Issues and Opinions

On End-User Computing Satisfaction

Introduction

The topic of end-user computing (EUC) has gained a great deal of attention in the MIS literature in recent years. However, there is still very little known about the factors that influence the success of EUC.

In a recent study, Doll and Torkzadeh (1988) explicated the meaning of end-user computing satisfaction (EUCS) and subsequently developed a 12-item instrument to measure it. They compiled 38 specific items, plus two global items, to measure the EUCS construct. Using a five-point Likert-type scale, the instrument was pretested in a pilot study by a sample of 96 end users. To assess the construct validity of each item, correlations between corrected item total scores and item scores were used to eliminate 15 items. In addition, five items were deleted "because they represented the same aspects with slightly different wordings . . . ." A shorter 18-item instrument was administered in 44 selected firms, and the MIS directors were asked " . . . to identify the major applications and the major users who directly interact with each application." Using 618 usable responses, factor analysis was employed to extract five orthogonal factors. The items with loadings greater than .3 on three or more factors were elimited from the instrument. Consequently, a 12-item instrument emerged.

Although this study has made an important contribution in terms of highlighting the importance of EUCS, it has several problems in the area of measurement.

Item Generation

There appears to be some ambiguity regarding the content of the items. Although the authors contend that they are measuring end-user computing *satisfaction,* several items in their original instrument are not attitudinal measures. All well-accepted theory linking attitudes and behavior is the theory of reasoned action (Ajzen and Fishbein, 1977). According to this theory, attitudes can best be conceptualized as the amount of affect that one feels for or against some object or behavior. One of the major applications of this theory is to predict behavior based on attitudes. In the context of EUCS, therefore, one can measure the satisfaction of an end user with a system (attitude toward object) or his/her satisfaction with using a system (attitude toward behavior) to predict the person's future behavior (e.g., subsequent use of the system). Because attitudes result from a set of evaluated beliefs (Schewe, 1976), it is important to understand not only the relationship between these psychological constructs, but also the link between attitudes and behavior. In other words, the strength of an attitude-behavior relationship depends in large part on the degree of correspondence between attitudinal and behavioral entities. It is through this understanding that one can use attitudinal measures such as satisfaction to predict certain behaviors.

Doll and Torkzadeh used a five-point Likert-type scale, where 1 = almost never and 5 = almost always. Then they asked the respondents to ". . . circle the response which best described their satisfaction. . . ." By doing so, it would appear that the authors assume that (a) the frequency with which a respondent is satisfied with a certain characteristic of an application is a surrogate measure of the degree of satisfaction with that characteristic, (b) all the items in the instrument are equally important in capturing the respondent's "satisfaction," and (c) such belief items as "Is the system flexible?" by themselves measure an end user's attitude toward that system.

In light of the above problems, it would have been more appropriate had the authors (a) used a scale measuring the *extent of satisfaction* rather than the *frequency* with which the respondent is satisfied with the different characteristics of the application, and (b) included another scale evaluating the *degree of importance* of each item to the respondent. The sum of the products of all the salient beliefs about the applications and their respective evaluations would in turn have measured the resondent's satisfaction with the application.

Measurement

The authors seem to misapply statistical techniques in the development process of the instrument. Specifically, in order to establish the construct validity of the items, they eliminate 15 out of 38 items in their pilot study ". . . if their correclation with the corrected item total was below .5 or if their correlation with the two-item criterion scale was below .4." As the authors correctly indicate, this method of scale construction is based on the assumption that the total score is a valid measure of the underlying construct. Because the construct validity of the total score is not known and the authors later report that the items measure five *distinct* factors, elimination of items at this stage based on this criterion is not justified. In other words, these elimination methods could have resulted in the deletion of some useful items.

Moreover, the authors delete five more items ". . . because they represented the same aspects with only slightly different wordings." It would be intriguing to know why these items were included in the instrument in the first place. If the intention of including these "redundant" items was to increase the reliability and ultimately the construct validity of the instrument, the deletion of these items has defeated the purpose.

In the subsequent survey part of the study, the authors state that ". . . the items being factor analyzed were selected because they were closely related to each other (i.e., all items were thought to be measures of the same EUCS construct)." They proceed with the factor analysis, using principal component analysis, which results in three factors with eigen values of greater than one. Because the factors resulting from this analysis ". . . appeared to contain two different types of items," they conduct the analysis specifying two, four, five, and six factors. A solution with five factors was accepted because it "resulted in the most interpretable structure." However, this solution led to the deletion of six more items because they had factor loadings greater than .3 on more than two factors. These five *orthogonal* factors obtained from varimax rotation, were named (C)ontent, (A)ccuracy, (F)ormat, (E)ase of use, and (T)imeliness.

A quick look at the rotated matrix of the 18-item instrument and the correlation matrix of measures reveals that the above procedure (a) contradicts the original assumption that there is only one common factor underlying the EUCS construct, and (b) results in the elimination of six potentially important variables. The rotated matrix of the 18-item instrument shows that, for example, items C1, C2, C3 and C4 have neither primary not secondary loadings on factor 2 (Accuracy). Because items A1 and A2 also have no loadings on other factors, there should be no significant correlation between A1 and C1, C2, C3, C4 or between A2 and C1, C2, C3, C4. The result of the correlation matrix, as shown in Table 1, proves otherwise.

Table 1. The Reported Correlation Matrix

C1	1.0											
C2	.72	1.0										
C3	.68	.68	1.0									
C4	.67	.66	.59	1.0								
A1	.49	.49	.41	.55	1.0							
A2	.48	.45	.41	.48	.82	1.0						
F1	.52	.56	.56	.56	.42	.48	1.0					
F2	.56	.55	.54	.55	.53	.57	.64	1.0				
E1	.51	.51	.46	.41	.37	.39	.37	.44	1.0			
E2	.52	.51	.47	.41	.39	.39	.43	.56	.75	1.0		
T1	.53	.53	.47	.50	.53	.51	.43	.46	.46	.44	1.0	
T2	.52	.51	.45	.55	.57	.54	.44	.48	.44	.37	.70	1.0
	C1	C2	C3	C4	A1	A2	F1	F2	E1	E2	T1	T2

As can be seen, there are relatively high correlations between various items of these five "orthogonal" factors. Again, let us focus on the correlations between the items belonging to factors A and C. Given the relatively high values of these correlations (.49, .49, .41, .55, .48, .45, .41, .48), and the very large sample (n = 618) employed in the study, it is not unreasonable to assume that these two factors are not distinct, as reported by the authors.

It should be mentioned that, before establishing a theory based on the results of an exploratory factor analysis, one can test the validity of the exploratory factor pattern. Confirmatory factor analysis provides a means to test whether a particular factor pattern (in this case the one obtained from the exploratory analysis) fits the correlation matrix of the measured variables. By performing such a test one hopes to retain the prescribed factor pattern (See Table 2).

In order to test the validity of the final model for measuring end-user computing satisfaction, the corresponding factor pattern shown in Table 2 was tested. Specifically, the actual correlation matrix of the 12-item instrument was analyzed by the method of confirmatory factor analysis provided in the LISREL program (Joreskog and Sorbom, 1985). Using various tests and techniques, the overall fit of this orthogonal factor pattern to the corresponding correlation matrix was assessed; however, the fit was found to be inadequate. This lack of fit can be attributed to several reasons, including the non-orthogonality of the five factors, inappropriate number of factors selected, or inappropriate position of the loadings of the items on these factors. Nonetheless, the validity of the reported factor pattern, and consequently the construct validity of the instrument, is questionable.

Finally, Mulaik (1972, p. 139) has stressed the importance of selecting at least three distinct variables for each factor to be determined. Failing to do so would result in situations where factors are indeterminate and therefore would have tenuous scientific status (Thurstone, 1947). More specifically, there is a danger of obtaining a correlation matrix to which an application of the model of common factor analysis would be inappropriate (see also McDonald, 1985). In Doll and Torkzadeh's study, the final 12 variables are assigned to five factors, resulting in four factors (Accuracy, Format, Ease of use, and Timeliness) defined by only two variables. Consequently, the behavior domain underlying these factors may not be clearly described or well-defined.

In summary, given the growing importance of end-user satisfaction as the ultimate measure of information systems success, we need reliable and valid measures to evaluate this construct. We believe that the study by Doll and Torkzadeh is a significant work because it is one of the only academic attempts at unravelling some of the intricate issues surrounding end-user computing.

Table 2. The Reported Factor Pattern*

Item Code	Content	Accuracy	Format	Ease of Use	Timeliness
C1	x	0	0	0	0
C2	x	0	0	0	0
C3	x	0	0	0	0
C4	x	0	0	0	0
A1	0	x	0	0	0
A2	0	x	0	0	0
F1	0	0	x	0	0
F2	0	0	x	0	0
E1	0	0	0	x	0
E2	0	0	0	x	0
T1	0	0	0	0	x
T2	0	0	0	0	x

*x indicates existence of a non-zero loading.

However, the instrument developed in their study cannot be used unequivocally because of the above methodological and conceptual problems.

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