | .764 |
| | This card would be a brand I particularly like and find attractive in purchasing food | Brand Image | .743 |
| | This card would be a good reputation in purchasing food | Brand Image | .739 |
| | This card would possess a positive symbolic meaning in purchasing food | Brand Image | .697 |
| | This card would make me feel cool and fashionable | Brand Image | .591 |
| | This card would relate to the pleasant experience in purchasing food | Brand Image | .558 |
| | This card would make me feel important and wealthy | Brand Image | .557 |
| | ***Cronbach's alpha = .906, % variance explained = 35.4 , Eigenvalue = 6.01*** | | |
| | *Awareness* | | |
| | There are restaurants using this card as their means of payment by the customers | Awareness | .737 |
| | This card offers features and benefits in purchasing food | Awareness | .675 |
| | This card can be used in restaurants to purchase food | Awareness | .651 |
| | Payments can be made in purchasing food using this card | Awareness | .583 |
| | This card can conduct various applications | Awareness | .575 |
| | ***Cronbach's alpha = .781, % variance explained = 13.1, Eigenvalue = 2.22*** | | |
| Attitude *(Mediating)* | *Attitude* | | |
| | Using this card in purchasing food would be beneficial for me | Attitude | .815 |
| | Using this card in purchasing food would be convenient for me | Attitude | .797 |
| | Using this card in purchasing food would be a good idea for me | Attitude | .771 |
| | I am willing to use this card in purchasing food | Attitude | .756 |
| | I will probably use this card in purchasing food in the future | Attitude | .746 |
| | I will use this card on a regular basis in purchasing food | Attitude | .738 |
| | I like the idea of using this card in purchasing food | Attitude | .656 |
| | I will share my good experience about using this card in purchasing food | Attitude | .642 |
| | I intend to use this card in purchasing food | Attitude | .641 |
| | I will continue using this card in purchasing food | Attitude | .583 |
| | I will recommend to my friends to get this card in purchasing food | Attitude | .581 |
| | ***Cronbach's alpha = .915, % variance explained = 50.0, Eigenvalue = 5.50*** | | |

Note: 1) *Independent variable:* Five items were removed due to factor loading < .55

2)*Dependent variable:* Two items were removed from having KMO < .50 and factor loading < .55
3)*Moderating variable:* Two items were removed due to factor loading < .55

One-factor structure solution was seen in both dependent and mediating variables. The dependent variable, or known as post purchase behavior explained 57.4% of the variance with two items were removed from having low individual KMO and insignificant factor loading. Attitude towards using E-payments (mediating variable) managed to maintain all its 11 items with factor loadings > .55. The variance explained by the factor was 50.0%.

There was substantial variation in the Cronbach's alpha values of all variables, ranging from .781 to .915. Given that alpha values greater than .70 are generally considered to indicate a reliable set of items, *Perceived Trust* and *Perceived Usefulness* were very reliable (.883 and .844 respectively). Brand image for moderating variable had excellent reliability (.906), while for awareness, the reliability was reasonable (.781). Both reliabilities for post purchase behavior and attitude were excellent at .902 and .915 respectively.

## 5.0 Conclusion

This study makes significant contributions to knowledge in relation to customer responsiveness of factors affecting smart card usage. Furthermore, it also provides an insight into the customers' needs and wants which may be essential for restaurant operators in order to provide better services to customers. This evidence is in line with Mozeik et al. (2009) confirmed that the adoption of e-services in restaurants namely the conventional computing devices and mobile computing devices were driven by perceived usefulness and perceived ease of use. In the light of these findings, several recommendations will be made which may be useful for restaurant operators and other related authorities. Restaurants should make their customer more aware of their new products or services, in this, "Touch 'n Go" smart card, to encourage a higher response rate. They can do so by having education and publicity through mass media will prove to be effective. Government authorities like Bank Negara Malaysia (BNM) can also play their role by issuing statements which reassure customer that the government recognizes "Touch 'n Go" smart card as a trusted brand. In order to receive greater response towards smart card, it is recommended that the stipulated restaurants and "Touch 'n Go" Sdn. Bhd. target their promotional activities towards those in the younger business personnel who are computer literate, well-educated and are quite well to do as they seem to be the most likely users of "Touch 'n Go" smart card as indicated in this study. Therefore, it is no exaggeration to say that smart card is becoming a necessity and one of the most important elements in this modern technology for customers and businesses in combating with the economic and financial needs of the country. Smart cards may also represent a viable solution to the restaurant industry's technology needs and having a payment system could facilitate the efficient movement of funds and financial development and the growth of the country's economy. Replication of this factor analysis through further research is significant to customize the research framework.

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