

# INFORMATION TECHNOLOGY CONTINUANCE: A THEORETIC EXTENSION AND EMPIRICAL TEST

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## ABSTRACT

This paper proposes a theoretical extension of the information technology (IT) continuance model by linking continuance intention to behavior and elaborating the contingent factors that shape IT continuance intention and behavior. Drawing on recent findings in the cognitive psychology literature, it conceptualizes perceived behavioral control as consisting of two dimensions — IT self-efficacy and facilitating conditions — and links these two dimensions respectively to IT continuance intention and behavior. Field data from a longitudinal survey of document management system usage among administrators and staff personnel at a governmental agency in Ukraine provides empirical support for our extended model. Our study advances the emerging body of research on IT continuance by extending the theoretical boundaries of the IT continuance model, and contributes to IT acceptance and usage research by clarifying the conceptualization and effect of the PBC construct.

**Keywords:** Information technology usage, continuance, expectation-disconfirmation theory, survey research.

## INTRODUCTION

In recent years, an increasing body of information technology (IT) adoption and usage research has focused on post-adoption behaviors such as continuance (e.g., [5, 17, 18, 21, 28, 29, 35]). IT continuance is defined as users' decisions to continue using an IT over the long run [5], in contrast to IT acceptance which focuses on users' initial or first-time decision to use IT. The importance of studying continuance is that "while initial acceptance of an IS [information system] is an important first step toward realizing IS success, long-term viability of an IS and its eventual success depend on its continued use rather than first-time use" [5] (pp. 351-352). Given that retaining existing users is significantly less expensive than acquiring new ones, the survival and success of many software and information service firms depends on their ability to retain continued users disconfirmation in addition to or in lieu of acquiring new users.

In one of the earliest works on IT continuance, Bhattacharjee [5] described the key distinctions between IT acceptance and continuance behaviors and proposed a preliminary model of IT continuance. This model drew from and adapted Oliver's [22] expectation-disconfirmation theory (EDT) in the marketing literature to the specific instance of IT usage. This model suggests that users' intention to continue using a given IT is driven by their satisfaction with prior usage of that technology and their perceived usefulness of further usage. Both satisfaction and perceived usefulness are based on the extent to which their initial expectations of IT usage were disconfirmed during prior usage experience. In addition, perceived usefulness is also postulated to influence satisfaction perceptions.

Since then, a growing number of studies have applied the above model to study IT continuance in different technological and organizational contexts and/or proposed minor extensions to the original model. Some studies have added Internet self-efficacy [17], perceived playfulness [21], perceived ease of use, and perceived usefulness [35] to the original IT continuance model. Others used the model to explain firms' satisfaction with using application service providers (ASP) services [29]. Still other studies have examined different kinds of expectations, such as expectations of system attributes (e.g., system usefulness, ease of use, information quality) and those of user attributes (e.g., system knowledge, personal benefits, attitude) and their corresponding effects on disconfirmation [28].

While the above studies did a reasonable job at predicting continuance intention, satisfaction, and/or disconfirmation, none have examined actual continuance behaviors. Even the original IT continuance model stops at intention as the final dependent variable without exploring the relationship between continuance intention and behavior, or factors that may influence the formation of intention and behavior. Researchers are interested in intention because of its ability to predict future behaviors. Often, intention is viewed as a proxy of future behaviors. This proxy may be more appropriate in some cases than in others, and there is empirical evidence that intention may not always accurately predict behaviors or may do so in an inconsistent manner. A meta-analysis by Sheppard et al. [25] found that correlations between human intentions and behaviors, in general, average about 0.58. While this correlation (0.92) was high for some behaviors such as voting [20], it was moderate (0.58) for other behaviors such as organ donation [15], and low (0.02) for yet others such as student cheating during examinations [10]. In the context of IT acceptance, the intention-behavior correlation was observed to be 0.35 (in the low-to-moderate range) in an empirical study of MBA students' use of a word processing program [11]. However, to date, there is no theoretical or empirical examination of this correlation within the IT continuance context. Nor it is known what other factors may influence users' IT continuance intentions or behaviors.

We attempt to fill the above gaps in the IT continuance literature by theorizing and empirically validating an extended model of IT continuance that (1) includes continuance behavior as part of the model, and (2) elaborates contingent factors that may influence IT continuance intention and behavior. Studying these issues is important because the goal of IT continuance research is to ultimately improve the prediction of continuance behaviors, and not just continuance intentions. We examine these issues by drawing upon recent insights on the theory of planned behavior from the cognitive psychology literature (e.g., [2, 26]) to conceptualize perceived behavioral control (PBC) in terms of two dimensions: self-efficacy and facilitating conditions, and linking these two dimensions to IT continuance

intention and behavior respectively. Additionally, we refine certain relationships in the original continuance model to make it more robust to a generic set of IT continuance behaviors. The extended model is then evaluated, relative to the original IT continuance model as a baseline reference, using empirical data collected from a longitudinal field survey of document management system (DMS) continuance among governmental employees at a municipal agency in Ukraine. We demonstrate that our extended model provides greater explanation of continuance intention compared to the original IT continuance model, and in addition, provides a reasonably strong explanation of continuance behavior.

The rest of the paper proceeds as follows. The next section describes the IT continuance model and our proposed theoretical extension to this model. The third section describes our research methods, including variable operationalization and data collection. The fourth section presents our data analysis procedures and findings. The fifth section discusses our key findings, limitations of our study, and its theoretical and practical implications.

## THEORY AND HYPOTHESES

### IT Continuance Model

The IT continuance model has its origins in the expectation disconfirmation theory (EDT) developed by Oliver [22] in the marketing literature. EDT was designed to explain the determinants and outcomes of consumer satisfaction and dissatisfaction in product repurchase and service retention contexts. This theory proposes that consumers go through a multi-stage process while making product repurchase decisions. First, before using it for the first time, they form an initial *expectation* about a product, based on marketing initiatives, media reports, feedback from prior users and so forth. Then, they use the product for a period of time and assess the extent to which their actual product experience matched their initial expectations. This match, termed *disconfirmation* in EDT, and their initial product expectations are postulated to jointly determine users' extent of *satisfaction* or dissatisfaction with that product. Satisfaction, an evaluative affect resulting from users' transactional experience with the product, influences their *intentions* to repurchase that product, such that satisfied users continue using it while dissatisfied users stop using it.

Since its inception, several variations have been proposed to the original EDT model described above. For instance, Churchill and Suprenant [8] and Tse and Walton [36] suggested perceived product performance as an additional determinant of disconfirmation and/or satisfaction. Others (e.g., [27]) have dropped the association between initial expectations and satisfaction, suggesting that the effect of expectations on satisfaction is fully mediated by disconfirmation, discounting Oliver's [22] use of expectations as a predictor of satisfaction.

In adapting EDT to the specific case of IT products and services, Bhattacharjee [5] proposed several extensions and modifications to the original model. These changes were grounded within our prior knowledge of long-term (longitudinal) IT acceptance and usage and several auxiliary theories, such as self-perception theory and cognitive dissonance theory. First, this study claimed that measurement of initial expectations as a predictor of disconfirmation and/or satisfaction is applicable only to those contexts where expectations remain reasonably stable

over time. This may be the case for typical consumer products and services, such as automobiles [23], camcorders [27], and restaurant services [30], but is less so for IT-based products and services such as software and information services, where user expectations can and do change quite dramatically with time (e.g., [31]). For instance, IT vendors routinely add new features and capabilities in later versions of their products to enhance user expectations. Further, users may have varied expectations of IT products and services, even when provided with identical information from vendors and/or third party sources. Some users form unrealistically high expectations, which when negatively disconfirmed, are lowered to more reasonable levels during the post-adoption phase. Others may initially have low expectations, if they are unsure of exactly what to expect from IT usage, which may increase during the post-adoption stage if they discover unanticipated benefits during actual usage experience. Under circumstances of changing expectations, [5] argued that initial or pre-adoption expectations, which predicts IT acceptance well, is less salient to predicting long-term continuance, and that post-adoption processes such as continuance should instead focus on post-adoption expectations that are based on actual usage experiences rather than on vendor or third-party information.

Second, drawing from longitudinal studies of IT acceptance and use, the IT continuance model postulated *perceived usefulness*, defined as users' perceptions of the instrumentality or benefits of IT usage, as the most salient post-adoption expectation related to IT continuance [5]. Instrumentality considerations are known to be the primary consideration underlying IT usage in the workplace, and are empirically found to be stable predictors of usage in both initial and long-term usage contexts [11, 19]. Though other beliefs, such as the ease of use of an IT and its compatibility to work procedures, may predict initial usage, research has also observed that the effects of these beliefs tend to wear out over time as users gain experience with the target IT and are displaced by instrumentality or usefulness considerations [19]. In view of the observed salience of perceived usefulness in predicting long-term IT usage behaviors, the IT continuance model postulated perceived usefulness as having a direct positive effect on continuance intention over and above the indirect effect mediated by satisfaction (see Figure 1). The rationale for this direct association was that users may sometimes intend to continue using an IT if they believe that such usage will eventually improve their job performance, even if such performance gains were not realized during prior usage experience. In other words, users who are negatively disconfirmed and dissatisfied with prior IT usage may still continue using an IT if they consider it to be useful in their work.

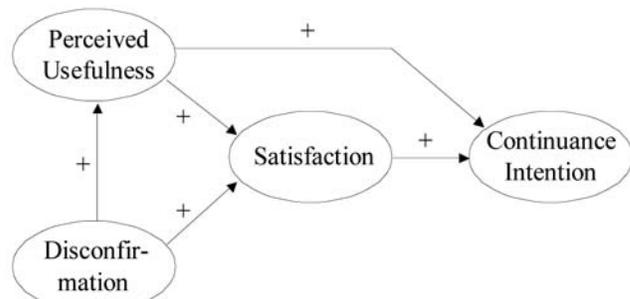


FIGURE 1: Original IT Continuance Model

A third change proposed in the IT continuance model is a direct positive association between disconfirmation and perceived usefulness. Extending Festinger's [13] cognitive dissonance theory, Bhattacharjee [5] proposed that disconfirmation of expectations, by virtue of its effect on satisfaction and intention, influences not only future behavior, but also future perceptions, such as post-adoption expectations of usefulness. This is because disconfirmation is an instance of cognitive dissonance, and when faced with such dissonance, users try to adjust their behavior, perceptions, or both to minimize the psychological effect of dissonance.

Lastly, Bhattacharjee [5] proposed a positive relationship between perceived usefulness and satisfaction. The rationale for this relationship was that since most attitude theories such as the theory of reasoned action (TRA) [3] and the theory of planned behavior (TPB) [1] posit attitude (an affect) as a mediator between cognitive beliefs and intention, and satisfaction, being the most salient affect in the continuance context, may well mediate the effect of perceived usefulness on continuance intention. In the next section, we highlight some of the salient shortcomings of the IT continuance model and present an extended model to overcome these shortcomings.

### **An Extended IT Continuance Model**

The IT continuance model [5] provides an excellent starting point for further exploration of the IT continuance phenomenon because this model is: (1) theoretically motivated, (2) supported by a growing empirical base in the marketing and IT usage literatures, (3) parsimonious, since it uses only three predictors to predict continuance intention, and (4) empirically testable in settings where research follows, rather than precedes, the initial introduction of the target IT as it only employs post-adoption constructs. However, the advancement of any preliminary model of human behavior requires additional theoretical refinement and empirical testing in order to improve its robustness and predictive ability across a wider range of contexts. In this spirit of theory advancement, we propose several modifications and extensions to the original IT continuance model.

First, the association between perceived usefulness and satisfaction in the original IT continuance model, which was modeled after a corresponding association between cognitive belief and attitude in generalized behavior models such as TRA and TPB, is problematic on several counts. In Oliver's [22] EDT model, satisfaction was predicted by initial or pre-usage expectations and not post-usage usefulness perceptions. It is unclear whether post-usage perceptions influence satisfaction in the same way as pre-usage expectations, or whether the causality is in the reverse direction. Second, Bhattacharjee [5] likened satisfaction to attitude, and suggested that satisfaction may mediate the association between post-usage usefulness beliefs and continuance intentions, just as attitude mediates the association between beliefs and intention in TRA and TPB. However, though satisfaction and attitude are two forms of affect, they are dissimilar in that satisfaction is a transaction-specific short-term affect based on the immediately preceding usage experience while attitude is a long-term, transaction-invariant affect, possibly aggregated from numerous prior transactional experiences. Hence, satisfaction may influence attitude, but is not equivalent to attitude, as proposed in the original IT continuance model. Further, the cognitive psychology literature is largely uncertain on whether belief causes affect or the reverse, and has

for the most part treated beliefs and affect as two distinct and separable components of attitude [12]. Furthermore, many IT acceptance studies (e.g., [37]) have noted that the affect-based attitude explains very little of intention when user beliefs are included and have therefore tended to drop attitude from IT usage models.

In light of the above arguments, we drop the direct association between post-usage perceived usefulness and satisfaction from the original IT continuance model, and instead present these constructs as having separable effects on IT continuance intention (see Figure 2). Note that satisfaction reflects the short-term, transaction-specific affect associated with the preceding usage experience, while post-usage usefulness (renamed as such to distinguish it from the pre-usage "perceived usefulness" construct commonly associated with TAM) reflects a long-term, transaction-invariant belief aggregated from prior usefulness perceptions. Hence, though both constructs are positively influenced by disconfirmation, the overall effect of disconfirmation users' continuance intention is realized in two ways: (1) an immediate effect on users' satisfaction and (2) a longer-term effect on their post-usage usefulness perceptions. Such representation is consistent with both the EDT-based continuance stream of research that emphasizes the role of satisfaction and prior longitudinal investigations of IT usage that focuses on user perceptions such as usefulness. Given the transactional basis of the satisfaction construct, satisfaction may have a more dominant effect on continuance intention if intention is assessed immediately following the transactional (usage) experience. However, the satisfaction effect is likely to attenuate with increasing temporal separation between prior experience and intention measurements, while the more stable, longer-term post-usage usefulness perception will likely have an increasingly dominant effect over time.

Second, both EDT and the IT continuance model designate intention, rather than behavior, as the dependent variable of interest. However, the goal of any theoretical model of human behavior should be to predict behavior rather than intention. Rational models of human behavior, such as TRA and TPB, posit intention as the most salient predictor of behavior. The positive association between intention and behavior has been extended to IT acceptance and usage contexts by models such as TAM and UTAUT. Since IT continuance in the workplace is also largely a rational choice, motivated by instrumentality and other considerations the same extension is appropriate in IT continuance contexts. This leads to our first hypothesis:

*H1. Users' IT continuance intention is positively related to their IT continuance behavior.*

Third, IT continuance intention is a necessary but not sufficient condition for IT continuance behavior. As stated before, the intention-behavior association in IT usage contexts tends to be in the low-to-moderate range [11], suggesting that intention should not be viewed as a reasonable proxy of actual behavior. Ajzen [1] suggested that the gap between intention and behavior tend to be more pronounced when individuals lack complete volitional control over their own behavior. For instance, even if IT users want to continue using an IT, such intention may not translate into actual behavior if users lack the resources (e.g., access to IT) or the technical skills to use the IT. This expectation led Ajzen [1] to introduce *perceived behavioral control* (PBC), defined as the extent to which one believes to have adequate control over his/her

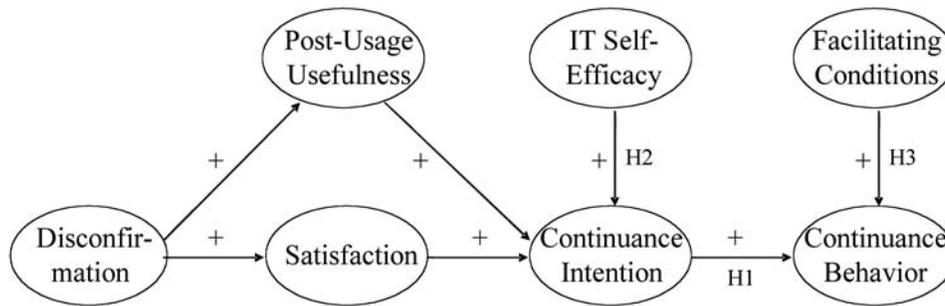


FIGURE 2: An Extended Model of IT Continuance

behavior, as an additional predictor of intention and behavior in his formulation of TPB. In essence, the inclusion of PBC allows us to generalize our models of volitional IT usage to non-volitional usage contexts.

Since then, numerous empirical evaluations of TPB in the social psychology literature have noted that PBC is not a unidimensional construct, but a combination of two distinct but related components: self-efficacy and controllability [2, 4, 26, 33]. *Self-efficacy* reflects one's conviction in her ability to independently perform an intended behavior, and *controllability* refers to one's perceived control over external resources needed to perform that behavior [2]. Not only do principal component analysis of items belonging to these components load up on two distinct factors, but these components are also conceptually distinct in terms of their locus of control (e.g., [26]). Self-efficacy reflects an internal locus of control since it focuses on one's personal skills and abilities, while controllability reflects an external locus of control over extraneous (e.g., organizational, technological) resources needed to perform that behavior. Note that in the IT acceptance and usage literature, PBC has been conceptualized primarily in terms of controllability (often labeled *facilitating conditions*, defined as the degree to which one believes that organizational and technical resources are available), while self-efficacy has been viewed as an independent construct [37].

Despite a clear two-factor structure for the PBC construct, the predictive validity of each factor on intention and/or behavior has remained unclear. Terry and O'Leary [33] found that the self-efficacy items had a strong and significant effect on subjects' intention to exercise regularly but had no effect on their actual behavior, whereas controllability measures had no effect on intention but was a significant predictor of actual behavior. However, in the context of low fat diet consumption, Armitage and Connor [4] found self-efficacy to explain both intention and behavior, and controllability (which was labeled PBC in this study) to have no significant effect on either dependent variable. Sparks et al. [26] reported that neither self-efficacy nor controllability had any significant effect on people's intention to consume red meat; however, self-efficacy significantly improved subjects' intention to eat french fries and controllability had no such effect.

In the IT acceptance and usage literature, Compeau et al. [9] demonstrated that computer self-efficacy can successfully predict users' utilization of computers at the workplace, though this study did not examine intention as a potential mediator. In contrast, Venkatesh et al. [37] suggested that self-efficacy tends to covary with and is possibly redundant to perceived ease of use or effort expectancy (the degree to which users perceive a system to be easy or difficult to use) in predicting IT usage intention. However,

facilitating conditions (often called PBC) is almost universally found to be associated with usage behavior, though not intention [37]. Studies that specified PBC as a combination of self-efficacy and facilitating conditions (e.g., [32]) found significant effects of PBC on both usage intention and behavior.

In view of the confusing predictive effects of the two components of PBC, it may be helpful to reconstruct these predictions based on their conceptual distinctions. Though self-efficacy and effort expectancy may be conceptually similar and possibly overlapping constructs, given the absence of effort expectancy in the IT continuance model and the increasing prominence of self-efficacy as a component of PBC in contemporary TPB research, self-efficacy can be justifiably included in our extended IT continuance model. Since self-efficacy focuses on users' personal skills and abilities (an internal locus of control) that they are aware of after initial usage but prior to making a rational choice about their continuance behavior, it is likely that their self-efficacy perceptions will be reflected in their continuance intention rather than continuance behavior. For instance, if a given user believes that s/he is less capable of using a complex organizational system after initially using the system, the user will naturally be reticent toward using that system. In contrast, controllability refers to the availability of external resources needed to use IT (an external locus of control), which may not be entirely known by users prior to their continuance choice or which evolve during the course of their usage, and therefore influence their actual continuance behavior rather than continuance intention. For instance, a user who is somewhat resistant to using an organizational system (low intention) may actually use it more than intended if the network is faster than expected or if adequate levels of technology support is available (high controllability). On the other side, someone who wants to use the system more (high intention) may actually use it less than expected if the network is slow or access is limited. Hence, we hypothesize:

*H2. Users' IT self-efficacy is positively related to their IT continuance intention.*

*H3. Users' perception of facilitating conditions is positively related to their IT continuance behavior.*

In summary, the extended model of IT continuance presented in this paper extends the original IT continuance model [5] into non-volitional contexts by including the notion of PBC and by linking continuance intention to continuance behavior. Further, it refines the original IT continuance model by clarifying the relations among post-usage perceived usefulness, satisfaction, and IT continuance intentions. Specifically, we identify two

components of PBC, self-efficacy and facilitating conditions, and link these components to IT continuance intention and behavior respectively, and remove the direct association between post-usage perceived usefulness and satisfaction from the original IT continuance model, and instead present these constructs as having separate effects on IT continuance intentions. To clearly delineate the focus and contribution of this study over and above prior continuance research, we did not state associations in the original IT continuance model as formal hypotheses, though these associations are included in our extended model. The next section describes an empirical study designed to test this extended model and compare its predictive ability to the original IT continuance model.

## RESEARCH METHODS

### Empirical Setting

Our hypothesized research model was empirically tested using a longitudinal field survey of document management system (DMS) continuance among administrative and staff personnel at L'viv City Hall in Ukraine. The DMS is a custom application built using Lotus Notes with the goal of improving the city's ability to record, track, and process construction permits, business licenses, zoning clarifications, and other requests filed by local citizens and businesses.

To motivate employee use of the DMS and improve citizen service, the Mayor of L'viv commissioned one of this study's authors to train its administrative and staff personnel in using the DMS. Eighty seven divisional employees (30 administrators and 57 staff members), from a total of 130 such employees, received three 8-hour days of training on using the Windows operating system, word processing, spreadsheets, electronic mail, web browsing, as well as Lotus Notes. This training included both lectures and hands-on components, wherein subjects had first-hand experience with processing actual service requests using the DMS. At the end of this three-day training a paper-based survey questionnaire was administered that elicited subjects' perceptions of disconfirmation, post-usage usefulness, satisfaction, self-efficacy, facilitating conditions and intention regarding continued DMS use. Subjects' self-reported system usage was captured three months later via a second questionnaire and the two questionnaires were matched using a four-digit self-selected number. Our final data sample consisted of 81 matched responses from 28 administrators and 53 staff personnel (from a maximum of 130 such employees), for an overall response rate of 62.3%. The data collected was part of a broader study on influence strategies, and is described in more detailed in Bhattacharjee and Sanford [6].

### Variable Operationalization

The seven constructs of interest in our extended IT continuance model were post-usage usefulness, disconfirmation, satisfaction, IT self-efficacy, facilitating conditions, IT continuance intention and IT continuance behavior. Each construct was measured using multiple-item scales, adapted and extended from prior research and reworded to relate specifically to the current context of DMS usage. Scale items are provided in the Appendix.

Post-usage usefulness was measured using Davis et al.'s [11] four-item scale that assessed subjects' expectations of productivity, performance and effectiveness gains from DMS

usage, and their overall usefulness perceptions. Each item was measured on a seven-point Likert scale anchored between "strongly disagree" to "strongly agree." IT continuance intention was measured using a modified version of Taylor and Todd's [32] three-item Likert-scale that examined subjects' intent to use the DMS within the next month, in the near future and for more of their job responsibilities.

Disconfirmation was measured using a four-item scale extended from Bhattacharjee's [5] perceived confirmation scale. These items examined the extent to which DMS usage indeed increased respondents' performance, productivity and effectiveness at work as they had initially expected, and the extent to which DMS usage in general exceeded their initial expectations. Though these items are similar to the usefulness items, usefulness captures users' expectations from IT usage, while disconfirmation examines the extent to which those expectations are met during actual usage. All four items were measured using seven-point Likert scales.

Satisfaction was measured using Bhattacharjee's [5] validated scale that captured respondents' satisfaction levels along four seven-point semantic differential adjective pairs: "very dissatisfied ... very satisfied," "very displeased ... very pleased," "very frustrated ... very contented," and "absolutely terrible ... absolutely delighted." Semantic differential items were more appropriate than Likert items for this scale, since satisfaction is an affect and affect is best measured along bipolar evaluative dimensions [3].

IT self-efficacy was measured using an adapted version of Venkatesh et al.'s [37] four-item self-efficacy scale. Since self-efficacy represents one's confidence in one's ability to independently perform a given behavior, IT self-efficacy was measured in this study using three items that examined subjects' confidence in their ability to use the DMS for performing their job if there was no one around to help them, if they had adequate time to complete the job, and if they had access to software manuals and online help only, plus a fourth item that assessed their overall confidence of performing their job using the DMS.

Since facilitating conditions, or controllability over external resources, has generally been conceptualized in the IT usage literature as perceived behavioral control [37], this construct was measured using a three-item scale adapted from Taylor and Todd's [32] perceived behavioral control construct. These items examined the extent to which subjects had access to the resources (e.g., dedicated computer terminals) needed to use the DMS, the extent to which they could use the system whenever and however they wanted (e.g., whether restrictions were imposed on their use), and whether they had full control over their use or non-use of the DMS.

Finally, IT continuance behavior was measured three months subsequent to the measurement of the explanatory constructs just described using a three-item scale adapted from Thompson, et al.'s [34] IT utilization scale. These items asked subjects to indicate the number of times per week they currently use the system, the total number of specific DMS applications they use and the percentage of received customer requests that they process using the system. Though the usage items were self-reported, the measurement scales were such that they required subjects to enter very specific usage data (such as number of times of use) rather than subjective perceptions of usage, which are less susceptible to respondent bias. More accurate system-generated measures of IT usage were not available since L'viv City Hall had no policy or practice of tracking usage data at the time of the study.

## DATA ANALYSIS AND RESULTS

### Assessment of Data Quality

Though several steps were incorporated in our research design to avoid common measurement errors, we performed additional post hoc analyses to ensure that our data sample was of acceptable quality. First, non-response bias was a less significant concern since a majority of the targeted population (62.3%) responded to our survey request, quite likely due to the overt support of the City Mayor. Additional comparison of means tests found that the respondent group did not differ significantly in age, years of formal education or years of work experience from the general population of employees, further alleviating any concerns of non-response bias.

Second, to avoid common method bias, the dependent and independent variables were measured using two separate survey questionnaires at two different points in time (spaced three months apart). Such a longitudinal design was especially important since we wanted to control for prior IT usage for those users who may have had some experience with the DMS prior to this study. However, we also conducted Harmon's single factor test [24] to test for any residual common method bias that could possibly exist in our data sample. In this test, if a substantial amount of common method variance is present in the data sample, either a single factor will emerge from the factor analysis or one general factor will account for most covariance in the dependent and independent variables. An exploratory factor analysis (EFA) of all of our scale items revealed seven factors with eigenvalues greater than 1.0, reflecting our underlying constructs. Collectively, these factors explained 86.8% of the variance in our data sample, with the first factor explaining 43.6% and the last factor explaining 4.3% of the total variance. This analysis suggested that our data sample was not likely contaminated by common method bias.

Third, social desirability bias was also a non-issue since both of our surveys were paper-based and completely anonymous (recall that the surveys were linked by the subjects' self-selected four-digit code). Neither the researcher nor the city administration had the ability to link specific responses to specific subjects or vice-versa, and subjects were repeatedly assured of that anonymity during the course of the study.

### Measurement Validation

Construct validity of the measurement scales was assessed using a confirmatory factor analysis (CFA). CFA analysis was performed via the partial least squares (PLS) approach, conducted using the Visual PLS 1.04 software program. Sample size considerations led us to prefer the variance-based PLS approach over covariance-based structural equation modeling approaches such as LISREL. While LISREL requires a minimum sample size of 5-10 times the total number of scale items, PLS requires a sample size of 10 times the largest estimation block [7]. While our sample size of 87 was clearly inadequate for 25 scale items for LISREL analysis, it was adequate for PLS since the largest measurement block in our model had eight items. For CFA analysis, all measured items were specified as reflective indicators of their corresponding latent constructs and each construct was allowed to covary freely with all other constructs. Raw data was used as input to the PLS program and path significances were estimated using bootstrap resampling

**TABLE 1: Confirmatory Factor Analysis Results**

Scale Item <sup>a</sup>	Item Mean	Item S.D.	Item Loading*	t-statistic
DC1	4.88	1.19	0.90	12.83
DC2	5.06	1.26	0.87	14.56
DC3	4.91	1.17	0.89	16.99
DC4	4.99	1.11	0.89	14.86
PU1	4.85	1.71	0.96	93.05
PU2	4.73	1.73	0.94	36.33
PU3	4.86	1.66	0.96	80.07
PU4	4.81	1.78	0.94	56.35
ST1	4.35	1.30	0.91	44.76
ST2	4.41	1.28	0.90	42.02
ST3	4.35	1.22	0.89	30.38
ST4	4.43	1.24	0.92	55.95
SE1	4.43	1.23	0.82	20.34
SE2	4.65	1.15	0.79	9.85
SE3	4.59	1.24	0.81	13.64
SE4	4.93	1.46	0.82	19.91
CI1	4.30	1.48	0.93	60.61
CI2	4.31	1.35	0.94	58.64
CI3	4.06	1.34	0.87	20.53
FC1	4.93	1.10	0.88	35.00
FC2	4.89	0.96	0.84	17.90
FC3	4.38	1.20	0.82	14.56
CB1	4.12	1.65	0.96	92.03
CB2	4.09	1.81	0.96	100.02
CB3	3.96	1.72	0.96	106.60

Item legend: DC: Disconfirmation, PU: Post-usage usefulness, ST: Satisfaction, SE: IT self-efficacy, CI: IT continuance intention, FC: Facilitating conditions, CB: IT continuance behavior.

\*All item loadings were significant at  $p < 0.001$ .

with 200 sub-samples. Results of this analysis are provided in Tables 1 and 2.

Convergent validity of scale items was assessed using three criteria suggested by [14]: (1) all item factor loadings ( $\lambda$ ) should be significant and exceed 0.70, (2) composite reliabilities ( $\rho_c$ ) for each construct should exceed 0.80, and (3) average variance extracted (AVE) for each construct should exceed 0.50. The CFA loadings for all scale items exceeded 0.70 (Table 3) and were significant at  $p < 0.001$ . Composite reliabilities of all factors exceeded the required minimum of 0.80. Finally, the smallest AVE value was 0.65, which was greater than the desired minimum of 0.50. Hence, all three conditions for convergent validity were met.

Discriminant validity was assessed using Fornell and Larcker's (1981) criterion that the square root of AVE for each construct should exceed the correlations between that and all other constructs. From the data in Table 2, we can see that the highest correlation between any pair of constructs in the CFA model was 0.74 (between satisfaction and IT continuance intention). This figure was lower than the lowest square root of AVE among all constructs, which was 0.80 for self-efficacy. Hence, the discriminant validity criterion was also met for our data sample.

## Hypotheses Testing

The next step in our data analysis was to test our research model and hypothesized associations. Specifically, we examined both the original IT continuance model (Figure 1) as a baseline reference model, and our proposed extended model (Figure 2). This analysis was also conducted using PLS, and the results are shown in Figures 3 and 4 respectively.

The baseline continuance model explained 62% of the variance in IT continuance intention (see Figure 3). Both

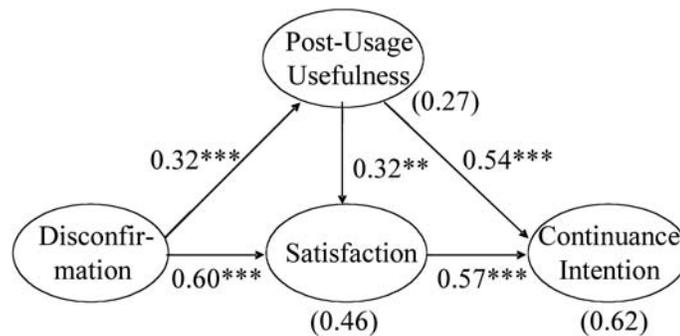
predictors of continuance intention, namely satisfaction and post-usage usefulness, had strong and significant effects on the dependent variable with standardized effect sizes of 0.57 ( $p < 0.001$ ) and 0.54 ( $p < 0.001$ ) respectively. Further, in this model, disconfirmation explained 27% of the variance in post-usage usefulness with a standardized path coefficient of 0.32 ( $p < 0.001$ ), while disconfirmation and post-usage usefulness jointly explained 46% of the variance in user satisfaction, 0.60 ( $p < 0.001$ ) and 0.32 ( $p < 0.01$ ) respectively.

In contrast, our hypothesized research model explained 74%

Construct	Mean	S.D.	$\rho_c$	Inter-Construct Correlations									
				AVE	DC	PU	ST	SE	CI	FC	CB		
DC	4.96	1.18	0.94	0.79	<i>0.88</i>								
PU	4.81	1.72	0.97	0.90	0.52	<i>0.94</i>							
ST	4.38	1.26	0.95	0.82	0.64	0.53	<i>0.90</i>						
SE	4.65	1.27	0.88	0.65	0.53	0.50	0.61	<i>0.80</i>					
CI	4.22	1.39	0.94	0.83	0.57	0.73	0.74	0.65	<i>0.91</i>				
FC	4.73	1.09	0.88	0.72	0.37	0.51	0.28	0.35	0.48	<i>0.94</i>			
CB	4.06	1.72	0.97	0.92	0.49	0.68	0.47	0.38	0.63	0.49	<i>0.98</i>		

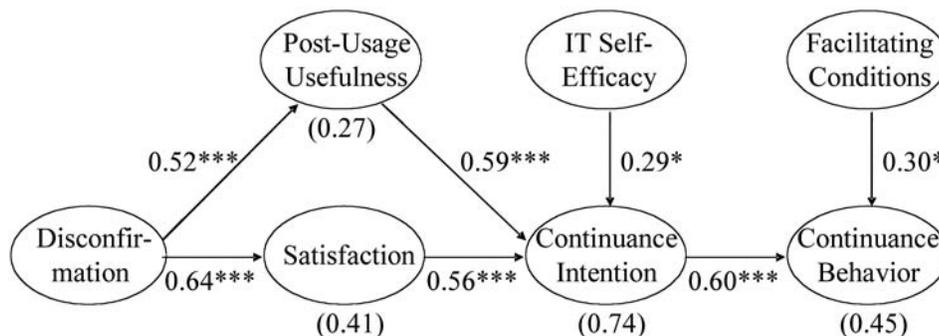
Construct legend: DC: Disconfirmation, PU: Post-usage usefulness, ST: Satisfaction, SE: IT self-efficacy, CI: IT continuance intention, FC: Facilitating conditions, CB: IT continuance behavior.

\* Diagonal elements (in italics) represent square root of AVE for that construct



Path significances: \*\*\* $p < 0.001$ , \*\* $p < 0.01$ ; \* $p < 0.05$ , <sup>ns</sup>  $p > 0.05$   
 Parentheses indicate  $R^2$  values for dependent variables.

FIGURE 3: PLS Analysis of Baseline Model



Path significances: \*\*\* $p < 0.001$ , \*\* $p < 0.01$ ; \* $p < 0.05$ , <sup>ns</sup>  $p > 0.05$   
 Parentheses indicate  $R^2$  values for dependent variables.

FIGURE 4: PLS Analysis of Research Model

of the variance in IT continuance intention; and 45% of the variance in IT continuance behavior (see Figure 4). A nested F-test confirmed that the increase in explanatory power of IT continuance intention from the baseline model (62%) to the research model (74%) was significant at  $p < 0.01$ , suggesting that the extended model indeed provided a superior explanation of IT continuance. Moreover, unlike the baseline model, the extended continuance model also provided a reasonable explanation of IT continuance behavior.

All of our three hypothesized associations in the extended IT continuance model were significant. IT continuance intention had a strong and significant effect on continuance behavior (standardized  $\beta = 0.60$ ;  $p < 0.001$ ), supporting Hypothesis H1. IT self-efficacy had a significant effect on IT continuance intention (standardized  $\beta = 0.29$ ;  $p < 0.05$ ), providing empirical support for Hypothesis H2. Facilitating conditions also had a significant effect on IT continuance behavior (standardized  $\beta = 0.30$ ;  $p < 0.05$ ), supporting Hypothesis H3.

The remaining (non-hypothesized) effects in the research model were also empirically supported. Post-usage usefulness and satisfaction had significant effects on IT continuance intention, as expected from the original IT continuance model. Disconfirmation had significant effects on post-usage usefulness and disconfirmation. Facilitating conditions and IT continuance intention jointly explained 45% of the variance in continuance behavior, while IT self-efficacy, post-usage usefulness, and satisfaction jointly explained 74% of the continuance intention variance. Implications of these findings are discussed next.

## DISCUSSION AND CONCLUSIONS

### Discussion of Findings

The objectives of this paper were to propose and validate an extended model of IT continuance that (1) included continuance behavior as part of the model, and (2) elaborated contingent factors potentially influencing IT continuance intention and behavior. The extended continuance model, synthesized from the original continuance model and recent research on PBC (see Figure 1), provided significantly greater explanation of continuance intention than the original continuance model by virtue of its inclusion of IT self-efficacy as a predictor variable, over and above users' satisfaction with prior usage. The self-efficacy effect implies that users lacking the confidence in their ability to use a given IT (low self-efficacy) are likely to have lower intentions to continue its use compared to users with higher self-efficacy, even if they are somewhat satisfied with their prior usage experience.

Unlike the original IT continuance model, the extended model also provided a good explanation of IT continuance behavior, by virtue of its inclusion of continuance intention and facilitating conditions as predictors of behavior. Though it is reasonable to expect a positive association between intention and behavior this association was not included in the original continuance model and prior research has not empirically evaluated the strength of this association. We demonstrated that the intention-behavior association in the IT continuance context is moderate in nature, explaining about 26% of the variance in continuance behavior, and that additional constructs may be needed to predict continuance behavior better. We validated facilitating conditions as one such construct, suggesting that users who perceive to have less control over the external conditions that enable or constrain their IT usage

are less likely to continue using the system, even if they intend to use it.

Finally, though not explicitly hypothesized or tested, we observed that dropping post-usage usefulness as a predictor of satisfaction dropped the variance explained in satisfaction from 46% in the baseline model to 41% in the extended model. This change in variance explained is only marginally significant at  $p < 0.05$ , suggesting that this effect may be empirically redundant, in addition to being theoretically problematic, as discussed earlier.

### Limitations of the Study

The results reported in this study should be evaluated in light of its empirical limitations. First, though the self-reported fill-in measure of perceived continuance is likely more accurate and unbiased than Likert-scaled measures, it is less accurate and more biased than objective continued usage data such as those derived from system logs. In our study, objective usage data was not available since the City of L'viv had no policy or procedure of tracking or recording such data. Though self-reported measures of IT usage have previously been employed elsewhere in IT usage research (e.g., [34]) and are generally considered acceptable, we urge future researchers to consider system log based measures of usage, if available.

Second, though adequate for PLS analysis, our sample size of 87 was inadequate for statistically more powerful techniques such as LISREL. Given that there were only 130 potential subjects with authority to use the DMS system, there was little we could do to improve the sample size. Note that although small sample size hurts statistical power and our ability to detect significant effects, we nevertheless found all our hypothesized effects to be significant.

### Implications for Research

This study contributes to the nascent body of current work on IT continuance by extending the initial continuance model proposed by Bhattacharjee [5] to include new constructs and new relationships that improve the explanatory power and practical relevance of the original model. Specifically, the original continuance model implicitly assumed, but did not explicitly theorize or validate, that IT continuance intention leads to continuance behavior. The proposed extended model made this association explicit and suggested two contingent factors (IT self-efficacy and facilitating conditions) that influenced continuance intention and outcomes. This model also refined the original IT continuance model by clarifying the relations among post-usage perceived usefulness, satisfaction and IT continuance intentions. Such theoretical extensions and refinements are essential for the advancement of any new and emerging area of research, and hence, this study makes a theoretical contribution to the IT continuance literature.

Our study also provides some theoretical clarity to the PBC construct and its relationship to IT usage. Prior IT acceptance and usage research based on TPB and UTAUT have theorized PBC to influence both intention and behavior, but empirical evidence have been mixed [37]. Further, the role of IT self-efficacy in IT usage has been ambiguous and confusing; leading some to suggest that it is not pertinent to IT usage. Drawing upon the work of Azjen [2], we conceptualized the PBC construct in terms of its two locus of control dimensions, and defined IT

self-efficacy as representing internal constraints that limit one's IT usage behavior and facilitating conditions as representing external (e.g., organizational) constraints. We then theorized and demonstrated that the internal constraint influences intention and not behavior, while the external constraint influences behavior and not intention. This conceptual clarification may not only help build better instrumentation that can adequately capture these two dimensions of PBC, but may also help advance TPB-based IT acceptance and usage research in general.

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#### APPENDIX: MEASUREMENT ITEMS

##### **Post-Usage Usefulness** (1: Strongly Disagree; 7: Strongly Agree)

- PU1. Using the DMS in my job will increase my productivity (e.g., make my work faster).
- PU2. Using the DMS in my job will improve my performance (e.g., make my work better).
- PU3. Using the DMS in my job will make me more effective (e.g., help me make better decisions).
- PU4. I will find the DMS to be useful in my job.

##### **Disconfirmation** (1: Strongly Disagree; 7: Strongly Agree)

- DC1. Using the DMS improved my performance much more than I had initially expected.
- DC2. Using the DMS improved my productivity much more than I had initially expected.
- DC3. Using the DMS improved my effectiveness much more than I had initially expected.
- DC4. My experience with using the DMS greatly exceeded my initial expectations.

##### **Satisfaction** (1: Strongly Disagree; 7: Strongly Agree)

How do you feel about your overall experience of using the DMS:

- ST1. Very dissatisfied . . . Very satisfied
- ST2. Very displeased . . . Very pleased
- ST3. Very frustrated . . . Very contented
- ST4. Absolutely terrible . . . Absolutely delighted

##### **IT Self-Efficacy** (1: Strongly Disagree; 7: Strongly Agree)

- SE1. I can perform my job using DMS even if there is no one around to help me.
- SE2. I can perform my job using DMS if I have adequate time to complete the job.
- SE3. I can perform my job using DMS using only software manuals or online help for reference.
- SE4. I am confident in my ability to perform my job using DMS.

##### **Facilitating Conditions** (1: Strongly Disagree; 7: Strongly Agree)

- FC1. I have access to the resources (e.g., a dedicated computer terminal) needed to use the DMS.
- FC2. I can use the DMS whenever and however I want.
- FC3. I have full control over my using or not using the DMS.

##### **IT Continuance Intention** (1: Strongly Disagree; 7: Strongly Agree)

- CI1. I intend to continue using the DMS on my job.
- CI2. I intend to continue using the DMS for processing more applications.
- CI3. I intend to continue using the DMS for more of my job responsibilities.

##### **IT Continuance Behavior:**

- CB1. Number of times you currently use the DMS per week:  
0 | 1-3 | 4-6 | 7-9 | 10-12 | Other : \_\_\_\_
- CB2. Number of DMS applications that you currently use:  
0 | 1 | 2 | 3 | 4 | 5 | Other (specify): \_\_\_\_
- CB3. Percentage of customer requests that you currently process using the DMS:  
0% | 1-10% | 11-20% | 21-30% | 31-40% | Other: \_\_\_\_