Product Customization on the Web: An Empirical Study of Factors Impacting Choiceboard User Satisfaction[i]

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Keywords:
e-Commerce, User Satisfaction, System Quality, Customer Relationship Management (CRM), Strategic Information Systems, IS Success Model, Strategic IT management.

Reference:
Bharati, P. and Chaudhury, A. (2006), "Product Customization on the Web: An Empirical Study of Factors Impacting Choiceboard User Satisfaction," Information Resources Management Journal, Vol. 19, No. 2, pp. 69 - 81.

INTRODUCTION

E-Commerce is coming of age (Markillie, 2004). Sales in the year 2003 exceeded $55 billion and revenues in 2004 are expected to be at least 20% higher (Syre, 2004). The total impact of e-commerce, however, cannot be expressed in simple sales figures; rather it lies in changing consumer behavior. Increasingly, consumers visit the website of a company to familiarize themselves with the firm's offerings and prices before deciding to buy. A website is becoming the gateway to a firm's brand, even in the case of off-line firms. Companies which realize the importance of their websites use technologies such as email, FAQ, online customer support, bulletin boards and search engines to assist customers in the buying decision process and, obviously, to persuade a purchase of their product.

The choiceboard is a recent addition to this repertoire of technologies, aiding consumers in the decision-making process (Andal-Ancion, Cartwright, and Yip, 2003; Bharati and Chaudhury, 2004a; Collins and Butler, 2003; Liechty, Ramaswamy and Cohen, 2001; Slywotzky, 2000). A choiceboard is a system that allows customers to design their own products by choosing from a menu of attributes, components, prices, and delivery options (Slywotzky, 2000). For example, in the automobile industry (buyatoyota.com), users can "build" or customize a Toyota and then follow up with a local dealer. In the construction industry (kitchens.com), users can get help to design a kitchen and actually place an

order. In the apparel industry (acustomtshirt4u.com), users can select color, fabric, and a suitable logo and lettering. In the entertainment industry (www.apple.com/itunes), customers at the itunes music store can build customized CDs by selecting individual tracks from existing CDs. Finally, in information technology, the websites of most computer firms (e.g. www.ibm.com), present individuals with a basic configuration defined by a processor and then "flesh out" the full configuration with choiceboards offering hard-drive size, memory, and add-ons such as CD/DVD drive, monitors, and printers.

Although choiceboard technology is being widely used to enhance the customer's experience, very little is known about the actual impact of this technology on overall user satisfaction or the intention to use the choiceboard. Similar concerns have been expressed for web-based decision support systems (Bharati and Chaudhury, 2004b). In particular, it remains unclear how the provision of more information, facilitation of decision-making through what-if analysis, and choice comparisons through the use of choiceboard technology affects user satisfaction and the intention to use. In this research, the relationships are developed and operationalized between system-level factors (such as quality of the system and information in choiceboards, and presentation of information) and user's decision-making and interface satisfaction. Furthermore, the analysis investigates the relationship between information and decision-making satisfaction, with overall satisfaction and intention to use. The statistical analysis consists of path analysis, assessesing a pattern of predictive relationships among the measured variables. This

research employs the Structural Equation Modeling (SEM) technique to analyze the data and then assess the pattern of predictive relationships.

The research views information systems' success in the new domain of e-commerce; and, in particular, in the context of choiceboard systems. It attempts to understand how choiceboards facilitate user decision-making in the web-based environment. It then develops a conceptual model that relates system-level factors, user satisfaction factors, and use factors. Specifically, it investigates inter-relationships between components of user satisfaction – interface satisfaction, decision satisfaction, and overall satisfaction – and their combined impact on intention to use.

LITERATURE REVIEW

The research is related to multiple theories such as the consumer decision-making model (Mowen 1995), consumer information processing model (Bettman 1979), cognitive decision-making model (Simon 1955), and information systems (IS) success model (Delone and McLean 1992, 2002). According to Mowen (1995), a consumer transits through several phases such as problem recognition, a search for alternatives, and an evaluation of alternatives before making a choice; that is, there is an information-processing phase and then a decision-making one. In this process, a consumer tries to minimize cognitive effort required to make a decision and yet maximize the quality of the decision reached (Bettman 1990). Furthermore, Bettman (1990) suggests that because of

bounded rationality constraint (Simon 1955), consumers actually will tradeoff decision quality for a reduction in information processing effort.

Consumers employ decision aids such as calculators, spreadsheets, consumer guides, and web-based comparison pricing in order to lessen the impact of bounded rationality constraints on decision quality. E-commerce retailers are incorporating choiceboards on their websites to assist customers in several phases of the decision-making process (Bharati and Chaudhury, 2004a; Bharati and Chaudhury, 2004b). The information search phase, for example, is facilitated by easy revelation of product alternatives; and the decision-making phase of alternatives evaluation is made easier by price and feature comparison. The IS success model (Delone and McLean 1992) – with its focus on issues relating to information processing and decision-making and its previous research on web based DSS (Bharati and Chaudhury, 2004b) – is useful in investigating the role of choiceboards in assisting users. In the recent literature, this model has served as the basis for investigating similar research areas such as IS and service quality (Bharati and Berg, 2003). The research on quality of information systems services (Jiang *et al*, 2002; Jiang *et al*, 2000; Kettinger and Lee, 1997; Kettinger and Lee, 1999; Pitt *et al*, 1995; Pitt *et al*, 1997; Van Dyke *et al*, 1997; Van Dyke *et al*, 1999; Watson *et al*, 1998) and WebQual (Loiacono *et al*, 2002) has also attempted to investigate this topic in a slightly different way.

Communications theory (Shannon and Weaver, 1949) was illustrated and modified in Mason's work (1978) to show that classes of information output are at the technical level, semantic level, and influence level. The IS success model (Delone and McLean, 1992, 2002) expanded the concept of levels of output to illustrate stages within those levels. Information is communicated to a recipient who is either influenced or not; he/she then impacts organizational performance. In other words, the information flows from its production to influence the individual and then the organization.

System quality and information quality, both singularly and jointly, impact use and user satisfaction. This research model is based on the IS success model and employs some of the constructs of that model specifically at the technical level of system quality and information quality, in the context of choiceboards, and in their impact on different components of user satisfaction (interface satisfaction, decision-making satisfaction, and resultant overall satisfaction). User satisfaction then influences the intention to use. The next section explains the research model and hypotheses.

RESEARCH MODEL AND HYPOTHESES

The research model (Figure 1) shows that system and information quality, and information presentation impact the different components of user satisfaction; and then, intention to use. The various constructs and the resulting hypotheses of the model are explained in this section.

System Quality

System quality is the individual perception of a system's overall performance, which is itself a manifestation of system hardware and software. Ease of use (Belardo, Karwan, and Wallace, 1982), convenience of access (Bailey and Pearson, 1983), and system reliability and flexibility (Srinivasan, 1985) are measures employed for the service quality construct.

Information Quality

The user estimates the value of an information system after evaluating the quality of information it provides (Gallagher, 1974). Information accuracy (Bailey and Pearson, 1983; Mahmood, 1987; Miller and Doyle, 1987; Srinivasan, 1985), completeness (Bailey and Pearson, 1983; Miller and Doyle, 1987), relevance (Bailey and Pearson, 1983; King and Epstein, 1983; Miller and Doyle, 1987; Srinivasan, 1985), content needs (Doll and Torkzadeh, 1988), and timeliness (Bailey and Pearson, 1983; King and Epstein, 1983; Mahmood, 1987; Miller and Doyle, 1987; Srinivasan, 1985) are the measures employed in the information quality construct.

Information Presentation

In information presentation the display of information based on formats, colors, and graphs versus tables is examined (Vessey, 1994). The interface evaluation has included presentation, format, and processing efficiency characteristics of the interface (Swanson,

1985-86). The measures used for information presentation construct are graphics, color, presentation style, and navigational efficiency (Swanson, 1985-86).

Interface Satisfaction

The quality of the information system interface is measured in interface satisfaction. The indicators used to measure interface satisfaction construct are easy to work (Doll and Torkzadeh, 1988; Goodhue, 1990), useful format (Doll and Torkzadeh, 1988; Goodhue, 1990), user friendly (Doll and Torkzadeh, 1988; Goodhue, 1990), does what I want it to do (Davis, 1989; Goodhue, 1990), and clear and understandable (Davis, 1989; Goodhue, 1990).

Hypothesis 1: System quality will positively contribute to interface satisfaction.

Hypothesis 3: Information quality will positively contribute to interface satisfaction.

Hypothesis 5: Good Information presentation will positively contribute to interface satisfaction.

Decision-Making Satisfaction

Decision-making satisfaction is the systems' ability to support the user's decision-making and problem-solving activities. The systems' support to the individual in recognizing problems, structuring problems, and making decisions related to the goal of controlling a business process are part of the construct (Garrity and Sanders, 1998). The construct measures the decision-making satisfaction using decision effectiveness (Chervany,

Dickson, and Kozar, 1972) and decision confidence (Goslar, Green, and Hughes, 1986; Guental, Surprenant, and Bubeck, 1984; Zmud, Blocher, and Moffie, 1983).

Hypothesis 2: System quality will positively contribute to decision-making satisfaction.

Hypothesis 4: Information quality will positively contribute to decision-making satisfaction.

Hypothesis 6: Good Information presentation will positively contribute to decision-making satisfaction.

Overall Satisfaction

Satisfaction is an important and widely used construct in the IS literature. Numerous researchers have modified the Bailey and Pearson (1983) user satisfaction instrument. The construct of overall satisfaction, a result of interface and decision-making satisfaction, was measured using extremely useful system (Sanders, 1984) and satisfactory in meeting user needs (Alavi and Henderson, 1981; Sanders and Courtney, 1985).

Hypothesis 7: Interface satisfaction will positively contribute to overall satisfaction.

Hypothesis 8: Decision-making satisfaction will positively contribute to overall satisfaction.

Intention to Use

Intention to use a system has often been employed as an important measure of IS success (Chang and Cheung, 2001; DeLone and McLean, 1992; Lucas, 1978; Van der Heijden, 2004; Welke and Konsynski, 1980). Possible to use and intend to use (DeSanctis, 1982) have been employed to measure the intention of user to use the system construct.

Hypothesis 9: Overall satisfaction will positively contribute to intention to use.

RESEARCH METHODOLOGY

The instrument (Appendix A) was constructed based on prior research; and most indicator items were adapted or borrowed from previously-validated instruments. The survey was first pre-tested with a smaller sample and then subsequently refined. The survey was administered to subjects who were undergraduate and graduate students at two different Universities. They were selected as subjects because they were users of or familiar with choiceboard systems. The experiment was conducted in a laboratory setting, with PCs running on the Windows operating system. The researchers, in conducting the experiment, adopted the following procedure.

First, the experimental procedure was explained to the subjects. Then, each subject was randomly assigned a website that employed a choiceboard that allowed the user to configure a product. The choiceboard sites were of a very similar nature, despite being owned by different firms. After configuring a product on the website, each subject completed a survey questionnaire. The total sample for the experiment was 192 subjects.

Structural equation modeling (SEM) was used to analyze the data. SEM subscribes to a causal indicator model, with the operational indicators reflective of the unobserved theoretical construct. It allows the specification of measurement errors within a broader context of assessing measurement properties. Confirmatory factor analysis, content validity, unidimensionality analysis, reliability analysis, convergent validity, and criterion-related validity tests were conducted to evaluate the model and constructs (Anderson, and D.W. Gerbing, 1988; Bollen, 1989; Chin, 1998).

DATA ANALYSIS

Confirmatory Factor Analysis

The measurement properties of the survey instrument were assessed with confirmatory factor analysis. A measurement model comprising of a weighted linear combination of the items in the scale were analyzed. In confirmatory factor analysis each theoretical construct is specified and analyzed to assess the fit of the data with the measurement model (Ahire, Golhar and Waller, 1996; Ravichandran and Rai, 1999; Venkatraman, 1989). For constructs with four or more indicators these guidelines were followed. As some constructs have fewer than three indicators, these constructs were pooled with constructs having four or more indicators. This was done to ensure adequate degrees of freedom for estimation of the model.

Content Validity

Content validity is ensured when the constructs are defined using the literature. The construct should adequately represent and measure the domain of meaning that it is supposed to represent (Bohrnstedt, 1983). If all the items grouped together for each construct reflect the underlying meaning then content validity exists (Dunn, Seaker and Waller, 1994). Since there is no rigorous way to assess content validity, in order to ensure thoroughness, multiple items were used to measure the construct (Bohrnstedt, 1983; Churchill, 1979). The instrument employed in the research used several indicators for each construct that were derived from an in-depth literature review; and thus content validity was ensured (Bohrnstedt, 1983).

Unidimensionality Analysis

A multidimensional construct helps with content validity and is acceptable as long as the scales are unidimensional. A scale has to be unidimensional in order to have both reliability and construct validity (Gerbing, and Anderson, 1988). The condition for a unidimensional scale is that the items of a scale estimate one factor. The goodness of fit index (GFI) measures a good fit of the measurement model as it indicates that all items load significantly on one underlying latent variable. There is no evidence of lack of unidimensionality when GFI is 0.90 or higher for the model. The GFI indices for all the scales are summarized in Table I and the results suggest that all the scales are unidimensional.

Reliability

Reliability of a scale is ensured if the scale is dependable, consistent, or stable (Gatewood, and Field, 1990). Cronbach's alpha coefficient was used to measure reliability, as the items of a scale explain the majority of the variation in the construct vis-à-vis measurement error (Cronbach, 1951). The results indicate that the scale is reliable because the alpha coefficient is greater than .70 (Table I).

Convergent Validity

Considering each item in the scale as a different approach to measure the construct usually assesses convergent validity. This was measured using the Bentler-Bonett coefficient (Δ)(Bentler and Bonett, 1980). The Bentler-Bonett coefficient (Δ) value of .9 or above means high convergent validity. All the scales had a Bentler-Bonett coefficient (Δ) of greater than .9 (Table I).

Criterion-Related Validity

Criterion-related validity tests the degree to which the outcome is predicted by the constructs (Ahire, Golhar and Waller, 1996; Venkatraman, 1989). Using SEM, the constructs are correlated with outcome constructs. As the correlation of the various constructs are positive and statistically significant (Table II), criterion-related validity exists for these constructs.

SEM produces parameter estimates of links between the latent variables; and so is also called latent variable analysis, or causal modeling. AMOS 4.0 and SPSS 10.1 (Arbuckle and Wothke, 1999) were employed for the SEM analysis.

RESULTS AND DISCUSSION

In summary, this research examined the impact of systems' quality, information quality, and information presentation on user satisfaction and intention to use in the context of choiceboard systems. The IS success model was used as the basis of the research model. The model was based on Shannon and Weaver's communication theory (1949), Mason's theory (1978); and the Delone and McLean (1992) model. The research model employed the constructs at the technical level, viz., systems' quality and information quality, in the context of choiceboards; and finally its impact on different components of user satisfaction such as interface satisfaction, decision-making satisfaction, and resultant overall satisfaction. The path coefficients calculated for the estimated model support the hypothesized relationships in both direction and magnitude with few exceptions. Overall, the statistical conclusions support the research model (Figure 1).

System quality is directly and positively correlated to interface satisfaction (H-1); so an increase in the quality of the system leads to an increase in satisfaction in using the interface. Information quality is directly and positively correlated to interface satisfaction (H-3); so an increase in the quality of the information leads to an increase in satisfaction

in using the interface. Information presentation is not directly and positively correlated to interface satisfaction; (H-5) therefore this hypothesis is not validated.

The path coefficients calculated for the estimated model also support the hypothesized relationships in both direction and magnitude in the case of decision-making satisfaction. Most of the hypotheses in the area of decision-making satisfaction have been validated using the data. System quality is directly and positively correlated to decision-making satisfaction (H-2); so an increase in the quality of the system leads to an increase in decision-making satisfaction. Information quality is directly and positively correlated to decision-making satisfaction (H-3); so an increase in the quality of the information leads to an increase in decision-making. Presentation is not directly and positively correlated to decision-making satisfaction (H-6); as this hypothesis is not validated.

System quality includes system ease of use, convenience of access, and system reliability. Thus, a net positive effect from these factors will result in a positive effect on interface satisfaction and decision-making satisfaction. In choiceboards as in other systems, the ease of use of the system, convenience of access, and system reliability are important considerations for the user. Information relevance, accuracy, completeness, and timeliness constitute the construct information quality. Thus, a net positive effect from these factors will result in a positive effect on decision-making satisfaction. Choiceboard systems should provide relevant, accurate, complete, and timely information for better decision-making satisfaction.

Graphics, color, presentation style, and navigational efficiency measures information presentation. Therefore, information presentation measures how information is displayed. It was hypothesized that a net positive effect from graphics, color, presentation style, and navigational efficiency would result in a positive effect on interface satisfaction and decision-making satisfaction. The data did not support this hypothesis.

The statistical conclusions support the hypotheses on user satisfaction. Interface satisfaction is directly and positively correlated to overall satisfaction (H-7); so an increase in interface satisfaction leads to an increase in overall satisfaction. Similarly, decision-making satisfaction is directly and positively correlated to overall satisfaction (H-8); so an increase in decision-making satisfaction leads to an increase in overall satisfaction. Overall satisfaction is also found to be directly and positively correlated to intention to use (H-9); so an increase in overall satisfaction leads to an increase in intention to use. The results from the research model also demonstrate the relative weight of system quality compared to information quality. Interestingly, decision-making satisfaction of end-users, the quality of the system is more important than the quality of the information.

As with all regression and structural equation modeling techniques, correlation does not prove the causality of the relation. Since, however, these causal relationships are based on an established literature and the theoretical grounding of the causality is adequate, it is

reasonable to concur with the causality, where it has been validated (Gefen, Straub and Boudreau, 2000).

MANAGERIAL IMPLICATIONS AND FUTURE RESEARCH

The research results empirically demonstrate the relationships between interface satisfaction, decision-making satisfaction, system quality, information quality, and information presentation. It also demonstrates the relationships among variables such as interface satisfaction, decision-making satisfaction, overall satisfaction, and the intention to use. These relationships are useful in influencing the intention to use among users of choiceboard systems. IS professionals need to understand these relationships to help their firms design choiceboard systems that are effective. This research provides an understanding of those inter-relationships.

In the context of choiceboards, the quality of information influences decision-making satisfaction. So, for example, for a choiceboard system that allows users to develop their own holiday itinerary, the research suggests that users would value complete, accurate, and relevant information about holiday sites, weather, local costs, flights, rentals, and hotels. Similarly, users will have better decision-making satisfaction with timely, accurate, and complete information as they develop alternative scenarios for their holidays.

The research suggests that ease of use, convenience of access, and system reliability also influence the decision-making satisfaction of users. A choiceboard, other than just being available and accessible, should also be easy to use. A user should not feel overwhelmed by available choices. The research also suggests that ease of use, convenience of access, and system reliability and flexibility influences interface satisfaction. The quality of the choiceboard system makes an impact if it is user friendly, clear, and understandable. Interface and decision-making satisfaction influences if the choiceboard has been satisfactory in meeting user needs – which effects intention to use. For choiceboard users, it is not only important that the quality of the choiceboard system and the information it provides is adequate but also that it provides them with interface and decision-making satisfaction. Thus they will intend to use the choiceboard if they find it useful and it meets their needs. This research shows that choiceboard users are deriving satisfaction with the system in a more complex fashion. If the choiceboard provides them interface as well as decision-making satisfaction such that there is overall satisfaction only then will they be a repeat user.

The empirical data suggest that the presentation of information is not important to the user in decision-making. The users are not particularly impressed by color, graphics, and presentation style; but are more interested in the pertinent information being provided to them via the system. This is an interesting result because in the recent past, there has been an increase in color and graphics on websites; but this presentation is of limited use if these websites are not able to provide the desired quality of information.

This research has examined the perceptions of users relative to their intention to use and how that perception is affected by overall satisfaction; which, in turn, depends on decision-making satisfaction and interface satisfaction. Much of the model is been validated by the data. Even the hypotheses that were not validated provide interesting insights. Studies should be conducted using other web-based systems to test if the results of the present study can be extended to other situations. Qualitative studies can also be conducted to study choiceboard systems. These studies have the possibility of providing insight about choiceboard system users. These studies will help build a wider body of research, which is needed for designing effective choiceboard systems.

Table I: Tests for Unidimensionality, Reliability, and Convergent Validity

No.	Construct	No. of Indicators	Unidimensionality : Goodness of Fit Index (GFI)	Reliability: Cronbach's α	Convergent Validity: Bentler Bonnet Δ
1.	System Quality	4	.99	.72	.97
2.	Information Quality	5	.97	.84	.95
3.	Information Presentation	4	.91	.82	.89
4.	Interface Satisfaction	5	.94	.87	.94
5.	Decision-making satisfaction* - System Quality - Information Quality	2	 .95 .96	.83	 .92 .95

	- Information presentation		.91		.90
6.	Overall Satisfaction* - Interface Satisfaction and Intention to Use	2	.91	.89	.93
7.	Intention to Use - Overall Satisfaction and Interface Satisfaction	2	.91	.74	.93

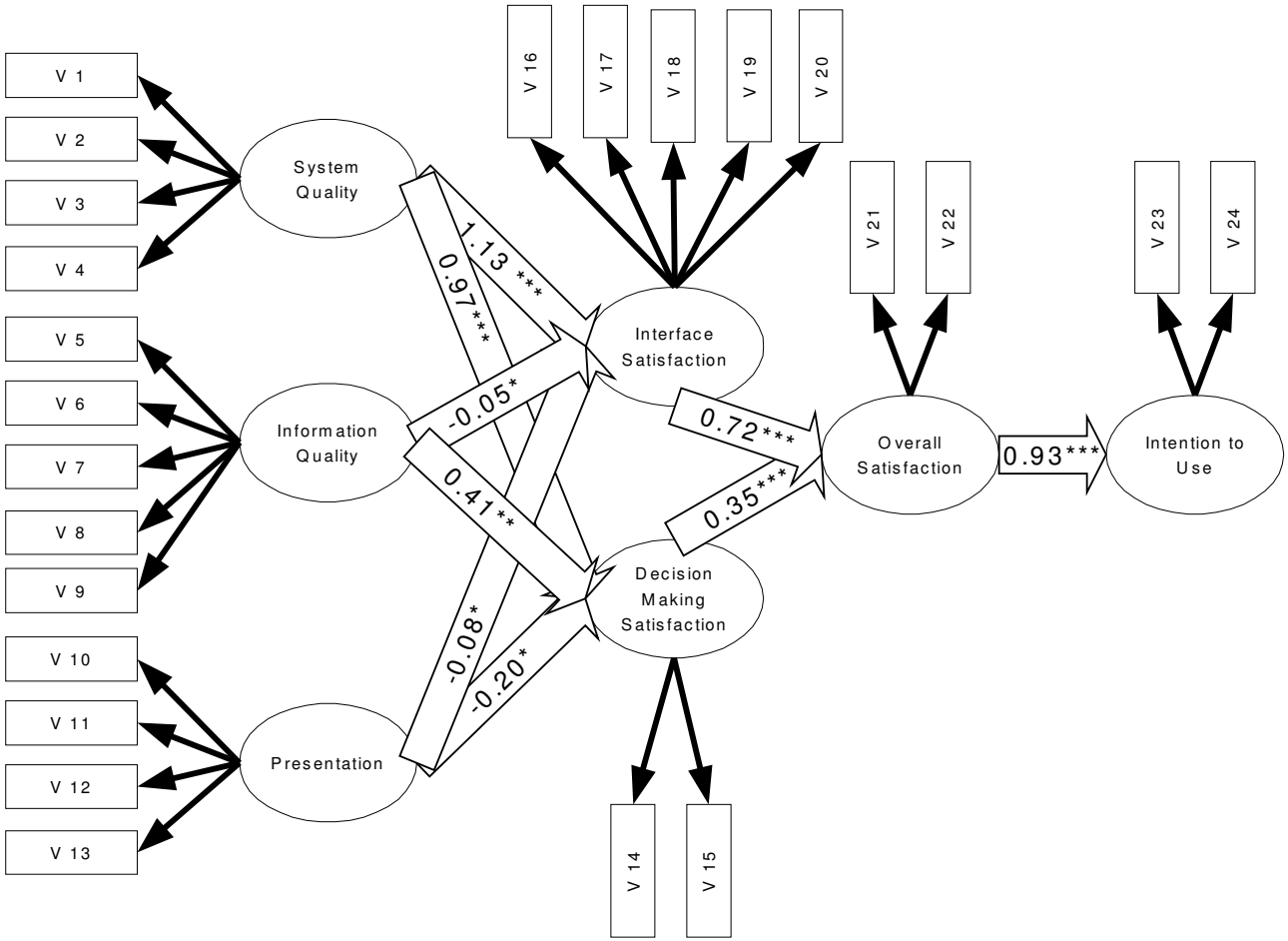
* A combined model was used for this construct.

Table II: Test for Criterion-Related Validity

No.	Construct	Interface Satisfaction	Decision-making Satisfaction	Overall Satisfaction	Intention to Use
1	System Quality	0.66**	0.65**	-	-
2	Information Quality	0.54**	0.69**	-	-
3	Information Presentation	0.50**	0.44**		
4	Interface Satisfaction	-	-	0.49**	-
5	Decision-Making Satisfaction	-	-	0.51**	-
6	Overall Satisfaction	-	-	-	0.56**

** $p<0.01$

Figure 1: Model with Results



*** p<.01; ** p<.1; * Statistically insignificant

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[i] A preliminary version of the paper was published in the *Proceedings of 2004 Americas Conference on Information Systems.*