The effects of Trust on Behavioral Intention and Use Behavior within e-government contexts

Apeksha Hooda
Assistant Professor
Jindal Global Business School
O P Jindal Global University
Sonipat Narela Road, Near Jagdishpur Village, Sonipat, Haryana 131001, India
Email: ahooda@jgu.edu.in

Parul Gupta
Faculty – Business and Corporate Law
Management Development Institute Gurgaon
Mahrauli Road, Gurugram, Haryana, 122007, India
Email: Parul.gupta@mdi.ac.in

Anand Jeyaraj
Professor of Information Systems
Raj Soin College of Business
Wright State University
3640 Colonel Glenn Highway, Dayton, OH 45435, USA
Phone: +1.937.775.2189
Email: anand.jeyaraj@wright.edu
Web: https://people.wright.edu/anand.jeyaraj

Mihalis Giannakis
Professor, Information Systems and Supply Chain Management
Audencia Business School
8 Route de La Jonelière, B.P. 31222, 44312, Nantes Cedex 3, France
Email: mgiannakis@audencia.com

Yogesh K Dwivedi [a, b]
[a]Emerging Markets Research Centre (EMaRC), School of Management, Room #323
Swansea University, Bay Campus, Fabian Bay, Swansea, SA1 8EN, Wales, UK
Email: y.k.dwivedi@swansea.ac.uk
[b] Department of Management, Symbiosis Institute of Business Management, Pune & Symbiosis International (Deemed University), Pune, Maharashtra, India

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ABSTRACT

As electronic transactions between governments and users become increasingly common, the role of users' trust in e-government assumes considerable importance. While prior models of technology acceptance have identified several factors that influence behavioral intention and use behavior, trust has largely been missing in such models. This study incorporates e-government trust into the unified theory of acceptance and use of technology (UTAUT) model and conducts an empirical analysis using meta-analytic structural equation modeling (MASEM) methods on findings gathered from 90 prior studies on e-government. Results show that trust plays a central role in users' intention to use and use of e-government systems. Specifically, in e-government contexts, trust is impacted by performance expectancy, effort expectancy, social influence, and facilitating conditions; has a direct effect on system use; and an indirect effect on system use through behavioral intention. Practitioners should strive to leverage users' trust to leverage the full potential of e-government systems.

Keywords: E-government; E-government trust; Behavioral intention; Use behavior; UTAUT model; MASEM

1. INTRODUCTION

E-government, which is implemented to make public administration transparent, open, participative, and accountable, has created immense opportunities for improved services to the community (Coursey & Norris, 2008). However, not every e-government project has met these high expectations and failure rates continue to be high despite the multiple benefits of e-government. E-government implementations around the world continue to fully or partially fail owing to budget overruns, delay, or unmet expectations of end-users (Anthopoulos et al., 2016; Dwivedi et al., 2015; Heeks, 2003). E-government services, which lack social cues and rely on faceless interaction, are not always adopted by users.

Prior literature has examined the factors that influence e-government adoption and use (Dwivedi & Weerakkody, 2007; Hung et al., 2013; Tang et al., 2009; Weerakkody et al., 2009) using various models[1] such as the Unified Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh et al. (2003). These models generally conclude that user perceptions influence behavioral intention, which in turn influences system use. While these models provide useful perspectives on technology adoption and use, they do not directly address a key aspect of decision making—trust in e-government (Rana, Dwivedi, & Williams, 2015). While it can be argued that trust may not always be applicable for technology adoption (e.g., work settings in which organizations provide systems for their employees), it is significant for e-government systems that deal with sensitive, personal data of users (Anthopoulos & Fitsilis, 2014). Thus, trust needs greater attention in technology acceptance models in e-government contexts. Studies

[1] These include the Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), Theory of Planned Behavior (TPB), Diffusion of Innovations model, and Information System (IS) Success model (Davis et al. 1989; DeLone and McLean 1992; 2003; Fishbein and Ajzen 1975; Moore and Benbasat 1991; Rogers 2005). Since the UTAUT model consolidated prior models of technology adoption (see, Venkatesh et al. 2003), these models are not explicitly mentioned in this context.

have incorporated trust in extending technology acceptance models to e-government contexts (e.g., Al Mansoori et al 2018; Al Nidawy et al. 2020; Azam et al. 2013), although trust has been treated differently in such studies—e.g., trust is modeled to influence performance expectancy and vice versa. Thus, there is a need to more clearly determine the role of trust in e-government settings.

This study seeks to address the research question: *What is the role of trust in e-government contexts?* In doing so, this study integrates e-government trust with the base UTAUT model to clarify its effect on behavioral intention and its interrelationships with other constructs. Since trust has been previously linked to behavioral intention, integrating trust with the UTAUT model would provide a clearer understanding of the role played by trust in the presence of other well-accepted constructs and resolve inconsistencies in the impacts of trust found in prior studies. To empirically test the proposed model, this study uses meta-analytic structural equation modeling (MASEM) methods (Jeyaraj & Dwivedi, 2020). MASEM is conducted by meta-analyzing prior empirical findings on the bivariate relationships in our research model and applying structural equation modeling methods to examine the complete research model, which can clarify the true relationships among constructs.

The findings of this study are of importance to both research and practice. For research, this study underscores the role of e-government trust, which is vital for both behavioral intention and system use in e-government contexts, and also how trust is shaped by other factors found in the UTAUT model. For practice, this study demonstrates that e-government initiatives should attach significant importance to trust and find ways to increase users' trust such that e-government

systems may be adopted and used to a greater extent, which can contribute to the success of such systems and efforts by governments.

2. THEORETICAL BACKGROUND

2.1. Trust in e-Government

Trust in e-government stems from trust in technology, electronic information storage, and perceived risk in electronic transactions (Horst et al. 2007; Milloy et al. 2002). It can be defined as the expectations of users that the promise of e-government concerning the authenticity of stored data, privacy of shared information, security of the transaction, quality of service and system, and goodwill of the government organization and institutional environment can be relied upon (Papadopoulou et al., 2010; Piehler et al., 2016). Electronic transactions are susceptible to privacy and security risks for user (Yang et al. 2019) and users generally do not have control over the flow of personal information shared in electronic transactions (Abu-Shanab 2014). Users generally express concerns related to the loss of control of their data and compromises to privacy over information collection, processing, and dissemination (Solove 2005). These concerns intensify when e-government service portals are managed by private entities since users face challenges in assessing whether the private entity managing e-government service portals is well- or ill-intentioned (Friedman et al. 2000). These issues may escalate the level of users' apprehensions about the potential misuse of personal information shared on online e-government service portals. Although technology-enabled services can improve the administrative efficiency of public service providers (Carter & Weerakkody 2008), adoption becomes possible only when users demonstrate trust in e-government service portals (Belanche et al. 2012; Hernandez-Ortega 2011; Chen & Dhillon 2003).

2.2. UTAUT Model

The UTAUT model was originally developed to investigate user acceptance of information systems in work contexts (Venkatesh et al., 2003) by unifying eight other technology acceptance models (Taherdoost, 2018). It contained four antecedents—i.e., performance expectancy, effort expectancy, social influence, and facilitating conditions—that were modeled to influenced behavioral intention or system use (Dwivedi et al., 2017) along with moderators such as age and gender that altered their impacts. UTAUT has since been adapted and examined in a variety of contexts, including e-government. Such adaptations resulted in the development of UTAUT2 (Venkatesh et al., 2012), which included three new antecedents: hedonic motivation, price value, and habit, based on an empirical analysis in a consumer context. Regardless, similar to several other major models of adoption and use, the UTAUT model did not include trust. Studies have incorporated trust in extending technology acceptance models to e-government contexts (e.g., Al Mansoori et al 2018; Al Nidawy et al. 2020; Azam et al. 2013), although the extended models have not always been applied in subsequent studies. But, trust has been handled in different ways in such studies. Azam et al. (2013) and Al Mansoori et al. (2018) proposed trust to influence intention but Al Nidawy (2020) modeled trust to impact use behavior. Al Niwady et al. (2020) proposed that effort expectancy and performance expectancy will influence trust, which in turn will influence use behavior but Li (2021) modeled trust to influence effort expectancy and performance expectancy, which is contrary to Al Niwady et al. (2020).

3. RESEARCH MODEL

Figure 1 depicts the research model, which incorporates trust in e-government with the base constructs of the UTAUT model.

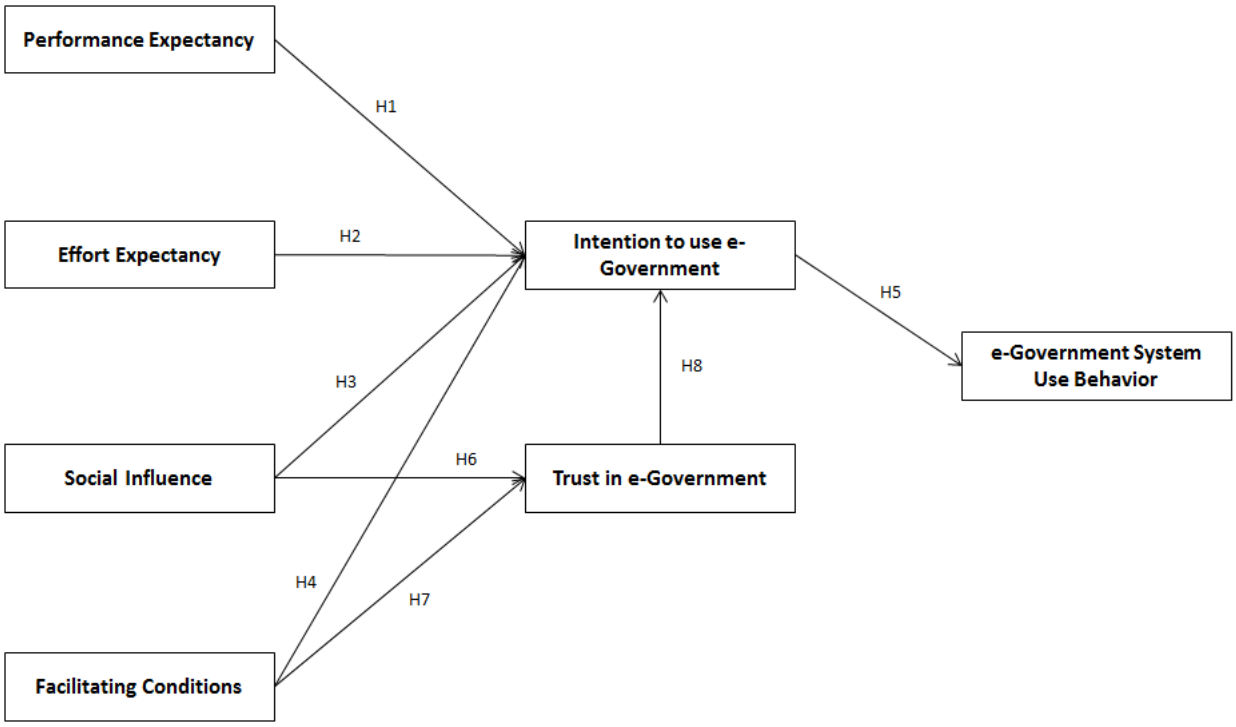

Figure 1. Research Model

3.1. UTAUT-based Relationships

Performance expectancy is defined as an individual's belief that using the system will help improve job performance (Venkatesh et al., 2003). In context of e-government, performance expectancy is the degree of users' perceived value or potential of e-government services such as e-complaints in public offices, e-voting, and e-tax. Prior studies have consistently found performance expectancy to be one of the most influential factors affecting behavioral intention to use (Alalwan et al., 2016; Sipior et al., 2011; Kamarudin et al., 2021; Liang et al., 2021; Talukder et al., 2020). It is related to extrinsic motivation as it gives emphasis to the utilitarian value offered by the system. Users often rationally evaluate the benefits and services offered by the system and the costs associated with using the system prior to acceptance (Venkatesh et al., 2012) and may be willing to accept systems that are convenient, beneficial, and enhance

performance (Carlsson et al., 2006). Users' intentions to use e-government applications are likely to be high when they perceive greater performance expectancies.

H1: Performance expectancy has a positive effect on intention to use e-government.

Effort expectancy of a system relates to the level of simplicity of use and is defined as the degree of the ease of use of a system (Venkatesh et al., 2003). In the e-government context, effort expectancy reflects governmental efforts to serve users and make them feel comfortable using public services. It measures the extent to which users believe that e-government service applications have reduced the effort required to avail public services (Kim and Lee, 2012). If the technology is simple to use, individuals' anxiety due to technological complexity is reduced and they may be willing to use the technology to a greater extent. Users typically assess the cognitive tradeoff between the benefits offered by a technology and the effort required to use it (Davis et al., 1989). Prior studies offer empirical support for the significant positive impact of effort expectancy on intention to use a technology (Hung et al., 2013, Lu et al., 2010). Users' intention to use e-government systems increases when they perceive their use to be free of effort.

H2: Effort expectancy has a positive effect on intention to use e-government.

Social influence refers to individuals' perceptions that important others believe that they should use a new technology (Venkatesh et al., 2003). In the e-government context, social influence may be characterized as the extent to which users value the opinions of others regarding the use of e-government systems (Xie et al., 2017). Social influence has a strong impact on behavioral intention as individuals are often influenced by the opinions of others in close proximity such as family, friends, peers, and colleagues (Chiu et al., 2012; Park et al., 2012). Individuals are likely to interact with important others to reduce the uncertainty, risks, and anxiety associated with new

technology use (Karahanna et al., 1999). Prior studies offer evidence that societal influence plays an important role in attitude formation and decision making of individuals to use a technology (Ziba & Kang, 2020; Chiu et al., 2012). Social influence is likely to exert a positive influence on users' intentions to use e-government.

H3: Social influence has a positive effect on intention to use e-government.

Facilitating conditions refer to an individual's perception about the availability and adequacy of organizational and technical infrastructures to support system use (Venkatesh et al., 2003). In the context of e-government, facilitating conditions describe the availability of infrastructures and resources to use e-government services including access to the internet or mobile data, software and hardware, and uninterrupted connectivity (Statista, 2017). Facilitating conditions provide assurance to the users that the service provider has the necessary resources to operate effectively, including the ability to offer trustworthy and responsive service (Yuen et al., 2015; Ratnasingam, 2004). Users typically acknowledge that the availability of technical resources, service, tools and support enable acceptance (Oliveria et al., 2014). Prior studies support a positive effect of facilitating conditions on behavioral intention to use (e.g. Chiu et al., 2012; Carter et al., 2012).

H4: Facilitating conditions has a positive effect on intention to use e-government.

Intention to use reflects an individual's psychological state just before the adoption of the technology in question (Davis et al., 1989). In the e-government context, intention to use refers to the degree to which a user has consciously formulated a plan to use e-government system (Huang & Kao, 2015). Prior literature based on the theory of reasoned action argues that individuals' actions are influenced by their behavioral intentions (Ajzen, 1991). The relationship between behavioral intention and system use has been validated in prior studies (Zhang & Zhu,

2020; Teo & Lee, 2010) in various technology contexts, and can be expected to hold in e-governments contexts as well.

H5: Intention to use e-government has a positive effect on e-government system use behavior.

3.2. Trust-based Relationships

Individuals may take advantage of recommended options, especially if others whom they admire and respect have availed and benefited by such options. By sending encouraging messages and signals, such influencers exert an influence on potential users, which ultimately plays a key role in developing positive perceptions about e-government systems (Carter et al., 2011). The implicit and explicit notions of these messages motivate the potential users to trust systems recommended by others (Al-Zoubi, 2019; Zahid & Haji, 2019). Due to the peculiar characteristics of online environments such as their impersonal and unpredictable nature and the potential opportunity for the service provider to take advantage of the users' vulnerable position in online transactions (Al-Sobhi, 2011), social influence through positive feedback of the users' connections also play a critical role in fostering e-government trust. Individuals who receive positive messages from their peer group or close others demonstrated higher level of trust with e-government systems.

H6: Social influence has a positive effect on e-government trust.

Users may face uncertainties related to the infrastructure for e-government systems due to many factors such as availability, accessibility, connectivity, security, hardware, software, and training (Venkatesh et al., 2003; Yuen et al., 2015). Facilitating conditions significantly contributes towards building users' trust in e-government systems by reducing uncertainty in the way the technology may behave. When users feel that resources are deployed to help them overcome

hurdles and barriers to use a new system/technology, their confidence in actions and behavior of the other party is enhanced (Gu et al., 2009; Singh et al., 2017). When users experience such support facilities, they may develop greater trust in e-government systems (Lu et al., 2005). When adequate effort and investment in facilitating conditions are possible, users believe that the government is committing sufficient resources to ensure the operations of e-government systems, which further strengthens users' e-government trust (Salimon et al., 2016). Thus, facilitating conditions play a key role in engendering users' trust by ensuring reliable and responsive e-government transactions (Ratnasingam, 2004).

H7: Facilitating conditions has a positive effect on e-government trust.

The impersonal nature of the internet as well as factors related to privacy and security are likely to curtail the acceptance of e-government unless countered by trust. Trust is an indispensable component of relationships among humans and is defined by reliability, honesty, and confidence in the other party (O'Neill, 2018). Trust serves as a mechanism to evaluate the extent to which an individual can expect positive outcome in a relationship with an exchange partner, and describes individuals' beliefs about the competence, benevolence, and honesty of the other party (Zaheer et al. 1998). Mutual trust between related parties plays a significant role in reducing the anxiety associated with perceived risks (Zahid & Haji, 2019; Morgan & Hunt, 1994). Similarly, trust between users and government through the e-government system will significantly diminish the adverse impact of perceived risks, which may influence users' intention to use e-government systems (Chan et al., 2020; Rehman et al., 2016).

H8: e-government trust has a positive effect on intention to use e-government.

4. RESEARCH METHODS

4.1. Sample

We conducted a comprehensive search for articles using multiple databases, namely, EBESCO, Emerald, ScienceDirect, SAGE, Google Scholar, Taylor and Francis, and SCOPUS. The search keywords included ("e-government" OR "electronic government" OR 'mobile government" OR "m-government" OR "digital government" OR "online government" OR "internet government") AND ("acceptance" OR "adoption" OR "usage" OR "usage behavior" OR "use" OR "intention" OR "behavioral intention" OR "continuance intention") and limited to articles published between 2000 and 2021 (April) and in English language. The initial search yielded 515 articles.

We conducted a manual screening to identify articles for the meta-analysis. First, we reviewed the title and keywords and dropped articles not relevant for the analysis. We also excluded review articles, editorials, notes, and duplicate articles. At this stage, 431 research articles remained for consideration. We filtered out experimental studies, qualitative studies, and studies that did not focus on the e-government adoption like studies by (Al Nagi & Hamdan, 2009; Shukur et al., 2018; Zhao et al., 2018). At this stage, 292 research papers remained for further consideration. Finally, we read the full text of the articles to ensure that studies had examined the constructs in our research model and reported the relevant statistics necessary for meta-analysis. The primary statistic of interest was the zero-order Pearson correlation. However, we retained studies (Lee et al., 2011; Shi, 2002) that reported statistics that may be converted to Pearson correlations. Our meta-analysis sample finally included 90 articles[2]. See **Appendix A** for summary details of the studies.

[2] The articles were published in various outlets: 7 studies in International Journal of Electronic Government Research, 6 studies in Electronic Government, 4 studies in Government Information Quarterly, 3 studies each in Computers in Human Behavior, Journal of Theoretical and Applied Information Technology, International

4.2. Coding

We applied a uniform coding method to gather data from studies in our sample. We coded descriptive information such as names of the authors, publication year, journal outlet, country, and the information technology for each study. Data for meta-analysis were coded at the construct and the relationship levels. For each construct, we coded the reliability, mean, standard deviation (SD), and Likert scale anchors. For each relationship, we coded the sample size and zero-order Pearson correlation.

We screened the coded data before analysis. First, we combined similar constructs for consistency. For instance, consistent with (Venkatesh et al., 2003), perceived usefulness, job fit, relative advantage, outcome expectations, and perceived advantage were coded as performance expectancy; perceived ease of use, ease of use, and complexity (reverse-coded) were coded as effort expectancy; perceived behavioral control, compatibility, and computing support were coded as facilitating conditions; and social norms, subjective norm, image, peer influence, and interpersonal influence were coded as social influence construct. Second, we reviewed the data for independence, i.e., each study can contribute only one observation for each relationship. When a study contributed multiple findings for the same relationship, the average of the multiple correlations was computed. For instance, (Riyadh et al., 2018) contributed multiple correlations for the relationships involving effort expectancy and performance expectancy with behavioral

Journal of Public Administration, and Journal of Systems and Information Technology, 2 studies each in Transforming Government: People, Process, and Policy, International Journal of Interactive Mobile Technologies, International Journal of Innovation, Creativity and Change, International Journal of Electrical and Computer Engineering, Information Systems Frontiers, IEEE Access, Information Development, SAGE Open, International Journal of Electronic Research, and International Journal of Information Management, and 1 study each in 41 other journals. The number of articles published in each year is as follows: 2004 (1), 2007 (1), 2009 (1), 2010 (2), 2011 (2), 2012 (1), 2013 (2), 2014 (1), 2015 (4), 2016 (6), 2017 (18), 2018 (10), 2019 (19), 2020 (20), and 2021 (3).

intention, and the average correlation was computed for each relationship. Third, we handled missing data for construct reliabilities that were not always available. Missing reliabilities can be handled in different ways—for instance, the mean reliability may be computed using data from other studies. However, in this study, we take a conservative approach and noted the missing data but did not employ mean substitutions. We coded 628 findings from prior studies.

4.3. Analysis

We used quantitative meta-analytic methods (Hunter & Schmidt, 2004) to correct the effect sizes for the relationships in our research model. The reliabilities of the constructs were used to correct the measurement error in observed correlations: $r_m = \frac{r_o}{\sqrt{r_{xx} r_{yy}}}$, where r_m is the correlation corrected for measurement error, r_o is the reported correlation, r_{xx} and r_{yy} are the construct reliabilities for the constructs. The sampling error in observed correlations were corrected using the sample size as the weight: $\bar{r_c} = \frac{\sum[N_i r_i]}{\sum N_i}$, where $\bar{r_c}$ is the corrected correlation, N_i is the sample size and r_i is the correlation reported in studies. The corrected correlations were used to conduct the MASEM analysis in Stata 15. Sobel tests were used to assess the mediating effects of trust (Sobel 1982).

5. RESULTS

5.1. Meta-analysis

The corrected correlations for all relationships are shown in **Table 1**. The mean, standard deviation (SD), and the composite reliability for the construct are shown in the first two columns. The reliability was computed as the average of the reliabilities for the construct reported in individual studies. The lower triangle includes the number of findings coded and the overall

sample size ($\sum N$) for each relationship. The upper triangle shows the credibility interval and the failsafe-N for each relationship. The credibility intervals suggest that most of the relationships in our model are positive since they do not include 0 (Whitener, 1990). The credibility interval for the relationship between effort expectancy and use behavior contained 0, which was an exception. The failsafe-N provides as estimate of the number of additional studies with non-significant results needed to overturn the meta-analysis results (Wu & Lederer, 2009). The range of Failsafe-N was 26 (for the relationship social influence and use behavior) to 746 (for the relationship between performance expectancy and behavioral intention). The average failsafe-N was 282 across the 21 relationships. These indicate that our study may not have a publication bias problem.

Table 1. Meta-analysis Results

Construct	**Mean (SD)**	**CR**	**INT**	**EE**	**FC**	**PE**	**TR**	**SI**	**UB**
Intention to use e-government (INT)	5.14 (2.72)	0.85		[0.10, 0.92] 544	[0.26, 0.91] 464	[0.22, 0.96] 746	[0.24, 0.89] 344	[0.16, 0.80] 436	[0.45, 0.81] 82
Effort expectancy (EE)	4.95 (1.32)	0.84	0.51 (59, 19814)		[0.11, 0.96] 381	[0.11, 0.92] 612	[0.15, 0.80] 163	[0.13, 0.79] 383	[-0.07, 1.06] 27
Facilitating conditions (FC)	4.94 (1.38)	0.84	0.58 (43, 16352)	0.53 (39, 14569)		[0.16, 0.83] 361	[0.26, 0.68] 102	[0.06, 0.82] 285	[0.30, 0.84] 31
Performance expectancy (PE)	5.03 (1.43)	0.84	0.59 (68, 24076)	0.52 (65, 24044)	0.50 (40, 15442)		[0.20, 0.86] 273	[0.16, 0.81] 451	[0.05, 0.94] 36
Trust in e-government (TR)	4.68 (1.55)	0.88	0.57 (33, 11841)	0.47 (19, 7618)	0.47 (12, 6006)	0.53 (28, 10957)		[0.20, 0.87] 147	[0.45, 0.88] 50
Social influence (SI)	4.78 (1.40)	0.83	0.48 (50, 17809)	0.46 (46, 16500)	0.44 (36, 13357)	0.49 (51, 18395)	0.54 (15, 6173)		[0.39, 0.57] 26
e-government system use behavior (UB)	5.04 (1.07)	0.87	0.63 (7, 3586)	0.49 (3, 1171)	0.57 (3, 1574)	0.49 (4, 1921)	0.67 (4, 1774)	0.48 (3, 1574)	

SD: Standard deviation; CR: Construct reliability
Lower triangle: Corrected correlation (Number of findings, Cumulative sample size)
Upper triangle: 90% credibility interval [Low, High] Failsafe N

5.2. Structural Equation Modeling

The matrix of corrected correlations, means, and SDs (Table 1) were used for the MASEM analysis in Stata 15. Since MASEM requires a single sample size, the minimum sample size (939) across all relationships was chosen.

The research model (Figure 1) was first tested using MASEM. It showed reasonable fit: χ^2 = 528.28, df = 7, $p < 0.01$, CFI = 0.865, TLI = 0.594, SRMR = 0.104, and RMSEA = 0.252. The hypothesized paths in our model were significant. The χ^2 / df ratio was higher than recommended (Carmines & McIver 1981; Sabherwal et al. 2006), CFI was acceptable (> 0.90), TLI was below 0.90 (Bentler & Bonett 1980), SRMR was higher than 0.08, and RMSEA also higher than 0.08 (Browne & Cudeck,1993; Sabherwal et al., 2006). Modification indices (MI > 10) showed that other unhypothesized paths may be added to achieve better fit.

The path between trust and use behavior (MI = 252.39) was added first. The resulting model showed better fit: χ^2 = 215.54, df = 6, $p < 0.01$, CFI = 0.994, TLI = 0.810, SRMR = 0.067, and RMSEA = 0.173. The hypothesized paths remained significant. The χ^2 / df ratio was greater than 3, CFI was acceptable, TLI was below recommendation, SRMR was acceptable, and RMSEA was above recommendation. Modification indices showed other paths were possible.

The path between performance expectancy and trust (MI = 100.48) was added. The resulting model showed better fit: χ^2 = 110.48, df = 5, $p < 0.01$, CFI = 0.973, TLI = 0.885, SRMR = 0.040, and RMSEA = 0.134. All hypothesized paths remained significant. The χ^2 / df ratio was higher than recommended, CFI was acceptable, TLI was below the recommended level, SRMR was

acceptable, and RMSEA was above the recommended level. Modification indices showed other paths were possible.

The path between facilitating conditions and use behavior (MI = 76.33) was added. The resulting model showed better fit than before: $\chi^2 = 31.83$, df = 4, $p < 0.01$, CFI = 0.993, TLI = 0.962, SRMR = 0.022, and RMSEA = 0.077. The hypothesized paths were significant. The χ^2 / df ratio was higher than recommendations but all other fit indices (CFI, TLI, SRMR, and RMSEA) were acceptable. However, modification indices showed other paths may be considered.

The path between effort expectancy and trust (MI = 21.95) was added. The resulting model showed even better fit: $\chi^2 = 9.66$, df = 3, $p > 0.01$, CFI = 0.998, TLI = 0.988, SRMR = 0.01, and RMSEA = 0.044. The hypothesized paths remained significant. The χ^2 / df ratio was higher than recommended but CFI, TLI, SRMR, and RMSEA were acceptable. This emergent model was accepted as the final solution (**Figure 2**) and it explained 42.5% variance in trust, 52.3% variance in intention to use, and 57.5% variance in use behavior.

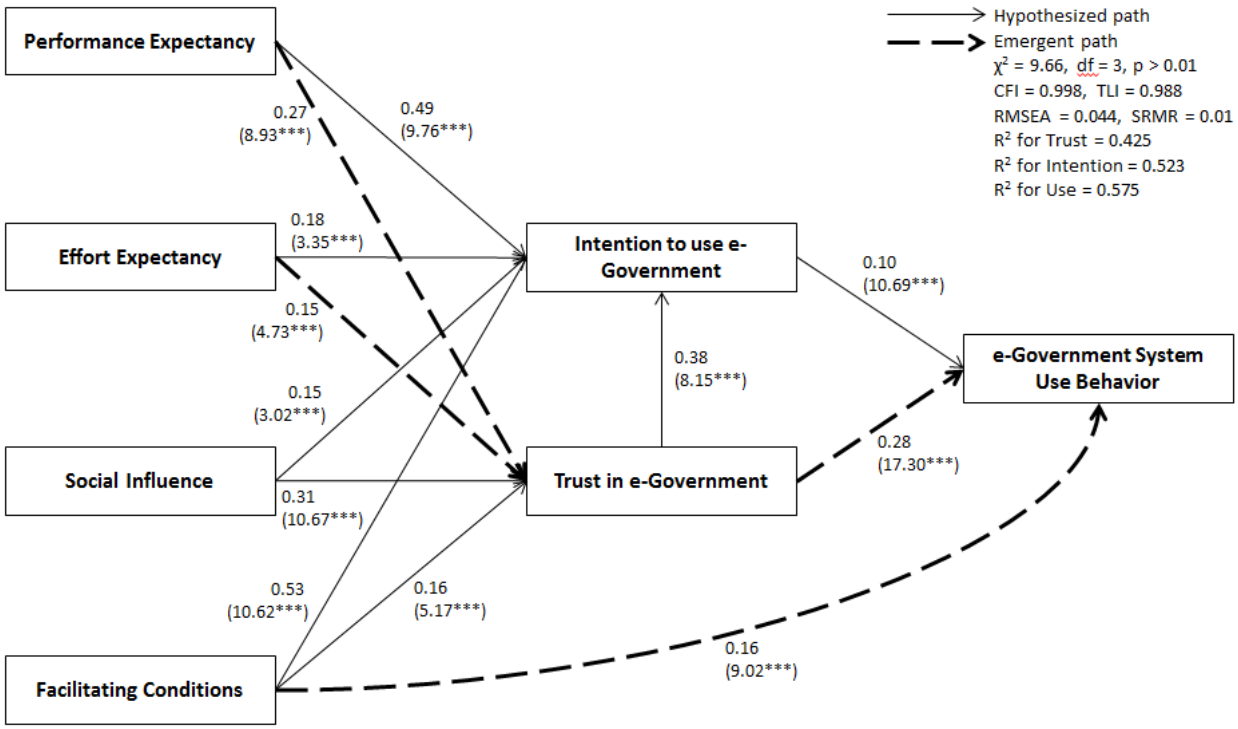

Figure 2. Emergent Model

5.3. Post-hoc Mediation Tests

Mediation tests were conducted to better understand the role of trust. Table 2 shows the Sobel test statistics, which demonstrate that e-government trust mediates the effects of performance expectancy, effort expectancy, social influence, and facilitating conditions on both behavioral intention and use behavior. The direct effects of performance expectancy ($\beta = 0.49$, $p < 0.01$), effort expectancy ($\beta = 0.18$, $p < 0.01$), social influence ($\beta = 0.15$, $p < 0.01$), and facilitating conditions ($\beta = 0.53$, $p < 0.01$) on behavioral intention in the presence of trust were all significant, which implies that trust partially mediates the effects of performance expectancy ($z = 6.02$, $p < 0.01$), effort expectancy ($z = 4.09$, $p < 0.01$), social influence ($z = 6.47$, $p < 0.01$), and facilitating conditions ($z = 4.36$, $p < 0.01$) on behavioral intention. The direct effects of the UTAUT constructs on use behavior in the presence of trust showed differences. The direct

effects of effort expectancy ($\beta = 0.05$, $p < 0.05$) and facilitating conditions ($\beta = 0.17$, $p < 0.01$) were significant, which indicate that trust partially mediates the effects of effort expectancy ($z = 4.56$, $p < 0.01$) and facilitating conditions ($z = 4.95$, $p < 0.01$) on use behavior. However, the direct effects performance expectancy ($\beta = -0.01$, n.s.) and social influence ($\beta = 0.03$, n.s.) were non-significant, which implies that trust fully mediates the effects of performance expectancy ($z = 7.93$, $p < 0.01$) and social influence ($z = 9.08$, $p < 0.01$) on use behavior.

Table 2. Mediation Test Results

Mediation by trust	Sobel statistic	Direct effects	Beta coefficient	Interpretation
PE→TR→BI	6.02***	PE→BI	0.49***	TR partially mediates effect on BI
EE→TR→BI	4.09***	EE→BI	0.18***	TR partially mediates effect on BI
SI→TR→BI	6.47***	SI→BI	0.15***	TR partially mediates effect on BI
FC→TR→BI	4.36***	FC→BI	0.53***	TR partially mediates effect on BI
PE→TR→UB	7.93***	PE→UB	-0.01	TR fully mediates effect on UB
EE→TR→UB	4.56***	EE→UB	0.05**	TR partially mediates effect on UB*
SI→TR→UB	9.08***	SI→UB	0.03	TR fully mediates effect on UB
FC→TR→UB	4.95***	FC→UB	0.17***	TR partially mediates effect on UB

*EE→UB had MI<10 in SEM analysis and was not included in the emergent model
***p<0.01, **p<0.05

6. DISCUSSION

6.1. Findings

This study finds that users' intention to use e-government systems is significantly influenced by performance expectancy, effort expectancy, social influence and facilitating conditions, supporting H1, H2, H3, and H4. Users generally intend to use e-government systems that provide utilitarian value, are easy to use and user-friendly, promoted by their social connections, and supported by facilitating conditions such as training and infrastructure. We also find that intention to use e-government systems influences e-government use, supporting H5. Consistent with the theories of reasoned action, our results show that intention influences use behavior. Thus, the UTAUT constructs demonstrate strong impacts on intention to use e-government systems, which influences use behavior.

We also found support for the relationships involving e-government trust. Our results show that social influence and facilitating conditions play an important role in strengthening users' e-government trust, supporting H6 and H7. The positive feedback and experience of peers and family serve to enhance users' trust with e-government systems while facilitating conditions reduce uncertainties associated with online public service transactions, both of which influence trust. Further, our analysis shows that e-government trust has a positive effect on intention to use e-government systems, supporting H8. Due to the inherent uncertainty and risks of vulnerability and privacy associated with online services, users' trust becomes crucial in their intention to use e-government systems.

Further, few unhypothesized paths emerged in our analysis. First, our results showed a positive relationship between facilitating conditions and e-government use. This implies that facilitating conditions has a direct effect on use behavior in addition to the indirect effect on use behavior through behavioral intention. A possible explanation for this relationship may be the dependence of e-government systems on digital infrastructure. The non-availability of required infrastructure and unfamiliarity of e-government systems among all social and economic classes of the population pose a significant challenge, known as the digital divide, and remain as obstacles for technology use (Carter & Weerakkody, 2008). By providing adequate organizational and technological infrastructure and training facilities, public service providers can create more functional value of e-government systems for users (Weerakkody et al., 2013).

Second, we found that performance expectancy and effort expectancy directly influence e-government trust. These paths indicate that users' trust is determined by their beliefs about the ease of using e-government systems and the potential benefits provided by e-government

systems (Abu-Shanab, 2014; Gu et al., 2016). When users believe that e-government systems are developed to facilitate governmental transactions in a more efficient way (performance expectancy) and are simpler to use (effort expectancy), their perception of overall responsiveness of government towards users' requirements increases which ultimately elevates level of trust in e-government (Hussein et al., 2014).

Finally, the relationship between trust and e-government system use behavior also emerged in our analysis. This implies that trust has a direct effect on use behavior in addition to the indirect effect on use behavior through intention to use e-government systems. While empirical support for the indirect impact of trust on use behavior through intention is known (Azam et al., 2013), our study finds that e-government trust is a direct determinant of use behavior of users. In the e-government context, the role of trust seems crucial since users typically lack the benefits of face-to-face communication such as the opportunity to observe behavior of the service provider and assurance mechanisms (Chen et al., 2018). Trust in e-government systems can address the limitation of online communication by strengthening users' beliefs that governments will not engage in opportunistic behavior and take undue advantage of their vulnerability (Bélanger & Carter, 2008; Gefen, 2000).

Our study underlines the importance of e-government trust for users. Trust not only has an indirect effect on use behavior through intention but also a direct effect on use behavior. Further, trust partially mediates the effects of performance expectancy, effort expectancy, social influence, and facilitating conditions on intention to use. These impacts suggest that the UTAUT factors are helpful in shaping e-government trust leading to intention. Trust also partially mediates the effects of effort expectancy and facilitating conditions on use behavior, indicating

that users may use e-government systems if they are easy to use and facilitated well. However, trust fully mediates the effects of performance expectancy and social influence on use behavior, suggesting that trust is influenced by usefulness and social influence before use. Although usefulness and social influence may drive intention, trust is needed to influence e-government use behaviors of individuals.

6.2. Implications for Research

This study raises several implications for research. First, though trust has been examined as an antecedent to the behavioral intention to adopt e-government in several studies, it has not been included in technology adoption models such as UTAUT. Arguing that trust is significant in e-government contexts, this study integrated e-government trust into the UTAUT model to uncover its impact on intention to use and e-government use behaviors of users. This study found that trust plays a central role through direct and several mediating effects on users' intention to use e-government and e-government system use behavior.

Second, this study deepens the understanding of technology features that can be leveraged to gain users' trust in new technology initiatives of the government. To date, information systems scholars have stressed upon sharing more and more information about different government activities with users without emphasizing much on the mediums used to spread the information (Porumbescu, 2016). The present study shows that peculiar features of the medium (i.e., efforts expectancy and performance expectancy) can play an important role in building and enhancing users' trust in e-governmental endeavors ultimately leading to its success (intention to use and system use). Thus, this study emphasizes the importance of new technologies in strengthening the relationship between users and public administrators.

Third, this study extends the focus of research from technological and environmental factors to psychological factors such as trust as predictors of users' behavioral intention to use and use behavior. Further, information systems research may consider technology features that may be useful in fostering healthy relationship with users. The significant impact of trust on users' intention to use and use behavior in addition to the UTAUT factors demonstrates the importance of integrated models that incorporate various technological, environmental, and psychological factors in studies of e-government acceptance.

Finally, this study helps resolve the direction of effects involving trust. The MASEM analysis showed that e-government trust is influenced by performance expectancy, effort expectancy, social influence, and facilitating conditions (e.g., Al Niwady et al. 2020) rather than trust having an impact on performance expectancy, effort expectancy, social influence, and facilitating conditions (e.g., Li 2021). In essence, e-government trust is not an antecedent of factors such as social influence and facilitating conditions, i.e., individuals' trust increases due to the social influence of others and the infrastructure and training for e-government.

6.3. Implications for Practice

The findings of this study have several implications for practice. First, our results show how imperative it is for the public service providers to win users' trust in e-government to fully leverage the potential of e-government systems. Since e-government is characterized by distant and impersonal nature, separation of time and space, absence of face-to-face communication, dependence on technology, and intrinsic uncertainty associated with online services, e-government trust plays a vital role in fostering users' intention to use e-government and developing desirable use behavior (Bélangera & Carter, 2008; Wang & Emurian, 2005). Like

other technological advancements, diffusion of e-government happens through society and therefore, trust is needed to counter users' negative sentiments in the insecure environments of online services (Myron, 2004). Our findings suggest that e-government system designers and service providers should strive to convince users that online portals are reliable, secure, and trustworthy.

Second, as new public service paradigms emerge and given the relevance of e-government trust, the role of facilitating conditions and social influence in converting passive user participation into active user participation should be emphasized while public services are delivered through online service portals. Our results indicate that these factors directly influence users' intention to use e-government and indirectly through e-government trust. Users' trust in e-government is significantly strengthened by positive social influence in terms of positive feedback and pleasant experience of their family and friends. Efforts should be made to spread positive word-of-mouth and create appreciative social environment. Further, facilitating conditions may be channeled to impact users' usage behavior through intention and e-government trust. Public service providers must provide support facilities such as help desks and user manuals and deploy necessary resources to enable smooth, dependable, responsive, and efficient online transactions. Adequate measures should be taken to reduce uncertainties associated with online service environment, which can assure users about service providers' capability to provide reliable and proficient public services (Ambali, 2009). Collective efforts of e-government system developers and service providers thus may uplift users' trust and thereby motivate them to use online public service portals more frequently.

Finally, our study showed performance expectancy and effort expectancy to influence e-government trust. These findings are especially relevant for e-government system designers and developers. Special attention should be paid to the aesthetic features of the system and its technical sophistication. The website should be simple to use, effortless, and user friendly. At the same time, it should offer relative advantage over contemporary e-government processes. Such expectancies in performance and effort tend to increase users' confidence and trust in e-government systems. More confident users are likely to have stronger intention to more actively engage with e-government systems (Lean et al., 2009). Further, performance expectancy and effort expectancy reduce resistance to change and elevate trust level that may ultimately translate into strong intention to use e-government system (Carter & Weerakkody, 2008). Public service providers should focus on publicizing the benefits and ease of using e-government systems for the users' everyday interactions with the government. If users believe that e-government systems would improve their efficiency of completing government transactions, they may switch from traditional processes to contemporary technology enabled systems.

6.4. Limitations and Future Research

The findings should be interpreted in light of the limitations of the study. First, the study relied on statistics such as effect sizes reported in prior studies and did not engage in primary data collection efforts. This study thus assumes the quality of prior studies and cannot independently verify the goodness of the reported statistics. Second, the study synthesized findings in prior studies, which may have employed different theoretical perspectives and empirical measures. This study assumes that it is meaningful to combine different constructs and the results may be acceptable. Third, this study did not accommodate the moderators (age, gender, experience) as found in the UTAUT model. While the use of the base UTAUT constructs has precedent in prior

literature (Dwivedi et al., 2019; 2020), non-use of moderators is nevertheless a limitation of the study. Fourth, the studies included in the meta-analysis were sourced from journals while studies from conferences and other sources have been excluded in this meta-analysis. The failsafe-N for the relationships included in our sample is reasonably high to potentially mitigate this limitation to some extent. Fifth, prior studies that did not report Pearson correlations were excluded from the meta-analysis, which implies that the results are based on a subset of relevant studies related to e-government. Sixth, despite the inclusion of trust, the theoretical model itself may be viewed as a limitation since it is based on the UTAUT model and not on the other models of technology adoption and use. Finally, while the coding process was uniform and stringent, accommodations had to be made for situations such as missing reliabilities.

Several avenues for future research can be derived. First, the emergent model identified in this study may be examined with primary data from new data collection campaigns. Second, it may be useful to delve into whether uncertainty, security, and privacy issues are significant for all e-government users such that trust is a major consideration in e-government research. While this study has asserted that e-government trust is crucial, there could be variations in e-government systems that users may not have to necessarily deal with trust. Third, it is unclear if users have any choice in using e-government systems. This information was difficult to ascertain from the studies in our meta-analysis, but if users do not have a choice over the systems they can use or they have to necessarily use the e-government systems, trust may not be a major consideration. Finally, due its focus on trust and its interrelationships, this study did not control for differences in primary studies such as geographic region, voluntariness, and type of respondents. It may be possible for future studies to model these as meta-analytic moderators and draw richer insights into e-government adoption and use.

7. CONCLUSION

Arguing that trust is crucial in the e-government context and that it had not been used in technology adoption models, this study developed a theoretical model that incorporated trust into the base UTAUT model. The integrated research model was empirically examined using a rigorous combination of meta-analysis and structural equation modeling methods, which yielded new insights into users' use of e-government systems. This study found that trust is central to users' intention to use and actual use of e-government systems. Specifically, trust has a direct effect on system use as well as an indirect effect on system use through intention. Further, trust is also influenced by performance expectancy, effort expectancy, social influence, and facilitating conditions. These findings have significant implications for practitioners, especially for those in public administration positions with visibility into e-government activities.

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APPENDIX A

Studies in meta-analysis

Author(s)	Country	N	Theories
Abu-Shanab and Haider (2015)	Jordan	458	UTAUT & TAM
Ahmad and Khalid (2017)	UAE	120	TAM
Al and M.I. (2019)	Jordan	416	TAM
AlBar and Hddas (2018)	Saudi Arabia	1218	D&M IS Success Model & TAM
Alharbi et al. (2017)	Saudi Arabia	625	UTAUT2
Al-Hujran et al. (2015)	Jordan	413	Tam
Alkraiji (2020)	Saudi Arabia	780	TAM and Seddon Model
Alkraiji (2020)	Saudi Arabia	780	D&M IS Success Model and TAM
Almahamid et al. (2010)	Jordan	125	TRA
Almaiah and Nasereddin (2020)	Jordan	320	UTAUT
Almaiah et al. (2020)	Jordan	807	GAM and UTAUT
Almarashdeh and Alsmadi (2017)	Saudi Arabia	468	TAM
Al-Omairi et al. (2020)	Oman	406	D&M IS Success Model
Alqaralleh et al. (2020)	Jordan	380	TAM
Alryalat et al. (2015)	India	377	TRA
Al-Sammarraie et al. (2017)	Iraq	75	UTAUT
Al-Sulami and Hashim (2018)	Iraq	160	D&M IS Success Model
Al-Swidi and Faaeq (2019)	Iraq	436	UTAUT
Al-Zahrani (2020)	Saudi Arabia	211	TAM and UTAUT
Ayyash et al. (2013)	Palestine	30	D&M IS Success Model & TAM
Azam et al. (2013)	Pakistan	435	UTAUT
Belanche et al. (2012)	Spain	416	TAM
Berlilana, et al. (2018)		366	CM
Bhuasiri et al. (2016)	Thailand	372	UTAUT
Bin Musa et al. (2019)	LIBYA	248	CM
Burhanudddin and Yapid (2019)	Thailand	396	UMEGA
Carter et al. (2016)	US vs Uk	140	TAM
Chen and Aklikokou (2020)	Togo	482	TAM
Chung et al. (2016)	Taipei	423	UTAUT
Dwivedi et al. (2017)	India	377	UMEGA
Eid et al. (2020)	UAE	326	CM
Faaeq et al. (2017)	Iraq	169	UTAUT2
Gilbert et al. (2004)	UK	111	TAM & DOI
Gultom et al. (2020)	Indonesia	477	TRA
Hariguna et al. (2017)	n/a	366	CM
Hariguna et al. (2019)	Indonesia	371	ECM
Horst et al. (2007)	Netherlands	144	TAM & TPB
Hu et al. (2019)	China	289	TAM
Hung et al. (2011)	Taiwan	750	TPB
Husin et al. (2017)	Malaysia	32	TAM
Hussein et al. (2010)	Malaysia	411	TAM
Jasimuddin et al. (2017)	UAE	83	TAM
Kamarudin et al. (2021)	Malaysia	388	UTAUT
Khatib et al. (2019)	Kuwait	628	D&M IS Success Model + UTAUT
Krishnaraju et al. (2016)	Arabic countries	143	UTAUT2
Kurfalı et al. (2017)	Turkey	529	UTAUT
Lallmahomed et al. (2017)	Mauritius	247	UTAUT2 and EGAM
Lean et al. (2009)	Malaysia	150	TAM & DOI
Liang et al. (2021)	China	93	TOE+TR

Mandari and Chong (2018)	Tanzania	407	Diffusion Theory
Mandari et al. (2017)	Tanzania	407	CM
Mensah and Mi (2017)	Ghana	520	TAM
Mensah and Mi (2018)	China	520	TAM
Mensah (2018)	China	347	TAM
Mensah (2019)	Africans in China	326	UTAUT
Mensah (2019)	China	369	UTAUT
Mensah et al. (2017)	South Koreans in China	400	TAM
Mensah et al. (2020)	China	318	UTAUT
Mensah et al. (2020)	Ghana	289	UMEGA and UTAUT
Munyoka (2020)	Zimbabwe	247	TAM2 and UTAUT2
Nasri (2019)	Tunisia	150	TAM
Nofal et al. (2021)	Jordan	458	TAM
Puthur et al. (2020)	India	570	TAM
Rana and Dwivedi (2015)	India	419	CM
Rana et al. (2017)	India	304	CM
Riyadh et al. (2018)	Iraq	727	UTAUT
Sabani (2020)	Indonesia	314	UTAUT
Sachan et al. (2018)	India	197	CM
Saengchai et al. (2020)	Thailand	700	CM
Santa et al. (2019)	Saudi Arabia	209	D&M IS Success Model
Sawalha et al. (2019)	JORDAN	297	UTAUT2
Saxena (2017)	India	311	TAM+UTAUT+TPB
Shahzad et al. (2019)	Pakistanis in China	505	CM
Shahzad et al. (2020)	Pakistan	574	Innovation diffusion + TAM
Sharma and Mishra (2017)	India	325	CM
Shuib et al. (2019)	Malaysia	801	TAM + DOI
Sijabat (2020)	Indonesia	219	TAM
Taiwo et al. (2014)	Malaysia	206	UTAUT
Talukder et al. (2019)	Bangladesh	216	UTAUT
Talukder et al. (2020)	Bangladesh	294	UTAUT
Tsui (2019)	Taiwan	400	TAM
Vejačka (2016)	Slovakia	326	TAM
Verkijika et al. (2018)	Saharan Africa	282	UMEGA
Virgiyanti et al. (2018)	Malaysia	22	UTAUT
Wirtz and Piehler (2016)	GERMANY	407	TRA, TAM and an extended model
Wirtz et al. (2019)	GERMANY	161	TAM
Xie et al. (2017)	China	268	TAM+TPB+TR+PR
Yap et al. (2019)	Malaysia	123	CM
Zahid and Din (2019)	Pakistan	396	TPB
Ziba and Kang (2020)	Malawi	259	TAM, TPB, TOE

The effects of Trust on Behavioral Intention and Use Behavior within e-government contexts

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CRediT Author Statement

Apeksha Hooda – Conceptualization, Data curation, Formal analysis, Writing – Original Draft

Parul Gupta – Conceptualization, Formal analysis, Investigation, Writing – Original Draft

Anand Jeyaraj – Conceptualization, Methodology, Validation, Writing – Review & Editing

Mihalis Giannakis – Project administration, Visualization, Writing – Review & Editing

Yogesh Dwivedi – Conceptualization, Methodology, Resources, Supervision