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Citizen Satisfaction With Mandatory E-Government Services: A Conceptual Framework and an Empirical Validation

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ABSTRACT Few studies have examined the antecedents of citizen satisfaction in relation to mandatory e-government services pertaining to promising sectors such as education. This study was thus aimed at developing and empirically test a model based on a blend of information systems success models, in conjunction with trust theory. In Saudi Arabia, the Ministry of Education has launched a mandatory e-government service intended to assist high school graduates in their university academic admission process. To test the model, a questionnaire was constructed and data from 780 university students were collected. The findings show that the perceived usefulness of and trust in e-government mediated the indirect effect of both system quality and information quality on citizen satisfaction. System quality exhibited the strongest such overall total effect on citizen satisfaction. Policymakers can take advantage of the findings in adjusting the resources required to increase citizen satisfaction with mandatory services in education.

INDEX TERMS Education, ease of use, information quality, mandatory E-government, satisfaction, system quality, trust, usefulness.

I. INTRODUCTION

Owing to advances in information and communications technology (ICT) and to the global diffusion of the Internet, electronic government (e-government) is being actively deployed throughout the world as a very important tool aimed at facilitating access to public services for both citizens and residents [1]–[3]. E-government refers to the use of ICT for the delivery—through the Internet or other digital means [4]— of government information and services to their potential beneficiaries (i.e., citizens, employees, businesses, and agencies). Over the last two decades, e-government has become a major topic of interest to information systems (IS) academics and practitioners, as increasing the numbers of citizens that make use of e-government is crucial in judging its success [5], [6].

In essence, any assessment of the success of e-government depends on citizen responsiveness, commitment, and dependency on the provided services [7]–[9]. Understanding the relationship between e-government services and citizen satisfaction is therefore essential to improve the quality of the services and to increase citizen engagement and participation [8], [9]. However, many countries have started to make e-government services mandatory as part of the inevitable transformation of public services; thus, their citizens can only access public services through e-government portals [6], [10]. Therefore, governments need to devote new strategies and more resources to stimulate citizen satisfaction with mandatory e-government services.

This research was focused on understanding the constructs that influence user satisfaction with e-government services; an essential process in the evaluation of any information system (IS) [5], [8], [6]. Within the literature on the adoption of e-government services, this topic has been regularly researched and grounded in the social psychology and IS success model streams to develop an intention-based model of success constructs. Evidence from the IS literature shows DeLone and McLean's IS success (D&M) model [11] and the Technology Acceptance Model (TAM) [12] to be the most cited and best-grounded theoretical IS success models [1], [13]. Within the stream of social psychology, trust theory is the most cited in illustrating citizen satisfaction with e-government services [14]–[18].

However, the relative importance of the constructs of IS success models (e.g., the usefulness of TAM) could differ

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when such constructs are applied to mandatory ICT contexts. A mandatory use environment has been defined as: ''one in which users are required to use a specific technology or system in order to keep and perform their jobs.'' [19, p. 283] In addition, the relative importance of the internal constructs of IS models—such as the beliefs, attitudes, behavioral intentions, and usage behaviors of citizens— as antecedents of the adoption process is likely to be minimized in a mandatory online environment [19], as they are moderated by the voluntariness of the use of the technology [3].

Further, in mandatory e-government contexts, citizens have no other option than to use the mandated services to achieve their goals. Therefore, frequent use does not imply system success; this is reflected by the benefits brought by the system, which generate user satisfaction [6], [3]. Therefore, in mandatory use environments, user satisfaction—rather than 'intention to use' and 'IS use'—is the more appropriate dependent variable. Prior research (e.g., [6], [20]) noted that user satisfaction is one of the most recognized key indicators of IS success. In the context of e-government, satisfaction has been viewed as a measure of citizens' psychological responses resulting from their cognitive appraisal of prior feelings and experience with e-government websites [21].

In Saudi Arabia, an interesting and important emerging mandatory e-government service is the Unified Electronic Admission System for students (UEAS), which is currently applied to the government universities and Technical College in Riyadh (the capital of Saudi Arabia). It is a crucial system that not only provides a mandatory service but also determines the students' future academic paths. All high school graduates who wish to apply for admission to government universities or to the Technical College in Riyadh are required to go through the UEAS as a mandated e-government service for academic enrollment. Therefore, the UEAS forms a suitable research context for an investigation into citizen satisfaction with mandatory e-government services

Through an analysis of data collected from foundation year university students in the first semester of 2018—who had thus recently used the UEAS—the key objective of this study is to develop and test a hybrid model of citizen satisfaction that is intended to tie and integrate the D&M, TAM, and trust theory into a single model. The research model hypothesizes that the ease of use and usefulness constructs of the TAM and trust significantly mediate the relationships between the influential variables of the D&M model (i.e., the system and the information quality) and citizen satisfaction in the context of mandatory e-government services.

This research makes additional contributions to IS research, particularly with regard to citizen satisfaction with mandated e-government services. First, the unique contribution of this study lies in the fact that it incorporates general IS success models, in conjunction with trust theories, into a comprehensive conceptual model aimed at examining the link between multi-dimensional constructs and citizen satisfaction with mandated e-government services. Scholars (e.g., [3]; [22], [23]) have advocated that there is a distinction between the voluntary and mandatory adoption of technology; yet, the dearth of research aimed at systematically examining the latter is particularly noticeable [3].

Second, this study advances a theory of e-government adoption in a promising and crucial field—i.e., government services in the education sector—in which there is a dearth of studies. E-government services aimed at citizens are extending beyond general topics (e.g., municipal affairs, finance, transportation, taxation, and civil services) to include crucial government services related to education, health, and welfare. Therefore, there is a need for confirmatory studies that involve the testing of hypothesized measurement models against new data to strengthen the theoretical research cycle [24]–[26].

In order to present the testing of the integrity of the hybrid research model, this paper proceeds as follows. First, it reviews e-government in Saudi Arabia and the literature on IS success models and trust theory in Section II. Then, it presents the conceptualization of the research hypotheses in Section III. Next, it offers a detailed description of the research method in Section IV. Thereafter, it presents the results of the data analysis in Section V. In Section VI, it provides a discussion of this study's findings, its conclusions, implications, and limitations, and makes suggestions for future research.

II. BACKGROUND

A. E-GOVERNMENT IN SAUDI ARABIA

As a strategic objective of Saudi Arabia's Vision 2030, the government of Saudi Arabia is investing substantial resources in e-government initiatives aimed at transitioning government services to the electronic domain [27]. Yesser, the main Saudi Arabian e-government program established in 2003, leads the digital process of transition to the e-government domain of public services, which are made available to citizens and residents across different platforms and portals with the highest technical and security standards. Saudi Arabia aims at ranking at least 25th in the United Nations' index for e-Government development in 2020 [28].

In addition, in 2020, the Saudi government is planning to launch a unified e-government services portal that is expected to be easily accessible to both citizens and residents. The portal is intended to serve as a central platform for all government information and services with a single sign-on. Further, alongside more common e-government services (e.g., municipal affairs, finance, transportation, taxation, and civil services), Saudi Arabia is leveraging those related to promising and crucial fields such as education, health, justice, and law [29].

The e-government transformation of the educational sector is the Saudi government's highest priority, given that Saudi Arabia's yearly population growth (2.5%) is among the highest worldwide, and that 70% of the country's population of 22 million is under 30 [30], which means that future demand for educational services is expected to be very

high. Therefore, the transition of educational services into the e-government domain is a top priority for the government, as is testing citizen engagement and satisfaction in order to strengthen the effectiveness of such services.

In recent years, the government of Saudi Arabia has launched several mandatory e-government service projects in the field of educational administration at both the general and higher education levels. One example of such projects is the UEAS, which has been developed by the Ministry of Education (MoE) in cooperation with Yesser, and is considered a key Saudi e-government initiative. The UEAS project is aimed at establishing new ways of standardizing and facilitating the admission procedures and to ensure the efficient allocation of the places available in the seven government universities and the Technical College in Riyadh, while providing equal and fair opportunities to all national students. The UEAS process, which is intended to be only used by high school graduates, begins at the end of each academic year, when the MoE announces the starting and closing dates for admission and the period during which the UEAS will be operational in all government-run universities in Riyadh.

B. CITIZEN SATISFACTION WITH E-GOVERNMENT

Prior research highlighted that e-government initiatives cannot succeed if the relationship-based satisfaction of citizens with e-government services is low [5], [6]. However, the extant studies have not reached a consensus with regard to the specific instruments to be used to measure user satisfaction with e-government services [6], [31]. The problem is that user satisfaction is a multi-dimensional entity [14], [31] the dimensions of which can be only determined by a government based on an understanding of its citizens' needs, and on its level of concern with them [32]. In investigating citizen satisfaction with mandated e-government services, this study incorporates the D&M model, the TAM, and trust theory as the most cited theories in prior research on the adoption of e-government services in voluntary settings. The following illustrates these theories.

1) IS SUCCESS MODELS

IS success models evolved as a natural development of the diffusion of technology and of serious deviations in the results of technological implementations in terms of both business value and of the benefits gained in relation to reasonable implementation costs and durations [9], [33]. The TAM and the D&M model are the theoretical models most validated by prior research on IS adoption; they have a relatively simple structure but reasonable explanatory power in, for example, explaining personal behavioral intentions to use innovative technologies [34].

Davis developed and validated TAM theory [12], which is specifically tailored to provide attitudinal and behavioral explanations of individual intentions to use technological innovation [35], [36] regardless of the end-user population and of the type of technology [36]. The TAM proposes causal linkages between two key influential variables of internal beliefs—i.e., perceived usefulness (PU) and perceived ease of use (PEOU)—that determine user attitudes toward intentions to use, which is considered a good predictor of the actual use of technology [36].

Davis [12, p. 320] defined PU as "the degree to which a person believes that using a particular system would enhance his or her job performance". PEOU is defined as "the degree to which a person believes that using a particular system would be free of effort" [12, p. 320]. Indeed, the TAM has demonstrated to be a parsimonious model [37] that, however, also provides a strong basis for tracing the influence of external constructs on internal beliefs [36]. Prior research (e.g., [38]–[40]) found that both PU and PEOU strongly influence citizen intentions toward the adoption of e-government services.

DeLone and McLean proposed their D&M model to assess the success of ISs in organizations [11]. This model shows how perceived system quality (PSQ) and perceived information quality (PIQ) influence user satisfaction. While PSQ measures system reliability and accessibility in regard to its performance of the required tasks [11], PIQ is normally measured in terms of the accuracy, format, completeness, and currency exhibited by the IS while the user is completing the task [11], [41].

The D&M model has been widely applied and empirically tested and validated in numerous contexts (e.g., [13], [42]) including e-government services (e.g., [39], [42], [43], [55]). For example, the D&M model was evaluated in measuring the success of e-government services in a Serbian municipality [42]; based on valid questionnaires collected from 154 employees, PSQ was found to be more significant than PIQ in relation to citizen satisfaction. In addition, the D&M model was validated using data from active citizens' users of e-excise in Thailand [43], whereas its applicability was confirmed based on data collected from users of online tax-filing systems in Taiwan [44].

2) TRUST

Trust has gained considerable importance in the marketing literature due to its direct impact on the establishment of solid and profitable relationships between service providers and consumers [45]; particularly in online environments, where the absence of face-to-face relationships tends to exacerbate uncertainty and risk [38], [46]. Trust has been defined as "the subjective assessment of one party [the trustor] that another party [the trustee] will perform a particular transaction according to his or her confident expectations, in an environment characterized by uncertainty" ([47], p. 245).

In the context of online environments, the accumulative process of trust-related user behaviors is somewhat rooted in the institution-based trust theory [48] as an antecedent that can generate trust in business relationships [46]. Institution-based trust has been defined as "the phenomenon that individuals or collective actors develop trust in the face of specific institutional arrangements in the business environment" ([49], p. 284). Therefore, the

willingness of citizens to expose their vulnerabilities while dealing with e-government services is influenced by their belief in the government's ability to perform [50].

Prior research on the adoption of e-government services by citizens (e.g., [10], [14]–[17], [50]–[54]) found that trust in e-government leads to greater citizen satisfaction with its services. In this study, trust in e-government, as a factor, refers to the aggregation of citizen belief in the ability of e-government services to consistently operate in a proper fashion [53]. Citizen belief is associated with the sense that a government website has sufficient structural assurances and situational normality to ensure the success of any online transaction (e.g., [18], [35], [46], [50]). Structural assurances refer to, e.g., safeguards, guarantees, regulations, promises, legal recourse, or other procedures applied by e-government websites to promote the success of online transactions. Situational normality refers to citizen belief that an e-government website is in proper order to enable the success of transactions.

III. CONCEPTUALIZATION OF THE RESEARCH MODEL

This section is aimed at modeling the factors that affect citizen satisfaction with mandated e-government services. The research model was designed based on factors drawn from the most popular IS success models (i.e., the D&M model and the TAM), in conjunction with Trust theory. Nine hypotheses were proposed: that perceived system quality (PSQ) is directly and positively correlated with 1) perceived ease of use (PEOU), 2) perceived usefulness (PU), and 3) trust in e-government (TEG); that perceived information quality (PIQ) has direct and positive causal correlations with 4) PU and 5) TEG; that PEOU has is directly correlated with 6) PU, whereas PU is positively and significantly correlated with on both 7) TEG and 8) perceived citizen satisfaction (PCS); that TEG is positively and significantly correlated with 9) PCS. Figure 1 presents the conceptual research model, while the following section presents a detailed description of the causal correlations between the research's hypothetical constructs with the help of previous research and theories.

A. PERCEIVED SYSTEM QUALITY (PSQ)

PSQ represents the technical capability of an e-government artifact of providing citizens with efficient online services while ensuring reliable performance [55]. PSQ is shaped based on citizen experience with the performance of e-government services in the completion of a particular task [5], [53]. From a technology-based perspective, the quality of an e-government system correlates with ease of use and prompt access to reliable online services and related information [7], [39], [53]. In addition, the perceived quality of e-government initiatives increases the relative value and usefulness of their online services for citizens [56].

Although some IS research (e.g., [26], [57], [58]) concluded that PU and PEOU measurements are to be used as the construct foundations of PSQ, other studies ([39], [59], [60]) empirically and distinctly demonstrated these constructs and their interrelationships, thus providing a grounding for the use of these distinct constructs in this proposed research model. For example, within the context of a data warehousing system, an integrated model has been validated in which PSQ, as an external factor, exhibits a significant influence on PEOU and PU as key influential factors of the TAM model [59]. When an online public grievance redressal system was also evaluated using data collected from Indian citizens [39], a higher overall regression weight and significant causal relationship between PSQ and PEOU were found. Accordingly, the following hypotheses were formulated:

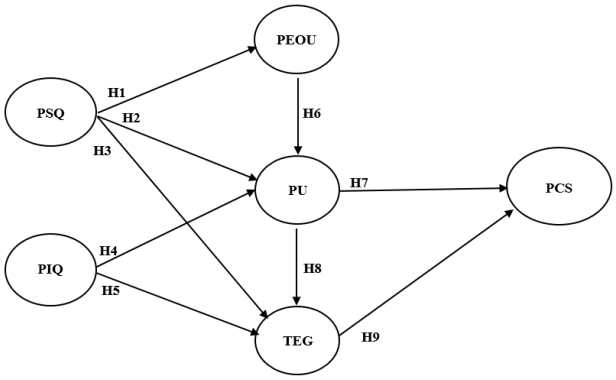

FIGURE 1. The research's conceptual model.

H1: PSQ is directly and positively correlated with PEOU.

H2: PSQ is directly and positively correlated with PU.

In addition, PSQ is expected be correlated with TEG. If citizens doubt the system quality of the underlying online services, they will attribute flaws and errors to the internal e-government environment, which will therefore result in less trust in and demand for e-government services [53]. Further, high levels of quality are expected to reduce citizen uncertainty in regard to detailed e-government technical features [18], and increase the belief that the government will take responsibility for ensuring the reliability of its services, thus enhancing citizen trust in them [17]. Therefore, a high perceived quality of an e-government system that consistently conforms to citizen expectations will arguably foster TEG among citizens [14], [17], [52]. Thus, the following hypothesis was proposed:

H3: PSQ is directly and positively correlated with TEG.

B. PERCEIVED INFORMATION QUALITY (PIQ)

The PIQ of an e-government system represents the quality of the content provided as a prerequisite to enhance the efficient use of its online services by citizens [53]. PIQ is subject to citizen assessment of whether the information provided by an e-government system is complete, accurate, clear, and timely [11], [41], [53]. Perceptions of the usefulness of e-government services will be based on citizen belief of the degree to which the provided information supports the completion of the task.

A number of prior studies on IS success models validated the significant correlation between PIQ and PU. For example, the impact of PIQ on PU was confirmed by an investigation of the Greek Taxation system by means of data gathered from the expert employees of public taxation agencies [61], and the argument that PIQ significantly influences the usefulness to citizens of e-government services was empirically validated [39]. The following hypothesis was therefore proposed:

H4: PIQ is directly and positively correlated with PU.

The causal relationship between PIQ and TEG evidences the direct effect of the former on the latter. A lack of e-government service PIQ will elicit in citizens feelings of ambiguity and confusion in relation to the credibility of e-government services and to their effectiveness in achieving the desired outcomes [17], which will consistently diminish citizen trust in them. Prior research of the adoption of e-government (e.g., [5], [14], [62]) demonstrated the positive influence of PIQ on TEG. Thus, the following hypothesis was proposed:

H5: PIQ is directly and positively correlated with TEG.

C. PERCEIVED EASE OF USE (PEOU)

This study hypothesized that PEOU will only have a causal correlation with PU. Although PEOU did show a small degree of significance on actual use, this effect consistently subsided over time, as user efforts to learn and use the technology may decrease after a prolonged exposure to it [36]. Therefore, PU was the strongest determinant of user acceptance, whereas PEOU only demonstrated a strong indirect effect—mediated through PU—on user technology acceptance [36], [63]. The direct effect of PEOU on PU stems from the fact that, when they are only required to make a small effort, users perceive the benefits linked to the use of the technology to be greater [36]. In the context of e-government, the impact of PEOU on PU also makes sense from a conceptual standpoint, as ease of use will result in a smaller effort needed to interact with online services to complete a task [38], [39]. Accordingly, the following hypothesis was formulated:

H6: PEOU is directly and positively correlated with PU.

D. PERCEIVED USEFULNESS (PU)

The effect of PU on user satisfaction is well-established and explains more than half of the variance found in the TAM [36]. A weight- and meta-analysis study also found that PU has a cumulative impact on citizen acceptance of e-government [39]. In addition, prior research (e.g., [51], [54]7) strongly demonstrated the validity of the impact of PU on PCS with e-government services. In view of the overall performance of this relationship, it was conceptually proposed that the benefits citizens get from mandatory e-government services are directly correlated with citizen satisfaction, as is stated in the following hypothesis:

H7: PU is directly and positively correlated with PCS with mandatory e-government services.

Moreover, PU is proposed as a key factor affecting citizen trust in e-government. The relative usefulness of e-government services reflects the expected advantages of their channel over traditional ones, which can increase citizen trust in such services [56]. This assumption is supported by cognition-based trust theory, which explains that trust is first and foremost built on the feelings of other parties [64]. In online environments, consumer trust is built on prior first-hand experience with online service providers; in these cases, feelings of trust would be weaker if the relative usefulness of e-government services was limited [35]. The previous argument led to the following hypothesis:

H8: PU is directly and positively correlated with TEG.

E. TRUST IN E-GOVERNMENT (TEG)

The degree of trust generated by the relationship between citizens and e-government services plays a central role in the former's satisfaction with the latter [5], [6], [17], [18], [20]. Consumer trust of online environments is based on the level of confidence that the websites of service providers are able to instill through their reliability and integrity [65]. Thus, in order for a government to endorse any e-government service initiatives, citizens need to trust that that government has the know-how and the technical resources essential to implement them and make them secure [66]. Low trust in e-government services leads to low levels of interaction and less satisfaction with them [51], [53]. Therefore, it can be argued that perceptions of accumulated confidence (in the form of trust) will affect the overall accumulated satisfaction of citizens with e-government services [6], [10]. The following hypothesis was therefore formulated:

H9: TEG is directly and positively correlated with PCS with mandatory e-government services.

IV. RESEARCH DESIGN AND METHODOLOGY

A. MEASUREMENT ITEMS

For this research, a self-administered survey questionnaire was developed on the basis of previously validated scales, some of which were modified to better fit the UEAS research context. All items in the proposed model were operationalized on five-point Likert scales that ranged from *strongly disagree* (1) to *strongly agree* (5). Appendix A presents the list of scales used in the measurement model and their original sources. In addition to the focal constructs, the researcher measured the students' demographic characteristics, including their gender, the final GPA recorded on their high school diplomas, and their chosen university. Moreover, the survey was translated from English to Arabic, Saudi Arabia's main language. The English and Arabic versions were then both reviewed by two academics in the field of translation and linguistics in Saudi Arabia to approve and confirm their equivalence in meaning [67].

B. DATA COLLECTION

This study's e-government service context was the UEAS, and its targeted population was Saudi fresh high school graduates, as the key users of that system. This study's focus

on a single e-government service and on a specific group of users was expected to improve its models' fit indices as well as the power of the hypotheses' testing. The sample participants to this study were drawn from the foundation year student body of Riyadh's government universities. These students were chosen because of their recent experience with the UEAS, which would ensure the reliability and validity of the results. The UEAS is currently operating only in the seven government-run universities and Technical College in Riyadh, as illustrated in the section on e-government in Saudi Arabia. However, once the UEAS will have fully matured and will have been proven to be fully effective, the MoE has plans to extend it to all government universities across the country. In Saudi Arabia, the government sectors are still the key and most powerful players in relation to economic development and welfare. Most Saudi students enroll in government universities because they are exempt from tuition fees, provide students with monthly study allowances, and are preferred in the national labor market.

In relation to the sampling procedure, the research offices of the government universities and of the Technical College in Riyadh were contacted for approval to distribute the questionnaire to those students who had applied for admission to government universities for the academic year 2018-2019. Only two universities—i.e., the King Saud Ibn Abdulaziz University for Health Science (KSAU-HS) and the Princess Nourah bint Abdulrahman University (PNU)— and the Technical College gave their consent for the data collection, recommending the use of a paper-based questionnaire—rather than an online survey—as they felt that it would be a more reliable approach in the context.

The research offices of the three case academic institutes followed a systematic sampling technique to distribute the questionnaires to their students on behalf of the researcher; they did so during the last 15 minutes of those lectures that were deemed to be less problematic (i.e., the Arabic Editing and Introduction to Computer courses. but not the Math, Physics, or Biology ones). Nevertheless, this technique ensured that each student had the same chance of being selected from the population, thereby producing a representative sample.

The data collection process was carried out during the first semester of 2018, starting in October and ending in late November; during this time, 1,050 questionnaires were distributed. Out of the 832 collected, 780 were found to have been completed in full. Table 1 lists the survey response rates for each institution. The respondents' profile characteristics are classified into three categories: gender, final GPA high school diploma results, and university, as shown in Table 2.

TABLE 1. Survey response rates.

University	Distributed	Received	Excluded	Remaining
PNU	350	277	11	266
Technical College	350	301	27	274
KSAU-HS	350	254	14	240
Total	1,050	832	52	780

TABLE 2. Demographic profiles of all respondents.

Gender	Male	420	53.8%
	Female	360	46.2%
	Total	780	100%
Final GPA Results	< 70%	15	1.9%
	< 75 – 70%	29	3.7%
	< 80 – 75%	61	7.8%
	< 85 – 80%	107	13.7%
	< 90 – 85%	182	23.3%
	< 95 – 90%	194	24.9%
	≥ 95%	192	24.6%
	Total	780	100%
University	KSAU-HS	240	30.8
	PNBAU	266	34.1
	T-College	274	35.1
	Total	780	100%

V. RESULTS

The purpose of this section is to validate the research model and present the outcomes of the hypotheses' testing. It starts by presenting descriptive statistics, which include the mean, standard deviation, and Cronbach's Alpha coefficient values. Then, the results of a confirmatory factor analysis (CFA), which was conducted to validate the measurement model in relation to discriminant and convergent validity, are presented. Finally, the hypotheses' testing results and the goodness of fit indices, obtained through structural equation modeling (SEM), are shown.

A. DESCRIPTIVE STATISTICS

Table 3 provides descriptive statistics—including mean, standard deviation (SD), and Cronbach's Alpha values—for all the constructs of the proposed research model. All of the constructs' mean values were found to be greater than 3.5, which means that, by and large, the students had responded in favor of the UEAS for academic admission. In addition, the SD values were found to be lower than 1 for all constructs, which indicates that the students' responses did not fluctuate much around the mean values. Reliability of scale or internal consistency was examined using Cronbach's Alpha coefficient, which indicates the average correlation among all the items in each construct. The analysis of the initial reliability results showed that all the constructs satisfied the recommended minimum threshold for the Cronbach Alpha value (0.7), with half measuring above 0.85, thus reflecting a good level of internal consistency [68]–[70].

B. MEASUREMENT MODEL

A confirmatory factor analysis (CFA) was conducted in order to specify how each group of the observed items depended on its construct and to assess the convergent and discriminant validity of scales. Convergent validity refers to the extent to which each measurement item correlates with its theoretical construct, whereas discriminant validity measures the degree to which two theoretical constructs are uncorrelated [71]. Table 4 presents the standardized factor loadings (FLs),

TABLE 3. Descriptive statistics.

Constructs	Mean	SD	α
PU	3.897	0.8234	0.897
PEOU	3.885	0.8013	0.855
PIQ	3.505	0.8563	0.913
TEG	3.727	0.8831	0.890
PSQ	3.714	0.8202	0.773
PCS	3.672	0.9798	0.882

TABLE 4. Measurement model results.

Constructs	Items	FLs	AVE	CR
PU	PU1	0.793	**0.639**	**0.898**
	PU2	0.823		
	PU3	0.820		
	PU4	0.812		
	PU5	0.745		
PEOU	PEOU1	0.744	**0.669**	**0.858**
	PEOU2	0.827		
	PEOU3	0.878		
PSQ	PSQ1	0.735	**0.535**	**0.775**
	PSQ2	0.711		
	PSQ3	0.747		
PIQ	PIQ1	0.745	**0.680**	**0.868**
	PIQ2	0.834		
	PIQ3	0.865		
	PIQ4	0.818		
	PIQ5	0.856		
TEG	TEG1	0.868	**0.732**	**0.891**
	TEG2	0.883		
	TEG3	0.814		
PCS	PCS1	0.863	**0.717**	**0.884**
	PCS2	0.864		
	PCS3	0.812		

average variance extracted (AVE), and composite reliability (CR) for the purpose of measuring convergent validity. All FLs were higher than the minimum threshold of 0.70 on their predefined constructs, as recommended by prior research (e.g., [69], [72]). The AVE values of all constructs were higher than 0.5. The CR values of all constructs exceeded 0.70 and were higher than the AVE ones for each factor, thus establishing convergent validity [71]– [74].

Discriminant validity was examined using a factor correlation matrix and the square root of the AVE. In order to verify discriminant validity, the correlation coefficient for each pair of factors needed to be lower than the square root of the AVE of each factor through the factor correlation matrix [71], [74] (see Table 5, which shows the AVE values for each construct in bold along the matrix diagonal). For example, the correlation coefficient between PU and PEOU was found to be 0.681, which was lower than the square roots of both their AVE values (i.e., 0.799 and 0.818 respectively). In addition, no multicollinearity issue was found, as all

TABLE 5. Factor correlation matrix and discriminant validity.

	PU	PEOU	PSQ	PIQ	TEG	PCS
PU	**0.799**					
PEOU	0.681	**0.818**				
PSQ	0.676	0.701	**0.731**			
PIQ	0.450	0.438	0.660	**0.825**		
TEG	0.568	0.540	0.698	0.467	**0.856**	
PCS	0.473	0.349	0.508	0.312	0.485	**0.847**

* Square roots of AVE are presented in bold and italic.

TABLE 6. Fitness indices.

Fit Index	(CMIN/DF)	GFI	AGFI	NFI	CFI	IFI	RMSEA
*Recommended Value	≤5	≥0.900	≥0.900	≥0.900	≥0.900	≥0.900	0.05 to 0.08
Actual Value	3.780	0.922	0.901	0.933	0.950	0.950	0.06

* Source: [76], P. 76.

correlation coefficients among constructs were found to be lower than 0.80 [75]. All these results verified the convergent and discriminant validity of the measurement model.

C. STRUCTURAL MODEL

To test the model fit and the hypotheses in the structural model, this study performed structural equation modeling (SEM) using the SPSS/AMOS V21 software.

1) MODEL EVALUATION CRITERIA

A set of fit indices was used to evaluate the adequacy of the structural model, these included: Chi square adjusted for degree of freedom (CMIN/DF), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Normed Fit Index (NFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), and Root Mean Square Error of Approximation (RMSEA). All the model fit indices were found to exceed their respective recommended values [76] (see Table 6). Thus, the proposed structure was found to adequately fit the research sample data (see Figure 2).

2) HYPOTHESES TESTING

Based upon the Maximum Likelihood estimation method, the research hypotheses were tested using SEM with Latent Variables, as shown in Figure 2. Table 7 shows the path coefficients, Critical Ratios (C.R), Probability values (P), and hypotheses testing results. The findings in Table 7 show that hypotheses H1 to H9 are supported, as all path coefficients were found to be statistically significant and their probabilities were found to be lower than 0.05 [77], [78].

Figure 2 presents the structural research model with standardized path coefficients, factor loadings, R-Squared values, and model fitness indices. For instance, the path coefficient of 0.42 between PEOU and PU indicates that when PEOU increases by 1 standard deviation, PU increases by 0.42 of a standard deviation.

In addition, the coefficient of determination, which is also denoted as R-Squared (R^2), was estimated as an essential criterion for assessing the endogenous latent variables of

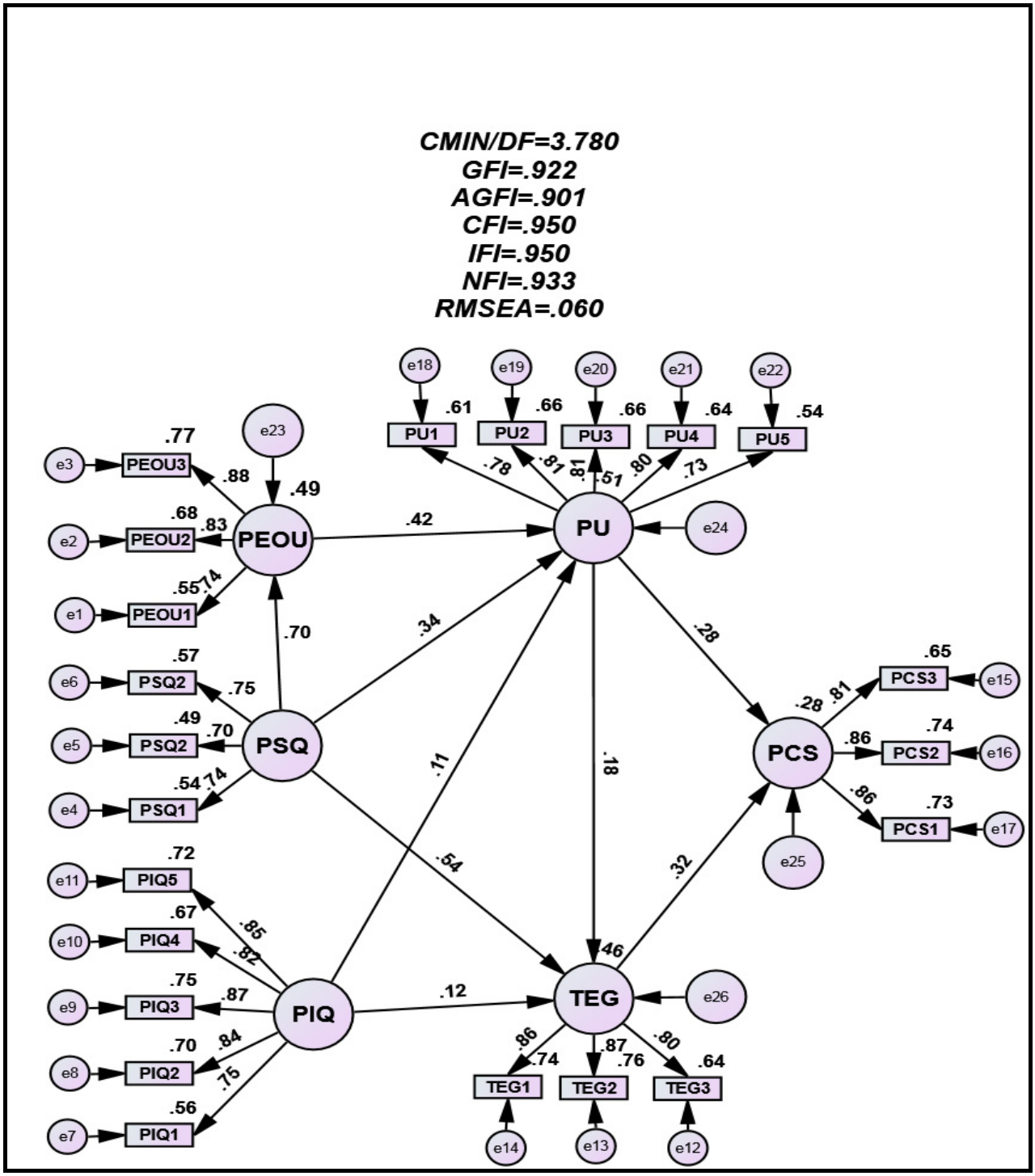

FIGURE 2. Structural model testing results.

the structural model [79]. R^2 refers to the proportion of the variance of the dependent variable that is predictable from the independent variable. R^2 values range between 0 and 1 [14]. In Table 8, an R^2 value of 0.507 means that the predictors of PU (e.g., PEOU, PSQ, and PIQ) explain about 50.7% of its variance, the residual being due to the error variance and so on.

Moreover, Table 9, 10, and 11 shows the direct, indirect, and total effects (standardized regression weights) of the structural model, respectively. As an example, the direct effect of PU on PCS is 0.282, and its indirect effect is 0.056; so the total effect of PU on PCS is 0.282 + 0.056 = 0.338, which means that, when PU increases by 1 standard deviation, PCS increases by 0.338 of a standard deviation.

TABLE 7. Hypotheses testing results.

H	Path	Path Coefficient	C.R	P	Result Supported/Rejected
H1	PSQ → PEOU	0.642***	14.401	0.000	Supported
H2	PSQ → PU	0.328***	6.035	0.000	Supported
H3	PSQ → TEG	0.121***	3.719	0.000	Supported
H4	PIQ → PU	0.106***	3.541	0.000	Supported
H5	PIQ → TEG	0.179***	3.578	0.000	Supported
H6	PEOU → PU	0.442***	7.620	0.000	Supported
H7	PU → PCS	0.350***	6.276	0.000	Supported
H8	PU → TEG	0.528***	9.613	0.000	Supported
H9	TEG → PCS	0.388***	7.016	0.000	Supported
*P <0.1 **P <0.05 ***P <0.01					

TABLE 8. Coefficients of determination.

Construct	R^2
PEOU	0.495
PU	0.507
TEG	0.463
PCS	0.277

TABLE 9. Direct effect in structural model.

	PIQ	PSQ	PEOU	PU	TEG
PEOU		0.703			
PU	0.109	0.342	0.420		
TEG	0.122	0.540		0.176	
PCS				0.282	0.319

TABLE 10. Indirect effect in structural model.

	PIQ	PSQ	PEOU	PU	TEG
PEOU					
PU		0.295			
TEG	0.019	0.112	0.074		
PCS	0.076	.388	0.142	0.056	

TABLE 11. Total effect in structural model.

	PIQ	PSQ	PEOU	PU	TEG
PEOU		0.703			
PU	0.109	0.637	0.420		
TEG	0.141	0.652	0.074	0.176	
PCS	0.076	0.388	0.142	0.338	0.319

As any perceptual questions in a survey are a potential threat to the validity of its results [80], the data were tested for common method bias (CMB), which indicates any bias in the respondents' answers potentially caused by an external source of influence. In a data set affected by CMB, most of the variance can be explained by a single factor [80]. To check for CMB, this research conducted Harman's single factor test on 21 scale-items [81]. The maximum variance explained by a single factor was found to be 39.24%, which is lower than the rule of thumb of 50%. This finding showed that the data set of this research was not affected by CMB [80], [81].

VI. DISCUSSION AND CONCLUSIONS

This study investigated citizen satisfaction with mandatory e-government services. Drawing upon the prior literature of general IS success models and trust theory, this research proposed and empirically examined a set of factors that may be correlated with citizen satisfaction with the UEAS academic admission system, a mandatory e-government service in Saudi Arabia (see Figure 1). The results provided significant support for the research's model and hypotheses. The research model incorporated nine positive causal relationships between six factors: namely, PSQ, PIQ, PEOU, PU, TEG, and PCS.

As shown in Table 7, Hypothesis 1 proposed a direct and positive correlation between PSQ and PEOU. The results of this study support this hypothesis ($\beta = 0.642$, $p < 0.01$). This empirical evidence supports the findings of the existing IS success models literature (e.g., [39], [59]), in which high-level quality e-government systems were found to provide citizens with more convenient and faster services.

The direct and positive correlation of PSQ with PU was proposed in Hypothesis 2. The results support this hypothesis ($\beta = 0.328$, $p < 0.01$), which is also consistent with the findings of the extant literature (e.g., [40], [60]). Furthermore, as citizen trust in e-government services is built on the basis of the experience of the quality of services (e.g., [14], [52], [53], [18]), PSQ was found to be positively correlated with TEG ($B = 0.121$, $p < 0.01$), thus providing support for Hypothesis 3. In the context of this study, high levels of PSQ will generate in students positive trusting attitudes toward the system.

Hypotheses 4 and 5, which proposed the correlations of PIQ on both PU and TEG were both found to be supported ($\beta = 0.106$, $p < 0.01$ and $\beta = 0.179$, $p < 0.01$ respectively), as shown in Table 8. Therefore, the accuracy, timeliness, and validity of the information provided by e-government services are crucial antecedents of public value and client trust [82].

The causal relationship between PEOU and PU was proposed in Hypothesis 6. The results supported it ($\beta = 0.442$, $p < 0.01$), and also suggested that PU is a significant determinant of PCS, thus providing support for Hypothesis 7 ($\beta = 0.350$, $p < 0.01$). This was in line with the findings of prior research (e.g., [3], [19]), which suggested that citizen satisfaction is the most appropriate dependent variable in the investigation of mandatory e-government services at the citizen level. Further, Hypothesis 8, which proposed a positive correlation of PU with TEG, was supported by the findings ($\beta = 0.528$, $p < 0.01$). In the context of this research, the UEAS academic admission system enables those students who so desire to apply for more than one university at the same time. This provides them with the possibility of identifying appropriate alternatives while ensuring equal and fair opportunities for all; thus, any increase in the public value of e-government services results in the 'production' of citizen trust in them [82].

The results also provided support for Hypothesis 9, which proposed a correlation of TEG with PCS ($\beta = 0.388$, $p < 0.01$). The results suggested that TEG is positively and directly correlated with PCS with e-government services.

As presented in Table 8, the research model showed that both PU and TEG explained 27.7% ($R^2 = 0.277$) of the variance of PCS. PSQ, PU, and TEG exhibited total effects of 0.388, 0.338, and 0.319, respectively, on PSC, whereas both PIQ (0.076) and PEOU (0.142) showed weaker total effects (see Table 11). An interesting insight drawn from the findings is that PSQ accounted for 49.5% ($R^2 = 0.495$) of the variance of the PEOU of a mandatory e-government service (see Table 8). The findings of this research also show that 50.7% of the variance of PU was explained by PSQ, PIQ, and PEOU.

As presented in Table 9, PEOU exhibited the strongest direct effect (0.420) on PU. However, PSQ demonstrated the strongest total effect (0.637) on PU (see Table 11). Further, 46.3% of the variance of TEG was explained by PSQ, PIQ, and PU (see Table 8), with PSQ exhibiting both the strongest direct (0.540) and total effects (0.652) on TEG (see Table 9 & 11). This finding shows that PSQ contributes to the establishment of citizen trust in e-government services, meaning that the more PSQ is provided by the UEAS for academic admission in Saudi Arabia, the more trust in it is generated in Saudi students.

A. THEORETICAL IMPLICATIONS

This research was aimed at incorporating IS success models and trust theories into a comprehensive conceptual model suited to examine the link between multi-dimensional factors and citizen satisfaction with mandatory e-government services in the field of education in Saudi Arabia. The integration of these perspectives in the context of building citizen satisfaction with mandatory e-government services extends the theoretical understanding of the adoption of mandatory e-government services on two levels.

First, this study has extended the IS success models to integrate the major constructs from the D&M model and the TAM, along with trust in e-government factors, to provide a better understanding of mandatory e-government service success. In addition, this study has bridged the research gap created by the dearth of studies in the promising and crucial field of e-government services in the education sector. At least within the research context, the UEAS for academic admission in Saudi Arabia not only provides a service, but also determines the students' future academic lives. As the results provide significant support for the model and for the hypotheses linked to it, they can help researchers to gain a better understanding of citizen satisfaction with mandatory e-government services in the education sector.

Second, little research has empirically and distinctly demonstrated the impact of PSQ on both PEOU and PU [39], as some of the extant literature (e.g., [57], [58]) advocates that the key measures of system quality are still those related to the constructs of PU and PEOU. In the context of this research, the findings show that PSQ is the most important aspect in relation to increasing citizen ease of use and the usefulness of mandatory e-government services. PSQ was found to explain 49.5% of the variance of PEOU. Among other factors, PSQ also exhibited the strongest total effect on PU, TEG, and PCS, meaning that PSQ is expected to provide conclusive impetus for the establishment of citizen satisfaction with mandatory e-government services at different levels.

In contrast, PIQ exhibited the weakest total effect on PU, TEG, and PCS; nevertheless, researchers should not underestimate the importance of PIQ in the development of future IS success models. An interpretation of this research finding, at least for the context of this study, is that students use different information sources—i.e., social media [83]—to enhance their awareness of the UEAS process for academic admission in Saudi Arabia. In addition, this may support the perspective that e-government services are currently evolving quickly, becoming more integrated and easy-to-use, and generally requiring only a few clicks and less information.

B. PRACTICAL IMPLICATIONS

The studies conducted on IS success models for e-government are aimed at providing government planners and policymakers with a better understanding of the antecedents essential for e-government success [3], [55]. Consequently, the relevance of this study for developments in managerial decision-making is self-evident. Its results will enable e-government practitioners to identify the factors on which they ought to focus and to fine tune the resources and interventions required to increase overall citizen satisfaction with mandatory e-government services.

The findings indicate that 49.5% of the variance of PEOU was explained by PSQ. In addition, PSQ was the strongest determinant of PU, TEG, and PCS. This means that, at least in the context of this study (i.e., Saudi Arabia), performance reliability is crucial for the success of mandatory e-government services. Efforts should be made to maintain the overall high quality of the UEAS for academic admission. In addition, e-government practitioners should develop a national system quality checklist for mandatory e-government services, as the dimensions of their quality can be only determined by the government through an understanding of local citizens' needs [32]. Although the direct correlations of PIQ with PU and TEG were supported, PIQ exhibited the weakest total effect on both. In addition, PIQ exhibited the weakest indirect total effect on PCS. This means that students may use different information sources to enhance their understanding of the processes of the UEAS

for academic admission. Thus, policymakers need to pay attention to those other information sources and to their quality and roles [83]. The results also indicate that PU is largely dependent on PEOU; hence, UEAS practitioners should take the appropriate actions aimed at establishing bi-directional feedback and comment channels with the citizens (i.e., students) to identify and analyze the latter's requirements [84]. This would enable managerial decision makers to redesign the UEAS in ways that would improve ease of use for students.

The results support the correlation of PU with PCS. This suggests that practitioners should maximize student benefits and public value in order to increase citizen satisfaction. Moreover, the confirmation of the correlation of PU with TEG also has important implications for management; maximizing the benefits of e-government services for citizens would encourage the latter to make the changes required for efficient use, which, in turn, would reflect their trust in e-government [14], [85].

C. LIMITATIONS AND FUTURE RESEARCH

This empirical study has some limitations that should be taken into consideration by future researchers. Firstly, the relevant data were collected from a single survey designed to investigate a hybrid model of citizen satisfaction with a mandatory e-government service (i.e., the UEAS for the academic admission of students to the government universities and Technical College located in the capital of Saudi Arabia, Riyadh). Although the focus on a single mandatory e-government service (i.e., academic admission) and on one specific group (i.e., foundation year university students) helped in improving the research model fit indices and therefore increased the power of the hypotheses' testing [86], it may have limited the generalizability of the findings to other mandatory e-government services and user groups. In order to validate the research model and to enhance the generalization of the results, future research should make use of large, cross-sectional samples within different mandatory e-government contexts.

Secondly, this study did not conduct a multi-group analysis (e.g., gender, university, culture, and economic background) to find how the characteristics of citizens can affect their satisfaction with mandatory e-government services. Thus, additional research is needed to examine the impact of sample diversity on the research model in order to increase the generalizability of the findings. Thirdly, although all the proposed hypotheses were supported, particular note should be taken of the relative low level of R^2 (0.277) obtained for PCS, meaning that the incorporation of other factors may improve the prediction of citizen satisfaction with mandatory e-government services. Therefore, longitudinal empirical IS studies may advance the theoretical understanding of the multi-dimensional antecedents of citizen satisfaction with mandatory e-government services, and of the causality and interrelationships among them.

APPENDIX A
RESEARCH MEASUREMENT ITEMS

Construct	ID	Measure	Original source
PU	PU1	The UEAS enables me to accomplish my admission tasks more quickly.	[12], [87]
	PU2	The UEAS enhances the effectiveness of completing my admission.	
	PU3	The UEAS improves the performance of my admission.	
	PU4	The UEAS makes it easier for me to complete the admission process.	
	PU5	The UEAS is useful overall.	
PEOU	PEOU1	The UEAS is easy to learn how to use.	
	PEOU2	The UEAS is clear and understandable in terms of how it works.	
	PEOU3	The UEAS is easy to use overall.	
PIQ	PIQ1	The UEAS provides me with rich information.	[11], [59]
	PIQ2	The UEAS provides me with clearly presented information.	
	PIQ3	The UEAS provides me with up-to-date information.	
	PIQ4	The UEAS provides me with accurate information.	
	PIQ5	Overall, the UEAS provides me with high quality information.	
PSQ	PSQ1	The UEAS performs reliably.	
	PSQ2	The UEAS is of high quality overall.	
TEG	TEG1	The UEAS has sufficient safeguards to reassure applicants during the application process.	[15]
	TEG2	The UEAS reassures the user that the legal and technological standards applied provide adequate protection from admission problems.	
	TEG3	The UEAS is in general a robust and safe system to use when transacting the personal application for admission.	
PCS	PCS1	The use of the UEAS is extremely positive.	[3], [23]
	PCS2	The use of the UEAS is extremely good.	
	PCS3	The use of the UEAS is extremely beneficial.	

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