Research on the Expectation-Confirmation Information Systems Continuance Model: A Meta-Analysis Post-Print

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Abstract

[Objective/Significance] The information system continuance model based on expectation-confirmation theory has been widely employed in research predicting users' continuance intention since it was first proposed. However, the conclusions drawn are inconsistent or even contradictory. Therefore, an objective evaluation of the stability of the relationships among model variables is needed to provide guidance and reference for future research.

[Method/Process] Meta-analysis was selected as the research methodology. Data including sample sizes and correlation coefficients were extracted from 108 studies, descriptive analysis was conducted, and effect sizes, fail-safe numbers, etc., were calculated.

[Results/Conclusion] The study demonstrates that the effect sizes and fail-safe numbers of five sets of variable relationships in the model all passed the stability test. However, the effect sizes and fail-safe numbers of the two variable relationships "perceived usefulness-continuance intention" and "perceived usefulness-satisfaction" were relatively low. The reasons for this were analyzed and recommendations were provided.

Full Text

Preamble

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Research on the Information Systems Continuance Model Based on Expectation Confirmation: A Meta-Analysis

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Abstract

[**Purpose/Significance**] Since its introduction, the Information Systems Continuance Model based on Expectation Confirmation Theory has been widely used to predict users' continuance intention. However, research findings have been inconsistent and even contradictory. Therefore, an objective evaluation of the stability of variable relationships in the model is needed to provide guidance and reference for future research.

[**Method/Process**] This study employs meta-analysis as the research method, extracting data on sample sizes and correlation coefficients from 108 articles for descriptive analysis, effect size calculation, and fail-safe number analysis.

[**Result/Conclusion**] The results show that the effect sizes and fail-safe numbers for all five variable relationships in the model pass stability tests. However, the effect sizes and fail-safe numbers for the "perceived usefulness–continuance intention" and "perceived usefulness–satisfaction" relationships are relatively low. This paper analyzes the reasons for this finding and provides recommendations.

Keywords: IS continuance model; expectation confirmation theory; adoption; meta-analysis; effect size; correlation coefficient

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1. Introduction

With the increasing application of information technology in work and daily life, IS/IT adoption research has attracted significant attention. Adoption research is divided into initial adoption and continuance adoption. While initial adoption represents only the first step toward IS success, users' continued use of an information system is the key to ultimate success [1-2]. Scholar A. Bhattacherjee broke through theoretical limitations by integrating Expectation Confirmation Theory (ECT) and the Technology Acceptance Model (TAM) to construct the Expectation-Confirmation Model of IS Continuance (ECM-ISC) [3]. Since its proposal in 2001, ECM-ISC has undergone extensive empirical testing and has proven effective in predicting individuals' continued use of IS/IT, demonstrating better explanatory power than other theoretical models [1]. Consequently, it has gained widespread recognition and become the most widely applied model in continuance research [4]. Although domestic research on ECM-ISC only began in 2006, the model's application scope has rapidly expanded over the past decade to government websites, educational platforms, e-books, shopping sites, social media, mobile apps, and other domains, yielding rich research findings.

However, domestic studies based on ECM-ISC have produced inconsistent and

even contradictory conclusions regarding variable relationships [5-9]. For example, Zhang Xuan and Wu Qinglie used ECM-ISC to study mobile commerce users' continuance intention, and structural equation modeling analysis showed that all variable relationships in ECM-ISC passed significance tests [10]. Chen Yao's research on social networking sites found that satisfaction and perceived usefulness of microblogs directly influenced continuance intention [12]. In contrast, Tang Lisi and Deng Shengli's analysis of 180 questionnaires found no significant relationships between perceived usefulness and satisfaction or between satisfaction and continuance intention [11]. Li Bin's empirical study confirmed that Weibo users' continuance intention was influenced by satisfaction [13]. These inconsistent and contradictory findings not only create confusion but also raise questions about the validity of ECM-ISC and the stability of its variable relationships, hindering future research.

Meta-analysis, as a method for reviewing empirical research literature, integrates independent study results to produce consistent findings, resolve controversial issues, and achieve scientific generalization from individual to general conclusions [14-15]. Since its introduction in the 1970s, meta-analysis has been widely applied in medicine, psychology, education, management, economics, and other disciplines, and is recognized as the most commonly used quantitative synthesis method in social sciences [16]. Despite its advantages, only one meta-analysis of ECM-ISC exists domestically—Bi Xinhua et al.'s study of 32 published articles [17]. That assessment was conducted five years ago, and domestic literature on ECM-ISC has grown substantially since then. For meta-analysis, changes in sample size significantly impact conclusions [18-19]. Therefore, this paper employs meta-analysis to integrate all domestic quantitative studies of ECM-ISC, calculating effect sizes and fail-safe numbers to test the model's validity and variable relationship stability, address the reasons for inconsistent findings, and provide references for future research.

2. Literature Review

The Information Systems Continuance Model integrates Expectation Confirmation Theory and the Technology Acceptance Model [1]. Expectation Confirmation Theory is primarily used to predict consumers' repurchase or reuse intentions (see Figure 1 [Figure 1: see original paper]). R. L. Oliver, the theory's proposer, argued that repurchase intention formation involves five steps: (1) consumers hold pre-purchase expectations; (2) after purchase, consumers form perceived performance based on experience; (3) consumers compare perceived performance with expectations, creating expectation confirmation; (4) based on confirmation level, consumers develop corresponding satisfaction—high confirmation leads to high satisfaction, low confirmation to low satisfaction; and (5) satisfaction directly influences repurchase intention [20-21].

After its proposal, Expectation Confirmation Theory was widely applied to consumer repurchase behavior research. A. Bhattacherjee noted that consumers' decisions to repurchase products/services share many similarities with users'

decisions to continue using information systems [22]. He also recognized the theory's limitations, such as ignoring post-purchase expectation changes and their impact on continuance intention, and inadequately explaining why users discontinue use after initial adoption. Pre-purchase expectations mainly derive from media information or others' opinions, while post-purchase expectations come from personal consumption experiences—these are fundamentally different, with post-purchase expectations more accurately representing factors influencing continuance intention. Therefore, Bhattacherjee transplanted perceived usefulness from TAM into Expectation Confirmation Theory to reflect users' changed expectations after initial IS adoption, constructing the complete ECM-ISC model shown in Figure 2 [Figure 2: see original paper].

ECM-ISC contains four variables: perceived usefulness (users' subjective judgment of whether an IS helps with work or learning after use), expectation confirmation (the degree to which perceived IS utility matches pre-use expectations), satisfaction (users' satisfaction level with an IS after use), and continuance intention (users' intention to continue using an IS over time). The model proposes five variable relationships: (1) satisfaction positively influences continuance intention; (2) expectation confirmation positively influences satisfaction; (3) perceived usefulness positively influences satisfaction; (4) perceived usefulness positively influences continuance intention; and (5) expectation confirmation positively influences perceived usefulness. To test the model's explanatory power, Bhattacherjee surveyed online banking users, using structural equation modeling for data analysis and hypothesis testing. All hypotheses passed, confirming ECM-ISC's validity and applicability. ECM-ISC focuses on user feelings and subjective attitudes, contributing a new theoretical model to continuance research and freeing subsequent studies from initial adoption theory constraints.

Since its proposal, ECM-ISC has attracted substantial academic attention and been widely applied across domains including communication services, finance, education, commerce, and government informatization. To outline the current domestic research landscape, the authors retrieved 12 representative articles from CNKI—5 published in the last three years and 7 cited over 20 times (see Table 1).

Table 1 reveals inconsistencies in Chinese ECM-ISC research findings, with some studies confirming variable relationships that others reject. For example, Guo Yingying and Zhao Yang's studies on mobile internet and library apps found significant relationships between perceived usefulness and continuance intention, while Zhan Xun and Tang Zhiwei's research on WeChat and government websites found no significant relationship [3, 23-25]. Bi Xinhua and Zhang Min's mobile commerce and search engine studies found significant relationships between perceived usefulness and satisfaction, whereas Tang Lisi and Sun Jianjun's social networking service and video website studies found no significant relationship [13, 26-28]. Similarly, Peng Xixian and Chen Yan's WeChat and BIM technology studies found significant relationships between satisfaction and continuance intention, but Chen Yao and Dai Yiling's social networking site and

hospital information system studies reached opposite conclusions [11, 29-31].

The validity and applicability of a model's variable relationships directly affect research results. These contradictory findings have puzzled researchers, raising questions about ECM-ISC's validity, the stability of its variable relationships, and its applicability in the Chinese context. To address these questions and deepen understanding of ECM-ISC, verifying the stability of its variable relationships is necessary. Meta-analysis, as the most important method in evidence-based research [33], offers advantages in objective quantification standards, integrating different conclusions, improving statistical validity, and generating new discoveries [33]. Its core is calculating effect sizes—standardized measures of variable relationship strength and direction. Positive effect sizes indicate positive relationships, with higher values indicating stronger relationships. Since G. V. Glass first proposed meta-analysis in the 1970s, scholars across disciplines have refined the method, and its application has matured. Recent meta-analysis applications in library and information science have grown rapidly [34], with related studies published in top-tier journals such as MIS Quarterly, International Journal of Information Management, Information & Management, and Journal of Knowledge Management, demonstrating the method's scientific rigor and practical value. Therefore, this paper employs meta-analysis to examine the stability of variable relationships in ECM-ISC.

3. Research Design

3.1 Meta-Analysis

G. V. Glass defined meta-analysis as statistical analysis of a large collection of analysis results to integrate findings [35]. M. Borenstein further defined it as a method using predetermined, transparent literature selection criteria to select numerous relevant studies on a specific topic and using statistical techniques to summarize main conclusions from these dispersed findings [36]. Domestic scholars Bi Xinhua et al. defined meta-analysis as a literature synthesis method combining qualitative and quantitative approaches, using statistical analysis to comprehensively evaluate multiple independent studies with common research purposes, identify universal conclusions, and discover differences [17]. Drawing on previous research and this study's purpose, we adopt Borenstein's definition and specify the following steps: (1) select research subjects, determine search terms, and retrieve literature; (2) screen literature according to inclusion criteria; (3) read each article and extract data; (4) conduct calculations and analysis using formulas; and (5) write analysis conclusions.

3.2 Research Literature Selection

We selected CNKI, China's largest full-text database, as the data source. After testing multiple search strategies, we determined that using "expectation confirmation model" OR "expectation confirmation theory" OR "ECM-ISC" OR "Expectation-Confirmation Model of IS Continuance" OR "Expectation-

Confirmation Model" as search themes yielded the most results—187 articles published between 2006-2017, retrieved on April 9, 2017. Literature inclusion criteria followed PRISMA standards: (1) quantitative research; (2) variables include adoption intention or continuance intention; (3) study reports correlation matrices or convertible statistics; (4) sample size reported; and (5) at least two variable relationships from original or modified models tested [37-38]. Screening the 187 articles against these criteria yielded 108 final papers—58 dissertations (50 master's, 8 doctoral) and 50 journal articles. Half were published in the last three years, with sample distribution shown in Figure 3 [Figure 3: see original paper]. Most studies used regression analysis or structural equation modeling, providing complete reporting of test statistics (correlation coefficients, standardized regression coefficients, and path coefficients). We read all 108 studies, extracting and coding authors, publication year, sample size, analysis method, correlation coefficients, and system attributes for subsequent analysis.

4. Data Analysis and Research Findings

4.1 Data Conversion

Before meta-analysis, different study results must be converted to effect sizes for comparison [39]. Among the 108 studies, 98.15% (106) reported correlation coefficients, while 1.85% (2) reported T-values, which were converted using formulas from Zhu Hui and Zhou Gengui [40]. After data preparation, we: (1) converted each study's Pearson correlation coefficient r to Fisher's Z to obtain combined correlations; (2) conducted Z-tests to assess statistical significance of Zr; and (3) calculated fail-safe numbers to examine result stability.

4.2 Data Analysis and Findings

We analyzed research quantity, correlation quantity, P-value ranges, and sample sizes for ECM-ISC's five variable relationships across 108 studies, obtaining 409 correlation coefficients. As Table 2 shows: perceived usefulness–continuance intention (PU-CI) yielded 74 correlations from 85 studies; perceived usefulness–satisfaction (PU-S) yielded 74 correlations from 83 studies; satisfaction–continuance intention (S-CI) yielded 104 correlations from 108 studies; expectation confirmation–perceived usefulness (C-PU) yielded 71 correlations from 72 studies; and expectation confirmation–satisfaction (C-S) yielded 86 correlations from 88 studies. P-value ranges were: PU-CI (-0.30 to 0.88), PU-S (-0.49 to 0.77), S-CI (-0.15 to 0.87)—with wide spans, including negative correlations in PU-S that contradict original model assumptions; C-PU (0.07-0.86), C-S (0.07-0.90). Sample sizes ranged from 133 to 1,247 respondents, with total samples highest for S-CI (33,479) and lowest for C-PU (23,135). Average sample sizes across relationships were 318-335, indicating similar participation levels.

Table 2. Descriptive Statistics of Variable Relationships

Variable Relationship	Studies	Correlations	P-value Range	Significant Correlations	Sample Range	Total Sample
PU-CI	85	74	-0.30 to 0.88	97.3%	133-1,247	27,413
PU-S	83	74	-0.49 to 0.77	95.9%	133-1,247	26,135
S-CI	108	104	-0.15 to 0.87	99.0%	133-1,247	33,479
C-PU	72	71	0.07 to 0.86	98.6%	133-1,247	23,135
C-S	88	86	0.07 to 0.90	98.8%	133-1,247	29,731

Using formulas from reference [41], we conducted Fisher r-to-Z transformation and calculated weighted Zr means and ranges (95% confidence interval). The weighted Zr mean is the meta-analysis focus for assessing overall model validity. Table 3 presents results: weighted Zr means ranked from high to low as S-CI (0.491), C-S (0.454), C-PU (0.347), PU-CI (0.269), and PU-S (0.245). Standard errors estimated from study standard errors ranged 0.003-0.007. Wald tests for ECM-ISC relationships showed all $|Z| > 1.96$, indicating statistically significant weighted mean effect sizes. All relationships were positive, consistent with original hypotheses, passing validity tests.

Finally, we conducted fail-safe number tests. Larger values indicate more stable results less likely to be overturned [42]. Using Li Maoneng's formula [43]: (1) convert Fisher's Z to Z-scores, (2) sum Z-scores, (3) calculate FSN as (sum of Z-scores)^2/(1.645)^2 minus study count. Table 3 shows all five relationships passed fail-safe tests. For example, PU-CI's significant relationship would require 40 additional studies to disappear; PU-S would require 28.

Table 3. ECM-ISC Meta-Analysis Results Summary

Relationship	r (Weighted)	Zr (Weighted)	SE	95% CI	FSN
PU-CI	0.310	0.269	0.003	$0.20 < Zr < 0.29$	40
PU-S	0.311	0.245	0.004	$0.18 < Zr < 0.27$	28
S-CI	0.481	0.491	0.006	$0.43 < Zr < 0.51$	272
C-PU	0.477	0.347	0.005	$0.27 < Zr < 0.37$	122
C-S	0.488	0.454	0.007	$0.37 < Zr < 0.48$	240

Using J. Cohen's method for interpreting weighted Zr means [44], we classified ECM-ISC's five relationships into high, medium, and low effect sizes. Cohen defines: low = 0.10-0.29, medium = 0.30-0.49, high $\geq$ 0.50. Table 4 shows S-CI has high effect size (0.505), two relationships have medium effect sizes (C-PU

= 0.357, C-S = 0.467), and two have low effect sizes (PU-CI = 0.277, PU-S = 0.252). All passed fail-safe tests.

Table 4. ECM-ISC Variable Relationship Effect Size Tests

Relationship	Effect Size	Classification	FSN Test	r Threshold
PU-CI	0.277	Low	Pass	$r \geq 0.20$
PU-S	0.252	Low	Pass	$r \geq 0.20$
S-CI	0.505	High	Pass	$r \geq 0.50$
C-PU	0.357	Medium	Pass	$r \geq 0.30$
C-S	0.467	Medium	Pass	$r \geq 0.30$

Figure 4 [Figure 4: see original paper] illustrates the effect sizes for ECM-ISC variable relationships.

5. Research Conclusions

Social science requires patterned, repetitive research to discover underlying patterns. As literature accumulates, meta-analysis becomes increasingly valuable for "summarizing existing repetitive research, gradually revealing truth, and identifying future research directions" [15]. This meta-analysis of domestic ECM-ISC empirical studies from 2010-2017 extracted 409 correlation coefficients from 108 papers. By calculating effect sizes and fail-safe numbers for the model's five variable relationships, we tested model validity and relationship stability.

Findings show all variable relationships are positive, consistent with original hypotheses, passing overall validity tests. However, stability varies across relationships. Specifically, satisfaction–continuance intention, expectation confirmation–perceived usefulness, and expectation confirmation–satisfaction show higher effect sizes and good stability. In contrast, perceived usefulness–satisfaction and perceived usefulness–continuance intention show low effect sizes and weaker stability.

Previous research shows the most controversial findings involve perceived usefulness–satisfaction and perceived usefulness–continuance intention relationships. This study's "dual low" effect sizes and fail-safe numbers for these relationships indicate weak stability and high probability of being overturned. Possible reasons include:

1. **System type effects:** Most samples focus on hedonic IS like social networking sites, where perceived usefulness is weaker than in utilitarian systems (e.g., online learning, e-banking), reducing perceived usefulness' impact on continuance intention [45].
2. **Environmental influence:** Strong interactivity in most IS means others' opinions significantly shape user cognition and behavior. Under "social influence," "subjective norms," and "critical mass," users may adopt systems because others use them, not because of perceived usefulness [46].

3. **Endogeneity issues:** Variable relationships are affected by IS type, group opinions, and other variables, not absolutely as originally specified. For example, A. Hayashi found social presence moderates the perceived usefulness–satisfaction relationship [47], suggesting undiscovered variables at work.
4. **Cultural context:** ECM-ISC was developed in Western culture. Uncritical application in Chinese contexts may reduce some variables' explanatory power. These two relationships may become focal points for future ECM-ISC research in China.

Following Li Maoneng's observation that "significance tests overly depend on sample size—larger samples yield smaller p-values" [43], sample size, sampling methods, and sources affect conclusions. Sample sizes in these studies range from 133 to over 1,000, mostly using convenience or snowball sampling, primarily among student populations. This sampling randomness provides a perspective for future research: determine sample sizes scientifically rather than arbitrarily, avoid convenience sampling in favor of random sampling for representativeness, and ensure sample sources are differentiated and stratified according to research questions.

Finally, meta-analysis has limitations. Without primary data collection, conclusions depend on existing studies' quality and sample characteristics. Therefore, the finding of low stability for perceived usefulness–satisfaction and perceived usefulness–continuance intention relationships requires corroboration from more future studies. Researchers applying ECM-ISC, especially to social networking contexts, should treat these two relationships cautiously.

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Research of IS Continuance Model Based on the Expectation Confirmation: A Meta-analysis

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Abstract: [Purpose/significance] Since the expectation confirmation model of IS continuance was put forward, it is widely used in the prediction of continuance intention, but the conclusion is inconsistent or contradictory. There-

fore, the evaluation is very important. [Method/process] In this paper, the meta-analysis was used as the method to extract the data of sample size and correlation coefficient in 108 articles. This paper analyzed the descriptive statistics, the calculation effect size, the failure-safety number of the extracted data. [Result/conclusion] The results show that the effect size and the failure-safety number of the five groups of variables in the model are stable, but the effect size and the failure-safety number of the "perceived usefulness-continuance intention" and the "perceived usefulness-satisfaction" are low, whose reasons are analyzed in this paper. At last, this paper gives recommendations.

Keywords: IS continuance model; expectation confirmation theory; adoption; meta-analysis; effect size; pearson correlation coefficient

Note: Figure translations are in progress. See original paper for figures.