Adoption and Use of an Electronic Voting System in Ghana

Isaac Kofi Mensah

Abstract—The manual system of voting has been the most widely used system of electing representatives around the globe, particularly in Africa. Due to the known numerous problems and challenges associated with the manual system of voting, many countries are migrating to the electronic voting system as a suitable and credible means of electing representatives over the manual paper-based system. This research paper therefore investigated the factors influencing adoption and use of an electronic voting system in Ghana. A total of 400 Questionnaire Instruments (QI) were administered to potential respondents in Ghana, of which 387 responded representing a response rate of 96.75%. The Technology Acceptance Model was used as the theoretical framework for the study. The research model was tested using a simple linear regression analysis with SPSS. A little of over 71.1% of the respondents recommended the Electoral Commission (EC) of Ghana to adopt an electronic voting system in the conduct of public elections in Ghana. The results indicated that all the six predictors such as perceived usefulness (PU), perceived ease of use (PEOU), perceived free and fair elections (PFFF), perceived credible elections (PCE), perceived system integrity (PSI) and citizens trust in the election management body (CTEM) were all positively significant in predicting the readiness of citizens to adopt and use an electronic voting system in Ghana. However, jointly, the hypotheses tested revealed that apart from Perceived Free and Fair Elections and Perceived Credible and Transparent Elections, all the other factors such as PU, Perceived System Integrity and Security and Citizen Trust in the Election Management Body were found to be significant predictors of the Willingness of Ghanaians to use an electronic voting system. All the six factors considered in this study jointly account for about 53.1% of the reasons determining the readiness to adopt and use an electronic voting system in Ghana. The implications of this research finding on elections in Ghana are discussed.

Keywords—Credible elections, democracy, Election Management Body (EMB), electronic voting, Ghana, Technology Acceptance Model (TAM).

I. INTRODUCTION

THE major principle of democracy is the ability to organize a legitimate process by which the representatives of the people are chosen within a particular jurisdiction or setting to manage and administer the affairs of a country, city, province, county and districts etc. on the behavior of the people. The paper based mode of voting has been the popular means of electing representatives around the globe, particularly in Africa. But countries such as the USA, Brazil and India have migrated to the use of an electronic voting system due to challenges associated with the manual paper-based system of

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voting such as costs of physical ballot papers and other auxiliary expenses, electoral delays, distribution of electoral materials and lack of confidence in the electoral management process [1]. The adoption and implementation of electronic voting technologies can help address these identified challenges in the election management processes [1]. Electronic voting is the application of appropriate information and communication technologies such as the Internet, to provide citizens' with an efficient and effective way to vote [2], [3]. It is also considered as the mechanism through which voting processes are produced and delivered to citizens by utilizing web-based Internet applications [4]. According to Kumar and Walia [5], e-voting is an electronic device used to counts votes in place of ballot papers and boxes which can be operated by the polling officer and the voter without any challenge. The application of an electronic voting system in the election management process must ensure 1) that voting secrecy is assured before the vote is cast to avoid coercion and vote-buying, 2) that anonymity of the voter to prevent the matching of a ballot to a voter, 3) that proper identification to prevent impersonation and multiple votes, 4) that the system would not be manipulated by either the voter or the election officer or any other third party, and 5) importantly results of the elections should be auditable and reproducible in case of a dispute arising out of election outcomes [6]-[8].

An electronic voting system must guarantee an End-to-End Verifiability to ensure that there are no human or electronic components that must be trusted for safeguarding the integrity of the vote cast [9]. The End-to-End Verifiability consists of three key pieces of evidence which are Cast-as-intended verification, Recorded-as-cast verification and universally verifiable tallying [9]. According to Culnane et al. [9], Cast-as-intended verification confirms that each voter gets an empirical evidence that his/her vote cast is exactly as intended for the desired candidate, while the Recorded-as-cast verification ensures that a voter gets evidence that her votes cast counted, included and unaltered in the tallying process. The Universally Verifiable Tallying guarantees that everyone can independently verify that the votes cast and tallied are the same as the announced election outcome [9].

Ghana has administered elections using the manual paper-based system particularly for the presidential and parliamentary elections in Ghana for over 20 years now. The recent presidential and parliamentary elections were held in December 2016. Due to challenges associated with the manual system, there have been calls by major stakeholders for the country to migrate to the use of an electronic voting system [10]. The adoption of an electronic voting system is expected

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to reduce or mitigate the challenges with the manual voting system, increase the trust of voters, citizens' and stockholders in the election management processes, increase transparency and general acceptance of election outcomes.

The objective of this research paper is to investigate factors influencing citizens' readiness to adopt and use an electronic voting system in Ghana. The factors considered are the PU of an electronic voting system, perceived ease of use (PEOU) of an electronic voting system, perceived free and fair elections (PFFF), perceived credible elections (PCE), perceived system integrity (PSI) and Citizens trust in the election management body (CTEM). In order to achieve the objectives of this study, the following research questions have been formulated. The research questions were adapted from a previous study [10].

1. Does PU of an electronic voting system have a positive impact on Citizens' Readiness to adopt and use an electronic voting system in Ghana?
2. Does Perceived Ease of Use an electronic voting system have a positive impact on Citizens' Readiness to adopt and use an electronic voting system in Ghana?
3. Do Perceived Free and Fair Elections have a positive impact on citizens' Readiness to adopt and use an electronic voting system in Ghana?
4. Does Perceived Credible Elections have a positive impact on Citizens' Readiness to adopt and use an electronic voting system in Ghana?
5. Does Perceived System Integrity have a positive impact on Citizens' Readiness to adopt and use an electronic voting system in Ghana?
6. Does Citizen Trust in Election Management Body have a positive impact on Citizens' Readiness to Adopt and Use an electronic voting system in Ghana?

The remainder of the paper is organized as follows: Challenges of manual voting system in Ghana, Technology Acceptance Model (TAM) as the theoretical foundation for the study, research model, research hypotheses, research method, results and discussions, conclusions and finally, limitations and proposed future research.

II. TECHNOLOGY ACCEPTANCE MODEL (TAM)

The Technology Acceptance model (TAM) developed by Davis [11] has been the most widely used technology acceptance theories to explain and predict the acceptance and adoption of technology related applications or tasks. According to Davis [11], the two major important determinates of intention to accept and use technology related applications is PU and perceived ease of use. Perceived usefulness is the users' belief that the use of a particular computer or technology related applications would enhance his or her work/job or life performance, while perceived ease of use is considered as the extent to which a user expects that the use of a particular technology related applications would be free from any challenges or difficulties [11]. Davis considered these very vital predictors to influencing the attitude of users towards the use of a system.

Several studies have validated through their research the robustness of the Technology Acceptance Model (TAM) in various fields of research settings. For instance, TAM has been used with Theory of Planned Behavior to examine the impact on perceived risked and perceived benefits on the adoption and use of Internet banking [12]. It has also been applied to evaluate the acceptance of eLearning by teachers and acceptance of online shopping [13], [14]. Lee et al., [15] used TAM to investigate university students' adoption behavior towards an Internet-based learning medium and found that perceived usefulness and perceived enjoyment was a determinant of students' behavior and intention to use of it as a learning medium. Other studies such as Liu et al. [16], Pituch and Lee [17] and Saade et al. [18] have all applied TAM to predictors of an e-learning system. TAM has also been applied to examine the acceptance of e-commerce by Pavlou [19], while in Finland; Pikkarainen et al. [20] demonstrated that perceived usefulness and information in online banking was very important factor predicting the acceptance of online banking. Mensah [21] using the TAM found that perceived ease of use, perceived service quality, citizen trust were major predictors of intention of citizens of Harbin to adopt and use e-government services in China. The study, however, interesting found that perceived usefulness was not a significant predictor of intention to use e-government services in Harbin, China [21]. This is in contrast to the findings of Ervasti and Helaakoski [22] that perceived usefulness was the strongest factor in the adoption of mobile services. In the study of Hsu and Chiu [23], the study found that the acceptance pattern and role of Internet self-efficacy was a major determiner of e-service adoption. In the area of electronic voting, Alomri [4] used TAM to show that beliefs and website design were not significant in predicting the intention to use e-voting websites but however the study revealed that, Jordanians intention to use electronic voting websites were significantly determined and influenced by trust in government, attitudes, perceived usefulness and complexity [4]. In the United States, it was demonstrated using TAM that perceptions of compatibility, usefulness, and trust had a significant impact on the intention to use an electronic voting system [24].

This study decided to use the Technology Acceptance Model (TAM) as the theoretical framework because, first, its robustness has been validated through multiple studies as have been discussed above, and secondly, it can be modified as compared to other models to include other predictors for a specific area of study such as e-government, e-commerce, Internet/online banking, eLearning etc.

III. RESEARCH MODEL

The research model for the study is depicted in Fig. 1. The model was adapted from Mensah [10]. Perceived usefulness of an electronic voting system, perceived ease of use of an electronic voting system, Perceived free and fair elections, perceived credible elections, Perceived system Integrity and Citizens Trust in the Election Management body are the independent variables, while Citizens readiness to adopt and use an electronic voting system in Ghana is the dependent variable. It is assumed that all the independent variables would
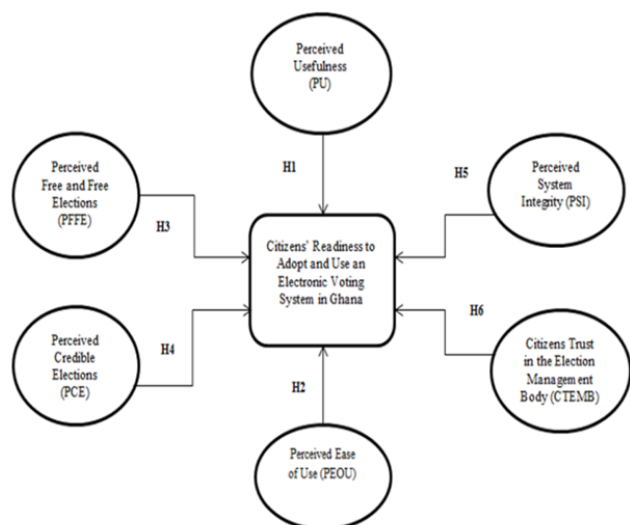
have a direct impact on the dependent variable.

Fig. 1 Research Model [10]

IV. RESEARCH HYPOTHESES

This study would seek to investigate the following research hypotheses. These research hypotheses were adopted from Mensah [10].

H1. Perceived Usefulness (PU) of an electronic voting system has a positive impact on Citizens' Readiness to Adopt and Use an electronic voting system in Ghana.

H2. Perceived Ease of Use (PEOU) of an electronic voting system has a positive impact on citizens' Readiness to adopt and use an electronic voting system in Ghana.

H3. Perceived Free and Fair Elections (PFFE) has a positive impact on Citizens' Readiness to adopt and use an electronic voting system in Ghana.

H4. Perceived Credible Elections (PCE) has a positive impact on Citizens' Readiness to adopt and use an electronic voting system in Ghana.

H5. Perceived System Integrity (PSI) has a positive impact on Citizens' Readiness to adopt and use an electronic voting system in Ghana.

H6. Citizen Trust in Election Management Body (CTEMB) has a positive impact on Citizens' Readiness to Adopt and Use an electronic voting system in Ghana.

V. RESEARCH METHOD

The research questions, research model, research hypotheses, and the variable instruments for this research were adopted from a previous study [10]. The previous study [10] was published as an ongoing work, and hence, was not completed, so this current study presents a completed version of the research undertaken. The QI were administered to 400 potential respondents in Ghana, of which 387 responded presenting a response rate of 96.7%. The Social Package for Social Science (SPSS) was used to capture and analyze the data. The Technology Acceptance Model (TAM) was used as the theoretical framework for the study. There were a total of

seven (7) variables, comprising of six (6) independent variables and one (1) dependent variable. Perceived Usefulness of electronic voting system (PU), Perceived Ease of Use (PEOU) of electronic voting system, Perceived Free and Free Elections (PFFE), Perceived Credible Elections (PCE), Perceived System Integrity (PSI) and Citizens Trust in the Election Management Body (CTEMB) are the independent variables, while Citizens readiness to adopt and use an electronic voting system in Ghana is the dependent variable. A total of 35 questions were contained in the entire questionnaire instrument. The questionnaire instrument was made up of five points Likert scales measurements ranging from Strong Disagree (SD) =1 to Strongly Agree (SA) =5. The questionnaires were pretested and piloted to achieve maximum clarity and remove any ambiguity that the respondents may have. The feedback and comments received were valuable in improving the content and wording of the questionnaire instrument before the main data collection exercise.

VI. RESULTS

A. Demographic Information

A total of 400 QI was administered to potential respondents, of which 387 responded representing 96.75%. The majority 201 (51.9%) of respondents were females, while the remaining 186 (48.1%) were males. This implies that more females took part in the study than males. It might have been caused by the random selection of the respondents. However, the figures show quite a fair representation of both sexes in the study sample. Table I illustrates the Gender of respondents.

TABLE I
GENDER OF RESPONDENTS

Gender	Frequency (N)	Percentage (%)
Male	186	48.1
Female	201	51.9
Total	387	100

With regard to age, majority 182 (47.0%) were found to be 18-25 years of age , followed by 26-30 years (16%), 31-35 years (11.6%), 36-40 years (10.9), 41-45 years (3.9%), 46-50 years (3.9%), 51 years and above (6.7%). The age of respondents is shown in Table II.

TABLE II
AGE OF THE RESPONDENTS

Age Range	Frequency (N)	Percentage (%)
18-25	182	47.0
26-30	62	16.0
31-35	45	11.6
36-40	42	10.9
41-45	15	3.9
46-50	15	3.9
51 and above	26	6.7
Total	387	100

Majority 342 of respondents were College/University graduates, which represents 88.4%, followed by Post-graduates (9.6%), while Junior and Senior High School

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respondents represent only 1.0%. By implication, the chances of the respondents providing accurate responses are very high, all things been equal, due to their high level of literacy. The Highest Level of Education of respondents is presented in Table III.

TABLE III
HIGHEST LEVEL OF EDUCATION

Level of Education	Frequency (N)	Percentage (%)
Junior High School	4	1.0
Senior High School	4	1.0
College/University	342	88.4
Post-graduate (Masters/Ph.D.)	37	9.6
Total	387	100

The majority of respondents were students (48.3%), followed by Teachers at a Junior High School (17.3%), Government Workers (16.8%), University Lecturers (2.8%), while other categories of professions represented 14.7%. The Profession of respondents is shown in Table IV.

TABLE IV
PROFESSION

Profession	Frequency (N)	Percentage (%)
University Lecturer	11	2.8
Junior High School Teacher	67	17.3
Government Worker	65	16.8
Student	187	48.3
Other	57	14.7
Total	387	100

In terms of Access to Computer by respondents, 325 indicated YES representing 84%, while 62 indicated NO, which represents 16%. This implies that majority of respondents are quite conversant with the use of the computer, a situation likely to enhance e-voting system adoption and development in Ghana. This is shown in Table V.

TABLE V
ACCESS TO COMPUTER

Responses	Frequency (N)	Percentage (%)
No	62	16
Yes	325	84
Total	387	100

The respondents were also asked if they had access to the Internet. The majority, 329, indicated YES (85%), while 58 said NO, representing 15%. This is illustrated in Table VI.

TABLE VI
ACCESS TO THE INTERNET

Responses	Frequency (N)	Percentage (%)
No	58	15
Yes	329	85
Total	387	100

Respondents were asked what they used most often to access the Internet. The majority (256) indicated that they use a Mobile phone (66.1%), Laptop (18.3%), Computer (8.55) and Tablet PC (7.0%). This is shown in Table VII.

TABLE VII
MODE OF ACCESS TO THE INTERNET

Mode of Access	Frequency (N)	Percentage (%)
Computer (Desktop)	33	8.5
Mobile Phone	256	66.1
Tablet PC	27	7.0
Laptop	71	18.3
Total	387	100

Respondents were also asked if they had participated in any General Elections in Ghana. The majority (249) of respondents indicated YES (64.3%), while 168 indicated NO (35.7%). This is shown in Table VIII.

TABLE VIII
PARTICIPATED IN ANY GENERAL ELECTIONS IN GHANA

Response	Frequency (N)	Percentage (%)
No	138	35.7
Yes	249	64.3
Total	387	100

The majority of respondents (273) indicated they had not visited the EC of Ghana website which represents 70.5% while 114 indicated YES (29.5%). This implies that the likelihood of the respondents providing a fair assessment of the electoral system is pretty high, as most of them had participated in General Elections in the country before. This is shown in Table IX.

TABLE IX
VISITED THE EC OF GHANA WEBSITE

Response	Frequency (N)	Percentage (%)
No	273	70.5
Yes	114	29.5
Total	387	100

Respondents were asked if they voted in the 2012 elections. More than half of the respondents (229) indicated YES, representing 59.2%, while 158 indicated NO (40.8%). This result is shown in Table X.

TABLE X
VOTED DURING 2012 GENERAL ELECTIONS

Response	Frequency (N)	Percentage (%)
No	158	40.8
Yes	229	59.2
Total	387	100

Some 275 of the respondents recommended the EC of Ghana to adopt an Electronic Voting System. This is shown in Table XI.

TABLE XI
RECOMMEND EC TO ADOPT EVS

Response	Frequency (N)	Percentage (%)
No	112	28.9
Yes	275	71.1
Total	387	100

The majority of respondents (314) indicated they will vote in the upcoming November 7 elections which represent

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81.1%, while 73 indicated NO (18.9%). This is shown in Table XII.

TABLE XII
INTENTION TO VOTE IN THE UPCOMING NOVEMBER 7, 2016, ELECTIONS

Response	Frequency (N)	Percentage (%)
No	73	18.9
Yes	314	81.1
Total	387	100

TABLE XIII
TEST OF RELIABILITY

Variables	No. of Items	Cronbach's Alpha
Perceived Usefulness(PU)		
PU1		
PU2	4	0.599
PU3		
PU4		
Perceived Ease of Use (PEOU)		
PEOU1		
PEOU2	4	0.607
PEOU3		
PEOU		
Perceived Credible Elections (PCE)		
PCE		
PCE1		
PCE2	5	0.655
PCE3		
PCE4		
PCE5		
Perceived System Integrity (PSI)		
PSI1		
PSI2		
PSI3	5	0.589
PSI4		
PSI5		
Perceived Free and Fair Elections (PFFE)		
PFFE1		
PFFE2		
PFFE3	5	0.639
PFFE4		
PFFE5		
Citizens Trust in the Election Management Body(CTEMB)		
CTEMB1		
CTEMB2	5	0.854
CTEMB3		
CTEMB4		
CTEMB5		
Citizens Readiness to Use Electronic Voting System(RAEVS)		
RAEVS1	3	0.525
RAEVS2		
RAEVS3		
Combined Variables	7	0.846

B. Test of Reliability

A test of reliability was conducted to check the level of internal consistency within the questionnaire items by computing the Cronbach's alpha values for each variable. It has been suggested that Cronbach's alpha values of ranging from 0.90 and above are considered excellent, 0.70 to 0.90 is high, 0.50 to 0.70 is considered as High moderate and 0.50 and below is regarded as low [24]. The variable with the highest Cronbach's alpha value is Citizens trust in the election management body with a value of 0.854. This is followed by Perceived Credible Elections (PCE) with a value of 0.655,

Perceived Free and Fair Elections (PFFE) with a value of 0.639, Perceived Ease of Use (PEOU) with an alpha value of 0.607, Perceived Usefulness (PU) with a value of 0.599, Perceived System Integrity (PSI) with a value of 0.589 and Citizens Readiness to Use Electronic Voting System (RAEVS) with a value of 0.525. The reported values for all the individual variables indicate that all the questionnaire items considered in the study are internal consistency and reliable, since the reported values fall within the recommended acceptable values for Cronbach's alpha. A reliability test was also conducted jointly on all the seven variables and indicates an alpha value of 0.846. These variables are shown in Table XIII. The questionnaire instrument used for the study, therefore, could be considered as reliable and consistent.

C. Pearson Correlation Analysis

A Pearson correlation was conducted to examine the extent of correlation among and between the variables used for the study. The results are displayed in Table XIV. The results show that all the variables considered in this study were all significant and positively correlated with each other. Perceived usefulness of electronic voting system was significant and correlated positively with perceived ease of use ($r = 0.469$, $p > 0.01$), perceived free and fair elections ($r = 0.446$, $p > 0.01$), Perceived credible elections ($r = 0.399$, $p > 0.01$), perceived system integrity ($r = 0.394$, $p > 0.01$), Citizens Trust in the Election Management Body ($r = 0.303$, $p > 0.01$) and Citizens Readiness to Use Electronic Voting System ($r = 0.356$, $p > 0.01$). Also perceived ease of use of electronic voting system was significant and correlated positively with perceived free and fair elections ($r = 0.517$, $p > 0.01$), perceived credible elections ($r = 0.49$, $p > 0.01$), perceived system integrity ($r = 0.455$, $p > 0.01$), Citizens Trust in the Election Management Body ($r = 0.399$, $p > 0.01$) and Citizens Readiness to Use Electronic Voting System ($r = 0.458$, $p > 0.01$).

Again, Perceived Free and Fair Elections was also found to be significant and correlated positively with perceived credible elections ($r = 0.585$, $p > 0.01$), perceived system integrity ($r = 0.468$, $p > 0.01$), Citizens Trust in the Election Management Body ($r = 0.390$, $p > 0.01$) and Citizens Readiness to Use Electronic Voting System ($r = 0.363$, $p > 0.01$).

Perceived Credible Elections significantly and positively correlated with perceive system integrity ($r = 0.561$, $p > 0.01$), Citizens Trust in the Election Management Body ($r = 0.419$, $p > 0.01$) and Citizens Readiness to Use Electronic Voting System ($r = 0.364$, $p > 0.01$).

Perceived System Integrity also correlated positively with Citizens Trust in the Election Management Body ($r = 0.508$, $p > 0.01$) and Citizens Readiness to Use Electronic Voting System ($r = 0.468$, $p > 0.01$). Finally, Citizens Trust in the Election Management Body was positively correlated with Citizens Readiness to Use Electronic Voting System ($r = 0.693$, $p > 0.01$).

The Mean and Standard Deviation for each of the variables are also shown in Table XIV. The Mean and Standard Deviation, respectively, for each of the variables are PU

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3.9677 (1.9606), PEOU3.7513 (0.77233), PFFE 0.39370 (0.93949), PCE 3.8873 (0.94694), PSI 4.0181 (0.95233),   CTEMB 3.6377 (0.92860) and RAVES 3.6245 (0.86024).

TABLE XIV
RESULTS OF CORRELATION AND DESCRIPTIVE STATISTICS

Variables	PU	PEOU	PFFE	PCE	PSI	CTEMB	RAVES
PU	-						
PEOU	0.469**	-					
PFFE	0.446**	0.517**	-				
PCE	0.399**	0.494**	0.585**	-			
PSI	0.394**	0.455**	0.468**	0.561**	-		
CTEMB	0.303**	0.399**	0.390**	0.419**	0.508**	-	
RAVES	0.356**	0.458**	0.363**	0.364**	0.468**	0.693**	-
Mean	3.9677	3.7513	3.9370	3.8873	4.0181	3.6377	3.6245
Standard Deviation	1.19609	0.77233	0.93949	0.94694	0.95233	0.92860	0.86024

**Correlation is significant at the 0.01 level (2-tailed)

TABLE XV
RESULTS OF HYPOTHESES TESTING

Hypotheses	R	R-square	f	sig	beta	t	sig
H1	0.356	0.127	55.798	0.000	0.356	7.470	0.000
H2	0.458	0.209	101.972	0.000	0.458	10.098	0.000
H3	0.363	0.132	58.425	0.000	0.363	7.644	0.000
H4	0.364	0.133	58484	0.000	0.364	7.671	0.000
H5	0.468	0.219	107.793	0.000	0.468	10.382	0.000
H6	0.693	0.480	355.740	0.000	0.693	18.861	0.000

D. Hypotheses Testing

A simple regression analysis was conducted to test the impact of the independent variables on the dependent variable. The results are displayed in Table XV.

H1 Perceived Usefulness (PU) of an electronic voting system has a positive impact on Citizen Readiness to Adopt and Use an electronic voting system in Ghana.

A simple linear regression analysis was conducted to determine the impact of Perceived Usefulness of an electronic voting system on the Citizens' Readiness to Adopt and Use an Electronic Voting System in Ghana. Statistical significance was tested at 0.05 level of significance. The results of the regression analysis are presented in Table XV. Results from Table III show a coefficient of determination (R Square) value of 0.124. This means that 12.4% of the variation in citizens' readiness to adopt and use an electronic voting system in Ghana is explained by their perceived level of usefulness of the system. In other words, the predictor variable (i.e. perceived usefulness) singlehandedly explains 12.4% of the reasons in citizens' readiness to adopt and use an electronic voting system, while the remaining 64.4% could be due to the effect of other extraneous variables. The correlation (R) value of 0.356 also suggests a positive relationship between perceived usefulness and citizens' readiness to adopt and use an electronic voting system in Ghana.

The level of significance of the effect of perceived usefulness on citizens' readiness to adopt and use an electronic voting system was also assessed. The results are presented in Table XV. Results from Table XV indicate that perceived usefulness has a significant effect on citizens' readiness to adopt electronic voting system in Ghana: ($F_{(1,385)} =$ 55.798 and p $-$ value $= 0.000$ is less than 0.05). In other words, citizens' perceived usefulness of an electronic voting system is a significant predictor of their readiness to adopt and use the system in Ghana.

Table XV presents the estimated coefficient of the regression model. From the table, the independent variable, thus perceived usefulness was a significant predictor of citizens' readiness to adopt and use an electronic voting system ($\beta= 0.356$, t = 7.470, p (0.000) < 0.05). The final regression line is given as:

$$CRAUES = 2.609 + .256PU$$

where: CRAUES = Citizens' Readiness to Adopt and Use an Electronic Voting System, PU = Perceived Usefulness.

H2 Perceived Ease of Use (PEOU) of an electronic voting system has a positive impact on citizen Readiness to adopt and use an electronic voting system in Ghana.

A simple linear regression analysis was conducted to test the above hypothesis. Statistical significance was tested at 0.05 level of significance or 95% confidence internal. The results of the regression analysis are presented from Table XV. The results from Table XV indicate a coefficient of determination (R Square) value of 0.209. This implies that 20.9% of the variation in citizens' readiness to adopt and use an electronic voting system in Ghana is accounted for by their perceived ease of use of the system. That is, the predictor variable (i.e. perceived ease of use) alone explains 20.9% of the variance in citizens' readiness to adopt and use an electronic voting system in Ghana, while the remaining 79.1% could be due to the effect of other variables. The correlation (R) value of 0.458 also suggests a positive relationship

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between Perceived Ease of Use and Citizens' Readiness to Adopt and Use an Electronic Voting System in Ghana.

The level of significance of the impact of perceived ease of use on citizens' readiness to adopt and use an electronic voting system was also explored. The results are presented in Table XV. Results in Table XV indicate that perceived ease of use has a significant effect on citizens' readiness to adopt and use an electronic voting system in Ghana; ($F_{(1,385)}$ = 101.972 and $p-value = 0.000$ is less than 0.05). That is, citizens' perceived ease of use of the electronic voting system is a significant predictor of their readiness to adopt and use the system in Ghana.

Presented in Table XV is the estimated coefficient of the regression model. From the table, the independent variable, thus perceived ease of use was a significant predictor of citizens' readiness to adopt and use an electronic voting system (β= 0.458, t = 10.098, p (0.000) < 0.05). The final regression line is given as:

$$CRAUES = 1.712 + .510\,PEOU$$

where: CRAUES = Citizens' Readiness to Adopt and Use an Electronic Voting System, PEOU = Perceived Ease of Use.

H3 Perceived Free and Fair Elections has a positive impact on Citizen Readiness to adopt and use an electronic voting system in Ghana.

A simple linear regression analysis was conducted to assess the impact of Perceived Free and Fair Elections on Citizens' Readiness to Adopt and Use an Electronic Voting System in Ghana. Statistical significance was tested at 0.05 level of significance or 95% confidence internal. The results of the regression analysis are presented in Table XV. Results from Table XV show a coefficient of determination (R Square) value of 0.130. The results imply that 13.0% of the variation in Citizens' Readiness to Adopt and Use an Electronic Voting System in Ghana is explained by their Perceived Free and Fair Elections. To put it differently, perceived free and fair elections account for 13% of the variance in citizens' readiness to adopt an electronic voting system, while the remaining 87.0% could be due to the effect of other variables. The correlation (R) value of 0.363 also indicates a positive relationship between Perceived Free and Fair elections and citizens' readiness to adopt and use an electronic voting system in Ghana.

The level of significance of the impact of perceived free and fair elections on citizens' readiness to adopt and use an electronic voting system was also assessed. The results are presented in Table III. Results from Table XV indicate that perceived free and fair elections has a significant impact on citizens' readiness to adopt and use an electronic voting system in Ghana; ($F_{(1, 385)}$=58.425 and p-value = 0.000 is less than 0.05). That is, citizens' level of perceived free and fair elections has a significant influence on their readiness to adopt and use an electronic voting system in Ghana.

Presented in Table XV is also the estimated coefficient of the regression model. From the table, the independent variable, thus perceived free and fair elections was found to be

a significant predictor of citizens' readiness to adopt and use an electronic voting system (β= 0.363, t = 7.644, p (0.000) < 0.05). The final regression line is given as:

$$CRAUES = 2.316 + .332\,PFFE$$

where: CRAUES = Citizens' Readiness to Adopt and Use an Electronic Voting System, PFFE = Perceived Free and Fair Elections.

H4 Perceived Credible Elections has a positive impact on Citizen Readiness to adopt and use an electronic voting system in Ghana.

A simple linear regression analysis was conducted to test the above hypothesis. Statistical significance was tested at 95% confidence internal. The results of the regression analysis are presented in Table XV. Results from Table III indicate a coefficient of determination (R Square) value of 0.133. The results imply that 13.3% of the variation in Citizens' Readiness to Adopt and Use an Electronic Voting System in Ghana is attributed to their Perceived Credible and Transparent Elections. In other words, perceived credible and transparent elections account for 13.3% of the variance in citizens' readiness to adopt an electronic voting system, while the remaining 86.7% can be attributed to the other variables. The correlation (R) value of 0.364 also indicates a positive relationship between Perceived Credible and Transparent elections and Citizens' Readiness to Adopt and Use an Electronic Voting System in Ghana

The level of significance of the impact of perceived credible and transparent elections on citizens' readiness to adopt and use an electronic voting system was also examined. The results are presented in Table XV. Results from Table XV indicate that perceived credible and transparent elections have a significant impact on citizens' readiness to adopt and use an electronic voting system in Ghana; ($F_{(1, 385)}$=58.848 and p-value = 0.000 is less than 0.05). That is, citizens' perceived level of credible and transparent elections has a significant influence on their readiness to adopt and use the system in Ghana.

Presented in Table XV is also the estimated coefficient of the regression model. From the table, the independent variable, thus perceived credible and transparent elections was found to be a significant predictor of citizens' readiness to adopt and use an electronic voting system (β = 0.364, t = 7.671, p (0.000) < 0.05). The final regression line is given as:

$$CRAUES = 2.339 + .331\,PCTE$$

where: CRAUES = Citizens' Readiness to Adopt and Use an Electronic Voting System, PCTE = Perceived Credible and Transparent Elections.

H5 Perceived System Integrity has a positive impact on Citizens Readiness to adopt and use an electronic voting system in Ghana.

A simple linear regression analysis was conducted to determine the impact of Perceived System Integrity on citizens' readiness to adopt and use an electronic voting

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system in Ghana. Statistical significance was tested at 0.05 level of significance. The results of the regression analysis are presented from Table XV. Results from Table XV show a coefficient of determination (R Square) value of 0.219. This implies that 21.9% of the variation in Citizens' Readiness to Adopt and Use an Electronic Voting System in Ghana is attributed to their Perceived System Integrity. In other words, citizens' level perceived system integrity accounts for 21.9% of the variance in their readiness to adopt an electronic voting system, while the remaining 78.1% can be attributed to other unknown variables. The correlation (R) value of 0.468 also indicates a positive relationship between Perceived System Integrity and citizens' readiness to adopt and use an electronic voting system in Ghana.

The level of significance of the impact of perceived system integrity on citizens' readiness to adopt and use an electronic voting system was also examined. The results are presented in Table XV. Results from Table XV indicate that perceived system integrity has a significant effect on citizens' readiness to adopt and use an electronic voting system in Ghana; ($F_{(1,385)} = 107.793$ and $p-value = $ 0.000 is less than 0.05). That is, citizens' perceived level of the electronic voting system's integrity has a significant impact on their readiness to adopt and use the system in Ghana.

Presented in Table XV is the estimated coefficient of the regression model. From the Table III, the independent variable, thus perceived system integrity was found to be a significant predictor of citizens' readiness to adopt and use an electronic voting system ($\beta = 0.468$, t = 10.382, p (0.000) < 0.05). The final regression line is given as:

$$CRAUES = 1.927 + .422\,PSI$$

where: CRAUES = Citizens' Readiness to Adopt and Use an Electronic Voting System, PSI = Perceived System Integrity.

H6 Citizen Trust in Election Management Body has a positive impact on Citizens Readiness to Adopt and Use an electronic voting system in Ghana.

A simple linear regression analysis was conducted to test the above hypothesis. Statistical significance was tested at 0.05 level of significance or 95% confidence internal. The

results of the regression analysis are presented from Table XV. Results from Table XV reveal a coefficient of determination (R Square) value of 0.480. By implication, 48.0% of the variation in Citizens' Readiness to Adopt and Use an Electronic Voting System in Ghana is attributed to their Trust in the Election Management Body. That is, Citizens' Trust in the Election Management Body account for 48.0% of the variance in their readiness to adopt an electronic voting system, while the remaining 52.0% can be attributed to the other variables. The correlation (R) value of 0.693 also indicates a positive relationship between Citizens' Trust in the Election Management Body and their readiness to adopt and use an electronic voting system in Ghana.

The level of significance of the impact of Citizens' Trust in the Election Management Body and their readiness to adopt and use an electronic voting system was also examined. The result is presented in Table XV. Results from Table XV indicate that Citizens' Trust in the Election Management Body has a significant effect on their readiness to adopt and use an electronic voting system in Ghana: $F_{(1,385)}$=355.740 and p-value=0.000 is less than 0.05). That is, Citizens' Trust in the Election Management Body has a significant influence on their readiness to adopt and use the system in Ghana.

Presented in Table XV is also the estimated coefficient of the regression model. From the Table XV, the independent variable, thus Citizens' Trust in the Election Management Body was found to be a significant predictor of citizens' readiness to adopt and use an electronic voting system ($\beta = 0.693$, t = 10.18.861, p (0.000) < 0.05). The final regression line is given as:

$$CRAUES = 1.289 + .642\,CTEMB$$

where: CRAUES = Citizens' Readiness to Adopt and Use an Electronic Voting System, CTEMB = Citizens' Trust in the Election Management Body.

E. Multiple Regression Analysis

A multiple regression analysis was conducted to determine the joint impact of the six variables on the readiness of citizens' in Ghana to adopt and use an electronic voting system. The results are displayed in Table XVI

TABLE XVI
RESULTS OF MULTIPLE REGRESSION ANALYSIS

Variable	R	R2	f	sig	Beta	t	sig
Model	0.729	0.531	71.637	0.000		3.280	0.001
Perceived Usefulness.					0.085	2.024	0.044
Perceived Ease of Use.					0.171	3.779	0.000
Perceived Free and Fair Elections.					-0.005	-0.101	0.919
Perceived Credible Elections.					-0.043	-0.886	0.376
Perceived System Integrity.					0.092	1.974	0.049
Citizens' Trust in the Election Management Body.					0.572	13.511	0.000

Results from Table XVI show a coefficient of determination (R Square) value of 0.531. By implication, 53.1% of the variation in Citizens' Readiness to Adopt and Use an Electronic Voting System in Ghana is influenced by their Perceived Usefulness (PU), Perceived Ease of Use (PEOU),

Perceived Free and Fair Elections (PFFE), Perceived Credible and Transparent Elections (PCTE), Perceived System Integrity and Security (PSIS), Trust in the Election Management Body (CTEMB). The remaining 46.9% can be attributed to other factors.

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The correlation coefficient (R) value of 0.729 also indicates a strong positive relationship between the predictors/independent variables (i.e. Perceived Usefulness, Perceived Ease of Use (PEOU), Perceived Free and Fair Elections, Perceived Credible and Transparent Elections, Perceived System Integrity and Security, Citizen Trust in the Election Management Body) and the dependent variable (i.e. citizens' readiness to adopt and use an electronic voting system). In other words, high levels of Perceived Usefulness, Perceived Ease of Use, Perceived Free and Fair Elections, Perceived Credible and Transparent Elections, Perceived System Integrity and Security, Citizen Trust in the Election Management Body are associated with high level of Citizens' Readiness to Adopt and Use an Electronic Voting System in Ghana.

The significance of the effect of the predictors on the dependent was also assessed. The results are presented in Table IV. Results from Table XVI indicate that Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Perceived Free and Fair Elections (PFFE), Perceived Credible and Transparent Elections (PCTE), Perceived System Integrity and Security (PSIS), and Citizens' Trust in the Election Management Body (CTEMB) jointly have a significant impact on citizens' readiness to adopt and use an electronic voting system in Ghana ($F_{(6, 380)}$ = 71.637 and p-value = 0.000 is greater than 0.05).

After determining the joint effect of the independent variables on the dependent variable, the individual effect of each predictor/independent variable on the dependent variable was also examined. The results are presented in Table XVI. Results from Table IV indicates that apart from Perceived Free and Fair Elections (p-value = 0.919 > α = 0.05) and Perceived Credible and Transparent Elections (p-value = 0.376 > α = 0.05) all the other predictors/independent variables were significant predictors of citizens' readiness to adopt and use electronic voting system in Ghana (all p-values are less than 0.05).

The final regression line is, therefore, given as:

$$CRAUES = 0.573 + 0.061PU + 0.191PEOU - 0.004PFFE - 0.039PCTE + 0.084PSIS + 0.530CTEMB$$

where: CRAUES = Citizens' Readiness to Adopt and Use an Electronic Voting System, PU = Perceived Usefulness (PU), PEOU = Perceived Ease of Use, PFFE = Perceived Free and Fair Elections, PCTE = Perceived Credible and Transparent Elections, PSIS = Perceived System Integrity and Security, CTEMB = Citizens' Trust in the Election Management Body.

The results in Table IV further reveal that Citizens' Trust in the Election Management Body (β = 0.572) exhibited had the largest effect on the citizens' readiness to adopt and use electronic voting system in Ghana, followed by Perceived Ease of Use (β = 0.171), Perceived System Integrity and Security (β = 0.092), and then Perceived Usefulness (β = 0.085).

VII. DISCUSSION

Electronic voting system adoption in the context of the Ghanaian society would generally be influenced by all the factors tested in this paper. In other words, Perceived Usefulness, Perceived Ease of Use, Perceived Free and Fair Elections, Perceived Credible and Transparent Elections, Perceived System Integrity and Security and Trust in Election Management Body, are all significant determiners of the Ghanaian readiness to adopt and use an e-vote system. But on the individual significance level of these factors, the result indicate that apart from Perceived Free and Fair Elections and Perceived Credible and Transparent Elections, all the other independent variables were influential or had a significant impact on citizen readiness to adopt and use an e-vote system. All these predictors of intention to use an electronic voting system in Ghana accounts for about 53.1% of the reasons explaining/determining the usage of electronic voting system in Ghana

What this means is that, the model tested per this research provides evidence that Ghanaians are ready to adopt and use an electronic voting system in so far as such a system is able to guarantee its usefulness in achieving the expected outcome, it features are easy to use to prevent a situation where people cannot use it, improved system security to ensure that citizens votes are secured without been tempered with and importantly the system should engender strong trust in the Election Management Body. Trust in an election management body is very critical to assure citizens that an e-vote system would not be used as a tool to rig and manipulate election results.

The findings on perceived usefulness and Trust corroborates the findings of Schaupp and Carter [25] which indicated that perceived usefulness and trust significantly had an impact on the intention to sue and electronic voting system. It also supports the findings of Alomari [4] that perceived usefulness was a positive determiner of Jordanian citizens' intention to adopt and use e-voting system.

VIII. CONCLUSION

The researcher strongly agrees with the respondents (71.1%) that the EC of Ghana should adopt an electronic voting system to conduct General Elections. However, mention needs to be made that Citizens' Readiness to Adopt and Use Electronic Voting System in Ghana is significantly dependent on their Perceived Usefulness of the system, Perceived Ease of Use, Perceived Free and Fair Elections, Perceived Credible Elections, Perceived System Integrity, and Perceived Trust in the Election Management Body.

Based on the findings of this research the following recommendations are made:
- The EC should adopt and use an electronic voting system to conduct elections in Ghana. However, the EC must ensure that the system to adopt is of the high level of integrity (i.e. the system should have strong security features to prevent citizens' valid votes from been rigged). Also, the system must be very useful so as to realize its full benefits.

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- In addition to ensuring that the system is useful, the EC must ensure that the system is very easy to use (i.e. it can be operated and used by ordinary and all citizens without the tendency of been disenfranchised). The system should also have the capacity to enhance free and fair elections and provide credible results.
- The EC must again conduct its activities in an impartial manner so as to win the trust of the citizens. Without this, the citizens would not have trust in the system that would be implemented.
- In implementing the e-voting system also, the EC must engage the key stakeholders extensively and broadly so as to generate the necessary inputs for the effective implementation of the system. Consideration must also be given to the electorates to enable them fully understand what an e-voting system is about.
- The EC should also visit countries which have adopted and implemented an e-voting system, so as to get first-hand information regarding the operation of the system. The success and challenges from these countries would be a learning ground for the EC of Ghana to successfully adopt and implement a similar system in Ghana.
- Moreover, appropriate laws (constitutional instrument) should be enacted to regulate the adoption and use of an e-voting system in the conduct of elections in Ghana.

IX. LIMITATION AND FUTURE RESEARCH

This study has a number of limitations. First, the sample size was only taken from about 400 respondents in Ghana so the interpretation of the results should be generalized with caution, and secondly, the predictors considered in the study may not have fully explored all the factors determining the adoption and usage of an electronic voting system in Ghana. Therefore, future research would seek to investigate other factors such as compatibility, effort expectancy, trust in government and the moderating role of demographic factors such as Gender, Age, Education and level of IT knowledge on the relationships between the predictors (Perceived Usefulness, Perceived Ease of Use, Perceived Free and Fair Elections, Perceived Credible Elections, Perceived System Integrity and Citizen Trust in Election Management Body) and the dependent variable Citizen Readiness to Adopt and Use E-voting System in Ghana.

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