ADOPTION OF TECHNOLOGY ACCEPTANCE MODEL (TAM) TO ELECTRONIC COMMERCE: A STATISTICAL META-ANALYSIS APPROACH

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Abstract

The purpose of this study is to statistically synthesize the results reported in a large body of literature concerning consumer acceptance of E-commerce technologies. Specifically, we adopted statistical Meta-Analysis methods in the area of E-commerce. Existing quantitative statistical findings of multiple studies were combined and standardized into one matrix to amalgamate and validate the constructs of the E-commerce Technology Acceptance Model (ECTAM). The results showed the selected 39 studies for the Meta-Analysis were homogenous and their existing findings were statistically combinable. In addition, the results did not suffer from a publication bias problem except for one tested relationship (Perceived Usefulness and User Attitude). The results indicated the most important factor affected user attitude and system level of usage is system usefulness. System ease of use comes second in place affecting attitude and level of usage; however it had a large effect in improving system usefulness.

1 Introduction

Electronic Commerce is an exponential growing area for consumer trading. The Census Bureau of the Department of Commerce estimated the U.S. retail E-commerce sales for the second quarter of 2005 at $21.1 billion. The total retail sales for the second quarter of 2005 were estimated at $940.8 billion. The second quarter 2005 E-commerce estimate increased by 26.0 percent (±3.6%) from the second quarter of 2004 while total retail sales increased by 8.4 percent (±0.5%) in the same period [1]. The projection for the year 2007 is the number of Asia-Pacific Internet users will be over 615 million, Western Europe with 290 million, the U.S. with 230 million, and the Middle East/Africa region will have the lowest number of Internet users at 96 million. However, forecasts indicate there will be nearly two billion Internet users world wide by 2010. Furthermore, Broadband Internet access (cable modems and Digital Subscriber Lines (DSL) will rise rapidly and have a great effect on the Internet user's experience [2].

The growth in Internet utilization and E-commerce profits created business opportunities for virtually all companies ranging from small startups to Fortune 100 companies. In the midst of the proliferation and diffusion of E-commerce applications and services in the mid 1990's, E-businesses, software engineers, and developers of E-commerce systems need to understand the factors influencing online consumer behavior in order to develop successful technologies. Therefore, researchers are interested in establishing models to measure ECTA. One of the most commonly tested and accepted models are Davis's Technology Acceptance Model (TAM) and few extended models were broadly applied and empirically tested through many studies.

The purpose of this study is to determine the strength of factors involving in E-commerce using TAM and Meta-Analysis. By integrating and synthesizing existing empirical findings and outcomes in quantitative terms of existing conflicting studies would improve the knowledge of consumers' and users' adoption behaviors and attitudes could be improved. Also, we investigated the relationships between the factors of ECTA with a larger sample of subjects than any individual study and over a long period of time including a fast array of E-commerce systems. The findings of this research will enhance the utilization of ECTAM or any other similar model in Information System IS and Information Technology IT future research fields.

2 Synthesizing E-Commerce Technology Acceptance

Several TAM models were applied to several computer applications under different conditions (e.g., time, culture, and work environment) with many control factors (e.g., gender, and organizational type and size) and with different subjects (e.g., women, students, and employees). The plethora of studies of E-commerce factors led to conflicting results of published studies. For example, in 2004, Qingxiong Ma noted that, *"Despite the plethora of literature on technology acceptance model, the empirical tests have so far produced mixed and inconclusive results, which vary considerably in terms of statistical significance, direction, or magnitude."*, and that *"The mixed findings not only undermine the precision of technology acceptance model, but also complicate efforts for IT practitioners and academicians to identify the antecedents to user acceptance behavior"* [3]. In addition, in 2003 Lee and Kozar noted the lack of sufficient statistical analysis that combines numerous published studies findings in field of TAM research. They stated, *"Despite its great success, however, few previous systematic efforts trace its history or investigate and evaluate its findings, limitations, and future"*

[4]. In an important study Mahmood and Swanberg [5] stated that, *"Historically, IS research suffered from unclear conceptualizations and validations of the constructs."* Similarly, the employment of TAM to measure the consumers' acceptance of E-commerce technologies confronted the same problematic issues as in the cases of computer usage. The cumulative studies on ECTA yielded indecisive and mixed findings, which reduced the accuracy of the ECTA factors. Thus, further investigation and evaluation using Meta-Analysis is needed to synthesis the results of the cumulative research findings. This raised the concerns of Scholars about how such findings could be synthesized and organized into coherent findings.

Thus, we formed the research problem statement as follows; via applying statistical Meta-Analysis methods to the field of E-commerce Technology Acceptance (ECTA), it is possible to establish a ECTA Model that traces, investigates, and synthesizes the inconclusive and mixed empirical results and findings of existing and various studies in order to obtain a more unified, conclusive results concerning the factors affecting ECTA. This research is a step towards a better understanding of the influencing factors on Information System, Computer Technology, and E-commerce. It should helps ECTA researchers to better understand existing research findings and attain more cohesive defined conclusions concerning the level of associations among ECTA factors. Moreover, the E-commerce businesses will be able to establish polices to increase usage of E-commerce and take the crucial decision of buying.

3   ECTA Model and Research Hypotheses

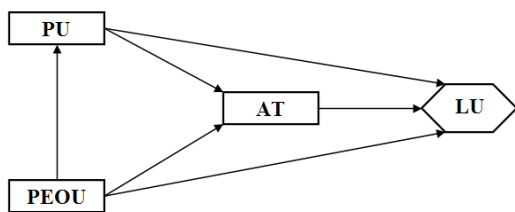ECTAM as shown in Figure 1 includes four important factors:

FIG. 1. E-COMMERCE TECHNOLOGY ADOPTION MODEL (ECTAM).

1. *E-commerce Technology Perceived Ease of Use (PEOU)* is defined as the degree to which an online consumer believes that using a particular E-commerce system would be effortless.
2. *E-commerce Technology Perceived Usefulness (PU)* is defined as the degree to which an online consumer believes that using an E-commerce system would improve his/her shopping or purchasing experience.
3. *E-commerce Technology Attitude (AT)* is defined as the online consumer feelings of advantageousness towards using an E-commerce technology.

4. *E-commerce Technology Level of Usage (LU)* is defined as the online consumer intentions to use the E-commerce technology for shopping.

This new research model investigated the relationship between the independent co-linear independent factors (PU, PEOU, and AT) on the dependent factor (LU). However, some factors could be independent and dependent. For example, PU becomes a dependent factor in relation to PEOU, and becomes an independent factor in relation to AT. Following are descriptions of the research factors.

Researchers developed tools for measuring and analyzing computer user satisfaction to explain system use. Generally, satisfaction is considered to be the aggregate of an individual's opinions or attitudes about a range of factors affecting a situation. Thus, it is calculated as the sum of a user's weighted reactions to a set of *n* factors. Our Satisfaction is defined as:

$$S = \sum_{ij} W_{ij} R_{ij} \quad i = 1,\dots,m, \quad j = 1,\dots,n$$

where R_{ij}, is the reaction to factor *j* by individual *i*, and W_{ij} is the weight of importance of factor *j* to individual *i*. Ajzen and Fishbein in 1975 explained and forecasted the behaviors of people in specific situations. Bailey and Pearson in 1983 identified 39 factors that can effect user satisfaction. Davis, in 1989 and 1993, introduced an acceptance model to address factors of why users accept or reject information technology. His model is an alteration and improvement of Ajzen and Fishbein's Theory of Reasoned Action (TRA). An important objective of Davis's Technology Acceptance Model (TAM) is to provide a basis for investigating the impact of external variables on internal beliefs, attitudes, and intentions. Davis theorized that an individual's Information Systems (IS) adoption is determined by four major variables: PU, PEOU, AT, and LU. Davis projected PEOU and PU to be the two most important factors in explaining system use. In addition, both TRA and TAM propose that external variables intercede indirectly impacting attitude, subjective norms, their relative weight (in the case of TRA), or influencing PEOU and PU (in the case of TAM). AT and LU are common to TRA and TAM; Davis applied Fishbein and Ajzen's method to measure them. TAM is considered a robust research model in the IS and IT fields. It provides demonstration of the mechanisms by which design choices impact user acceptance of IT. Also, it has proven to be helpful in practical models for exploring, assessing user acceptance of E-commerce technologies, and explaining and forecasting the determining factors of individual behavior toward a given E-commerce system (which is system usage/adoption). Thus, Davis's model appears most appropriate as a theoretical foundation for WEB retailing research because the systems that are the basis of the Internet are computer based [6]. In this study six hypotheses of the ECTAM were investigated through statistically

synthesizing the mixed results of existing research via applying Meta-Analysis methodology:

- H1: Synthesized E-commerce Technology Perceived Ease of Use (PEOU) will have a positive effect on synthesized E-commerce Technology Perceived Usefulness (PU).
- H2: Synthesized E-commerce Technology Perceived Ease of Use (PEOU) will have a positive effect on synthesized E-commerce Technology Attitude (AT).
- H3: Synthesized E-commerce Technology Perceived Ease of Use (PEOU) will have a positive effect on synthesized E-commerce Technology Level of Usage (LU).
- H4: Synthesized E-commerce Technology Perceived Usefulness (PU) will have a positive effect on synthesized E-commerce Technology Attitude (AT).
- H5: Synthesized E-commerce Technology Perceived Usefulness (PU) will have a positive effect on synthesized E-commerce Technology Level of Usage (LU).
- H6: Synthesized E-commerce Technology Attitude (AT) will have a positive effect on synthesized E-commerce Technology Level of Usage (LU).

4 Statistical Meta-Analysis procedures

This study is an effort to solve the problem of conflicting and indecisive findings in the ECTA literature through applying statistical Meta-Analysis methods. These methods are applied in disciplines such as medicine, pharmacy, and IT studies. Meta-Analysis is a scientific approach for research integration. An essential feature of Meta-Analysis is that it is a statistical methodology for summarizing findings of many empirical studies. Meta-Analysis constitutes the best–known and probably most flexible alternative available today [7] and [8]. It offers a set of quantitative techniques that permit synthesizing the results of many types of research including opinion surveys, correlational studies, experimental and quasi-experimental studies, and regression analyses probing causal models. Meta-Analysis specifically allows for organizing and extracting consistent information from a large number of quantitative studies that are nearly incomprehensible by other means. Generally, in this research we utilized simple correlation coefficients r, which are a common measure of the linear relationship between factors to compute the *effect size*. If the simple correlation coefficients r were not reported in the studies while regression (beta) coefficients were reported as alternatives, we harvested beta coefficients. Traditionally, Meta-Analysis synthesizes simple correlation coefficients; however, researchers started utilizing regression (beta) to produce relatively accurate and precise effect size estimates [9, 10].

On the other hand, in case of the absence of both the simple correlation and regression (beta) coefficients while the primary data was reported in different types of statistics (e.g. *t*-test, F test, P value, means, SD, and SE), we apply Meta-Analysis methods on these statistics to convert them to a more standardized form which a correlation like statistic and it departs from zero to 1 (see Table 1). The distribution of the correlation coefficient that was sampled from a population is skewed. This creates bias when comparing correlation coefficients from different studies. Thus, many researchers such as Rosenthal [11] and Wolf [12] recommended the calculation of Fisher's z-transform as the individual effect size for each study. Fisher's z-transformation is selected to ensure the sample distributions are normal.

$$Z = \ln \sqrt{(1+M)/(1-M)} \tag{1}$$

where M is *Meta-Statistic*. In addition, the asymptotic variance of z is computed as [13]:

$$V_z = (n-3)^{-1} \tag{2}$$

TABLE 1: FORMULAS FOR META-STATISTIC, M TRANSFORMATION

Statistics to be Converted	Test Purpose	Transformation Formula	Comment
Z-test	To determine whether there is a significant difference between two group means	$M = \sqrt{\dfrac{Z^2}{N}}$	Stand. Norm. Deviate N > 30
t-test	To determine whether there is a significant difference between two group means	$M = \sqrt{\dfrac{t^2}{t^2 + DF}}$	N < 30 data ; DF= $N_a + N_b - 2$; assumed to be normal
F-test	To compare variances for differences	$M = \sqrt{\dfrac{F}{F + DF}}$	Use only for comparing two group means with DF= $N - 1$
χ^2-Chi Square test	To examine if there is a relationship between the independent and dependent variables when taking sampling errors into account	$M = \sqrt{\dfrac{\chi^2}{N}}$	N= Sample Size Use only for 2×2 frequency table (DF=1)

Consequently, the combined effect sizes for each relationship were calculated *(classified as low CES ≤ 0.20, medium 0.20 < CES < 0.40, and large CES ≥ 0.40)* and so the confidence interval (95%) for effect sizes, degree of heterogeneity, and fail-save numbers for each cumulative effect size. Also, the findings were investigated for publication bias, also known as file drawer problem. The following are definitions of these terminologies:

1) *Effect Size.* - A statistical measure that describes the degree of strength to which a given event is present in a sample or a population (relationship between factors).
2) *Heterogeneity* - The variability in effect size estimates to expected from chance (sampling error alone).
3) *Publication Bias* - The selective publication of articles showing positive results over those showing other types of results (i.e., ignoring statistically insignificant results). Peer-Reviewed Published results tend to be biased toward

statistically significant studies. This may bias our Meta findings by looking for statistically significant studies.

4) *Fail-Safe Number (FSN)* – The number of statistically non-significant studies that reverse the current Meta-Syntheses conclusion. The original and most frequent method to calculate the FSN comes from Rosenthal [14]. This method is based on the sum of Z, combined probabilities. Rosenthal's method computes the number of additional studies, N_R, with a mean effect size equal zero, that are required to reduce the combined significance to a desired level (usually $\alpha = 0.05$). N_R is computed as:

$$N_R = \left(\left[\sum_1^N Z(P_i) \right]^2 / \sum_\alpha^2 \right) - N \qquad (3)$$

Where N is the number of studies, $Z(P_i)$, are the Z-scores for the individual significance values, and Z_∞ is the one-tailed Z-score related to α. It is important to note that in calculating the effect size and degree of heterogeneity it is assumed there is a global cumulative effect size; however, the individual effect sizes may not be identical in both magnitude and direction and the variations between them are lager than what is expected by sampling error or chance. Therefore, the "*Mixed-Effect Meta-Analysis*" was applied where it was assumed that the effect sizes being estimated in the different studies were not identical.

$$E_{Mixed} = \left(\sum_{i=1}^N W_{i(mixed)} Z_i \right) / \left(\sum_{i=1}^N W_{i(mixed)} \right) \qquad (4)$$

Where N is number of studies, Z_i is the Effect Size for i study, and $W_{i(mixed)}$ is the study weight $W_{i(mixed)}$ is the study weight (Mixed-Effect):

$$W_{i(mixed)} = \left(Vi + \sigma_{Pooled}^2 \right)^{-1} \qquad (5)$$

Where V_i is the sampling Variance for i study, and σ_{Pooled}^2 is pooled study variance (between study Variance). The Variance of E_{Mixed} is computed as:

$$S_{Emixed}^2 = \left(\sum_{i=1}^N W_{i(mixed)} \right)^{-1} \qquad (6)$$

Where N is number of studies, $W_{i(mixed)}$ is study weight (Mixed-Effect).When confidence intervals bracket zero this indicates non-significant effect size. In this case, it is agreed upon in the literature to set the left (lower) limit of the intervals to zero. Nevertheless, in order to statistically improve and refine the findings all confidence intervals were recalculated by using the bootstrap method by randomly choosing (with replacement) n studies from sample size of n. This process is repeated many times (999 times) to generate a distribution. Then, the lowest

and highest 2.5 % values are chosen to represent the lower and upper 95% bootstrap confidence intervals limits. The bootstrap method yielded better results when the study did not bracket zero, which indicated that the cumulative effect sizes were significant. Furthermore, the confidence intervals were shrunk to more accurate upper and lower limits. For example, we were able to reduce the confidence intervals of the cumulative effect size for the PU and UA factors from (0.245 to 0.541) to bootstrap (0.302 to 0.492). Notice that the bootstrap interval is shorter. In addition, Quantile Plot was used over Funnel plot to test for the level of publication bias because Funnel plot is not a very reliable method. Sometimes, it is difficult to determine if a Funnel plot is actually shaped as a funnel. However, it could give some idea on whether the study results are scattered symmetrically around a central, more precise effect size. In our effort to obtain a more unified understanding about the effect sizes among the ECTA factors, we conducted an exploratory study that included 39 randomly selected publications, which yielded 49 data entry (Appendix A) that were published ranging from 1998 to 2006. The sample sizes range from 24 to 1,259 participants (in total of 15,296 participants). In this study data was collected through bibliographical references and specialized databases on the Internet. *The publication selection criteria for Meta-Analysis* is:

- Davis's acceptance model is used in an empirical study.
- The research methodology is described and contains information about statistical methods and statistics (e.g., correlations, means, SD, SE, DF, *t* score, F score, and sample size).
- The research findings are available or transformable to standardized form (Meta-Statistic, M).
- Efforts (e.g., quantile graphs) are made to avoid "file drawer problem" or publication bias by including all levels of findings.
- The important assumption in Meta-Syntheses is the independence of the individual findings: statistics reported in different studies are statistically independent.

5 Meta-Analysis results of ECTAM

This section presents the Meta-Analysis results of hypotheses which were investigated in this research. In particular, we provide statistical results on how large and significant are effects sizes, its confidence intervals, degree of heterogeneity among effect sizes, publication bias, and Fail-Safe Numbers. Thirty-two studies measured the effect of PEOU on the PU. The cumulative effect size z = 0.564, a *high* effect size with bootstrap (95%) confidence interval (0.460, 0.659). The total heterogeneity Q_T is 35.586. By testing the total heterogeneity against the χ^2 - distribution with 31degree of freedom and the null hypotheses for this test (effect sizes are equal). The result were insignificant with p-value, P = 0.261 which means that the individual effect sizes where not found to be heterogeneous (i.e. the effect sizes are equal), see Tables 3 and 4, and Figure 2. The Rosenthal's fail safe number

was 1688.7, which is the number of new non-significant studies required to reverse the meta-analysis results. The obtained FSN is considered high and established confidence in our result.

TABLE 2: EFFECT SIZES AND CONFIDENCE INTERVALS (95%)

Hypotheses	Effect Size	Sqrt Pooled Variance	Est. of Pooled Variance	CI (95%)	Bootstrap CI (95%)
PEOU-PU	0.564	0.253	0.007	0.463-0.659	0.460-0.659
PEOU-AT	0.310	0.267	0.007	0.186-0.343	0.207-0.434
PEOU-LU	0.313	0.228	0.008	0.2-0.427	0.208-0.439
PU-AT	0.393	0.375	0.007	0.245-0.541	0.302-0.492
PU-LU	0.368	0.356	0.008	0.233-0.502	0.232-0.514
AT-LU	0.680	0.419	0.006	0.501-0.860	0.510-0.923

TABLE 3: LEVELS OF HETEROGENEITY AND FAIL SAFE NUMBERS

Hypotheses	Heterogeneity	DF	Prob. (Chi-quare)	Rosenthal's Fail-Safe Number
PEOU-PU	35.586	31	0.26	1688.7
PEOU-AT	20.771	21	0.47	199.5
PEOU-LU	28.637	19	0.07	232.3
PU-AT	12.438	25	0.98	263.8
PU-LU	37.441	30	0.16	328.4
AT-LU	33.625	23	0.07	517.7
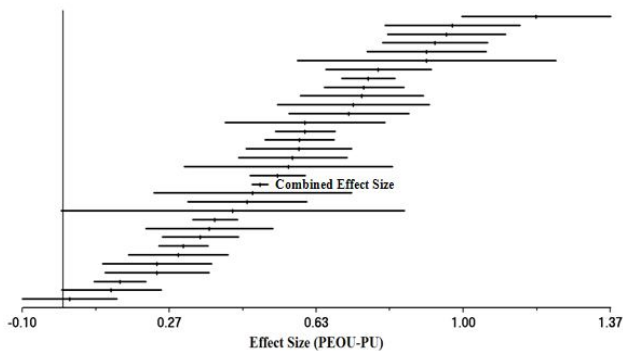
FIG. 2. EFFECT SIZES WITH CONFIDENCE INTERVALS (95%) FOR PEOU AND PU.

By evaluating the weighted histogram graph (which show the weight of each study, we noticed that the highest frequency (Study weight) ($W_j =1/v_j$) ($v_i=1/n-3$) of the studies is 1871 for the individual effect size class of 0.31. On the other hand, the lowest frequency (Study weight) is for the individual effect size class of 1.12. In addition we find that classes 0.54 and .77 are also having high frequency (Fig. 3).
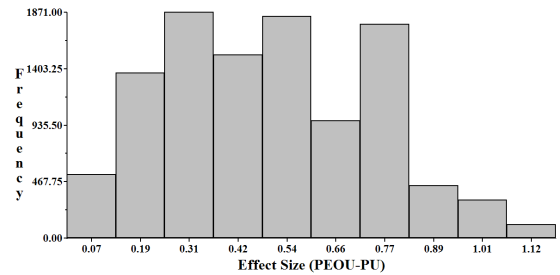
FIG. 3. WEIGHTED HISTOGRAM FOR PEOU-PU.

5.1 Results of E-commerce Technology Perceived Ease of Use (PEOU) on E-commerce Technology Attitude (AT)

Twenty two studies measured the effect of PEOU on the AT. The cumulative effect size z = 0.310, a *medium* effect size with bootstrap (95%) confidence interval (0.207, 0.434). The total heterogeneity QT is 20.771. By testing the total heterogeneity against the χ^2 - distribution with 21degree of freedom, the null hypothesis for this test is that all effect sizes are equal. The result were insignificant with p-value P = 0.473 which means that the individual effect sizes where not found to be heterogeneous (i.e. the effect sizes are equal), see (Tables 3 and 4, and Fig. 4). Rosenthal's Fail Safe Number was calculated to be 199.5. The obtained FSN is considered high and establishes confidence in our result.
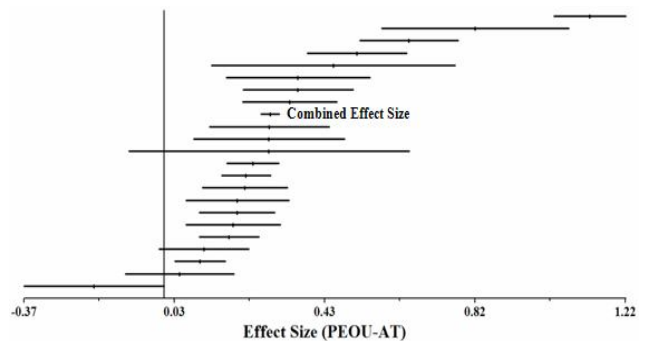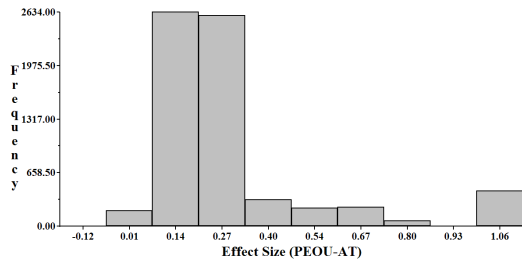

FIG. 4. EFFECT SIZES WITH CONFIDENCE INTERVALS (95%) FOR PEOU AND AT.
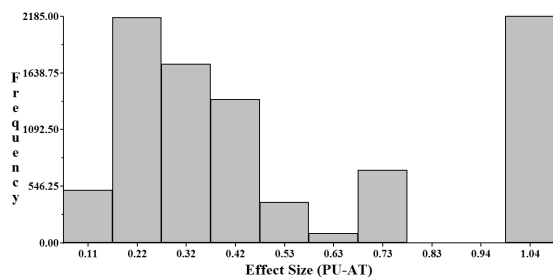
By evaluating the weighted histogram graph (which shows the weight of each study) it is noticed that the highest frequency (Study weight) ($W_j =1/v_j$) ($v_i=1/n-3$) of the studies is 2,634 for the individual effect size class of 0.14. On the other hand, the lowest frequency (Study weight) is for the individual effect size class of 0.8. In addition, it was determined that a class 0.27 is having a high frequency (Fig. 5).

5.2 Results of E-commerce Technology Perceived Usefulness (PU) on E-commerce Technology Attitude (AT)

Twenty-six studies measured the effect of PU on the AT. The cumulative effect size z = 0.393, a *medium* effect size

with bootstrap (95%) confidence interval (0.302, 0.492). The total heterogeneity QT is 12.438. By testing the total heterogeneity against the χ^2 - distribution with 25 degree of freedom and the null hypotheses for this test is that all effect sizes are equal. The results were insignificant with p-value P = 0.983 which means that the individual effect sizes were not found to be heterogeneous (i.e., the effect sizes are equal; see Tables 3 and 4 and Fig. 6). Rosenthal's Fail Safe Number was calculated as 263.8. The obtained FSN is considered high and established confidence in the results.
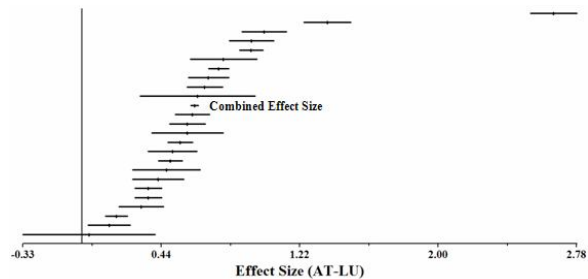

FIG. 5. WEIGHTED HISTOGRAM FOR PEOU-AT.
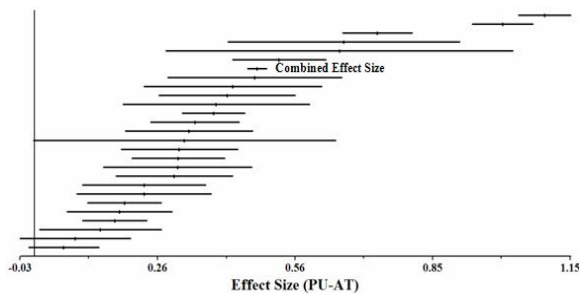
FIG. 6. EFFECT SIZES WITH CONFIDENCE INTERVALS (95%) FOR PU AND AT.

FIG. 7. WEIGHTED HISTOGRAM FOR PU-AT

By evaluating the weighted histogram graph (which shows the weight of each study) it was noticed that the highest frequency ($W_j = 1/v_j$) ($v_i = 1/n-3$) of the studies is 2,634 for the individual effect size class of 1.04. On the other hand, the lowest frequency is for the individual effect size class of 0.63. In addition, it was found that a class 0.22 is having a high frequency (Fig. 7). For the studies is 3866 for the individual effect size class of 0.43.

On the other hand, the lowest frequency (Study weight) is for the individual effect size class of 1.47 (Fig. 9).

5.3 Results of E-commerce Technology Perceived E-commerce Technology Attitude (AT) on E-commerce Technology Level of Usage (LU)

Twenty-four studies measured the effect of AT on LU. The cumulative effect size z = 0.680, a *high* effect size with bootstrap (95%) confidence interval (0.510, 0.923). The total heterogeneity QT is 33.625. By testing the total heterogeneity against the χ^2 - distribution with 23 degree of freedom and the null hypotheses for this test is that all effect sizes are equal. The results were insignificant with p-value P = 0.071 which means the individual effect sizes were not found to be heterogeneous (i.e., the effect sizes are equal; see Tables 3 and 4 and Fig. 8). Rosenthal's Fail Safe Number was calculated as 517.7. The obtained FSN is considered high and establishes confidence in the results.

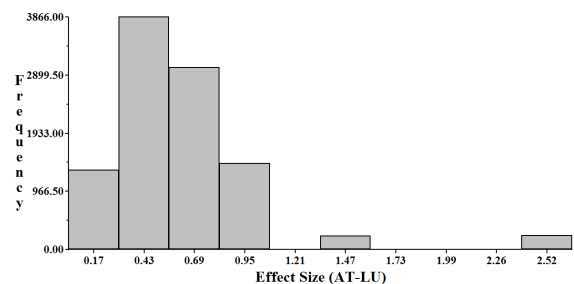**FIG. 8. EFFECT SIZES WITH CONFIDENCE INTERVALS (95%) FOR AT AND LU.**

FIG. 9. WEIGHTED HISTOGRAM FOR AT-LU

5.4 Results of E-commerce Technology Perceived Ease of Use (PEOU) on E-commerce Technology Level of Usage (LU)

Twenty studies measured the effect of PEOU on LU. The cumulative effect size z = 0.313, a *medium* effect size with bootstrap (95%) confidence interval (0.208, 0.439). The total heterogeneity QT is 28.637. By testing the total heterogeneity against the χ^2 - distribution with 19 degree of freedom and the null hypotheses for this test is that all effect sizes are equal. The results were insignificant with p-value P = 0.07 which means that the individual effect sizes were not found to be heterogeneous (i.e., the effect sizes are equal; see Tables 3 and 4 and Fig. 10). Rosenthal's Fail Safe Number was calculated

to be 232.3. The obtained FSN is considered high and establishes confidence in the results.
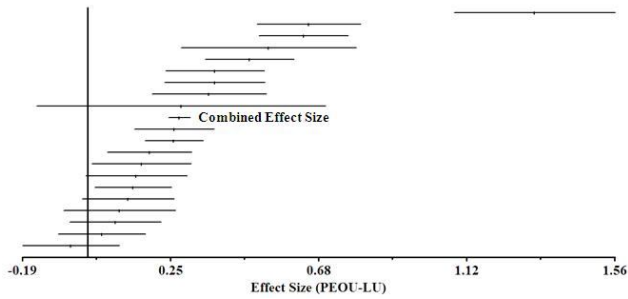

FIG. 10. EFFECT SIZES WITH CONFIDENCE INTERVALS (95%) FOR PEOU AND LU

By evaluating the weighted histogram graph (which shows the weight of each study) it is noticed the highest frequency (Study weight) $(W_j =1/v_j)$ $(v_i=1/n-3)$ of the studies is 31253.19 for the individual effect size class of 0.16. On the other hand, the lowest frequency (Study weight) is for the individual effect size class of 0.57 (Fig. 11).
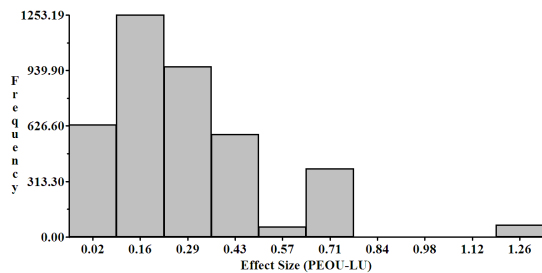
FIG. 11. WEIGHTED HISTOGRAM FOR PEOU-LU

5.5 Results of E-commerce Technology Perceived Usefulness (PU) on E-commerce Technology Level of Usage (LU)

Thirty one studies measured the effect of PU on the LU. The cumulative effect size z = 0.368, a *medium* effect size with bootstrap (95%) confidence interval (0.232, 0.514). The total heterogeneity QT is 37.442. By testing the total heterogeneity against the χ^2 - distribution with 30 degree of freedom and the null hypotheses for this test is that all effect sizes are equal. The results were insignificant with p-value P = 0.16 which means that the individual effect sizes were not found to be heterogeneous (i.e., the effect sizes are equal; see Tables 3 and 4 and Fig. 12). Rosenthal's Fail Safe Number was calculated as 328.6. The obtained FSN is considered high and establishes confidence in the results.

6 Results for Publication Bias

Normal Quantile plots were drawn (Figures 14 through 19) to test our findings for publication bias or file-drawer problem and to make sure the combined

Effect Sizes were not overestimated. For similarity, two distributions were compared against each other--standardized effect size and standard normal distribution. It was found that the majority of individual effect sizes points (for all hypotheses) were located close to the line X=Y line and within the confidence bounds. This indicated the two distributions are similar and normal. Only a few studies showed a borderline of confidence bounds. However, PU-AT result showed some bias which indicated that more publications be included or less bias publications such as unpublished doctoral dissertations for further investigation be included.
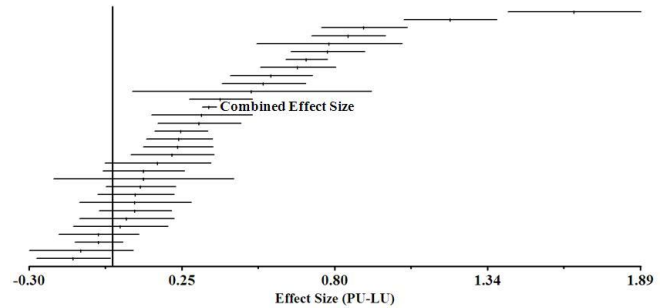

FIG. 12. EFFECT SIZES WITH CONFIDENCE INTERVALS (95%) FOR PU AND LU

By evaluating the weighted histogram graph (which shows the weight of each study) it is noticed that the highest frequency $(W_j =1/v_j)$ $(v_i=1/n-3)$ of the studies is 1560 for the individual effect size class of 0.13. On the other hand, the lowest frequency is for the individual effect size class of 1.56. In addition, it was found that a class 0.31 was a high frequency (Fig. 13).
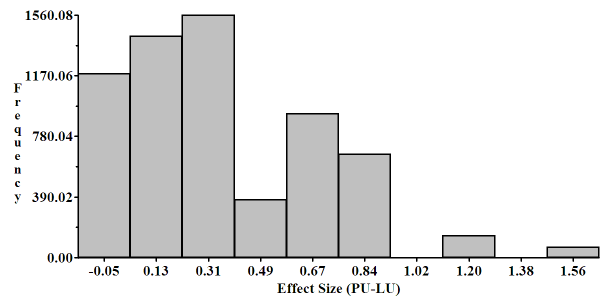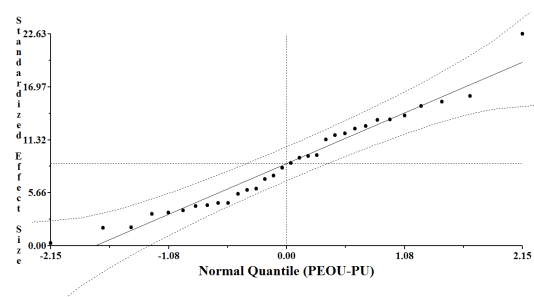

FIG. 13. WEIGHTED HISTOGRAM FOR PU-LU

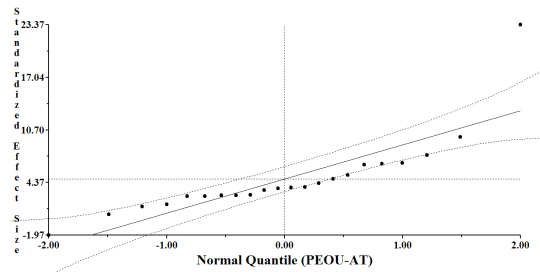

FIG.14. THE NORMAL QUANTILE PLOT FOR PEOU-PU.
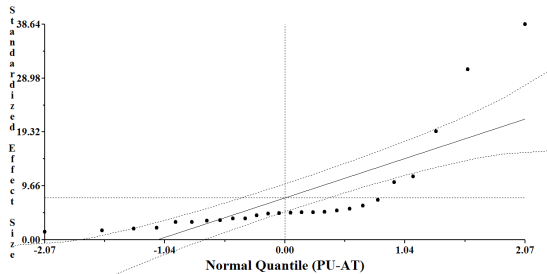
FIG.15. THE NORMAL QUANTILE PLOT FOR PEOU-AT.

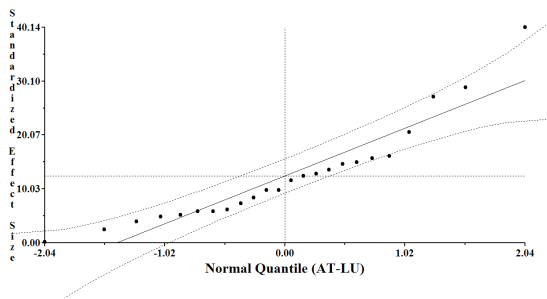**FIG.16. THE NORMAL QUANTILE PLOT PU-AT.**

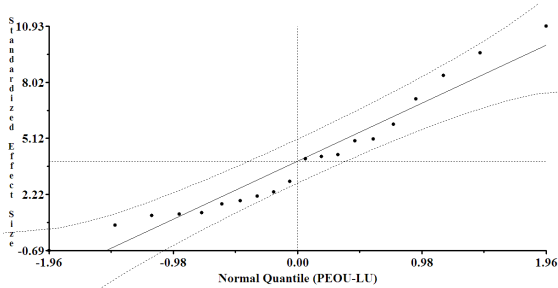**FIG.17. THE NORMAL QUANTILE PLOT AT-LU.**

FIG.18. THE NORMAL QUANTILE PLOT PEOU-LU

7 Conclusion

The Meta-Analysis results show system usefulness as the most important factor directly affected user attitude and level of usage (CES: 0.393 and CES: 0.368). This indicated that E-commerce consumers would have a good attitude toward executing an Internet transaction from a web site whenever he/she believes the transaction will be of benefit even though, for example, the User Guide Interface (UGI) is not user friendly. Also, improving system ease of use will increase system usefulness (CES:

0.564). In addition, system ease of use will increase directly user attitude and level of usage (CES: 0.310 and CES: 0.313). The results indicated the success of an E-commerce site is achieved by creating a good user attitude, where attitude has the largest influence on level of usage (CES: 0.680).
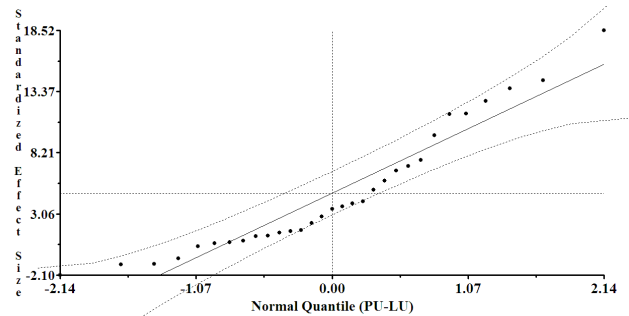

FIG. 19. THE NORMAL QUANTILE PLOT PU-LU

Therefore, we recommend that E-businesses improve consumer acceptance of E-commerce technologies by: (a) a dedicated software engineering process in terms of design, security, information celerity, and ease of use, (b) aggressive business advertisements in the media, including the Internet, (c) clear privacy policy, instructions, tutorials, and providing live chat for help, and (d) obtaining rewords and alliance seals (e.g. secure payments and privacy protection). In summary, the effect sizes of the hypotheses the tested hypotheses where supported on different levels of strength. Fig. 20 showed two strong effect sizes (CES$\geq$ 0.4), and four medium effect sizes (0.2<CES<0.4). To show confidence in our results, we calculated the Rosental's Fail-Safe Numbers. These numbers were high for PEOU-PU, PU-LU, and PEOU-LU. On the other hand, PU-AT and PEOU-AT have lower FSNs. All FSNs are sufficiently large and indicated a confidence and assured our results (Table 3).
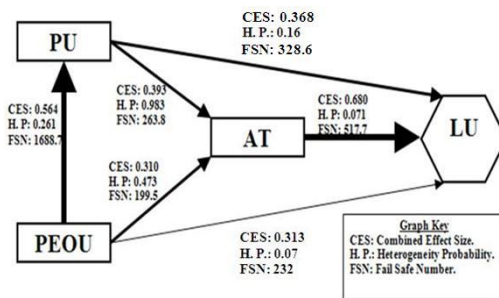

FIG.20. ECTA META-ANALYSIS RESULTS.

Normal Quantile plots were drawn (Fig. 14 through 19) to examine the results for publication bias or file-drawer problem to assure the combined Effect Sizes were not overestimated. It was found that most of the studies were located within the confidence bounds of the normal quantile and only very few are borderline of these confidence bounds which indicated the study does not have a significant publication bias and the its findings reflected the true Effects Sizes in the population. Alongside the potency of the academic contributions, a Meta-

Analysis study on ECTAM contexts is also significant to IT management and business practice. By grasping the essential antecedents to consumer and user Internet adoption organizations, E-commerce businesses, and software developers can make more successful business decisions and technical improvements for greater technology adoption or usage achievements. IT management needs to know consumers' and users' prescriptions. There are several promising approaches for academic research to contribute to practice. One way is by synthesizing accumulative findings after a large body of literature exists about a phenomenon. These results are important for the IS research community in that they assist E-commerce technologies acceptance researchers to understand past research findings and reach clearer conclusions about the extent of relationships among factors that constructed ECTA. The statistical Meta-Analysis approach was selected for this study for several reasons: first, it makes it possible to synthesize the literature by combining the findings of various studies. Second, every data entry used for analysis is acquired from a published individual study rather from an individual participant. Infrequently, single experiments present adequately definitive answers for policy decisions. Third, Statistical Meta-Analysis research includes studies over extended periods of the time and scope. Potentially the factors can be validated over time. Fourth, since technology changes over time the effect of factors at different stages of technological development can be combined. In this Statistical Meta-Analysis study homogenous studies were selected and their findings are statistically combinable.

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