

The Role of Cognitive Decision Effort in Electronic Commerce Recommendation System

Cheng-Che Tsai, Huang-Ming Chuang

Abstract—The purpose of this paper is to explore the role of cognitive decision effort in recommendation system, combined with indicators "information quality" and "service quality" from IS success model to exam the awareness of the user for the "recommended system performance". A total of 411 internet user answered a questionnaire assessing their attention of use and satisfaction of recommendation system in internet book store. Quantitative result indicates following research results. First, information quality of recommended system has obvious influence in consumer shopping decision-making process, and the attitude to use the system. Second, in the process of consumer's shopping decision-making, the recommendation system has no significant influence for consumers to pay lower cognitive decision-making effort. Third, e-commerce platform provides recommendations and information is necessary, but the quality of information on user needs must be considered, or they will be other competitors offer homogeneous services replaced.

Keywords—Recommender system, Cognitive decision-making efforts, IS success model, Internet bookstore.

I. INTRODUCTION

IN recent years, the domestic Internet population continues to rise, the consumer online shopping habits have evolved to promote e-commerce market value has doubled, used in e-commerce marketing strategy has also emerged. Most consumers will buy the product before the first Internet search-related product information than the majority of users experience more compelling business marketing advertising [1]. In this study, we attempt to explore the perspective of consumer decision-making and rethink the recommendation system performance issues based on information system quality and how the recommendations to influence consumer decisions. The system performance was measured by customer satisfaction. The main purposes of this study are as follows: (a) the quality of recommendation system impact on consumer decision-making. (b) Explore the recommended information on consumer decision-making. (c) With the consumer point of view of cognitive thinking decision making, evaluation recommended to improve system performance and future direction.

II. LITERATURE REVIEW

A. Recommended system

Although embedded in the site recommendation system which has been shopping information processing as a part of,

C. C. Tsai, Department of Information Management, National Yunlin University of Science and Technology, Yunlin, 64002 Taiwan R.O.C. (phone: 886-5534-2601#5392 (e-mail: g9923805@yuntech.edu.tw).

H. M. Chuang Department of Information Management, National Yunlin University of Science and Technology, Yunlin, 64002 Taiwan R.O.C. (e-mail: chuanghm@yuntech.edu.tw).

but because of its own with the assistance of the decision-making characteristics can still be regarded as a special independent information system [2]. In previous information management study can be found, good information systems must let users consider to be perceived useful (Perceived usefulness), then users will have the intention to use [3].

According to information system success model [4], the *Information quality* and *System quality* of information system is the main impact factors on users in evaluating the system performance. The decision-making model and data sources determine the quality of recommendation systems. Traditional information systems include characters with *Input*, *Process* and *Output*, and the recommendation system architecture must also be incorporated into the algorithm. When the characteristics of traditional information systems and decision-making mechanism combined with mathematical calculations, the information system with decision support features, as known as *Decision Support System (DSS)* [5]. Based on this view, this research used the *Recommended System type*, *Data entry*, *Process* and *Data output* as the system characteristics.

B. Consumers shopping decision making

Consumers think they decide whether to order an important factor is the efficiency of retail sites, followed by product information credibility. In general, the consumer buying decision behavior can be included down into seven steps [6]. But not all of the purchase decision must perform a step by step, consumer's buy depending on their own situation and make adjustments.

C. Cognitive decision-making efforts

In cognitive science research, cost-effective architecture is a common behavioral decision theory. The theory shows that decision makers will try to minimize the effort (*decision costs*) in order to maximize the decision accuracy (decision-making interests). When consumers shopping, there are variety of considerations must be the basis for decision-making based on such a trade-off process must pay a considerable effort. Previous studies have pointed out that consumers would like to pay more decision-making efforts to improve the accuracy of their choice. In certain cases, consumers will choose to pay a minimum of effort and needs in order to achieve their best that is the best accuracy [7].

The traditional cost-effectiveness decision theory was founded on an independent decision-making environment, the final decision is in consideration of the cost of context, can all be a compromise choice of a compromise decision to make the most accurate, and efforts to avoid the unnecessary effort to pay. Previous studies have pointed out, decision-makers only care about to minimum the making efforts to pay. However,

Todd and Benbasat had series experiments of decision support information systems [8-13]. It showed that decision-making through information technology assistance must be put more efforts to achieve higher accuracy. Taylor [14] pointed out that human cognition is largely replaced by information tools to aid in the face of decision-making environment; the cognitive effort will reduce the information systems supporting the environment.

However, Fogg and Nass [15] found that computer users are still very value of information systems to assist in the completion of the work. Their study subjects complete a task within assistance from the information system. A study of Bechwati and Xia [16] also pointed out that consumer decision-making satisfaction will be a positive experience when consumer cognitive efforts are supplemented by information generated by the auxiliary system.

D. IS success model

In 1992, DeLone & McLean combined with the results of many empirical studies to develop *Information System Success Model*, include information quality and system quality assessment of information system success model [4]. In 2003, DeLone & McLean amendments ISS model [17], according to the view from Pitt [18] in 1995 that based on the original IS Success Model, presented the views of service quality should be added to the model system. And adjust the model to six indicators: *System quality*, *Information quality*, *Service quality*, *Use*, *User satisfaction* and *Net benefit*. (Fig. 1)

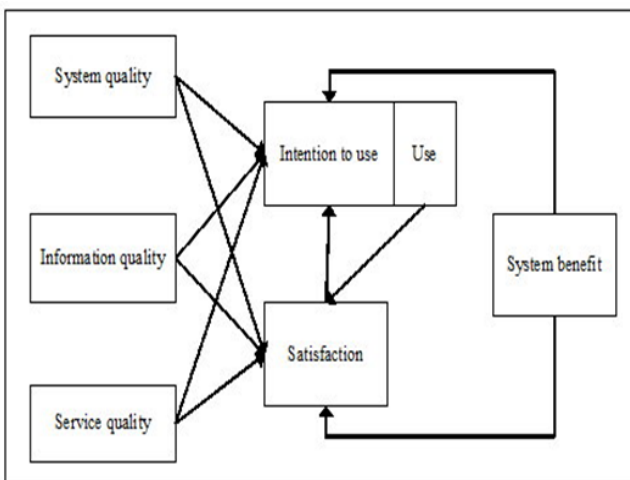


Fig. 1 IS Success Model

Recommendation system is like the general DSS, reliance on external data provided by the user before it can meet the user needs to provide decision support information. Corresponds to the online store's recommendation system, the user need only enter a small part of the message, we recommend the system will self-extract the behavior of other consumer information, consumers do not need to carry out other operations. Just in decision-making process to determine whether to adopt the recommendation system to provide the information. Therefore, the assessment recommended system quality and reliability of the information generated on the Internet is more important to consumers [19].

Unlike the previous information systems success study investigated from the perspective of the user to take the use of information systems, this study from the user point of view, assessment of information quality and recommendation system is able to influence consumer service quality the behavior of those who buy goods and satisfaction. Therefore, in this study use the information system success model assessment index as measured of the consumer evaluating recommendation system reference factors.

III. RESEARCH METHODS

A. Research design

This study focused on e-commerce environment, the recommended system is able to influence consumer purchase decisions, significant benefits to consumers, and this research will examine the scope of Internet users in the group setting.

In addition, the subjects experienced the background of the site must meet the following conditions: (a) A site with a considerable size: the target site must have a certain amount of site users to be able to collect a sample of a certain number of studies to be undertaken. (b) This study investigated the consumption of consumer behavior on the site for decision-making mode, it will be affected by the impact of recommendation systems, so the site must allow consumers behavior, and the recommended mechanism is highly related.

B. IS success model

Recommended information generated by the system, generally including the recommended way, recommended product types, and network evaluation of three parts. Buy recommendations on the site will affect consumers shopping information in decision-making cognition. Cognitive decision-making efforts from the perspective of the role of recommendation system is to reduce the effort required by consumers (*Decision Costs*). Through rational analysis, product recommendation information is sufficient to meet the needs of consumers purchasing decision? Whether the consumer can be recommended because of the use of information and speed up decision-making process? The above information for consumers is to assess the value of the main factors recommended [2]. Therefore, the study recommended that the system can generate the recommendation information through its quality, and recommended service quality, to discuss the recommendation system to help consumers in decision-making process the feelings experienced by, and affect customer satisfaction with the system after use degree and a sense of trust, and to assess the effectiveness of the system, and then with the system link between the commitment.

Therefore, this study successful models of information systems evaluation criteria for reference, that the impact assessment of consumer recommendation system for the important independent variables for the *System Quality* and *Service Quality*, it will affect consumer satisfaction with the recommendation system, and the impact consumer perception of the system benefits and trust, and the future once again the intention of using the same system. In consumers shopping decision making process, recommendation system really

reduce the consumers have to pay the cognitive effort, the way through intermediaries to explore the possibility of an impact. The research framework presented in Figure 2.

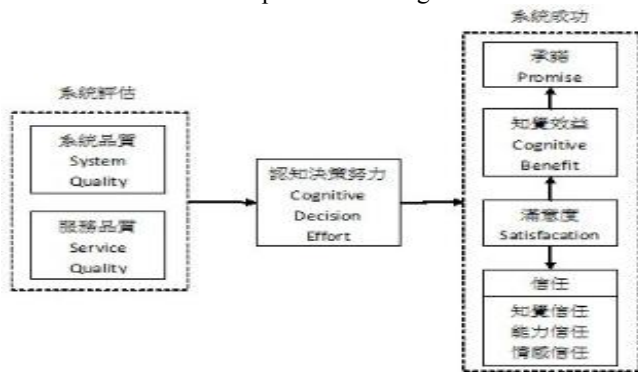


Fig. 2 Research Framework

C. Hypothesis

Based on the research framework and the operational definition of variables, assumptions of this study are as follows:
 H1: *System Quality* of recommendation system will negatively affect the user's *cognitive decision-making efforts*.
 H2: *Service quality* of recommendation system will negatively affect the user's *cognitive decision-making efforts*.
 H3: Users of the "cognitive decision effort" has negative impacts on user's *satisfaction*.
 H4: User's *Cognitive decision-making efforts* will negatively affect the *perceived benefit*.
 H5: User's *Cognitive decision-making efforts* will negatively affect the user's *commitment*.
 H6: User's *Cognitive decision-making efforts* will negatively affect the user's *trust*.

D. Sampling methods

As the object of this study to the network bookstore shopping in Taiwan population, the subjects should have the basic understanding of the use of the network, so this research online survey was conducted to collect the sample, the survey questionnaire set up in website, and through BBS stations, discussion boards and forums, virtual community information published questionnaires, respondents to answer in the questionnaire after completion of the web site survey. In this study, SEM was used to analyze results. Therefore, expected recovery of the sample should be larger than 200 samples in order to achieve the sample using the SEM analysis of demand for numbers [20]. To improve the response rate and increase the number of samples, in addition to other widely publicized, this study will increase the raffle as an incentive to attract more people to complete the questionnaire. Moreover, online questionnaires because they are not face to face, so cannot confirm whether there is one problem more programs to prevent duplication of answer, the questionnaire will ask respondents had left behind in the e-mail, for identification. Also, to avoid the subjects did not truthfully answer the test questions added to the questionnaire, if the answer does not meet the standards of the questionnaire is considered invalid, if the main content of more than half did not fill or check all the same, is also all invalid questionnaires.

IV. DATA ANALYSIS

A. Basic data analysis sample

Internet users in this study as the research object bookstore, a total of 411 were recovered, after remove the invalid questionnaires, 343 valid questionnaires. Cronbach's α value of the future in order to conduct reliability test, measurement item questionnaire asked whether the internal consistency. Table 1 shows all dimensions are greater than 0.8, α straight, with good reliability. (Table. I)

TABLE I
 CRONBACH'S A VALUE

Potential dimensions	Cronbach's α
System quality	0.880
Service quality	0.934
Cognitive decision-making efforts	0.867
Satisfaction	0.951
Perceived benefit	0.859
Commitment (with intent)	0.931
Perceived competence trust	0.863
Perceived integrity of the trust	0.875
Perceived emotional trust	0.894

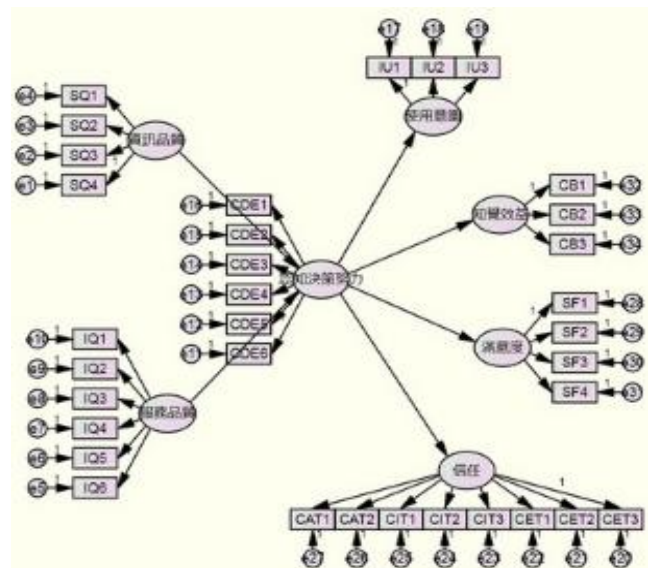


Fig. 3 AMOS Framework

All the variables of the questionnaire and dimensions are finishing from the literature, the face validity was passed. The content validity refers to whether the questionnaire covers the entire dimensions of the questionnaire by experts to make changes for later, and invited the eligible sample of 30 pre-test questionnaire, modify semantic topics, and to avoid confusion, it has content validity.

B. Structural Equation Modeling

Based on the assumptions and research framework to establish an overall framework of the map to AMOS model is expressed as to Figure. 3. Evaluation model to measure the overall pattern in accordance with the basic goodness of fit within the two parts to fit to the evaluation, the basic goodness of fit must first check whether there is offending estimates. Internal models based on Bagozzi & Yi [21] recommendations

to the reliability of individual items, the composition of latent variables and latent variable reliability of the average variance extracted amount measured in three areas.

C. Discriminant validity

Mainly used to assess the dimensions of the Questioner key difference between the other dimensions of the degree, if the measurement model has discriminant validity, the dimensions of the coefficient of each other dimensions must be less than the coefficient itself, that is, and each diagonal value must be greater than all non-diagonal values, the dimensions of this study are consistent with its provisions, so the whole, have discriminant validity.

D. Structural model evaluation

Assess the overall model fit indexes can fit level (Goodness-of-Fit Index) that is used to determine the hypothetical model and the actual data fit the situation. Chi-square value is the level used to test fit the situation, but due to chi-square value will be the impact of sample size, therefore, can be calculated by chi-square and the ratio of degrees of freedom, the future level of fit to conduct the comparison between models. Chi-square degrees of freedom is generally recommended ratio of between 1 to 3 [21-22], the degree of freedom of the chi-square ratio of 3.16, close to the standard value 3. (Table. II)

TABLE II
 ANALYSIS OF OVERALL MODEL FIT TABLE

Fit index (Fit Indices)	Recommend ed to Standard requirements	Research Results
χ^2 (Chi-Square) / degrees of freedom	3	3.16
Fit index (Goodness of Fit Index, GFI)	> 0.8	0.52
Fit of the adjusted index (Adjusted Goodness of Fit Index, AGFI)	> 0.8	0.46
Asymptotic root mean square error (Root Mean Square Error of Approximation, RMSEA)	< 0.1	0.14
Fitness of benchmark indicators (Normed Fit Index, NFI)	> 0.9	0.62
Level indicators of the relative fit (Relative Fit Index, RFI)	> 0.9	0.59
Comparative fit index level (Comparative Fit Index, CFI)	> 0.9	0.64

GFI theoretical model can be seen that the variance and covariance, sample data can explain the variance and covariance of the level, AGFI is to use the freedom and the ratio

of the number of variables to adjust the GFI. The GFI and AGFI, the closer one between the indicator that the better degree of fit, GFI of this study was 0.52, AGFI was 0.46, not consistent with Browne & Cudeck[23] proposal, the value must be greater than 0.80. Therefore, this study fit the ideal level of performance have not yet attained.

RMSEA (Root Mean Square Error of Approximation) smaller when the index, said the model has good fit and usually less than 0.05 as the "good fit", .05 to .08 can be considered as "not bad fit", this study The RMSEA value of 0.08, from 0.08 to 0.1 is the Normal fit, but if the table is greater than 0.1 is a poor fit, RMSEA value of 0.14, this study has reached the standard level of bad fit.

E. Path analysis

This study used statistical software AMOS structural equation modeling to conduct analysis; to test the hypothesis is significant. The test result shown in Table. III.

TABLE III
 VERIFY HYPOTHESES

Hypothesis	Standardized parameter estimates	Significant
H1: Recommendation System, "System Quality" will negatively affect the users "cognitive decision-making efforts."	-1.29 (-10.65)	Yes
H2: Recommendation System "service quality" will negatively affect the user's "cognitive decision-making efforts."	0.14 (0.27)	No
H3: Users of the "cognitive decision effort" has negative impacts on users "satisfaction."	-1.05 (-15.90)	Yes
H4: Users of the "cognitive decision-making efforts" will negatively affect the user of the "perceived benefit."	-0.86 (-11.72)	Yes
H5: Users of the "cognitive decision-making efforts" will negatively affect the user's "commitment" (with intent).	-1.13 (-14.95)	Yes
H6: Users of the "cognitive decision-making efforts" will negatively affect the user's "trust."	-0.99 (-15.12)	Yes

V. CONCLUSION

With the emergence of electronic commerce, how to get more customers and understand customer needs, thereby creating a profit, is required for many of the website, then the recommendation system came into being. This study from the user perspective, based on the IS success model, combining cognitive decision-making point of view the operation of the performance of recommendation systems. Although the fit of the model output for the standard has not yet reached the threshold, but some of the recommendation system can ascertain the relationship with the user.

a. With help from Information system, people can still significantly reduce the time have to pay during the decision-making efforts, and reduce decision-making costs.

b. When users feel that they pay the cost of the decision-making and not reduce because of the help from information systems, for the satisfaction of the system will

show negative attitudes. Also, the effectiveness of the site awareness, a sense of trust will have negative effects.

This study is based on the IS success model by adding decision-making and strive to explore the cognitive factor, but did not show a better explanatory power of research findings, suggested that future researchers can consider other point of view of the user recommendation system is really impact on consumer behavior.

Due to the small sample size did not adjust the variable part of the future, researchers can adjust the variables included to explore, to understand the type of product, and the user expertise and so will affect the decision-making behavior of consumers.

REFERENCES

- [1] O. Commerce, D.o., 2008 Yearbook of the Republic of China e-commerce2009, Taipei: Institute for Information Industry.
- [2] Bo, X. and I. Benbasat, E-commerce Product Recommendation Agents: Use, Characteristics, and Impact, in MIS Quarterly2007, MIS Quarterly & The Society for Information Management. p. 137-209.
- [3] Davis, F.D., Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology, in MIS Quarterly1989, MIS Quarterly & The Society for Information Management. p. 319-340.
- [4] DeLone and McLean, Information systems success: the quest for the dependent variable. Information systems research, 1992. 3(1): p. 60-95.
- [5] Brown, D.L. and D.R. Jones, Factors that Influence Reliance on Decision Aids: A Model and an Experiment, in Journal of Information Systems1998, American Accounting Association. p. 75-94.
- [6] Blackwell, R.D., P.W. Miniard, and J.F. Engel, Consumer behavior. 10th ed2006, Mason, Ohio: Thomson Business and Economics. xlii, 774 p.
- [7] Creyer, E.H., J.R. Bettman, and J.W. Payne, The impact of accuracy and effort feedback and goals on adaptive decision behavior. Journal of Behavioral Decision Making, 1990. 3(1): p. 1-16.
- [8] Todd, P. and I. Benbasat, An experimental investigation of the impact of computer based decision aids on decision making strategies. Information systems research, 1991. 2(2): p. 87-115.
- [9] Todd, P. and I. Benbasat, The use of information in decision making: an experimental investigation of the impact of computer-based decision aids. MIS Quarterly, 1992. 16(3): p. 373-393.
- [10] Todd, P. and I. Benbasat, An Experimental Investigation of the Relationship Between, Decision Makers, Decision Aids and Decision Making Effort. INFOR-OTTAWA-, 1993. 31: p. 80-80.
- [11] Todd, P. and I. Benbasat, The influence of decision aids on choice strategies: an experimental analysis of the role of cognitive effort. Organizational Behavior and Human Decision Processes, 1994. 60(1): p. 36-74.
- [12] Todd, P. and I. Benbasat, Evaluating the impact of DSS, cognitive effort, and incentives on strategy selection. Information systems research, 1999. 10(4): p. 356.
- [13] Todd, P. and I. Benbasat, Inducing compensatory information processing through decision aids that facilitate effort reduction: an experimental assessment. Journal of Behavioral Decision Making, 2000. 13(1): p. 91-106.
- [14] Taylor, A.R., Perceived Effort Saved; Influence on Perceptions of Effort and Accuracy.
- [15] Fogg, B. and C. Nass. How users reciprocate to computers: an experiment that demonstrates behavior change. 1997. ACM.
- [16] Bechwati, N. and L. Xia, Do computers sweat? The impact of perceived effort of online decision aids on consumers' satisfaction with the decision process. Journal of Consumer Psychology, 2003: p. 139-148.
- [17] DeLone and McLean, The DeLone and McLean Model of Information Systems Success: A Ten-Year Update, in Journal of Management Information Systems2003, M.E. Sharpe Inc. p. 9-30.
- [18] Pitt, L., R. Watson, and C. Kavan, Service quality: a measure of information systems effectiveness. MIS Quarterly, 1995. 19(2): p. 173-187.
- [19] Wathen, C. and J. Burkell, Believe it or not: Factors influencing credibility on the Web. Journal of the American Society for Information Science and Technology, 2002. 53(2): p. 134-144.
- [20] Fan, X., B. Thompson, and L. Wang, Effects of sample size, estimation methods, and model specification on structural equation modeling fit indexes. Structural Equation Modeling: A Multidisciplinary Journal, 1999. 6(1): p. 56-83.
- [21] Bagozzi, R. and Y. Yi, On the evaluation of structural equation models. Journal of the academy of marketing science, 1988. 16(1): p. 74-94.
- [22] Hair, J., et al., Multivariate analysis. Englewood: Prentice Hall International, 1998.
- [23] Browne, M. and R. Cudeck, Alternative ways of assessing model fit. Testing structural equation models, 1993. 154: p. 136-162.