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AN INVESTIGATION OF COGNITIVE ANTECEDENTS TO SATISFACTION USING WEB-BASED DECISION SUPPORT SYSTEMS

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Abstract

Web sites play a critical role in attracting customers. Many Web sites provide different functionalities to assist customers in decision-making. Despite the importance of different types of functionalities provided by Web sites, there is little knowledge about how Web customers' satisfaction is formulated using Web-based decision support systems (DSS). In this study, we develop a conceptual model for investigating cognitive antecedents to Web users' satisfaction in the context of Web-based DSS. The empirical examination of the research model indicates that perceived effectiveness is influenced by perceived accuracy and effort and, in turn, has a positive impact on satisfaction in using Web-based DSS. The implications of this study provide information to Web site designers and developers as to how a Web-based DSS needs to be implemented to enhance Web users' satisfaction.

Keywords: Web-based DSS, decision strategies, satisfaction, effectiveness, accuracy, effort

Introduction

In recent years, online retailing on the Web (hereafter Web retailing) has expanded rapidly and rivaled physical brick-and-mortar stores in share of the market. This growth is due to the heavy investment in Web retailing by "brick and click" retailers with both traditional storefronts and Web sites, as well as "click only" retailers, which make all of their sales through Web sites.

Many Web sites provide functionalities such as searching, sorting, and comparing products to help users make decisions. The different types and levels of functionalities provided by Web sites to facilitate consumer decision making in an easy and effective manner can be defined as decision support systems (DSS) (Parikh et al. 2001). Most studies examined the role of DSS as a contributor to efficiency and effectiveness (Silver 1991; Todd and Benbasat 1992). More precisely, some studies investigated decision strategies and found the trade-off relationship between accuracy and effort (Chenoweth et al. 2004; Johnson and Payne 1985). Sharda et al. (1988) and Lilien et al. (2004) studied DSS effectiveness. Vessey and Galletta (1991) proposed the cognitive fit perspective for understanding the use of information displays in decision making. Parikh et al. (2001) and Silver (1991) examined how DSS functionalities enlighten users' decision-making processes. Todd and Benbasat (1991) suggested different research models in evaluating the impact of DSS. Such studies can apply to the Internet environment. To enable a high level of consumer purchasing activity, Web retailers have designed attractive and friendly Web sites and gone to considerable lengths to support these sites with fast and accurate "back office" systems so that the Web sites provide accurate information and handle transactions efficiently and securely. Web retailers would like potential customers to be able to navigate their sites and understand their offerings. With the growth of Web retailing, the retailers are compelled to be competitive in making their Web sites better for consumers. Under these circumstances, understanding how to satisfy customers who use decision support systems provided by Web sites will be critical for establishing long-term client relationships, which consequently increases profitability (McKinney et al. 2002). Therefore, understanding how Web users formulate satisfaction when using decision guidance tools such as a DSS, is of great importance to Internet business. However, based on our knowledge, there are very few studies that examined satisfaction as an outcome of decision-making processes under a turbulent Internet environment. In addition, none of these studies applied decision strategies in developing DSS.

This study attempts to address the following research questions: In the context of Web-based decision support systems, what are the antecedents of Web users' satisfaction? How does support for decision strategies apply to Web-based decision support systems? Note that these research questions imply a set of boundary conditions for our research. Specifically, we are not attempting to study overall Web satisfaction, only satisfaction with decision support features that might help consumers choose a product. Furthermore, the focus on decision strategies implies that we are focusing on the process of choice.

In answering these questions, we draw on expectancy– satisfaction theory (Doll et al. 2004; McKinney et al. 2002; Melone 1990), decision strategies (Johnson and Payne 1985; Todd and Benbasat 1992), and cost-benefit theory (Johnson and Payne 1985). Our research model hypothesizes that perceived accuracy and effort influence Web users' perceived effectiveness, which in turn changes Web users' overall satisfaction. Also, we developed three different Web-based DSS based on decision strategies. This study was conducted in two phases to test our research model. In the first phase, we identified relatively important decision variables in our context and collected data for selecting the most important variables. These variables were then used to apply decision strategies in developing Web-based DSS. In the second phase, we developed an instrument to measure important constructs, such as Web users' satisfaction with Web-based DSS and its antecedents. The model is tested in a controlled laboratory experiment. Structural equation model is used for data analyses. The next section provides the theoretical background for the study. The subsequent two sections report on the research design and data analyses. In the final section, we provide the conclusion of this study.

Theoretical Background

End-user satisfaction has been studied in different contexts and recognized as an important area of IS research in terms of measuring IS success and use (McKinney et al. 2002). The conceptualization of the research model is based on the customers' salient beliefs related to Web-based DSS and the role of such beliefs in shaping customers' satisfaction. The expectancy-value approach (such as customer value-satisfaction hierarchy) can assist in comprehending customers' satisfaction (Melone 1990) and decision strategies (Johnson and Payne 1985) provide the theoretical background for the conceptualization process in this study.

Expectancy Approach

The expectancy-value approach postulates that an individual's attitude emerges from a multiple belief structure in a linear-additive form. An individual user's satisfaction is enhanced by the evaluation of product-service attributes. In other words, the user satisfaction is formulated by evaluating different types of product-service attributes such as accuracy and relevance, format and node, or support for development (Melone 1990; Oliver 1997). Ajzen and Fishbein (1980) provided groundwork for this approach and suggested a more decomposed form known as the theory of reasoned action. Davis (1989) developed the technology acceptance model based on both the expectancy-value approach and the theory of reasoned action.

In IS research, two different types of expectancy were studied. Effort expectancy is defined as the degree of effort reduction associated with the use of the system. Performance expectancy refers to the degree of outcome associated with the use of the system (Venkatesh et al. 2003). Effort expectancy can be conceptualized as perceived ease-of-use or complexity, and performance expectancy has been captured as perceived usefulness, extrinsic motivation, relative advantage, or outcome expectation in different theories (Venkatesh et al. 2003). In general, DSS leads to different decision outcomes (Lilien et al. 2004). From the perspective of Web DSS, effort expectancy is instantiated as perceived cognitive effort and performance expectancy is instantiated as perceived accuracy. An individual customer strives to reduce the amount of cognitive effort associated with decision making and to enhance accuracy of their decision (Johnson and Payne 1985).

Effort and accuracy in decision making, however, are not independent. *Ceteris paribus*, one can obtain better accuracy by applying more effort. This is expressed in the tradeoff between effort and accuracy as decision makers choose among decision strategies (Johnson and Payne 1985). Decision makers are quite adept at making this tradeoff and can compare two decision strategies that differ on both effort and accuracy dimensions as they choose which decision strategy to use in a particular decision context (Payne et al. 1993). Moreover, decision makers are aware of when the effort or accuracy aspect of a strategy is changed by support (or lack of it) from a DSS (Todd and Benbasat 1991, 1992, 1994). This implies that Web DSS users are perfectly capable of assigning a single evaluation of a Web DSS based on both its effort and accuracy components. Such an evaluation of a Web DSS can be thought of as an evaluation of its effectiveness. Effectiveness means not only doing a good job but completing the job in a timely manner.

Decision Strategies

A decision maker has limitations in acquiring and processing information, especially when confronting a large amount of information (Lilien et al. 2004). In order to maximize the performance of decision making, each decision maker has preferences concerning the amount of importance (s)he places on various attributes. For example, one consumer may care mostly about price and little about features while another consumer may be willing to pay a high premium to get a certain constellation of features and still not be attracted to some other constellation of features. To express these preferences, consumers execute decision strategies in assessing the features of products they are considering. These strategies can be non-compensatory or compensatory (Payne et al. 1993; Todd and Benbasat 1994), and computer systems could give varying levels of support for each type of strategy. *Non-compensatory strategies* are fairly simple in that they do not allow high values of one attribute of a product (or service) to compensate for low values of another attribute. Examples of non-compensatory strategies include satisficing, and elimination-by-aspect. *Compensatory strategies*, enable desirable values of one attribute of a product or service to "compensate" for undesirable values of another. An example of a compensatory strategy is a weighted-additive strategy in which a weight (relative importance) is assigned to each attribute and multiplied by its value. The product of the value and weights for each attribute are summed up to provide a score for every product. Then the product with the highest score is selected. Without DSS, compensatory strategies are more accurate, but also more difficult, than non-compensatory strategies. The effort requirement can be changed by adding DSS features (Payne et al. 1993; Todd and Benbasat 1994).

Research Model

In the e-commerce arena, many e-tailers (electronic retailers) provide different functionalities to help customers make decisions. The level of satisfaction of Web customers may vary depending on their perception about the outcome of Web-based systems. From this perspective, in addressing our research questions, we applied expectancy-satisfaction theory to conceptualize our research model and used decision theories in developing Web-based DSS.

Web-Based User Satisfaction

Many researchers have investigated users' satisfaction in terms of end-user satisfaction, which is considered to be an important factor in IS success and use (Doll et al. 2004; Ives et al. 1993; McKinney et al. 2002). After DeLone and McLean (1992) provided guidance for studying end-user satisfaction, many attempts were made to verify and modify their model (Molla and Licker 2001; Seddon 1997). Doll et al. (2004) reviewed the literature of satisfaction and refined the satisfaction measure as a second-order construct of content, accuracy, format, timeliness, and ease of use. Especially, McKinney et al. (2002) proposed a comprehensive model for Web customers' satisfaction. They argued that Web customers' satisfaction is a result of satisfaction with information quality and system quality. They decomposed information quality and system quality into various aspects of information (relevance, understandability, reliability, adequacy, scope, and usefulness) and system (access, usability, entertainment, hyperlinks, navigation, and interactivity). Satisfaction is also an important outcome in studies of DSS. Parikh et al. (2002) examined the role of guidance in DSS in the decision-making process. They found that guidance in DSS generally improves user satisfaction. We adopt Web users' satisfaction as the most importance outcome in using Web-based DSS, and build on the prior research to improve understanding of it. Based on the previous studies, we propose our research model as presented in Figure 1. In this conceptualization, we identified perceived effectiveness as the most important antecedent of Web users' satisfaction. Also, we identified perceived accuracy and perceived effort as the two antecedents of perceived effectiveness.

Effectiveness of Web-Based DSS on Web Users' Satisfaction

Studies on DSS or decision strategies point to effectiveness as the most important factors for end users (Lilien et al. 2004; Parikh et al. 2001; Sharda et al. 1988). Sanders (1984) noted that decision support satisfaction is high when system intervention assists in decision making and better performance of the user's job. According to the DSS literature, we view effectiveness as perfor-

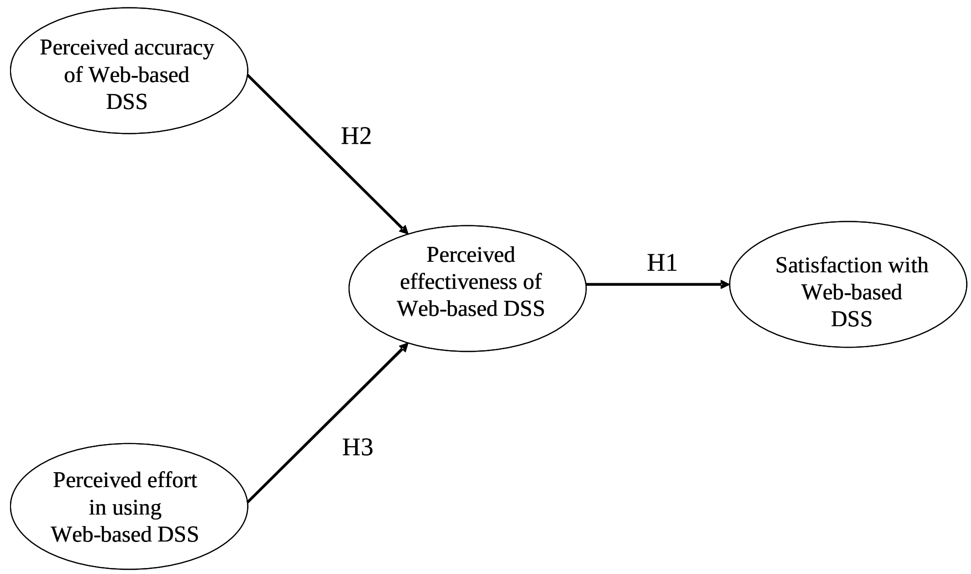

Figure 1. Research Model

mance of using the system and define perceived effectiveness as people's belief about how worthwhile and productive it is to use the DSS. This definition is in line with the previous studies in terms of decision quality or decision outcomes (Lilien et al. 2004; Sharda et al. 1988). Several studies have examined the effectiveness of decision support systems in a broader context, and most of them have generated mixed results. Vessey and Galletta (1991) argued that users need to effectively complete the task to enhance their performance in using a DSS. Sharda et al. (1988) reviewed the results of previous studies concerning the effectiveness of DSS-aided decision making and found that out of 11 studies they reviewed, only 6 showed a significant increase in decision quality. Guimaraes et al. (1992) found that among many perspectives of decision support system success, user satisfaction was regarded as a major criterion. However, the individual perceptions of users concerning the decisions and the processes that lead to the decisions such as satisfaction do not necessarily improve after the use of a DSS (Lilien et al. 2004). Furthermore, a study considering Web customer satisfaction suggests that system quality of Web site significantly influences Web customers' system satisfaction (McKinney et al. 2002). Hence, it would be interesting to study how the perceptions of effectiveness of a DSS influence the perceptions of satisfaction. Therefore, we hypothesize that

Hypothesis 1: *Web users' perceived effectiveness of Web-based DSS positively influences Satisfaction with Web-based DSS.*

The Role of Effort and Accuracy

Users' evaluation of the accuracy of a Web-based DSS is pertinent in the context of a user's decision to buy a product online. In the process of interacting with a Web-based DSS, users also spend considerable effort in evaluating the choices. In this study, consistent with expected utility rule, perceived accuracy is defined as the user's belief about the ability of the Web-based DSS to produce alternatives with highest expected values (Johnson and Payne 1985; Thorngate 1980). Perceived effort is defined as the user's belief about the total use of cognitive resources needed to complete the task (Johnson and Payne 1985; Russo and Dosher 1983).

Although the role of perceptions of effort and accuracy is well recognized, their impact on the effectiveness of decision support systems is still largely under-investigated. Based on cost-benefit theory, most decision makers try to maximize their benefits (accuracy) while minimizing mental costs (effort) (Johnson and Payne 1985). Many studies applied the theory in human behavior, especially in decision-making strategies. The theory posited that an individual's choice of decision-making strategy is a function of accuracy and effort (Johnson and Payne 1985; Kuo et al. 2004). Decision makers use different strategies to make decisions, and the selection of a strategy depends on the accuracy of a DSS and the mental effort required to interact with it (Johnson and Payne 1985; Todd and Benbasat 1991).

Previous research has shown that users as a group understand the accuracy and effort dimensions of decision strategies (Chu and Spires 2003). Studies on the multi-attribute choice strategies indicate that decision makers adapt to differences in task features by selecting a strategy that is determined by a trade-off between the goals of minimizing effort and maximizing accuracy and that the trade-offs affect the quality of the decision outcomes (Fennema and Kleinmuntz 1995; Johnson and Payne 1985; Kuo et al. 2004; Todd and Benbasat 1994). Hence, in light of the importance of accuracy and effort in decision making, we posit that

Hypothesis 2: *Web users' perceived accuracy of using a Web-based DSS positively influences perceived effectiveness of the Web-based DSS.*

Hypothesis 3: *Web users' perceived effort of using a Web-based DSS negatively influences perceived effectiveness of the Web-based DSS.*

Research Design and Data Analyses

The context of this study is Web-based apartment rental systems for Web customers. Testing our research model involved two phases. In the first phase, we identified the important attributes of Web-based DSS and developed three different Web-based DSS based on the results of the identification process. In the second phase, we developed the instrument and conducted a series of experiments.

Phase I: Identification of Important Decision Attributes of DSS and Development of Web-Based DSS

The domain of this study involved developing Web-based DSS that provided different types of apartment features for helping customer decision making or choice. In order to develop the systems, we first visited commercial Web sites to identify potential features of apartments. Then, we developed a survey containing the list of apartment features, such as rental fees, number of bedrooms, apartment features, and community features as reported in Appendix A. A total of 21 subjects participated in this phase. They were asked to evaluate the importance of the attributes. The participants equally rated rental fees and number of bedrooms as the most important features. In addition, the participants also rated their preferences for the features in the categories of apartment and community features as reported in Table 1. Therefore, we incorporated number of bedrooms, affordable monthly rental fees for selected bedrooms, and the top three attributes in each of the apartment and community features categories in developing the Web-based DSS.

Based on the results of the first phase, we developed three different Web sites, which contained three different types of Web-based DSS to help customers select apartments to rent. Each system was created based on a particular decision strategy such that, across systems, particular strategies differed in their effort requirement. The consumer would need a way to easily find out which products or services obtained the highest scores, such as having the system sort or select products based on scores. The procedure for computing scores is provided in Appendix C.

Table 1. Descriptive Statistics of Decision Guideline Features

Apartment Features	Mean	STD	Community Features	Mean	STD
Air conditioning	35.5	17.0	Swimming pool	11.4	6.9
Dish washer	15.6	5.9	Fitness center	9.3	7.1
Fireplace	1.6	3.6	***Cable TV***	26.7	16.2
Microwave	7.1	7.5	Pet allowed	10.2	15.1
Ceiling fans	10.1	6.5	***Laundry facility***	15.7	12.8
Washer and dryer	10.6	11.4	Business center	4.0	4.1
Washer and dryer Hook up	6.4	5.7	***Covered parking***	14.3	10.0
Disposal	8.3	7.8	Others	7.4	8.0
Others	4.4	4.6			

The cloud system was created based on non-compensatory strategies. It provides elimination-by-aspects functionality; for example, the consumer can sort apartments based on the value of an attribute (as in sorting by price and by number of bedrooms; see the snapshot of the cloud system in Appendix D, Figure D1). Some e-tailers, such as BestBuy.com, give support for non-compensatory strategies. The volcano system was developed based on a type of compensatory strategy. It required users to assign points to each attribute, which reflected its relative importance in a set of attributes. The total points for all attributes added up to 100. The Web site containing the second system displays various attributes, which enable Web users to select the apartments based on multiple criteria. This system computes a score for each apartment based on the user's preferred attributes and their associated weights. Web users can easily find out which apartment obtained the highest scores by having the system sort or select apartments based on the scores (see the snapshot of the volcano system in Appendix D, Figure D2). The River system was created based on the partial support for compensatory strategies and enabled users to select or deselect displayed items. The selected attributes are provided equal weight in calculating scores (see the snapshot of the river system in Appendix D, Figure D3.) The Volcano System and the River system were identical, except that the Volcano system computed scores for the apartments based on the user's own weights while the River system used equal weights in computing scores for the apartments. Some e-tailers, such as apartments.com, give partial support for compensatory strategies.

Phase II: Instrument Development and Data Analyses

The scales for measuring the constructs were developed based on a literature review to ensure the content validity, as reported in Appendix B. Perceived accuracy can be measured by addressing how close the information is to the ideal choice (Tabatabaei 2002). The scale for perceived effort consisted of three 7-point items that measure consumption and investment of energy and time in acquisition of information (Johnson and Payne 1985). The items measuring perceived effectiveness address improvement, productivity, and support (Ayers et al. 1997). As far as measuring satisfaction is concerned, there is no consensus in the literature. Some have measured satisfaction as user information satisfaction (Ives et al. 1983), satisfaction with outcome (Lim and Benbasat 1992-1993), or ease of use and format perspectives (Doll et al. 2004). In this study, we measured overall Web users' satisfaction (McKinney et al. 2002) rather than performing a detailed analysis of user satisfaction. Therefore, three satisfaction measures were adapted from the work of McKinney et al. (2002).

Participants were MBA and senior undergraduate students at a large business school in a university in the United States. The participants were randomly assigned to three different Web sites and the data collection resulted in a total of 111 observations (Web site 1 with 35; Web site 2 with 37; Web site 3 with 38). Participants were told that the experiments were intended to help Web sites improve their services. To increase the seriousness of participation, participants received extra course credit and a chance to participate in a lottery drawing for participating in the study. Participants were asked to assume the role of a user in need of an apartment. Participants were then asked to visit the assigned Web site and examine its systems with care. Later, participants answered questions pertaining to the measurement of beliefs and satisfaction. Table 2 shows the profiles of the participants.

Most participants were familiar with activities on the Web and had experience with decision functionalities provided on commercial Web sites. Using students as study subjects always generates the question of external validity. Many studies found that there are no significant differences between student subjects and nonstudent subjects in individual behavior, organization psychology, and so forth (Locke 1986). In addition, participants in this study have the characteristic that defines the population being sampled, which is that they are Web purchasers. Hence, the type of subjects in this study does not present a significant threat to external validity and could be considered as representative of the general customers who seek apartment information.

The reliability of the constructs was measured using Cronbach's alpha, composite factor reliability (CFR), and average variance extracted (AVE). All Cronbach's alpha values are above the cut-off value of 0.70. Similarly, CFR and AVE are above the threshold of 0.70 and 0.50, respectively (Segars 1997), as reported in Table 3.

We also carried out confirmatory factor analysis (CFA) for establishing the convergent validity. The CFA loadings, t-value, and item R^2 are reported in Table 4. All loadings exceeded 0.70, hence convergent validity is met (Fornell and Larcker 1981). The fit indices of the CFA are good. The normed χ^2 (χ^2/d.f.) was 1.40. RMSEA was 0.06, which meets the 0.06 cut-off (Hu and Bentler 1999), indicating a satisfactory model fit. CFI, TLI, GFI, and AGFI were 0.98, 0.97, 0.93, and 0.91, respectively, which were above the cut-off values (Bhattacherjee 2002; Gefen et al. 2003), as reported in Table 6.

Table 2. Profiles of Participants (n = 111)

	Male	Female	Mean	Std. Dev.	Median
Gender	73	38			
Age			24	4.2	23
Web Activities			5.25	1.28	5.0

In order to measure Web activities and Web DSS experience, we used the following item on a seven-point scale:

- I ***rate*** my skill in using Web sites that provide functionalities which help my decision making as ***expert***.

Table 3. Reliability Measures for Model Constructs

Constructs	Cronbach's Alpha	CFR[a]	AVE[b]
Accuracy (ACCU)	0.86	0.91	0.78
Effort Spending (EFFORT)	0.90	0.94	0.84
Effectiveness (EFFECT)	0.90	0.94	0.83
Satisfaction (SATIS)	0.93	0.96	0.88

[a]Composite factor reliability. [b]Average variance extracted.

Table 4. Confirmatory Factor Analysis: Measurement Model

Constructs	Items	Loading	t-value	R^2
Accuracy	ACCU1	0.89	8.17	0.62
	ACCU2	0.98	9.30	0.73
	ACCU3	1.00	0.00	0.66
Effort	EFFORT1	0.86	11.60	0.63
	EFFORT2	1.00	0.00	0.90
	EFFORT3	0.89	15.10	0.74
Effectiveness	EFFECT1	1.00	0.00	0.78
	EFFECT2	0.97	17.71	0.82
	EFFECT3	0.93	14.23	0.67
Satisfaction	SATIS1	1.00	0.00	0.87
	SATIS2	0.94	16.60	0.78
	SATIS3	0.97	15.54	0.78

Table 5. Pairwise Discriminant Analysis of Constructs

Models	χ^2_{df}	χ^2 Difference from Original
Original measurement model	$\chi^2_{48} = 67.17$	–
Satisfaction and Accuracy	$\chi^2_{51} = 92.65$	25.48
Satisfaction and Effort	$\chi^2_{51} = 268.33$	201.16
Satisfaction and Effectiveness	$\chi^2_{51} = 107.79$	40.62
Effectiveness and Accuracy	$\chi^2_{51} = 99.62$	32.45
Effectiveness and Effort	$\chi^2_{51} = 269.69$	202.52
Effort and Accuracy	$\chi^2_{51} = 265.29$	198.12

Table 6. Fit Indices for the Measurement Model and Estimated Model

Goodness of Fit Indices	Measurement Model	Estimated Model	Recommended Cut-off
Normed χ^2 (χ^2/d.f.)	1.40	1.56	Below 3
CFI (Comparative Fit Index)	0.98	0.97	Above 0.90
TLI (Tucker-Lewis Index)	0.97	0.96	Above 0.90
GFI (Goodness of fit Index)	0.93	0.92	Above 0.90
AGFI (Adjusted Goodness of Fit Index)	0.91	0.90	Above 0.80
RMSEA (Root Mean Square Error of Approximation)	0.06	0.07	Below 0.06
SRMR (Standardized Root Mean Square Residual)	0.05	0.06	Below 0.10

In addition, following the procedure suggested by Gefen et al. (2003), we assessed discriminant validity by comparing the original measurement model (CFA) with four latent variables against other measurement models with three constructs, which included every possible combination of collapsing two constructs into one. Since combining any three latent variables adds three degrees of freedom to the model, the χ^2 of the original measurement model (CFA) should be greater than at least 11.34 ($p = 0.01$). Here, all differences are above 25.48 as reported in Table 5. Therefore, the χ^2 value in the original CFA was significantly better than the reduced measurement models, and the discriminant validity criterion is met.

The research model was estimated using the SEM technique. The fit indices of the SEM are shown in Table 6. The normed χ^2 was 1.56, which is desirably below the cut-off value. CFI, TLI, GFI, and AGFI were also well above the cut-off value. In addition, the index of SRMR indicating the badness-of-fit was below the cut-off value. However, the RMSEA is slightly above the cut-off value.

The estimation results of the research model including the estimated parameters, the t-values, and R^2 values for constructs are shown in Figure 2. Hypothesis 1 posited that the perceived effectiveness of using Web-based DSS positively influences individual users' satisfaction with Web-based DSS. The estimation result supports H1 with a t-value of 14.39. Hypothesis 2 posited that perceived accuracy from Web-based DSS positively influence perceived effectiveness of using Web-based DSS.

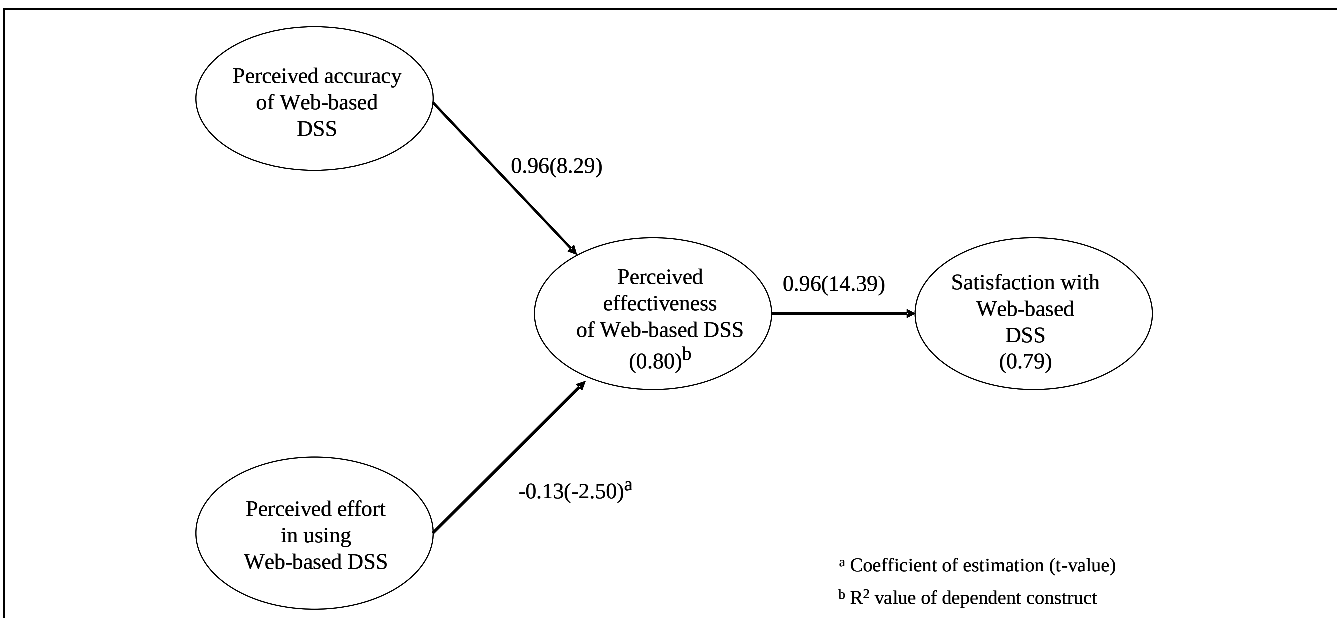

Figure 2. The Estimated Model

The estimation result supports H2 with a t-value of 8.29. H3 posited that the perceived effort spending negatively influences the perceived effectiveness of using Web-based DSS. The estimation result also supports H3 with a t-value of -2.05.

Discussion and Implication

The growth of online retailing on the Internet has been phenomenal over the last few years. In the context of heightened competition, it is important for e-tailers to provide Web site functionalities, not only to support consumers making purchases online but also to provide them with features that make the selection of products result in a high level of satisfaction. If the features provided by Web sites help consumers' choice processes by making the choices easier and consistent with their preferences, then consumers would experience greater satisfaction (Doll et al. 2004). Thus, while user satisfaction has been studied in numerous contexts, Web DSS has such high monetary implications that it deserves to be studied in its own right. Web DSS serves as a rich context for studying user satisfaction because it can draw on the very precise distinctions of decision strategies learned in the behavioral decision literature. We extend prior DSS literature by shifting the focus from the users' cognitive processing of strategies while using a DSS to the users' perceptions of the experience of using DSS.

Our research contributes to the literature, by proposing and testing a model that explicitly includes perceived effectiveness as an intervening variable between perceived effort and perceived accuracy and user satisfaction. This insight was gained because of the DSS context, which has to deal with the user's trade-off between perceived effort and perceived accuracy, implying that the user must reach a combined assessment of the two, and that this combined assessment is, in essence, the perceived effectiveness of the system.

This study also contains some limitations and needs to be extended. Previous studies suggested that age, gender, and previous experience play important roles in expectancies. Therefore, this study can be extended to consider such control variables. Second, the current study accounts for subjective evaluation of decision processes and decision outcome of using Web-based DSS. The future study can be extended to examine what features of Web-based DSS influences which Web customers' salient beliefs.

Given the importance of having satisfied Web customers, this study suggests an opportunity for Web retailers to provide features to assist consumers in making choices. This study also suggests a warning for the developers of such DSS features. Web developers should not dare to build DSS features without finding out if consumers are actually satisfied with the features. If the level of satisfaction turns out to be too low, this study provides the theoretical roadmap leading to possible changes in the DSS that would increase the level of Web shoppers' satisfaction.

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Appendix A. Instrument in Phase I

I. Which of the following is the most important criteria when you rent an apartment on a scale of 1 to 4? (1-most import, 2-second important, 3-third important, 4-fourth important)

Rental fee	
Number of bedrooms	
Apartment features (Features such as Washer/Dryer, Dishwasher, and Microwave etc)	
Community features (Features such as Swimming pool, Garage and Fitness center etc)	

II. How many bedrooms do you mostly look for? ______________________ bedroom(s)

III. Please indicate what you consider affordable monthly rental fee ranges associated with each type of apartment

1 bedroom: approximately $ ___________
2 bedrooms: approximately $ ___________
3 bedrooms: approximately $ ___________

IV. You have 100 points to distribute across the following apartment features shown. Please distribute the points based on the relative importance of the features in renting an apartment. Please make sure that your total adds up to 100.

Features	**Assigned Points**
Air conditioning	
Dish washer	
Fireplace	
Microwave	
Ceiling fans	
Washer and dryer	
Washer and dryer Hook up	
Disposal	
Others	
Total points	100

V. You have 100 points to distribute across the following community features shown. Please distribute the points based on the relative importance of the features in renting an apartment. You numbered should add up to 100.

Features	**Assigned Points**
Swimming pool	
Fitness center	
Cable TV	
Pet allowed	
Laundry facility	
Business center	
Covered parking	
Others	
Total points	100

Appendix B. Instrument in Phase II

All items were measured on a seven point Likert scale [1: Strongly disagree, 7: Strongly agree]

Accuracy

Accu1 I believe that the website I used in searching information about apartments produces the information I am looking for.
Accu2 I believe that the website I used in searching information about apartments matches my desire for the apartment.
Accu3 I believe that the website I used in searching information about apartments shows the best apartment for me.

Effort

Effort1 I believe that I have spent a great deal of time and attention in finding information about apartments using the website.
Effort2 I believe that I have put lots of energy in finding information about apartments using the website.
Effort3 I believe that I have invested a lot in finding information about apartments using the website.

Effectiveness

Effect1 I believe that the website I used in searching information about apartments improves my task.
Effect2 I believe that the website I used in searching information about apartments generates productive outcomes.
Effect3 I believe that the website I used in searching information about apartments stands by me if I need to search more for information.

Satisfaction

Satis1 After using the website in looking for information about apartments, I am very pleased.
Satis2 Using the website in looking for information about apartments made me content.
Satis3 After using the website in looking for information about apartments, I am very delighted.

Appendix C. Score Computation Procedure for Web-based DSS

We collected the data for 263 apartments in a midwestern city. The data from these apartments resulted in 102 records for one bedroom apartments where the rent ranged from $325 to $895, 113 records for two bedroom apartments with a minimum rent of $403 and a maximum rent of $1085, and 57 records for three bed room apartments with rent ranging from $355 to $1568. We designed a SQL server database that contained the details of each apartment.

Based on the user inputs into the DSS, a score is generated for each of the records in the database in the following fashion.

To begin with, score for rent is computed using the following formula:

$$S^{rent} = 1 - \left(\left| \frac{|AvgRent - DatabaseRowRent|}{Max\left(|AvgRent - MaxDBrent|, |AvgRent - MinDBrent|\right)} \right| \right)$$

AvgRent is the average of the maximum and minimum affordable rent provided by the user. Database row rent corresponds to the database record of rent of an apartment for which the score is generated. MaxDBrent corresponds to the maximum rent for a specific type of an apartment (for example, one bed, two bed or three bed) and minimum rent corresponds to the minimum rent for a specific type of an apartment that exists in the database. The basic idea is to generate a rental score for an apartment based on user provided criteria and to have this score ranging between 0 and 1. If the user input for an rent matches with the rent of an apartment record, then a score of 1 for will result for the rental criterion.

The cloud system, which supported only non-compensatory strategies, did not have a score computed, but allowed users to specify the number of bedrooms and view apartments sorted by an attribute of their choice.

The volcano and river systems also allowed users to specify the number of bedrooms, and displayed apartments sorted by score. Scores for the volcano and river systems are computed as follows:

$$Score = \left[\left(S_{\text{rent}} \times weight \right) + \sum_{i=1}^{6} \left(a_i \times weight \right) \right]$$

a_i refers to the availability of an attribute for a specific record of an apartment in the database for which the score is computed. The way to calculate weight for the volcano and the river systems are different. First, in the colcano system, the weight is provided by the user for each attribute. If the user provides a weight of 10 points, these points get multiplied by 1(the feature is available in the apartment for which the score is computed) or 0 (the feature is not available). Once the scores are generated for each apartment, the scores are sorted in descending order and the apartment listings corresponding to the scores are presented to the user. However, the river system provides equal weights (14.28 in this case) and these weights get multiplied by 1(the feature is available in the apartment for which the score is computed) or 0 (the feature is not available). Once the scores are generated for all the apartments in the above described fashion, then the scores are sorted in descending order and the apartment listings corresponding to the scores are presented to the user.

Appendix D. Snapshots of the Web-Based Decision Support Systems

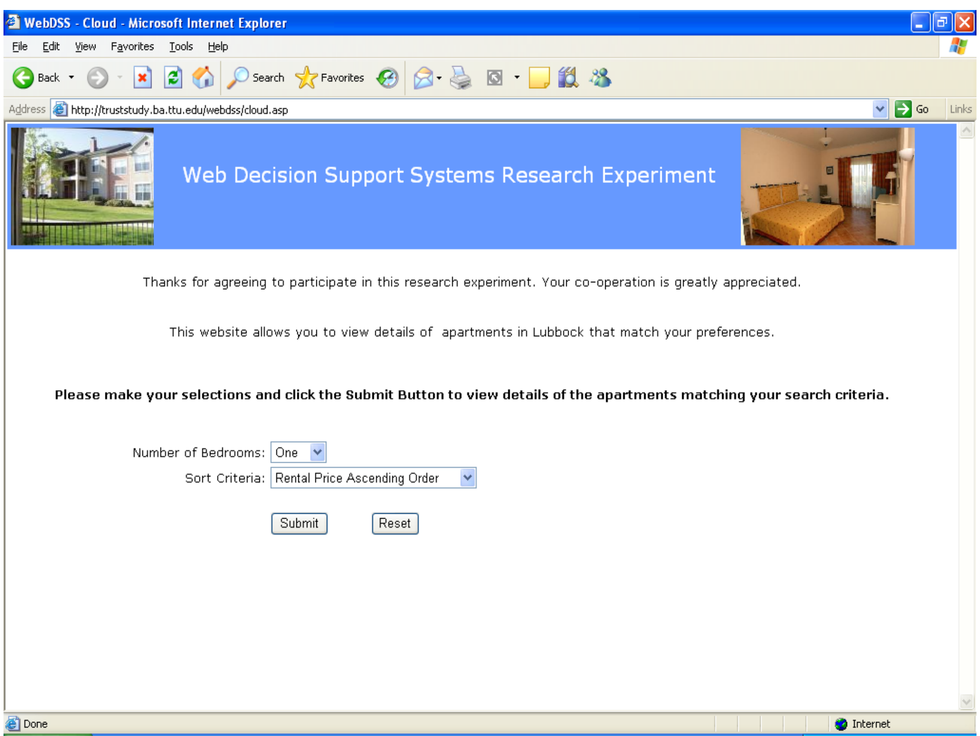

Figure D1. Web-Based DSS: Cloud System

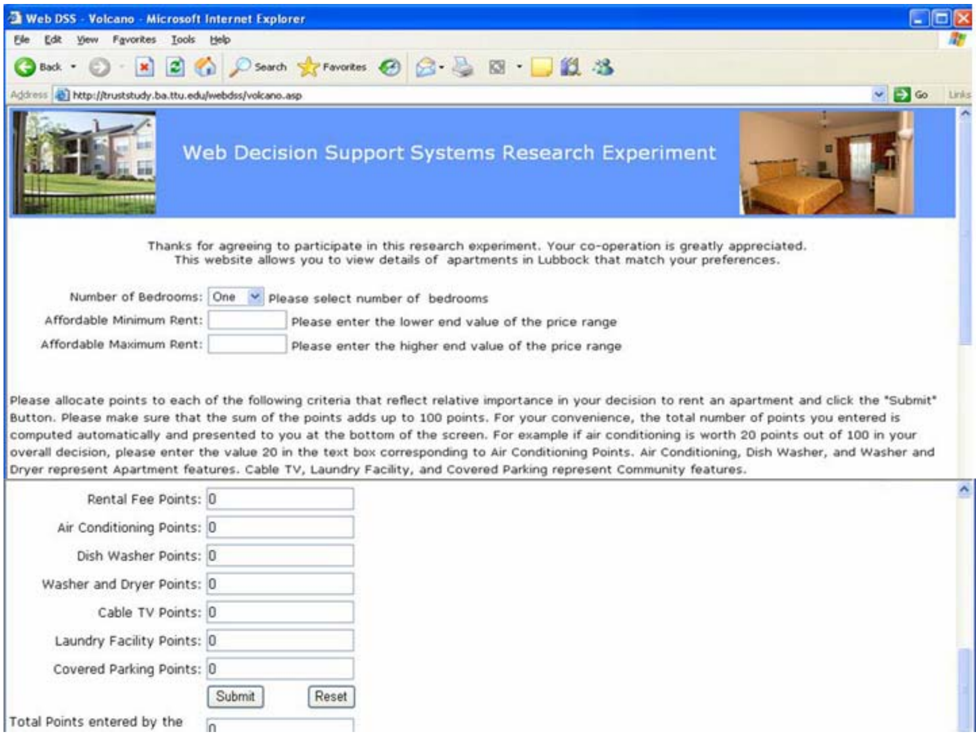

Figure D2. Web-Based DSS: Volcano System

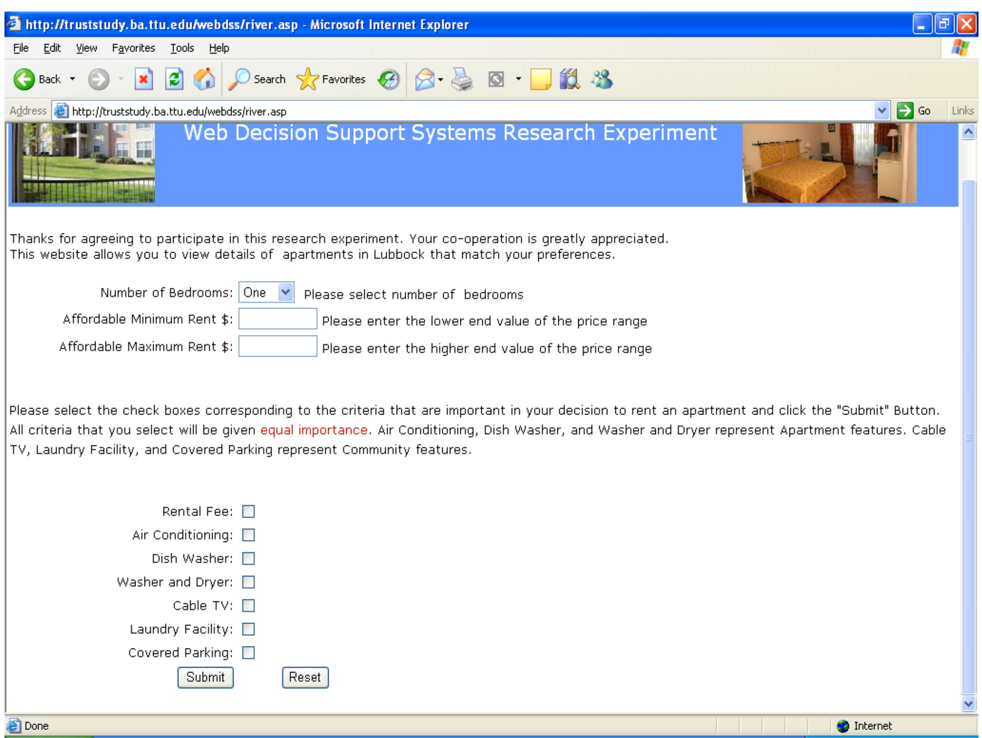

Figure D3. Web-Based DSS: River System