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A PROPOSED MODEL AND MEASUREMENT INSTRUMENT FOR THE FORMATION OF IS SATISFACTION: THE CASE OF END-USER COMPUTING SATISFACTION

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Abstract

This paper presents a model that explicitly defines satisfaction and the antecedent factors that help form it. The model distinguishes between the notions of expectations and desires and argues that both have an impact on overall satisfaction in the form of the difference between priors and post hoc *usage perceptions coupled with the individual's evaluation of these discrepancies. These two types of satisfaction, in turn, will have both direct and multiplicative impact on overall satisfaction. Given this understanding, we highlight possible limitations in existing instruments and provide a solution for creating new measures that should overcome these limitations. A complete set of measures is provided in this paper for future empirical testing, which are general enough to allow researchers to create measures for other aspects related to IS satisfaction beyond those targeted in this paper. We employ our model within the context of the five satisfaction areas outlined by Doll and Torzadeh (1988). Building upon their initial set of perceptual measures, we examine whether there are indeed two types of discrepancy effects, whether there are multiplicative effects for each discrepancy, and whether there is a higher order interaction between the two discrepancy components. Partial least squares analyses of data consisting of over 200 instructional staff member at a large university related to their satisfaction with an online grading system are employed and the results presented at the conference.*

Keywords: End-user computing, measures, satisfaction, user expectations, user information satisfaction, partial least squares

1. INTRODUCTION

The measurement of satisfaction has had a long history within the IS discipline. In the areas of end-user computing, a number of studies have attempted to capture the overall post hoc evaluation that end users have regarding the use of an IS system (i.e., satisfaction) as well as the most immediate antecedent factors that form this satisfaction (Doll et al. 1995; Doll and Torkzadeh 1988, 1991; Henry and Stone, 1994; Torkzadeh and Doll 1991).

2. RESEARCH OBJECTIVES AND QUESTIONS

The purpose of this paper is to build further upon this existing body of research by providing a new conceptual perspective on how end-user computing satisfaction (EUCS) is formed and how it ought to be measured. In addition, this paper operationalizes this new perspective by providing a new measurement instrument for empirical testing (see Appendix A). Beyond the EUCS context, we suggest that this model and approach are general enough to be used to create new measures in other IS satisfaction areas where concerns have been raised (e.g., service quality, Van Dyke et al. 1997).

As a baseline for comparison, we use Doll and Torkzadeh's (1991) EUCS set of measures given that it is probably one of the best known and frequently employed sets in the literature. We also develop additional measures for their five constructs. This is considered necessary in order to avoid methodological problems dealing with actual or empirical under-identification when used in a structural equation modeling analysis.[1] Data recently obtained are currently being analyzed and will be presented at the conference. The extent to which our new approach provides greater understanding and explanatory power over the baseline set of measures will be considered.

3. THEORETICAL FOUNDATIONS OF THE STUDY

3.1 Definition of End-User Satisfaction

In order to discuss our model of end-user computing satisfaction, we start with a definition of end-user satisfaction. Consistent with past research, we define end-user satisfaction with an information system as the overall affective evaluation an end-user has regarding his or her experience related with the information system. The term "experience" can be made more specific to focus upon different aspects related to the information system (e.g., computing, training, etc.). In general, past studies have focused primarily on the satisfaction measurement of the computing/use aspect of a system, but it may well be satisfaction with activities other than system use (e.g., training, participation or involvement in development or selection) that may also be of value in predicting subsequent behavior (e.g., utilization) or performance. Alternatively, a global measure of the end-user computing experience may equally be of value. For the purposes of this study and to be consistent with prior research, we will focus on the system use, but we note that our instrument is meant to be a general one such that a researcher can easily modify it in order to include other aspects related to end-user satisfaction.

Methodologically, we recommend that the explicit use of the term satisfaction or a synonymous term be applied in either Likert or semantic differential scale format. In the case of semantic differential scales, close attention needs to be applied in selecting additional adjective pairs that reflect the satisfaction construct (e.g., see Appendix A).

For comparison, we note that Doll and Torkzadeh's (1988) 12-item Likert scale measures only used the term satisfaction once. The remaining measures are either perceptual measures of the system (e.g., "Is the system easy to use?") or a gap measure of desire/needs (e.g., "Does the system provide the precise information you need?). As will be discussed next, we believe that perceptual measures of the system and gap measures of desires represent a portion of the antecedent factors that form satisfaction - but are not equivalent to satisfaction.

3.2 Antecedent Factors: Desire and Expectations as Standards for Disconfirmation Modeling

Central to our model is the notion of disconfirmation. Essentially, satisfaction is viewed as being formed by the amount of gap between *post hoc* perceptions of the system and a prior standard. Previous research has traditionally used expectations as the standard for comparison (Churchill and Carol 1982). Yet, there may be other frames of reference or standards for assessing the gap. This paper extends the notion of gap between prior expectations and *post hoc* perceptions to include the role of desires. Thus, we argue that it is not only the fit between prior expectations and subsequent results from using the system that have an impact on satisfaction, but also how well the system meets an end-user's original desires. Expectations and desires are different concepts. For example, an end-user may have low performance expectations from an IS developed in-house (because the in-house development team is known to be of a poor caliber), but he or she may actually desire a lot more from such an IS. A system that surpasses expectations, but not desired needs, may still lead to feelings of dissatisfaction. Conversely, an end-user's desire may

[1]For a single confirmatory factor analysis, a necessary condition for analysis is to have three or more measures for the construct. When there are only two measures per construct, constructs must be modelled as correlated in order to obtain unique parameter estimates.

be quite low (i.e., he or she really doesn't really want the system). Yet, if the developed system failed to meet one's original expectation (e.g., based on what the project team claims the system will do), the end-user might still feel some dissatisfaction with the in-house group's inability to meet their stated objectives. In other words, independent of ones desire, we can still feel disappointment when expected performance is not met.

We also argue that these differences between prior (i.e., before system use) and subsequent (i.e., after experiencing system use) perceptions (on desire and expectations) are moderated by the individual's ***evaluation*** of the differences. Following an additive difference model (Tverksy 1969), we suggest that satisfaction is affected by the discrepancy between what an end-user receives and a standard (i.e., prior desire or expectation) multiplied by an evaluation of this discrepancy (i.e., relative goodness or badness of the difference). Whether such an interaction effect truly exists can be tested (e.g., Chin et al. 1996). It may well be that a linear combination of the gap and evaluation of the gap is enough. In either case, we believe it important to include the evaluation of the discrepancy rather than just the discrepancy alone. Our measurement approach of the discrepancies is meant to avoid the problems associated with the use of difference scores (Van Dyke et al. 1997). Finally, we hypothesize the possibility of a higher-level interaction between satisfaction produced from meeting expectations versus satisfaction produced from meeting desire. Besides the direct impact of individual component satisfaction from expectations and desires, we argue that desire-based satisfaction may moderate the impact of expectation-based satisfaction. In other words, while we expect that overall satisfaction depends on the amount of satisfaction felt from both expectations and desire, the impact of satisfaction from expectations on overall satisfaction will be more pronounced when the individual has a larger desire-based satisfaction. Conversely, the dissatisfaction based on unmet expectation will have more impact on overall satisfaction when the level of dissatisfaction based on unmet desires is higher. In other words, imagine that you are dissatisfied with the system produced by your IS department because it failed to meet your expectations. While the impact of this failure has a certain effect on you, you might imagine that you would even be more upset from this same level of failure if you have a stronger desire (therefore, a larger gap in unmet desires).

The proposed model for end-user satisfaction (see Figure 1), therefore, states that an end-user's overall feelings of satisfaction arise from both direct and multiplicative combinations of expectation-based satisfaction and desire-based satisfaction. The expectation- and desire-based satisfaction components, in turn, are formed in a similar fashion through the perceptions of and evaluation of the level of discrepancy regarding desires and expectations. The discrepancy perceptions, in turn, are based on the *post hoc* perceptions related to the system and the prior expectations/desires. This model can be applied to whatever specific object/domain of satisfaction interests the researcher (e.g., satisfaction with ease of use, accuracy, etc.).[2]

3.3 Expected Impact of the Baseline Measures

Given our discrepancy model, one can conjecture the relative impact of our baseline set (i.e., Doll and Torzadeh's five EUC constructs) on overall satisfaction. In examining the measures (see Table 1) to our model (see Figure 1), we immediately see that these measures, in general, do not capture satisfaction, nor do they capture all the relevant factors that form satisfaction. Furthermore, measures for some of the constructs are conceptually incompatible. In particular, the accuracy measures are partially confounded by having one measure use the term satisfaction (area J in Figure 1), while the other is a perceptual measure of the system's accuracy (area C). Measures that actually tap into discrepancy with desires rather than actual satisfaction are C1 through C3 and T1. C4 and T2, on the other hand, are not discrepancy measures, but yet other *post hoc* perceptions of the system. F1, while a discrepancy measure of desire, is less general since it explicitly focuses on the need for the format to be useful. Finally, the other format measure F2 and the ease of use measures (E1 and E2) are further examples of *post hoc* system perceptions.

In Doll and Torzadeh's defense, they did state that their measures were intended to be a cognitive alternative to the attitudinal/ affective based approach for measuring satisfaction. However, as suggested by our model, their items were predominately measuring antecedents to satisfaction as opposed to actual cognitive statements of satisfaction.

[2]As a further extension, we would suggest including one more standard for gap assessment: normative ideal. Consistent with Boulding et al. (1993), users' satisfaction may also be affected by the difference between an ideal level (i.e., should receive) and what they subsequently perceived to have received. Thus, beyond the "expected/will receive" gap and the "desire/want" gap, we believe overall satisfaction can be impacted by an "ideal/should" gap as well.

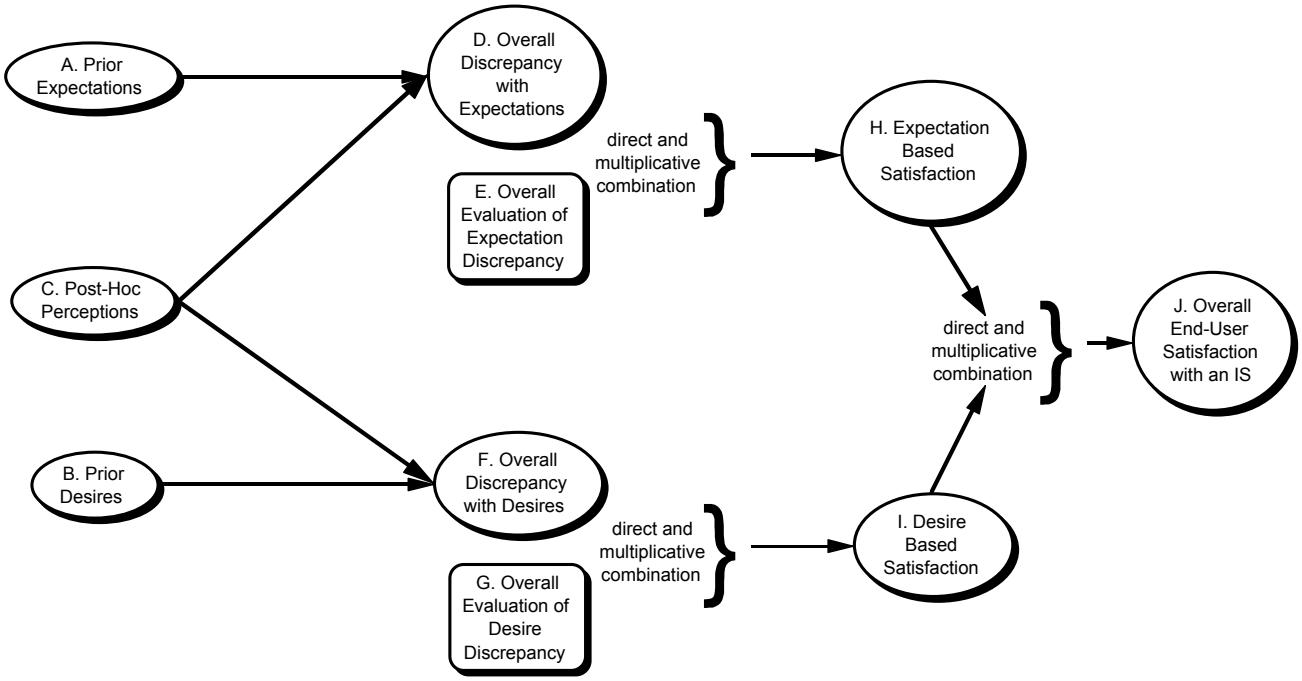

Figure 1. Formation of End-User Computing Satisfaction

Table 1. Doll and Torkzadeh's End-User Computing Satisfaction Measures

Content

C1. Does the system provide the precise information you need? [F]
C2. Does the information content meet your needs? [F]
C3. Does the system provide reports that seem to be just about exactly what you need? [F]
C4. Does the system provide sufficient information? [C]

Accuracy

A1. Is the system accurate? [C]
A2. Are you satisfied with the accuracy of the system? [J]

Format

F1. Do you think the output is presented in a useful format? [C]
F2. Is the information clear? [C]

Ease of Use

E1. Is the system user friendly? [C]
E2. Is the system easy to use? [C]

Timeliness

T1. Do you get the information you need in time? [F]
T2. Does the system provide up-to-date information? [C]

As an alternative to the baseline set of measures, this paper presents a new set focusing on the same five construct domains, but specifically capturing the discrepancy and discrepancy evaluation. We would conjecture that these measures should be more strongly related to the overall measures of satisfaction than the baseline model (see Appendix A for the new set).

While the five constructs in the baseline set attempts to focus on satisfaction with aspects of a system that help decision making (Doll and Torkzadeh 1988, p. 259), we would argue that overall operating speed might also represent another factor. Within the human computer interaction literature, the speed with which a computer system responds has been argued to be an important factor influencing the usability and emotional responses among users. Similarly, we suggest that satisfaction with the operating speed of a system should have a strong impact on the overall satisfaction with system use above and beyond the other functional attributes being considered (i.e., accuracy, information content, ease of use, timeliness, and format).

We, therefore, define satisfaction with operational speed as *the extent to which an individual is satisfied with the operational speed of the system*. In addition to examining the impact of this construct on overall system use satisfaction, the development of Likert scale satisfaction measures for this construct will allow us to test explicitly the strength of the relationship of the antecedent discrepancy factors proposed in our model.

Our model does differ from the second order factor presented by Doll and Torkzadeh. Their approach assumes that an overall feeling of satisfaction already exists and affects the satisfaction level of each of their five constructs. Conversely, we are interested in how the overall feeling of satisfaction is formed and thus have the causal direction of the five constructs affecting overall satisfaction. The two models are not necessarily incompatible, with either one potentially being more appropriate depending on the temporal nature of the measurement. Our model is likely more consistent when the objective is to determine the relative importance of key constructs in the formation of overall satisfaction (for further discussion of second order models, see Chin and Gopal 1995) similar to the service quality model in marketing (Cronin and Taylor 1994, p. 128). Finally, we do note that Chin and Newsted (1995, pp. 77-78) have statistically shown that the second order factor model can be less appropriate than a correlated model.

4. RESEARCH METHODOLOGY, CURRENT STATUS, AND PROPOSED PRESENTATION

This paper has presented a model that explicitly defines satisfaction and the antecedent factors that help form it. The model is unique from prior IS research by separating expectations from desires and arguing that both standards have an impact in the form of the difference between priors and *post hoc* usage perceptions. Furthermore, these discrepancies must also be combined with the individual's evaluation of them. These two types of satisfaction, in turn, will have both direct and multiplication impact on overall satisfaction. Given this understanding, the paper highlights possible limitations in existing instruments and provides a solution for creating new measures that should overcome these limitations. A complete set of measures is provided in this paper for future empirical testing. The set of questions is general enough to allow researchers to measure other areas related to end-user computing beyond those targeted in this paper. We are in the process of analyzing data on over 200 instructional staff members at a large university related to their satisfaction with a online grading system and will present the findings at the conference. As suggested, we will contrast our model in the context of Doll and Torzadeh's constructs. We will examine whether there are indeed two types of discrepancy effects, whether there are multiplicative effects for each discrepancy, and whether there is a higher order interaction between the two discrepancy components. Due to page limitations, we are not able to present the analytical methodology. Instead, we have emphasized the theoretical foundation along with the operationalization of the measures. But we do plan to present the approach via partial least squares (Chin 1998; Chin and Newsted 1999) at the conference. We also note that the procedure for assessing the multiplicative portion of the analyses has been described by Chin et al. (1996).

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Appendix A. Instrument to Measure Satisfaction and Antecedent Factors

This contains the entire set of questions used for our study. They include the Doll and Torkzadeh measures and additional ones created to allow for potential use of covariance based Structural Equation Modeling (e.g., LISREL). Thus, this represents the upper bound of items for those interested in a complete research analyses. Pragmatically, if one only wished to evaluate the impact of expectations and desires, the items in the Post Hoc Perceptions section can be eliminated. Furthermore, additional items/sets can be eliminated when using Partial Least Squares. In assessing different domains of satisfaction (e.g., service quality or training quality), you can replace the italicized section with the respective domain of assessment.

Overall Satisfaction Set 1

How would you rate your satisfaction with *the use of the system?*

-3	-2	-1	0	+1	+2	+3
very dissatisfied			neither			very satisfied

Are you satisfied with *using the system*?

-3	-2	-1	0	+1	+2	+3
extremely dissatisfied	quite dissatisfied	slightly dissatisfied	neither	slightly satisfied	quite satisfied	extremely satisfied

Overall Satisfaction Set 2

All things considered, I am:

-3	-2	-1	0	+1	+2	+3
very dissatisfied			neither			very satisfied

with *using the system.*

Repeat with these additional 3.

very pleased/ very displeased
quite contented/ quite frustrated
delighted/disappointed

Meeting Original Expectations Set 1

In comparison to the level of *information content* that you expected from the system, how big was the difference between what you expected and what the system actually provided?

1	2	3	4	5	6	7
exactly as I expected			somewhat different from what I expected			extremely different from what I expected

How good or bad was this difference?

-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
very bad					neither good nor bad					very good

repeat with

In comparison to the level of *information accuracy* that you expected from the system, how big was the difference between what you expected and what the system actually provided?

In comparison to the *format of the information* that you expected from the system, how big was the difference between what you expected and what the system actually provided?

In comparison to the level of *ease of use* that you expected from the system, how big was the difference between what you expected and what the system actually provided?

In comparison to the *timeliness of the information* that you expected from the system, how big was the difference between what you expected and what the system actually provided?

In comparison to the *speed of operation* that you expected from the system, how big was the difference between what you expected and what the system actually provided?

All things considered, in comparison to what you originally expected from the system, how big was the difference between what you expected and what the system actually provided?

Meeting Original Expectations Set 2

To what extent does the *information content* provided by the system meet your original expectations?

-4	-3	-2	-1	0	+1	+2	+3	+4
Far below my expectations	Quite below my expectations	Below my expectations	Slightly below my expectations	About what I expected	Slightly above my expectations	Above my expectations	Quite above my expectations	Far above my expectations

How good or bad was this difference?

-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
very bad					neither good nor bad					very good

repeat with the following:

To what extent does the *information accuracy* of the system meet your original expectations?

To what extent does the *information format* of the system meet your original expectations?

To what extent does the *ease of use* of the system meet your original expectations?

To what extent does the *timeliness of information* provided by the system meet your original expectations?

To what extent does the *speed of operation* provided by the system meet your original expectations.

All things considered, to what extent does the system meet your original expectations?

Meeting Original Expectation Set 3

How well does the *information content* provided by the system fit what you originally expected?

-4	-3	-2	-1	0	+1	+2	+3	+4
Far below my expectations	Quite below my expectations	Below my expectations	Slightly below my expectations	About what I expected	Slightly above my expectations	Above my expectations	Quite above my expectations	Far above my expectations

How good or bad was this difference?

-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
very bad					neither good nor bad					very good

repeat with the following:

How well does the *information accuracy* of the system fit what you originally expected?

How well does the *information format* of the system fit what you originally expected?

How well does the *ease of use* of the system fit what you originally expected?

How well does the *timeliness of information* provided by the system fit what you originally expected?

How well does the *speed of operation* provided by the system fit what you originally expected?

All things considered, how well does the system fit what you originally expected?

Meeting Original Desires Set 1

In comparison to the level of *information content* that you desired from the system, how big was the difference between what you wanted and what the system actually provided?

1	2	3	4	5	6	7
exactly as I desired			somewhat different from what I desired			extremely different from what I desired

How good or bad was this difference?

-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
very bad					neither good nor bad					very good

repeat with

In comparison to the level of *information accuracy* that you desired from the system, how big was the difference between what you wanted and what the system actually provided?

In comparison to the *format of the information* that you desired from the system, how big was the difference between what you wanted and what the system actually provided?

In comparison to the level of *ease of use* that you desired from the system, how big was the difference between what you wanted and what the system actually provided?

In comparison to the *timeliness of the information* that you desired from the system, how big was the difference between what you wanted and what the system actually provided?

In comparison to the *speed of operation* that you desired from the system, how big was the difference between what you wanted and what the system actually provided?

All things considered, in comparison to what you originally desired from the system, how big was the difference between what you wanted and what the system actually provided?

Meeting Original Desires Set 2

To what extent does the *information content* provided by the system meet what you originally desired?

-4	-3	-2	-1	0	+1	+2	+3	+4
Far below what I wanted	Quite below what I wanted	Below what I wanted	Slightly below what I wanted	About what I expected	Slightly above what I wanted	Above what I wanted	Quite above what I wanted	Far above what I wanted

How good or bad was this difference?

-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
very bad					neither good nor bad					very good

repeat with the following:

To what extent does the *information accuracy* of the system meet what you originally desired?

To what extent does the *information format* of the system meet what you originally desired?

To what extent does the *ease of use* of the system meet what you originally desired?

To what extent does the *timeliness of information* provided by the system meet what you originally desired?

To what extent does the *speed of operation* provided by the system meet what you originally desired?

All things considered, to what extent does the system meet what you originally desired?

Meeting Original Desires Set 3

How well does the *information content* provided by the system fit what you originally wanted?

-4	-3	-2	-1	0	+1	+2	+3	+4
Far below what I wanted	Quite below what I wanted	Below what I wanted	Slightly below what I wanted	About what I expected	Slightly above what I wanted	Above what I wanted	Quite above what I wanted	Far above what I wanted

How good or bad was this difference?

-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
very bad					neither good nor bad					very good

repeat with the following:

How well does the *information accuracy* of the system fit what you originally wanted?

How well does the *information format* of the system fit what you originally wanted?

How well does the *ease of use* of the system fit what you originally wanted?

How well does the *timeliness of information* provided by the system fit what you originally wanted?

How well does the *speed of operation* provided by the system fit what you originally wanted?

All things considered, how well does the system fit what you originally wanted?

Post Hoc Perceptions
(* = Doll and Torkzadeh's items)

Content of the System

Does the system provide the precise information you need?*

1	2	3	4	5	6	7
never	almost never	some of the time	about half of the time	most of the time	almost always	always

Does the information content meet your needs?*
Does the system provide reports that seem to be just about exactly what you need?*
Does the system provide sufficient information?*
Does the output from the system meet your needs?
Does the information provided by the system fit your needs?
Does the system give you the right amount of information for your needs?

Accuracy

Is the system accurate?*
Are you satisfied with the accuracy of the system?*
Is the system error free?
Does the system provide correct information?
Does the system provide accurate information?
Does the system provide reliable information?
Is the information presented by the system dependable?

Format

Do you think the output is presented in a useful format?*
Is the information clear?*
Are you satisfied with the layout of the output?
Is the format of the output satisfactory?
Are you satisfied with how the information is presented to you?
Are you satisfied with the way in which the information is presented?

Ease of Use

Is the system user friendly?*
Is the system easy to use?*
Is it easy to get the system to do what you want it to do?
Is your interaction with the system clear and understandable?
Is the system easy to interact with?
Is it easy to operate the system?

Timeliness

Do you get the information you need in time?*
Does the system provide up-to-date information?*
Does the system provide you with the information in a timely manner?
Does the system provide information that is too old to be useful?
Do you get information from the system that is too late for your needs?

Satisfaction with System Speed

Definition: The extent to which an individual is satisfied with the operational speed of the system?
Are you satisfied with how quickly the system operates?
Does the system operate at a satisfactory pace?
Are you satisfied with how quickly the system runs?
Is the speed of the system satisfactory?