WEB-BASED INFORMATION SYSTEMS SATISFACTION
Theoretical Development and Testing of Competing Models

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Abstract: User satisfaction has been widely used in evaluating the performance of web-based information systems (WIS) since the growth of the World Wide Web. This study aims at investigating the structure and dimensionality of the WIS satisfaction construct. We tested the competing models built upon the web satisfaction model and assessed the psychometric properties of the factors and measuring items using confirmatory factor analysis. Our findings suggested that WIS satisfaction can be explained by a higher-order factor model with six first-order factors (i.e., understandability, reliability, usefulness, access, usability, and navigation) and two correlated second-order factors (i.e., web information satisfaction and web system satisfaction). The model provides a good-fit to the data and is theoretically valid, reflecting the logical or formal consistency. Implications of the current investigation for practice and research are provided.

1 INTRODUCTION

User satisfaction is one of the most important measures of information systems success (Rai et al., 2002; DeLone and McLean, 1992; 2003; Zviran and Erlich, 2003). It has become a particularly important evaluation measurement of web-based information systems (WIS) since the rapid growth of the World Wide Web. Despite the fact that there is a rich literature of end-user information satisfaction conducted in traditional information system (IS) environment, very little is known about user satisfaction in the web-based environment due to the different natures of these two kinds of IS (Isakowitz et al., 1998, Kaschek et al., 2004). The users of traditional information system are mainly professionals in organizations while those of WIS comprise of both professional and non-professional users. Besides, these systems perform different functions to fulfill the needs of these two types of end-users. Furthermore, the richness of information and the nature of unstructured and highly individually customizable interactions typically exhibited by WIS redefine the standard of user satisfaction in the web environment. As a result, findings from prior studies on user satisfaction may not be valid in the context of WIS. There is a need to investigate the concept of user satisfaction under the new context of WIS.

The purpose of this study is thus to investigate the multi-faceted structure and dimensionality of the web-based information systems satisfaction construct through an examination of several competing theoretical measurement models. The results are anticipated to increase our understanding of WIS satisfaction, thereby laying a concrete foundation for the development of a validated and robust instrument for measuring WIS satisfaction, which may serve as a practical evaluation tool for evaluating web-based information systems.

2 THEORETICAL BACKGROUND

Satisfaction has been extensively studied from diverse theoretical perspectives. The discipline of information systems has a long history of research in

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End-User Computing (EUC) satisfaction, which is also a widely adopted indicator of IS success (DeLone and McLean, 1992; 2003; Rai et al., 2002). EUC satisfaction is generally defined as an overall affective evaluation an end-user has regarding his or her experience related to the information system. Doll and Torkzadeh (1988) developed a 12-item instrument that measures the five components of EUC satisfaction, namely, content, accuracy, format, ease of use, and timeliness. This instrument was one of the best known and frequently employed measurements of end-user computing satisfaction (e.g., McHaney et al., 2002). Doll et al. (1994) performed a confirmatory factor analysis of the EUC satisfaction instrument, so as to test the alternative factor structures of EUC satisfaction and to assess the psychometric properties of the factors and items. Their results provide strong support for their EUC satisfaction instrument.

One of the differences between WIS and traditional IS is that the former involves more end-users direct information consumption and interaction than the latter. Hence, information provided by the system and the quality of the systems are decisive in determining the level of web-based information system satisfaction. In this regard, McKinney et al. (2002) proposed a theoretical model of web satisfaction, which argues that web satisfaction should be analyzed at information level and system level. In other words, web satisfaction can be analyzed in terms of web information quality satisfaction (Web-IQ satisfaction) and web system quality satisfaction (Web-SQ satisfaction). Building upon expectation confirmation theory, Web-IQ satisfaction and Web-SQ satisfaction is determined by Web IQ disconfirmation and Web SQ disconfirmation respectively, and these disconfirmations are based on the evaluations of the expectation and perceived performance on the quality constructs.

3 FACTOR STRUCTURE FOR WIS SATISFACTION

McKinney et al. (2002) conceptualized web-based information system satisfaction as a multidimensional concept that was made up of Web-IQ satisfaction and Web-SQ satisfaction, which, in turn, was comprised of three dimensions respectively. This hierarchy implies that users evaluate WIS performance at multiple levels with multiple dimensions, and ultimately combine these evaluations to arrive at an overall WIS satisfaction perception. WIS satisfaction is therefore the overall affective evaluation a user has regarding his or her experience related to the web-based information system. In McKinney et al.'s (2002) web satisfaction model, understandability, reliability, and usefulness of information were the three key dimensions related to information quality. They also empirically determined three dimensions of system quality for web customer satisfaction, including access, usability, and navigation (See Table 1).

Table 1: Dimensions of Web Information Satisfaction.

Dimensions	Definition	Manifest Variables
Under-standability	Concerned with such issues as clearness and goodness of the information	▪ Clear in meaning ▪ Easy to understandin g ▪ Easy to read
Reliability	Concerned with the degree of accuracy, dependability, and consistency of the information	▪ Trustworthy ▪ Accurate ▪ Credible
Usefulness	Users' assessment of the likelihood that the information will enhance their decision	▪ Informative ▪ Valuable
Access	Refers to the speed of access and availability of the web site at all times	▪ Responsive ▪ Quick loads
Usability	Concerned with the extent to which the web site is visually appealing, consistent, fun and easy to use	▪ Simple layout ▪ Easy to use ▪ Well organized
Navigation	Evaluates the links to needed information	▪ Easy to go back and forth ▪ A few clicks

4 COMPETING MODELS FOR WIS SATISFACTION

In this study, we followed Doll et al.'s (1994) approach to test the five alternative factor structures of WIS satisfaction with 21 observable items.

Models 1 to 3 represent the non-hierarchical structure with only first-order factor, and Model 4 and 5 represent the hierarchical structure with more than one level of abstraction.

Model 1 is a first-order factor model. One factor (WIS satisfaction) is hypothesized to account for all the common variance among the 21 items. This is consistent with the idea used in the end user computing satisfaction literature, adding the item scores to obtain a total satisfaction score.

Model 2 hypothesizes six orthogonal or uncorrelated first-order factors (i.e., understandability, reliability, usefulness, access, usability, and navigation). McKinney et al. (2002) performed an exploratory factor analysis resulting in six factors. Thus, Model 2 is considered a plausible alternative model of underlying data structure.

Model 3 is a first-order factor model with the six factors correlated with each others to represent different dimensions of the concept of WIS satisfaction. Assuming the six factors are correlated allows us to capture the common variance in the model.

Model 4 hypothesizes six first-order factors and two second-order factors (web information satisfaction and web system satisfaction). Based on McKinney et al.'s (2002) model, understandability, reliability, and usefulness are dimensions of information quality. We believe these three first-order factors are highly correlated, and their covariations can be captured by a second-order factor (Web information satisfaction). Similarly, access, usability, and navigation are closely related to system quality, and a second-order factor (Web system satisfaction) is proposed to capture their covariations.

Model 5 assumes that the two second-order factors in Model 4 are correlated. Similar to Model 3, we assume the correlations between the two second-order factors, so that the common variation in the model can be captured.

5 RESEARCH METHOD

The sections below describe the details of data collection procedure, measurement, data analytical approach, and model competing criteria.

5.1 Data Collection

The web-based information system in question is known as "Blackboard Learning System (http://www.blackboard.com)", an Internet-based learning portal for students in campus-based education institutions. Through this portal, students can access to course materials, course announcements, and other relevant documents of each course they are enrolled in. The portal also contains communication facilities (e.g., discussion forums, group pages, and virtual classrooms) for students to exchange ideas and opinions.

The web-based portal was introduced to the first-year undergraduate students at the beginning of the semester. After six-week's usage, students were invited to voluntarily complete an online questionnaire that covered all the measures of the constructs in this study. A total of 515 usable questionnaires were collected. The respondent rate was 64.4%. Among the respondents, 54.8% were female and 45.2% were male.

5.2 Measurement

Table 2 lists the measures used in this study. Basically, we borrowed the measures from McKinney et al. (2002) but modified the wordings so as to fit them to this particular context of web-based information systems user satisfaction. The measurements employed a seven-point Likert scale, from "1=never" to "7=always".

5.3 Data Analytical Approach

The proposed factor structures were examined through the LISREL VIII framework. LISREL is one of the most widely used Structural Equation Modeling (SEM) techniques in IS. According to Chin (1998), if SEM is accurately applied, it can surpass the first-generation techniques such as principle components analysis, factor analysis, discriminant analysis, or multiple regression. Specifically, SEM provides a greater flexibility in estimating relationships among multiple predictors and criterion variables. It allows modeling with unobservable latent variables, and it estimates the model uncontaminated with measurement errors.

As suggested by Doll et al. (1994), competing models should be specified based on logic, theory, and prior studies. The LISREL framework offers us a systematic approach to statistically compare the theoretical models using the goodness-of-fit indexes. The best model is then selected as representing the factor structure and dimensionality of WIS satisfaction in the sample data. Further, the psychometric properties (i.e., reliability and validity) of the selected model are examined.

5.4 Criteria for Comparing Model-Data Fit

The determination of model fit in structural equation modeling is not as straightforward as it is in other statistical approaches in multivariate procedures. Chi-square test is the only statistical test that identifies a correct model given the sample data. In contrast to traditional significance testing, the researcher is interested in obtaining a non-significant chi-square. Such a finding indicates that the predicted model is congruent with the observed data. Another alternative is the ratio of the chi-square to the degrees of freedom. Researchers have recommended using Normed Chi-Square as low as 2 or as high as 5 to indicate a reasonable fit (Hair et al. 1992). However, Chi-square test is highly sensitive to the sample size and the departures from multivariate normality of the observed variables (Bollen, 1989). Given its sensitivity to many factors, researchers are encouraged to complement the chi-square measure with other fit indexes (Hair et al., 1998).

In IS research, absolute fit indexes and incremental fit indexes are the two most widely used measures to determine how well the data fits the proposed model. For instance, Doll et al. (1994) used absolute fit indexes, including the Goodness-of-Fit Index (GFI) and the Root Mean Square Residual (RMSR), to evaluate individual models. They also used incremental fit indexes, including the Normed Fit Index (NFI) and the Adjusted Goodness-of-Fit Index (AGFI), to reflect the improvement in fit of one model over an alternative. Some researchers (Joreskog and Sorbom, 1996; Hair et al., 1998) provided the criteria and interpretation of these measures.

6 RESULTS

The models are analyzed using confirmatory maximum likelihood estimation.

6.1 Checking for Multivariate Normality

Multivariate normality is an important assumption of confirmatory factor analysis. To check if our observations are independently and identically distributed, we examined the skewness and kurtosis for each scale. Skewness refers to the lack of symmetry of a data distribution, while kurtosis refers to whether the data distribution is peaked or flat relative to a normal distribution. Skewness for scale items ranged from 0.014 to 0.336 and kurtosis ranged between 0.015 and 1.041 were well within the robustness thresholds for normality.

Table 2: Lists of the Measures used in this Study.

Dimensions	Items	
Under-standability	UND1	The information on Blackboard is clear in meaning
	UND2	The information on Blackboard is easy to comprehend
	UND3	The information on Blackboard is easy to read
	UND4	In general, information on Blackboard is understandable for you to use
Reliability	REL1	The information on Blackboard is trustworthy
	REL2	The information on Blackboard is accurate
	REL3	The information on Blackboard is credible
	REL4	In general, information on Blackboard is reliable for you to use
Usefulness	USE1	The information on Blackboard is informative to your usage
	USE2	The information on Blackboard is valuable to your usage
	USE3	In general, information on Blackboard is useful for you to use
Access	ACC1	Blackboard is responsive to your request
	ACC2	Blackboard is quickly loading all the text and graphic
	ACC3	In general, Blackboard is providing good access for you to use
Usability	USA1	Blackboard is having a simple layout for its contents
	USA2	Blackboard is easy to use
	USA3	Blackboard is of a clear design
	USA4	In general, Blackboard is user-friendly
Navigation	NAV1	Blackboard is being easy to go back and forth between pages
	NAV2	Blackboard is providing a few clicks to locate information
	NAV3	In general, Blackboard is easy to navigate

6.2 Model Estimation

Specification of the models included fixing one of the paths from each of the six primary factors at 1.0, and the factor variance for the higher-order factor at 1.0. These are important for model identification. Model 1 fixes the factor variance for the single first-order factor (WIS satisfaction) at 1.0 and allows the 21 observable variables to be free. For Models 2 and 3, the first path for each of the six first-order factors (i.e., understandability, reliability, usefulness, access, usability, and navigation) is fixed to 1.0. For Model 2, the covariances among the six first-order factors are fixed to zero. For Models 4 and 5, the first path for each of the six first-order factors (i.e., understandability, reliability, usefulness, access, usability, and navigation) is fixed to 1.0. The first path for each of the two second-order factors (i.e., Web-IQ satisfaction and Web-SQ satisfaction) is fixed to 1.0. For Model 4, the covariances between Web-IQ satisfaction and Web-SQ satisfaction is fixed to zero. For all five models, the number of available data point is $p(p+1)/2 = 21 \times 22 / 2 = 231$.

For Model 1, there are 42 free parameters that include 21 error variances for the measured variables and 21 factor loadings. This leaves (231-42) = 189 degrees of freedom for Model 1. There are 42 free parameters for Model 2 which include 21 error variables, a total of (21-6) = 15 factor loadings, and 6 first-order factor variances. This results in 189 degrees of freedom for Model 2. The free parameters for Model 3 include 21 error variables, 15 factor loadings, 15 covariances among the first-order factors, and 6 first-order factor variances. Thus, Model 3 has 174 degrees of freedom. For Model 4, there are 46 free parameters that include 21 error variances for measured variables, 15 first-order factor loadings, 4 second-order factor loadings, 6 primary factor disturbances. This leaves 185 degrees of freedom. Finally, there are 47 free parameters for Model 5, including 21 error variances for measured variables, 15 first-order factor loadings, 4 second-order factor loadings, 6 primary factor disturbances, and 2 second-order factor variances, and 1 covariance between second-order factors. This provides 182 degrees of freedom.

6.3 Goodness-of-Fit

Table 3 summarizes the goodness-of-fit indexes for the five competing models. As expected, the large sample size causes the chi-square statistics of all models statistically significant with p-value < 0.0001. Models 1 to 3 are the first-order factor models. Both Models 1 and 2 provide poor fit to the data, where their fit indexes do not fulfill the recommended acceptance levels. Model 3 provides a good fit to the data with desirable goodness-of-fit indexes, and demonstrates a significant improvement over Model 2. The NFI index increases significantly from 0.66 (Model 2) to 0.94 (Model 3), and the AGFI index improves from 0.43 (Model 2) to 0.87 (Model 3).

Model 4 and Model 5 represent the second-order factor models. The two models provide reasonable model-data fit, and their fit indexes are close to the recommended levels. Comparing Model 4 and Model 5, Model 5 performs slightly better than Model 4, with a lower value of normed chi-square (Model 4: 7.67, Model 5: 3.46) and a higher value of GFI (Model 4: 0.86, Model 5: 0.89). Like Model 3, Model 5 also provides substantial improvement over Model 4. The NFI index increases significantly from 0.86 (Model 4) to 0.94 (Model 5) and the AGFI index improves from 0.82 (Model 4) to 0.87 (Model 5).

Table 3: Goodness of Fit Indexes for Competing Models (n=515).

Model	Chi-square (df)	Normed Chi-square (Chi-square/ df)	Absolute Fit Measures		Incremental Fit Measures	
			GFI	RMSR	AGFI	NFI
1	1539.80 (189)	8.15	0.74	0.05	0.68	0.85
2	3429.03 (189)	18.14	0.53	0.55	0.43	0.66
3	592.05 (174)	3.40	0.90	0.03	0.87	0.94
4	1418.96 (185)	7.67	0.86	0.47	0.82	0.86
5	630.29 (182)	3.46	0.89	0.04	0.87	0.94

GFI – Goodness of Fit Index
RMSR – Root Mean Square Residual
AGFI – Adjusted Goodness of Fit Index
NFI – Normed Fit Index

In comparing the goodness-of-fit among all competing models, we notice that the first-order model (Model 3) performs the best. As suggested by Marsh and Hocevar (1985), the purpose of higher-order model is to explain the covariation among the lower-order factors in a more parsimonious way. In fact, even the higher-order model can explain the factor covariation effectively, its goodness-of-fit can never be better than the corresponding first-order model. Harlow and Newcomb (1990) further suggested four guidelines for model selection, including (a) logical or formal consistency, (b) empirical adequacy, (c) the ability to capture most of the essential relations among the variables, and (d) simplicity. Based on these criteria, only Model 3 and Model 5 could be retained. Among the two models, Model 5 is more theoretically valid, reflecting the logical or formal consistency. Similar to the case in Harlow and Newcomb (1990), Model 5 presents the relationships in the data in an organized and conceptually descriptive manner. In sum, Model 5 is the most appropriate model to capture the structure of WIS satisfaction. Figure 1 depicts the hierarchical structure of Model 5 with their respective factor loadings and residual variances. Each of the factor loadings is large and highly significant with correspondingly low residence variances, offering further support for Model 5.

Indeed, we believe that a third-order factor model with six first-order factors (i.e., understandability, reliability, usefulness, access, usability, navigation), two second-order factors (Web-IQ satisfaction and Web-SQ satisfaction), and one third-order factor (WIS satisfaction) may provide a richer explanation of the underlying structure of WIS satisfaction. However, this model cannot be uniquely determined and hence cannot be estimated. According to Rindskopf and Rose (1988), there must be at least three second-order factors (for the third-order factor model) if the model is to be identified

6.4 Psychometric Properties

After examining the overall model fit, we turn to examine the parameters estimates for Model 5. Table 4 presents the statistical significance of the estimated loadings, their corresponding t values, and R-square values for the 21 observed variables. All items present significant factor loadings, each with a t-value higher than 2.00, on their underlying latent factor. Fornell and Larcker (1987) stated that a loading of 0.70 to latent variable is considered to be a high loading since the item explains almost 50 percent of the variance in a particular construct. In our study, all items have high loadings (0.71 or above) to its respective construct.

Composite reliability (CR) and average variance extracted (AVE) are also computed to assess the construct validity. A composite reliability of 0.70 or above and an average variance extracted of more than 0.50 are deemed acceptable (Hair et al., 1998). As shown in Table 4, all the measures fulfill the recommended levels, with the composite reliability ranges from 0.87 to 0.93 and the average variance extracted ranges from 0.68 to 0.79. Overall, the measures of the selected model have desirable psychometric properties.

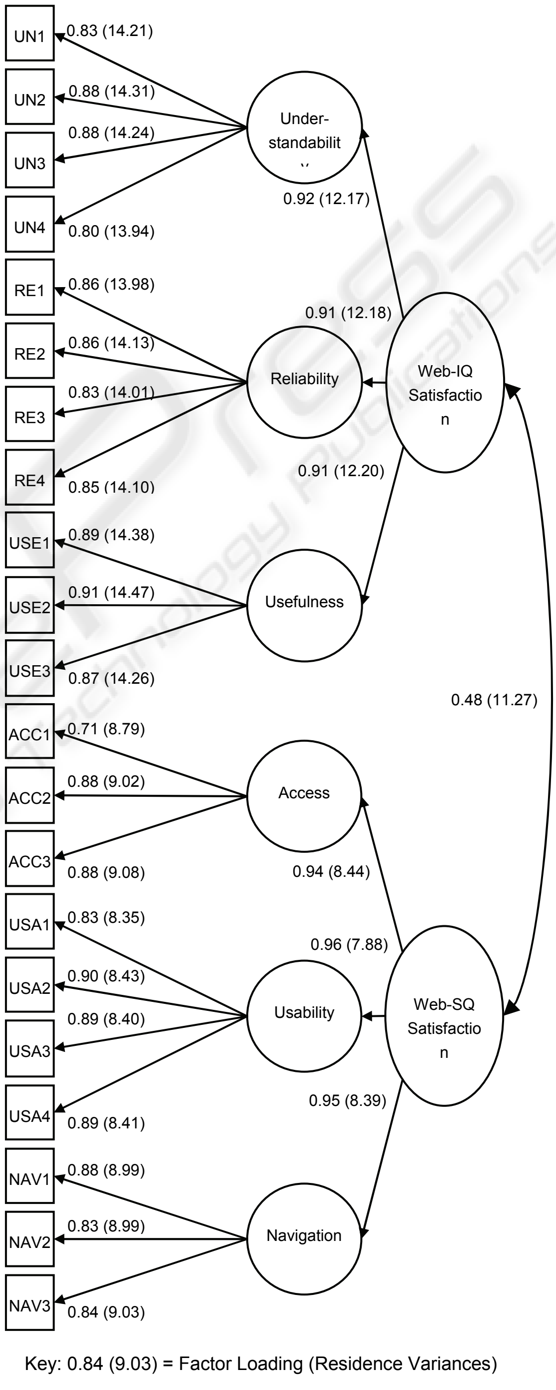

Figure 1: Factor Loadings and Residence Variances in Model 5.

Table 4: Parameter Estimates For Model 5 (Six first-order factors and two second-order factors).

Latent Variable	Observed Variable	Factor Loading	t-value	R-squares
Under-standability CR = 0.91 AVE = 0.72	UN1	0.83	14.21	0.76
	UN2	0.88	14.32	0.78
	UN3	0.88	14.24	0.77
	UN4	0.80	13.94	0.70
Reliability CR = 0.91 AVE = 0.71	RE1	0.86	13.17	0.70
	RE2	0.86	12.70	0.73
	RE3	0.83	13.07	0.70
	RE4	0.85	12.82	0.72
Usefulness CR = 0.92 AVE = 0.79	USE1	0.89	11.89	0.75
	USE2	0.91	11.30	0.77
	USE3	0.87	12.45	0.72
Accountability CR = 0.87 AVE = 0.68	ACC1	0.71	14.26	0.50
	ACC2	0.88	13.14	0.61
	ACC3	0.88	11.39	0.70
Usability CR = 0.93 AVE = 0.77	USA1	0.83	13.88	0.68
	USA2	0.90	12.85	0.76
	USA3	0.89	13.37	0.73
	USA4	0.89	13.16	0.74
Navigation CR = 0.89 AVE = 0.72	NAV1	0.88	12.95	0.70
	NAV2	0.83	13.03	0.69
	NAV3	0.84	12.14	0.74

7 DISCUSSION AND CONCLUSION

The results suggested that WIS satisfaction can be assessed by a large number of highly related factors. The second-order factor model (Model 5) with six first-order factors (i.e., understandability, reliability, usefulness, access, usability, and navigation) and two correlated second-order factors (i.e., web information satisfaction and web system satisfaction) provides a good-fit to the data and is more theoretically valid, reflecting the logical or formal consistency.

7.1 Managerial Implications

Understanding WIS satisfaction is particularly important because a high level of WIS satisfaction is associated with several key outcomes, including enhanced IS continuance usage (Bhattacherjee, 2001), the realization of IS success (DeLone and McLean, 1992; 2003), and improved user performance (Gelderman, 1998). In the current study, our higher-order factor model can greatly assist web designers in understanding how users assess web-based information systems satisfaction. Essentially, the model can help explain three basic issues: (1) what defines WIS satisfaction, (2) how WIS satisfaction is formed, and (3) which attributes are relatively important to the formation of WIS satisfaction. These three factors require managerial attention in efforts to improve user satisfaction with the web-based information systems. Thus, we believe our hierarchical structure model can substantially enhance web designers' conceptualization and understanding of WIS satisfaction.

In addition, the multilevel conceptualization of WIS satisfaction allows for analysis at different levels of abstraction. Web designers can use the complete scale to determine an overall WIS satisfaction, or they can focus on specific area that is in need of attention.

7.2 Research Implications

This study also has significant implications for academics. In response to the call for developing standardized instruments and completing a research cycle (Doll et al., 1994), the current study performed a confirmatory factor analysis on the McKinney et al. (2002) satisfaction instrument to test the alternative factor structures of WIS satisfaction and to assess the psychometric properties of the factors and their measuring items. Our results provide a strong support for McKinney et al.'s instrument. An obvious extension of this research is to conduct replication studies for other web-based information systems, and to explore the adaptation of this scale in other online environment.

Researchers in social sciences argued that the use of hierarchical factor structure can enhance the conceptualization and the estimation of human judgment models. Similarly, we believe our higher-order factor model can capture users' overall evaluation of WIS satisfaction through the underlying commonality among dimensions in the second-order factor.

Finally, this study demonstrates the advantages of using confirmatory factor analysis (CFA) for comparing alternative factor structures. CFA facilitates researchers to define alternative models for the testing of competing models and to generate parameter estimates of the models. Also, researchers can easily perform model comparisons using subjective indicators. However, indeterminacy of hierarchical models is common when sufficient restrictions are not imposed. This work has been restricted to estimating only second-order hierarchical models. Future research must attempt to find means to estimate higher-order structures.

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REFERENCES

Bhattacherjee, A., 2001. An empirical analysis of the antecedents of electronic commerce service continuance, *Decision Support Systems,* **32,** 201-214.

Bollen, K. A., 1989. *Structural equations with latent variables,* Wiley.

Chin, W. W., 1998. Issues and opinion on structural equation modeling, *MIS Quarterly,* **22,** 7-16.

Chin, W. W. and Lee, M. K. O., 2000. In *Twenty-First International Conference on Information Systems* (Eds, Orlikowski, W. J., Ang, S., Weill, P., Krcmar, H. and DeGross, J. I.) Brisbane, Australia, pp. 553-563.

DeLone, W. H. and McLean, E. R., 1992. Information systems success: The quest for the dependent variable, *Information Systems Research,* **3,** 60-95.

DeLone, W. H. and McLean, E. R., 2003. The DeLone and McLean model of information systems success: A ten-year update, *Journal of Management Information Systems,* **19,** 9-30.

Doll, W. J. and Torkzadeh, G., 1988. The measurement of end-user computing satisfaction, *MIS Quarterly,* **12,** 259-274.

Doll, W. J., Xia, W. and Torkzadeh, G., 1994. A confirmatory factor analysis of the end-user computing satisfaction instrument, *MIS Quarterly,* **18,** 453-461.

Fornell, C. and Larcker, D., 1987. Evaluating structural equation models with unobservable variables and measurement error, *Journal of Marketing Research,* **18,** 39-50.

Gelderman, M., 1998. The relation between user satisfaction, usage of information systems and performance, *Information and Management,* **34,** 11-18.

Hair , J. F., Anderson, R. E., Tatham, R. L., 1992. *Multivariate Data Analysis: With Readings*, 3rd ed., New York, MacMillan Publishing Co.

Hair, J. F., Anderson, R. E., Tatham, R. L. and Black, W. C., 1998. *Multivariate data analysis,5th Ed.,* Englewood Cliffs, NJ: Prentice-Hall.

Harlow, L. L. and Newcomb, M. D., 1990. Towards a general hierarchical model of meaning and satisfaction in life, *Multivariate Behavioral Research,* **25,** 387-405.

Isakowitz, T., Bieber, M. and Vitali, F., 1998. Web Information Systems, *Communications of the ACM,* **41,** 78-80.

Joreskog, K. G. and Sorbom, D., 1996. *LISREL 8: User's Reference Guide,* Scientific Software International.

Kaschek, R., Schewe, K.-D., Wallace, C. and Matthews, C., 2004. In *Web Information Systems* (Eds, Taniar, D. and Rahayu, J. W.) IDEA Group Publishing, Hershey, PA.

Marsh, H. W. and Hocevar, D., 1985. Application of confirmatory factor analysis to the study of self-concept: First- and higher order factor models and their invariance across groups, *Psychological Bulletin,* **97,** 562-582.

McHaney, R., Hightower, R. and Pearson, J., 2002. A validation of the end-user computing satisfaction instrument in Taiwan, *Information and Management,* **39,** 503-511.

McKinney, V., Yoon, K. and Zahedi, F. M., 2002. The measurement of web-customer satisfaction: An expectation and disconfirmation approach, *Information Systems Research,* **13,** 296-315.

Rai, A., Lang, S. S. and Welker, R. B., 2002. Assessing the validity of IS success models: An empirical test and theoretical analysis, *Information Systems Research,* **13,** 50-69.

Rindskopf, D. and Rose, T., 1988. Some theory and applications of confirmatory second-order factor analysis, *Multivariate Behavioral Research,* **23,** 51-67.

Zviran, M. and Erlich, Z., 2003. Measuring IS user satisfaction: Review and Implications, *Communications of the Association for Information Systems,* **12,** 81-103.