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Urban Big Data and Smart Cities through UTAUT Model (The Case of the Kingdom of Saudi Arabia)

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Abstract:

The use of Information and Communication Technology (ICT) is the primary goal of the construction of a smart city, with the end goal being a more efficient management of urban resources such as electricity, public transportation, roadways, and wastewater management systems along with judicious use of resources and infrastructure. It is necessary for the technologies to make a contribution to the building of an inclusive society that has a high level of civic involvement and transparency. Therefore, it is vital to investigate the behavior of people, their motivation, incentives and the elements that impact the desire to use and the use of the communication technologies for the purpose of resolving day-to-day responsibilities and problems. We used the UTAUT model in addition to the structural equation modelling based on partial least squares (PLS-SEM). In the UTAUT model, these major contributors are Behavioral Intention and Use Behavior. The findings of this research will enable the authorities of Saudi Arabia to facilitate all of the processes of putting the smart city concept into action by increasing the population's involvement in the use of applications along with cybersecurity framework in all as-pects of day-to-day life.

Keywords: Smart cities, UTAUT, Urban Big Data, Kingdom of Saudi Arabia.

1. Introduction:

The use of Information and Communication Technology (ICT) is the primary goal of the construction of a smart city, with the end goal being a more efficient management of urban resources such as electricity, public transportation, roadways, and wastewater management systems along with judicious use of resources and infrastructure. As per the definitions by (Nikitas et al., 2020) and (Toli & Murtagh, 2020), a metropolitan region is considered to be a smart city if it implements information, telecommunication, and digital technologies on conventional networks in order to improve the flexibility, efficiency, and sustainability of such networks. Components of a smart city include intelligent infrastructure, intelligent energy, intelligent transportation, intelligent government, intelligent healthcare, intelligent education, intelligent energy, intelligent buildings, intelligent technology, and intelligent residents. The quality of life in a smart city may be gauged by its residents' economic standing as well as their mental and emotional health. The Internet of Things (IoT) is at the center of every deployment of a smart city. A smart city should contain elements that depend on the Internet of Things (IoT), such as connectivity, intelligence, and instrumentation (Nikitas et al., 2020). The emergence of smart cities around the globe, particularly in the Middle East, Latin America, Asia, and Africa, represents a wave of entrepreneurial urbanism (Silva et al., 2018).

The Saudi Arabian Vision 2030 plan describes the nation's objective of having at least three cities listed among the top 100 most intelligent cities in the world by the year 2030. The goal of the smart aspiration is to increase the overall quality of life for all people and to fulfil the requirements of residents by ensuring that they have access to services and infrastructure of the highest possible standard. introduced the Riyadh and Neom smart city frameworks. This provides us with a beginning point for constructing a stronger framework towards a suitable e-government framework that does not contradict the social, economic, or cultural values of Saudi Arabia. Specifically, this gives us a starting point for establishing a suitable e-government framework.

In smart cities, the population occupies a unique and important role. People are assumed to be the driving force behind developments in smart cities, as well as the focus and primary concern of all activities, according to the presumption underlying the notion of smart cities. The term "smart city" refers to an area in which existing networks and services are made to operate more effectively via the use of digital and telecommunication technologies for the purpose of serving the needs of

the city's residents and companies (Das, 2020; Lim et al., 2019; Saba et al., 2020). There are a variety of elements that influence people's perspectives about information technology in a variety of contexts. Some residents of the city do not accept information technologies or have certain problems and concerns with their use due to a variety of reasons, such as personal characteristics, a lack of knowledge or technical resources, cyber security threats and so on (Habib et al., 2020; Soyata et al., 2019). Other residents of the city accept information technologies but have certain problems with their use. Because the use of information technology is a demand that smart cities put forth, it is possible that these individuals may have difficulties integrating into the activities of a smart city, which may, in turn, constitute a barrier to the functionality of a smart city (Razmjoo et al., 2021; Sharma et al., 2020). It is also inefficient from an economic standpoint, due to the fact that the non-use of technology leads in poor resource allocation and low effectiveness (Lee et al., 2014; Razmjoo et al., 2021; Yigitcanlar, 2015). The creation of smart city regions demands an integrated knowledge of the numerous aspects of services that impact the choice that people make about whether they will utilize these services. In the alternative, they have the potential to be the origin of new kinds of social exclusion owing to a lack of skills and competency in the use of technologies (Andone et al., 2014; Perätalo & Ahokangas, 2018), or a weak infrastructure or the absence of required equipment (Bomba et al., 2018). It is necessary for the technologies to make a contribution to the building of an inclusive society that has a high level of civic involvement and transparency (Preston et al., 2020; Robinson, 2020). Therefore, it is vital to investigate the behaviour of people, their motivation, incentives and the elements that impact the desire to use and the use of the communication technologies for the purpose of resolving day-to-day responsibilities and problems.

1.1 UTAUT Model:

Because of their reliance on information and communication technology, the smart cities in Saudi Arabia are vulnerable to cyberattacks. The country needs to devise a cyber-security policy framework for its various programs, which then has to be tailored to the specifics of the local environment. This article examines how the nation may establish a cyber-security policy framework for its smart cities, how the framework can be customized to the country's local environment, and how the framework may have an influence on the country's people. According to the findings in pre-survey, Saudi Arabia ought to adopt an appropriate cyber security policy

framework for its smart city projects. This policy framework should include a digital trust platform, a cyber threat intelligence and analysis platform, a cyber competencies and awareness program, privacy by design, and cyber response and resilience. The research, on the other hand, will be centered on the creation of a cyber-competencies and awareness program that takes into account the customs, culture, society, and economics of the Kingdom. In addition, the research has a certain scientific value due to the fact that it applies the Unified Theory of Acceptance and Use of Technology (UTAUT) model. This model is typically utilized for the purpose of researching aspects; however, we applied it for the purpose of examining how people generally accept technological instruments. In addition, while this approach is often used when discussing technology, the writers will be focusing on web applications. This newness has the potential to contribute to the improvement of the techniques' implementation. the researchers suggested that the legislative framework for the country's cyber-security should be tailored to the country's specific local context. Issues that arise from the interoperability, convergence, and interconnection of urban processes and systems may be addressed by effectively synchronizing the framework with the Saudi Arabian smart cities strategy. In addition, the nation must do a comprehensive analysis of how its population are affected by the country's technological advancements and infrastructure. Following the conclusion of the research, a cyber-security policy framework that is well-suited for Saudi Arabia's smart cities will be produced.

In our research, we used the UTAUT model (Figure 1) in addition to the structural equation modelling based on partial least squares (PLS-SEM). PLS-SEM is a technique that is often used in the estimation of route models that include latent variables and the connections between them. The identification of the most important contributors to target constructs is a typical objective of PLS-SEM analysis. In the UTAUT model, these major contributors are Behavioral Intention and Use Behavior.

Performance Expectation (PE) (H1), Facilitating Conditions (FC) (H2), Social Influence (SI) (H3), Effort Expectation (EE) (H4), Behavioral Intention BI), Use Behavior (UB), Attractions towards the adoption of Cybersecurity Frameworks was used as the UTAUT con-structs. Age, Gender, Experience, Working Sector and Education were considered as moderators.

After making some minor modifications, the survey questions that were used to measure the UTAUT components were taken directly from the research. The evaluation of these statements in the questionnaire was done using a Likert scale of five points.

Two separated questionnaires were structured to collect the data from IT experts working in hubs and general public using any IT gadget and apps.

The following hypotheses were tested

H1: The lack of trust related to cyber infrastructure issues, services from governments and companies, cyber threats attacks and cyber based economy limit cybersecurity frameworks adoption in Saudi Arabia.

H2: The lack of developments related to shortage of cyber awareness programs and lack of trained personnel limit cybersecurity frameworks adoption in Saudia Arabia.

H3: Cultural influences, including use of social apps and influence Saudi Arabia's adoption of cybersecurity awareness methods.

H4: The lack of IT professionals in public sector (a shortage of local expertise) limits the implementation of cybersecurity frameworks in Saudi Arabia.

The data was collected by circulating the questionnaire among the participants and was analyzed by using SmartPLS 4.0 software. The UTAUT model was validated for all model fit parameters.

Table 1: UTAUT Model components, General Public

Hypothesis	UTAUT Model Component	Items/Questions Post Survey	
Mediating component	**Attraction**	20.How well the program mode of delivery attracts public to give out their problems	ATR1
		30.Do you think that the current IT infrastructure (internet speed, security and accessibility) is suitable for the success of the program?	ATR2
Citizen's desire to live in smart cities	**Behavior Intention (Dependent Variable)**	10. After watching the induction video: how much do you want to register and take advantage of the program's features	BI1
		11.Do you agree that the program will be a reliable awareness source instead of other unreliable sources?	BI2

		24.Do you think the program will help promote e-commerce instead of traditional trade?	BI3
H4	**Effort Expectancy**	8. Does the program meet your expectation?	EE1
		14.Do you agree the proposed program will reduce your fears about online shopping?	EE2
		16.Do you agree the proposed program will reduce your fears about share your personal information with e-government services?	EE3
		19.I'm confident with the cyber security information I get from expertises via the program	EE4
		22.Do you think the program will increase your knowledge of the risks of cyber threats?	EE5
		25.To what extent were the society cyber issues will be solved with the program?	EE6
		28. Do you think the program will help you to attain gains ?	EE7
H2	**Facilitating Conditions**	12.It will be easy now to solve the cyber security issues when the program will be implemented.	FC1
		13.Do you agree the program will make smart cities safer and more aware?	FC2
		29.How much do you think the program will be easy to use?	FC3
H1	**Performance Expectancy**	7. In a range of 1-5 rate the proposed program.	PE1
		15. How much do you think the program will affect Saudi Arabia's move towards e-commerce and the digital economy?	PE2

		17. How confident are you in sharing your issues through the program?	PE3
		23. Are you ready to pay a small fee for the course if any?	PE4
H3	**Social Influence**	9. How much do you rate this idea: the program has several partnerships and sponsors as a parallel program to qualify recent graduates or non-specialists to be new members and to ensure the continuity of the program	SI1
		18. The proposed program will increase the public awareness of the cyber security	SI2
		26. Based on the previous survey result shows that culture of Saudi Arabia is affected by social apps. Analyzing the results, it has been observed that snapchat (51.4%) and Twitter (32.4%) are the two mostly used social media apps in the Saudi Arabia. Do you agree that awareness programs will reduce cyber threats through social media applications and how to deal with them?	SI3
Behavior towards cybersecurity frameworks adoption	**Use of Behavior (Dependent Variable)**	21. Has the video changed your viewpoint on the cyber security?	UOB 1
		31. Are you willing to adopt the program to your life or recommend it ?	UOB 2

Table 2 UTAUT Model components, IT experts

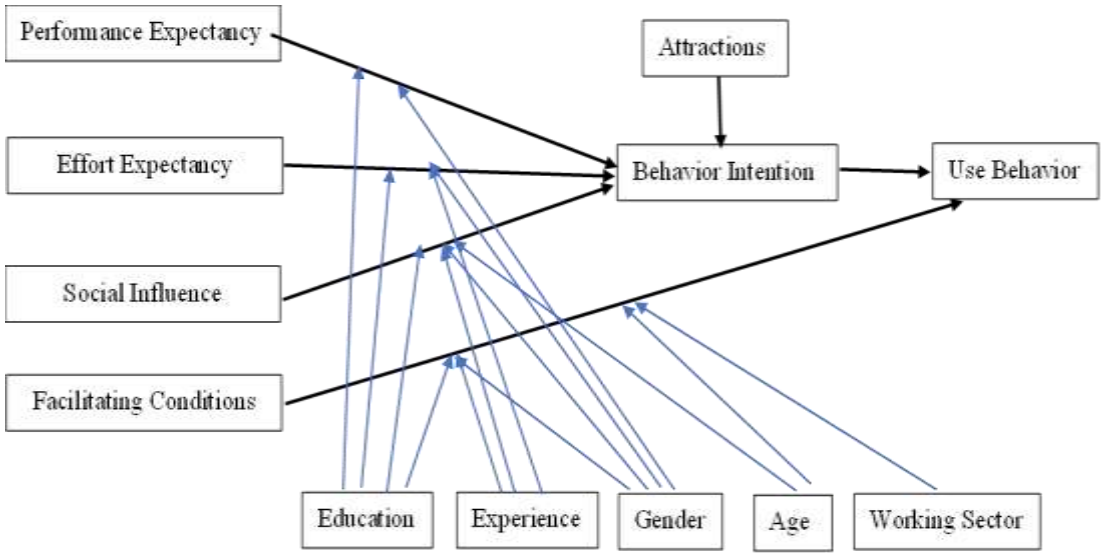
Hypothesis	**UTAUT Model Component**	**Items/Questions Post Survey**

Mediating component	**Attraction**	20. How satisfied are you with the incentives and bonuses mentioned in the program?	ATR1
		24. Do you agree the program will attract the residents of villages to live in smart cities?	ATR2
Citizen's desire to live in smart cities	**Behavior Intention (Dependent Variable)**	10. After watching the induction video: how much do you want to register and take advantage of the program's features	BI1
		11. Do you agree that the program will be a reliable awareness source instead of other unreliable sources?	BI2
		27. With proposed program it is now beneficial to work in public sector than in private sector.	BI3
H4	**Effort Expectancy**	8. Does the program meet your expectation?	EE1
		16. Do you agree the program solve cyber security issues in public sector?	EE2
		18. The proposed program will enhance cyber awareness	EE3
		21. To what extent were the society cyber issues will be solved with the program?	EE4
		29. How much do you think the program will be easy to use?	EE5
H2	**Facilitating Conditions**	13. The smarter cities use modern and safe technologies, as the risk of cyber threats increases.	FC1
		14. Do you agree that the program is effectives in promoting smart cities?	FC2
		30. Do you think that the current IT infrastructure (internet speed, security and accessibility) is suitable for the success of the program?	FC3

H1	**Performance Expectancy**	12. The program promotes the knowledge on cyber security threats and appropriate practices to reduce risk for citizens living in smart cities in Saudi Arabia.	PE1
		15. Do you agree that the program is effectives in promoting digital economic and use of eCommerce?	PE2
		19. Do you agree the program can help to improve your skills and knowledge?	PE3
		25. The program will solve the issue of shortage of ICT professionals in public sector and serving the society.	PE4
		28. Do you think the program will help you to attain gains?	PE5
H3	**Social Influence**	9. How much do you rate this idea: the program has several partnerships and sponsors as a parallel program to qualify recent graduates or non-specialists to be new members and to ensure the continuity of the program	SI1
		17. The proposed program will lead to mutual benefit both to the community and professionals in terms of cyber education	SI2
		22. How much do you agree in this phrase: Saudi society is characterized by great trust among its members such as friends and family, increasing awareness and safety in smart cities will reduce the threats of social engineering such as impersonation to penetrate privacy.	SI3

		23. Based on the previous survey result shows that culture of Saudi Arabia is affected by social apps. Analysing the results, it has been observed that snapchat (51.4%) and Twitter (32.4%) are the two mostly used social media apps in the Saudi Arabia. Do you agree that awareness programs will reduce cyber threats through social media applications and how to deal with them?	SI4
Behavior towards cybersecurity frameworks adoption	**Use of Behavior (Dependent Variable)**	26. Does the program increase the interest among professionals in ICT sector in working in the public sector?	UOB1
		32. Are you willing to adopt the program to your life or recommend it ? To what extent	UOB2

Figure 1. Modified UTAUT Model plan:



2. Methodology:

A particular developmental research methodological framework was developed to design and implement a proposed cybersecurity framework. Initially a cyber competence and awareness-based program was designed as a proposed one for Saudi Arabia.

The program was subdivided into one of two interrelated categories: a societal awareness program and a cyber-hub. The cyber hub is the part of the program where advanced knowledge on cyber security and actions that would increase the adoption and safe usage of smart cities is shared with other participants. Members often include those with advanced entry level participation, professionals working in ICT, and specialists in ICT. Members of the program will earn points in this level of the program that may be redeemed for awards that attest to the individual's growing level of expertise in matters pertaining to cyber security and industry standards. It is the members' willingness to teach members of the general public about cyber security and awareness that determines whether or not they get points for their efforts. The second level of the program is the one that raises social consciousness and focuses on the public by way of online seminars, conferences, and community centers.

At this stage of the program, participants will exchange knowledge about the safest cyber practices and the most effective ways to use smart infrastructure in smart cities. The process of developing the program architecture is the second phase in the research approach. This part of the research is going to be handled by experienced educators and programmers from the workforce.

The following step will consist of analyzing and designing the program. In order to collect data from industry professionals and to acquire insights and data that will serve as the foundation for the cyber-competency and awareness program, a survey has been developed. Following the development of the program, the further steps of the research would consist of putting the program into action and analyzing how well it performs its intended function. The gathering of feedback from participants is an essential step in determining where adjustments are required and identifying areas of weakness. The comments will also make it possible to further tailor the program so that it better reflects the social, cultural, and economic character of the country. In the subsequent part of this investigation, a greater level of depth will be devoted to the examination of significant facets of the cyber-competency and awareness program for Saudi Arabia and its smart cities.

2.1 Literature Review:

As an integral component of the information security awareness campaign, informative videos play a significant role. There is no need for a proper classroom trainer, nor is it necessary to have personnel who cannot be reached with the use of software designed for online education. One concerning the most significant problems associated with traditional methods of dissemination of information among the challenges presented by techniques is keeping a trainee's attention and there

are required intensive efforts to explain your target and purpose of any program. Videos and other visuals adequate in length to convey an appropriate message are much effective especially when the trainees are difficult to approach them in person. Videos seen online give a number of benefits. The participants may see and learn from the videos as per their convenience. Visuals and graphics' interactive features contribute to the increased efficiency of the videos in comparison to non-interactive ways, although it is more costly. In addition, the videos can be watched and viewed again and again to enhance the understanding of the beneficiaries of any program.

(Abawajy, 2014) reported that In today's world, operating systems and programs are more secured, therefore hackers are focusing their efforts on breaking into organizations' information systems via vulnerabilities in its human workforce.

They focused on the analyses and assesses the impact of a variety of information security awareness distribution strategies that have been utilized to improve the information security awareness and behavior of end users. There is a broad variety of training delivery techniques available for information security awareness, such as training materials based on the internet, contextual training, and embedded training. A text-based approach, a game-based approach, and a video-based approach were the three modes of information security awareness training that they experimented with in order to ascertain which format was preferred by users. According to the findings of this research, a combination of several distribution strategies for security awareness is superior than using a single way. The videos and other visual methods of delivery were found to be most effective among all available sources of information dissemination. (Kruger & Kearney, 2006) reported a study based on the development of a prototype model for evaluating information security awareness in a multinational mining corporation. The results concluded that the prototypes had significant impact on awareness programs as compared to traditional methods of information dissemination.

(Abawajy & Kim, 2010) evaluated the effectiveness of various information security awareness delivery methods, such as interactive videos, internal training session classes, screen savers, emails, and social media. These methods were used to improve end-user awareness and behavior, particularly in relation to phishing attacks. They investigated the efficacy of approaches that were based on text, games, and videos respectively. The trials were carried out with sixty different individuals, and the results showed that the subjects' top choices for techniques were video, followed by texting in their order of preference. (Ahmed et al., 2017) employed both online and

offline polls of people in Bangladesh to determine the amount of cyber-security knowledge those individuals had. According to the findings of the survey, the current level of knowledge is unsatisfactory, and a significant proportion of the population is uneducated on the fundamentals of cybersecurity. However the videos and other protypes enhanced the awareness level significantly.

The objective of the cyber-competency and awareness program being implemented in Saudi Arabia is to guarantee that the issues that are now being faced by smart cities and cyber security are met. The training will be divided into two halves, and participants will be ranked based on their degree of experience as either novices, professionals, or experts.

The social awareness program will be the component of the program that will get the greatest attention from the general public. In this component of the program, the goal will be to educate the general public about cybercrime, cybersecurity, and appropriate ways to engage with various forms of technology. During the first phase of the program's rollout, entry-level participants will be recruited. These participants might be students attending reputable educational institutions or members of the general public holding any kind of recognized credential. The participants will be asked to take part in online courses, seminars, community centers, and conferences that are intended to educate them about the dangers of cyberspace and the appropriate ways to use resources in smart cities. Awarding members 5 points for each hour spent offering their services to the community of spreading information and educating members on cyber awareness is one way to encourage active participation and increase competency in the field. This can also be done as a means of increasing members' cyber awareness. The curriculum will place an emphasis on fundamental knowledge and skills in the areas of cyber security and space, and participants will be evaluated regularly on their technical and human abilities. The societal awareness program provides its participants with the opportunity to obtain essential technical knowledge that will assist them in navigating the complex world of smart cities and interacting with others online in a more secure manner.

3. Results

3.1 Professional (IT Experts)

By using Descriptive Statistics as show in table 3, the results of analysis, the frequency of male participants in the study was 87, while that of female participants were 23 with the frequency of

79% and 21% respectively. The results also explained that the frequency of public sector employees in the study were 38, while those belonging to private sector were 30, 7 were self-employed and 35 were students. 36 study participants had diploma, 52 participants had bachelor's level qualification, 17 had Master's level qualification, 2 had Post-graduation and 3 participants had phd level qualification, in the current survey project.

Table 3 *Frequency and Percentage of the Participants of the Study (N= 110)*

		Frequency	Percent	Valid Percent	Cumulative Percent
Age					
	18-25 years	46	41.8	41.8	41.8
	26-35	43	39.1	39.1	80.9
	36-45 years	16	14.5	14.5	95.5
	46-55 years	5	4.5	4.5	100.0
	Total	110	100.0	100.0	
Education					
	Diploma	36	32.7	32.7	32.7
	bachelor's	52	47.3	47.3	80.0
	Master's	17	15.5	15.5	95.5
	Post-graduation	2	1.8	1.8	97.3
	Phd	3	2.7	2.7	100.0
	Total	110	100.0	100.0	
Experience					
	no experience	18	16.4	16.4	16.4
	less than 1 year	27	24.5	24.5	40.9
	1-5 years	32	29.1	29.1	70.0
	5-10 years	14	12.7	12.7	82.7
	More than 10 years	19	17.3	17.3	100.0
	Total	110	100.0	100.0	
Gender					
	Male	87	79.1	79.1	79.1
	Female	23	20.9	20.9	100.0
	Total	110	100.0	100.0	
Working Sector					

public sector	38	34.5	34.5	34.5
private sector	30	27.3	27.3	61.8
self employed	7	6.4	6.4	68.2
Student	35	31.8	31.8	100.0
Total	110	100.0	100.0	

By applied the Scales Reliability and Validity of UTAUT components (*N=147*) and applied Correlation Analysis *(N= 110)* and T-test Analysis of Gender,:

- All the components of the UTAUT model have Cronbach's alpha value as above 0.7. This means that all the components are valid and reliable. Statistics Scale reliability (N=147)
- There is significant and positive relationship observed among different variables of the study. Results showed that effort expectancy is positively and strongly associated with attraction, while negatively associated with behavior intention. In addition to this it was also observed that behavior intention is also presenting positive and significant relationship with social influence.
- The overall results showed that there was no significant relationship among other variables of the study and participant's gender.

By applied the ANOVA Analysis for Working Sector, Work Experience, and Education The analysis revealed that:

- The participants belonging to public sector reported more facilitating conditions by presenting the p value at .002 and in term of social influence, by presenting p value .042. However, there was no significant analysis observed on anova in term of working sectors of the participants and other variables.
- The participants with 1-5 years of work experience show more facilitating conditions by presenting p value .000 and similar experience category also presented association with social influence by presenting the p value at .007. However, there was no significant analysis observed on anova with working experience of the participants and other variables of the study.

- The participants with bachelor's level of education show more significant association with facilitating conditions and social influence as well as use of behavior by presenting the p value significant at .000, .001. and .042 respectively.

3.2. IT experts' UTAUT Model Validation

3.2.1. Evaluation of Measurement Model

All the twelve constructs in the model were measured reflectively. The composite reliability (CR) was calculated to measure the internal consistency of the constructs. The Cronbach's alpha is used to test the reliability of the data and all the calculated values of Cronbach's alpha against all 12 constructs of the model are above 0.7 which reflects the validity of model The CR was greater than 0.7 for all the constructs. The outer loadings were significant and found to be higher than 0.7 for all constructs. Average variance extracted (AVE) which is a measure of convergent validity was found to be greater than 0.5 and significant at 95% level. The discriminant validity was established using the criteria of Heterotrait Monotrait (HTMT) ratio. This criterion is the strictest amongst the other two criteria for discriminant validity viz. cross loading criteria as compared to the Fornell and Larker criteria. The discriminant validity was established since all the values were below 0.85. Only between the constructs performance expectancy and gender (0.88) was higher than 0.85 which is still acceptable being close to 0.85 and therefore retained. All the factor loading in table 1 are above 0.7 and all factor weights are below 0.5 which confirm the model fit and validity of UTAUT Model adding Attraction as an independent variable.

3.2.2. Evaluation of Structural Model

The path coefficients (Figure 2 and Figure 3) are ascertained after running the PLS algorithm. The algorithm is designed to reject a set of path specific null hypothesis of no effect. Also, the path coefficient from behavioral intention, to use behavior, was both strong and significant. Also, as per Preacher and Hayes (2008), there was no requirement to test direct effect before and after including the mediator.

FIGURE 2. THE STRUCTURAL MODEL (MODIFIED UTAUT MODEL) OF THE SHOWING OUTER MODEL VALUES AS CRONBACH'S ALPHA. ALL THE VALUES ARE ABOVE 0.7.

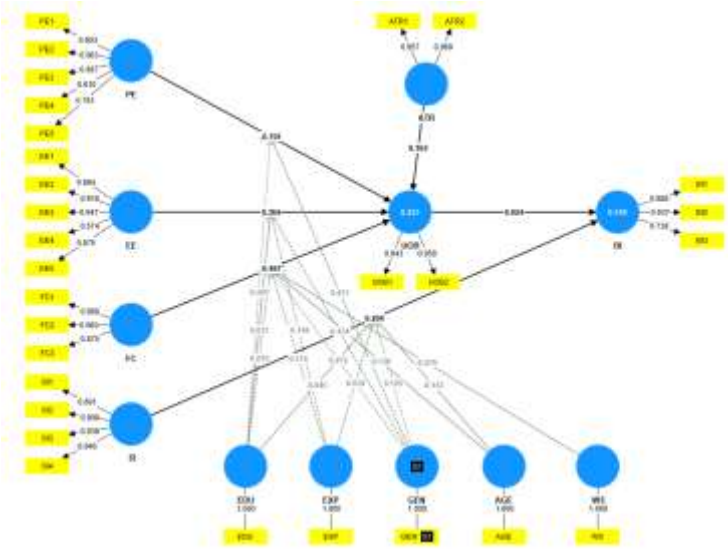
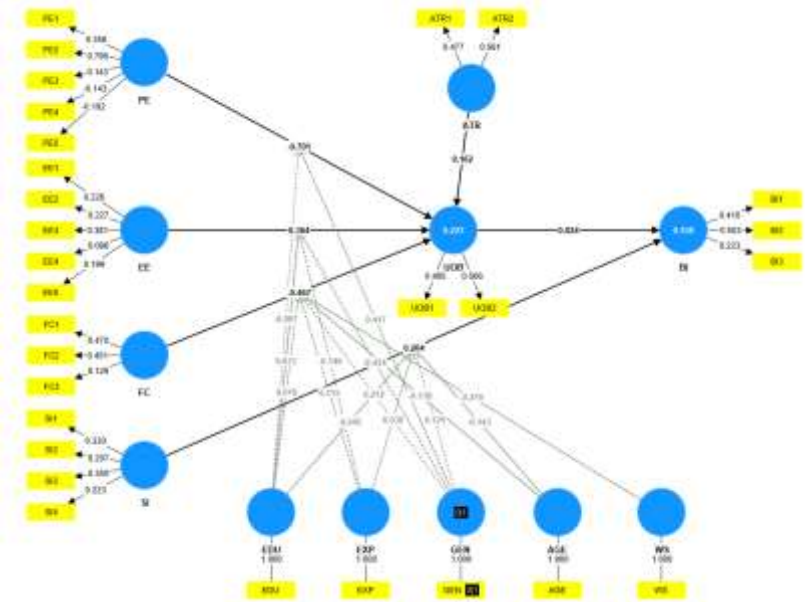


FIGURE 3. THE STRUCTURAL MODEL (MODIFIED UTAUT MODEL) OF THE SHOWING OUTER WEIGHTS. ALL THE WEIGHTS ARE BELOW 0.5



3.2.3. Test for Goodness of Fit

The goodness of fit measure was ascertained as per Henseler and Sarstedt (2013). The standardized root mean square residual (SRMR) was 0.064 which was well below the threshold limit of 0.092. Thus, the model was an overall good fit (Table 4).

Table 4. Standardized root mean square residual

Fit Summary	Saturated model	Estimated model
SRMR	0.064	0.092

Importance-Performance Map Analysis (IPMA)

The construct "effort expectancy" was found not to be the most impactful construct (total effect = 0.109) (Table 55), however its performance was good (Figure 4). This means that the potential for improvement was the highest for this construct. Thus, in actionable terms, the IT companies for obtaining the maximum returns on their user initiatives, could focus on "effort expectancy" the users. The other constructs were close to each other in their performance (Figure 4).

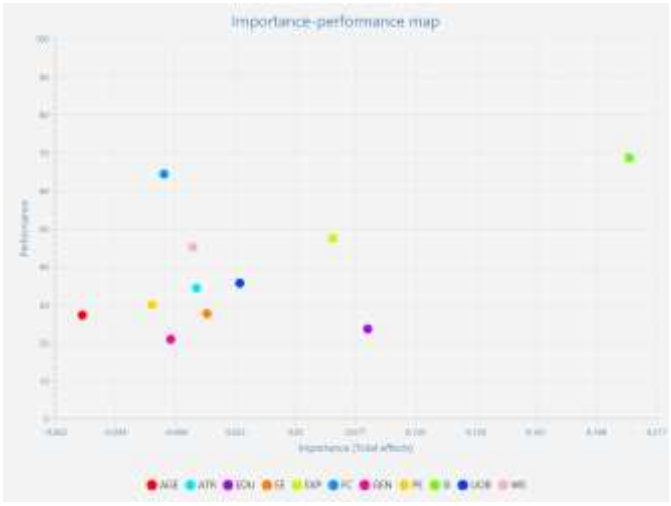


Figure 4. IPMA plot

3.3. General Public Results

3.3.1. Descriptive Statistics

By using Descriptive Statistics as show in table 5, According to the results of analysis, the frequency of male participants in the study was 93, while that of female participants were 54 with the frequency of 63% and 37% respectively.

Participants belonging to the age category of 18 – 25 years were 10, between the age of 26-35 were 48, between the age group of 36 – 45 years old were 56 and just 3 participants reported their age above 55 years of age. The results also explained that the frequency of public sector employees in the study were 100, while those belonging to private sector were 29, 10 were self-employed and 8 were students. 22 study participants had diploma, 83 participants had bachelor's level qualification, 33 had Master's level qualification, 1 had Post-graduation and 8 participants had phd level qualification, in the current survey project.

Table 5: *Frequency and Percentage of the Participants of the Study (N= 147)*

	Frequency	Percent	Valid Percent	Cumulative Percent
Age				
18-25 years	10	6.8	6.8	6.8
26-35	48	32.7	32.7	39.5
36-45 years	56	38.1	38.1	77.6
46-55 years	30	20.4	20.4	98.0
greater than 55	3	2.0	2.0	100.0
Total	147	100.0	100.0	
Education				
diploma	22	15.0	15.0	15.0
bachelor's	83	56.5	56.5	71.4
Master's	33	22.4	22.4	93.9
Post-graduation	1	.7	.7	94.6
PhD	8	5.4	5.4	100.0
Total	147	100.0	100.0	
Gender				
Male	93	63.3	63.3	63.3
female	54	36.7	36.7	100.0
Total	147	100.0	100.0	
Working Sector				
public sector	100	68.0	68.0	68.0
private sector	29	19.7	19.7	87.8
self employed	10	6.8	6.8	94.6

student	8	5.4	5.4	100.0
Total	147	100.0	100.0	

By applied the Scales Reliability and UTAUT Model Validity (*N=110*) and applied Correlation Analysis *(N= 147)* and T-test Analysis of Gender the results showed that:

- All the components of the UTAUT model have Cronbach's alpha value as above 0.7. This means that all the components are valid and reliable.
- The significant positive and negative relationship among different variables of the study. Results showed that attraction is significantly and positively associated with use of behavior. However, use of behavior found to be significantly associated with facilitating conditions, social influence and behavior intention, positively and negatively respectively. In terms of behavior intention, it was shown that behavior intention is positively associated with performance expectancy and effort expectancy, while negatively associated with facilitating conditions and social influence. In addition to this, effort expectancy positively associated with performance expectancy and negatively associated with facilitating conditions.
- There was no significant relationship among Attraction, Behavior Intention, Effort Expectancy, Facilitating Conditions, Performance Expectancy, Social Influence and Use of Behavior and participant's gender.

By applied the ANOVA Analysis for Age, Working Sector, and Education The analysis revealed that:

- There was no significant relationship among Attraction, Behavior Intention, Effort Expectancy, Facilitating Conditions, Performance Expectancy, Social Influence and Use of Behavior and participant's age in the current survey project.
- The participants belonging to public sector reported more social influence by presenting the p value significant at .05. However, there was no significant analysis observed on anova in term of working sectors of the participants, dependent and independent variables.
- The participants with bachelor's level of education show more significant association with use of behavior, attraction and facilitating conditions by presenting the p value significant at .03, 04 and .003 respectively.

3.4. Public Response - UTAUT Model Validation

3.4.1. Evaluation of Measurement Model

All the eleven constructs in the model were measured reflectively (Table 6). The composite reliability (CR) was calculated to measure the internal consistency of the constructs. The Cronbach's alpha is used to test the reliability of the data and all the calculated values of Cronbach's alpha against all 11 constructs of the model are above 0.7 which reflects the validity of model The CR was greater than 0.7 for all the constructs. The outer loadings were significant and found to be higher than 0.7 for all constructs. Average variance extracted (AVE) which is a measure of convergent validity was found to be greater than 0.5 and significant at 95% level. The discriminant validity was established using the criteria of Heterotrait Monotrait (HTMT) ratio (Table 26). This criterion is the strictest amongst the other two criteria for discriminant validity viz. cross loading criteria as compared to the Fornell and Larker criteria. The discriminant validity was established since all the values were below 0.85. All the factor loading in table 1 are above 0.7 and all factor weights are below 0.5 which confirm the model fit and validity of UTAUT Model adding Attraction as an independent variable.

Table 6. Reliability and validity

Construct	Items	Factor Loadings	Factor Weights	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)
Attraction				0.888	0.947	0.899
	ATR1	0.950	0.534			
	ATR2	0.947	0.520			
Behavior Intention				0.927	0.950	0.863
	BI1	0.930	0.505			
	BI2	0.912	0.245			
	BI3	0.945	0.325			
Effort Expectancy				0.955	0.963	0.791
	EE1	0.966	0.164			
	EE2	0.709	0.101			
	EE3	0.961	0.152			
	EE4	0.821	0.214			
	EE5	0.860	0.180			
	EE6	0.932	0.157			
	EE7	0.946	0.156			

Facilitating Conditions				0.882	0.927	0.808
	FC1	0.877	0.314			
	FC2	0.928	0.428			
	FC3	0.890	0.368			
Performance Expectancy				0.956	0.966	0.876
	PE1	0.974	0.356			
	PE2	0.887	0.183			
	PE3	0.957	0.326			
	PE4	0.924	0.193			
Social Influence				0.815	0.886	0.723
	SI1	0.776	0.284			
	SI2	0.888	0.377			
	SI3	0.882	0.505			
Use Behavior				0.903	0.954	0.911
	UOB1	0.951	0.502			
	UOB2	0.958	0.545			
Age		1.0	1.0	1.0	1.0	1.0
Working Sector		1.0	1.0	1.0	1.0	1.0
Education		1.0	1.0	1.0	1.0	1.0
Gender		1.0	1.0	1.0	1.0	1.0

3.4.2. Evaluation of Structural Model

The path coefficients (Figure 5 and Figure 6) are ascertained after running the PLS algorithm. The algorithm is designed to reject a set of path specific null hypothesis of no effect. The “f square” value is given in Table 27. Also, the path coefficient from behavioral intention, to use behavior, was both strong and significant. Also, as per Preacher and Hayes (2008), there was no requirement to test direct effect before and after including the mediator.

FIGURE 5. THE STRUCTURAL MODEL (MODIFIED UTAUT MODEL) OF THE SHOWING OUTER MODEL VALUES AS CRONBACH'S ALPHA. ALL THE VALUES ARE ABOVE 0.7.

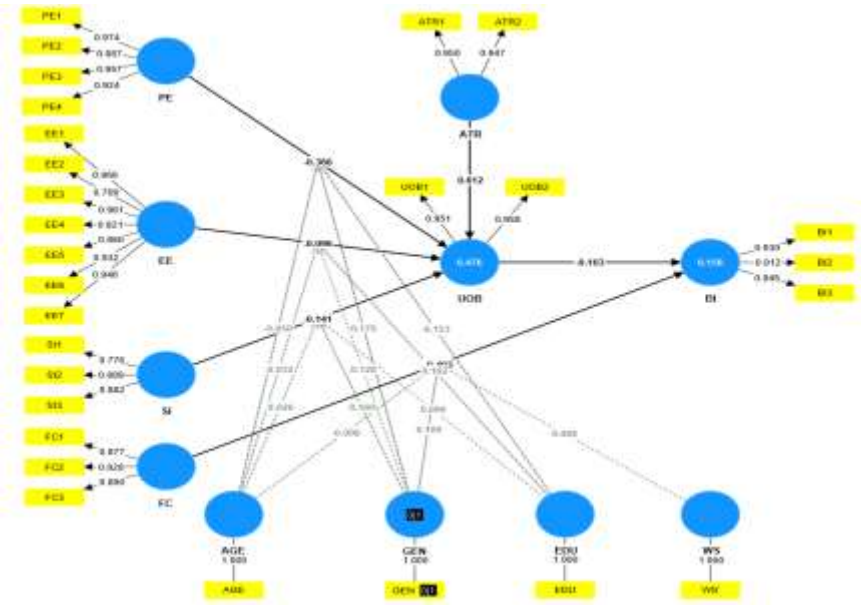
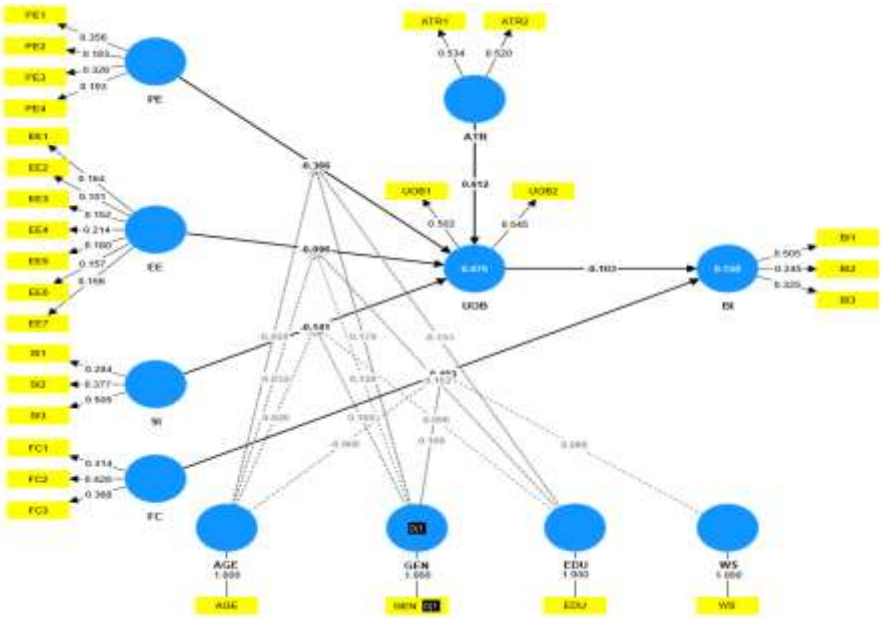


FIGURE 6. THE STRUCTURAL MODEL (MODIFIED UTAUT MODEL) OF THE SHOWING OUTER WEIGHTS. ALL THE WEIGHTS ARE BELOW 0.5



3.4.3. Test for Goodness of Fit

The goodness of fit measure was ascertained as per Henseler and Sarstedt (2013). The standardized root mean square residual (SRMR) was 0.061 which was well below the threshold limit of 0.092. Thus, the model was an overall good fit (Table 7).

Table 7. Standardized root mean square residual

Fit Summary	Saturated model	Estimated model
SRMR	0.061	0.092

3.4.4. Importance-Performance Map Analysis (IPMA)

The construct "Use Behavior" was found not to be the most impactful construct (total effect = -0.103), however its performance was good (Figure 3). This means that the potential for improvement was the highest for this construct. Thus, in actionable terms, the IT companies for obtaining the maximum returns on their user initiatives, could focus on "Use Behavior" of the users. The other constructs were close to each other in their performance (Figure 7).

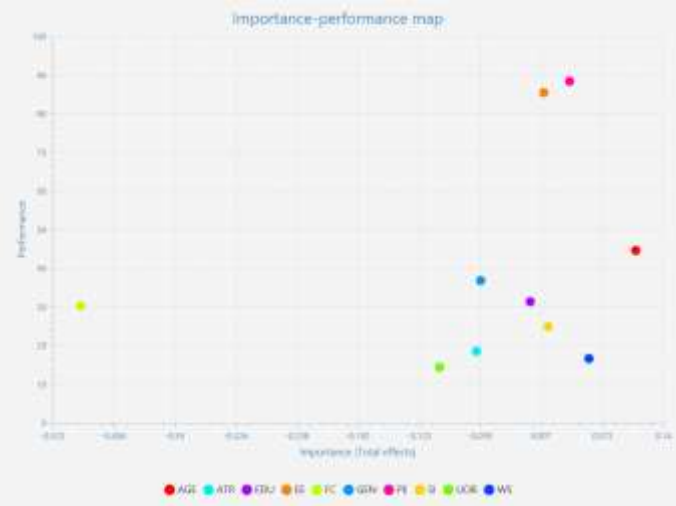


Figure 7. IPMA plot

4. Discussion:

A smart city specifies specific standards that must be met in order to ensure that its implementation is effective at all levels of the city's structural hierarchy. The degree to which residents of a smart city are prepared to make use of the various technological advancements available to them is one of the most important considerations to take into account, given that the establishment of a smart city hinges on the utilization of technology in the performance of all of the city's functions. Therefore, it is extremely crucial for the implementation of the idea of smart cities to determine whether or not the people living in a smart city are prepared to utilize the technologies for the day-to-day operations of the city. Further the development and adoption of cybersecurity frameworks makes the use of IT easy and user friendly.

Researchers are looking at technologies from both a technical and a social perspective as they investigate them. According to (Hollands, 2020), a large number of studies believe that the primary component in constructing smart cities and achieving success is the heavy use of information and communication technology. Nevertheless, people and administration are just as important to the concept of a smart city as the technology themselves (Baraniewicz-Kotasińska, 2022). As a result, in order to transform these technologies from merely technical solutions into truly intelligent solutions that can be used to alter the urban environment, cities should be designed with a focus on people and facilitate the inclusion of people in active life within an environment that is enabled by smart technology (Shelton & Lodato, 2019). It is of utmost significance in the modern day, when the idea of a smart city is being put into practise in the urban environment, bringing about changes in people's lives, companies, and other administrative procedures, among other things. (Abbas et al., 2019). The concept of "smart" is applied to government, communities, social learning, environmental sustainability, knowledge, and creativity (Ernst, 2019; Nam & Pardo, 2011).

The purpose of this research is to investigate the elements that influence people's intentions to utilize and adopt cybersecurity frameworks. In our research, we used a method known as partial least squares structural equation modelling (PLS-SEM), which is extensively utilized as a technique for estimating the route models that include latent variables and their respective associations. Specifically, we employed the UTAUT model. The UTAUT theory (Williams et al., 2015) is used by a large number of researchers in their investigations regarding the utilization of e-services, such as e-government (AlAwadhi & Morris, 2008; Li, 2021). Additionally, the UTAUT theory is broadly utilized to investigate the adoption of a variety of information systems.

This model can be interpreted in a number of different ways, each of which includes anywhere from four to seven or more determinants, such as performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating conditions (FC), Behavior Intension (BI) and User Behavior (UOB). The last two determinants are included to account for consumer behavior.

Within the parameters of the model that was researched, our investigation did not uncover any gender disparities. It is possible that this finding was the consequence of a unique circumstance and that it will not be replicated when performing research on additional samples. At the same time, such a finding may represent a distinguishing characteristic of the people living in Saudi.

Recent years have seen a substantial increase in the number of persons who are of retirement age in industrialized nations, as shown by demographic trends. Because of this fact, it is necessary to pay close attention to the preservation of the quality of life of senior people, in particular, in order to avoid the age-based segmentation of society while using e-services to resolve day-to-day problems. The age gap continues to have a substantial influence on the usage of e-services (Inkinen et al., 2018) and may contribute to digital inequality, despite the fact that older people are becoming more literate in digital technologies.

Additionally, we take into account the model's primary building blocks. The term "Facilitating Conditions" refers to the availability of certain technological equipment, specialized expertise, and the opportunity to acquire assistance when making use of the apps. According to the study that was given, the construct of Facilitating Conditions did not have an impact that was directly related to Behavioral Intention; rather, it has an influence on BI that is indirectly related to PE, SI, and EE.

It has been shown by (Ashari et al., 2018) that persons who own gadgets have a more favorable attitude toward technological advancements. The knowledge and skill competencies of individuals are also a part of the Facilitating Conditions component. While the authors assume that computer usage frequency and prior computer skills have a positive influence on attitudes toward using the technologies have found that frequent computer usage and prior computer skills have a positive impact on attitudes towards using the technologies. According to (Jan, 2018), a person's level of digital literacy as well as the amount of time spent using computers and other electronic devices have a major impact on their perspective about the implementation of ICT.

If we consider these factors as direct predictors of people's attitudes towards technologies, the results of this study differ; however, if we consider that competences and skills in the computer field make interaction with applications easier and make communication efficient without any special effort, this interpretation is supported by the obtained results, since FC indirectly affects the intention to use the applications via PE (expected productivity and efficiency).

This interpretation is supported by the fact that competences and skills in the computer field make interaction with applications easier and make communication efficient without any special effort (easy interaction without special learning).

All of the hypotheses were supported by results significantly and the UTAUT model was validated.

5. Conclusion:

The study investigates how individuals in smart cities feel about adopting cybersecurity frameworks in their day-to-day activities. As a result, the idea of a smart city as well as its inhabitants as its primary component were taken into consideration. Following an examination of the many models currently in use for the characterization of the attitudes of a population toward technological advancements, the authors came to the conclusion that the Unified Theory of Acceptance and Use of Technology would be most useful (UTAUT). All of the four hypotheses were validated. The performance expectancy, the effort expectancy, the social influences, and the Behavior intension towards the adoption of such cybersecurity frameworks all have a beneficial impact on the likelihood that residents would actually utilize the frameworks in their day-to-day living. Through the processes of PE, SI, and EE, the Facilitating Conditions construct has an indirect impact on BI. The Attractions (ATTR) construct has an indirect influence on BI, which in turn affects UOB

The findings of this research, the authors believe, will enable the authorities of Saudi Arabia to facilitate all of the processes of putting the smart city concept into action by increasing the population's involvement in the use of applications along with cybersecurity framework in all aspects of day-to-day life. This is what the authors consider to be the most important takeaway from the study. The study is innovative from a scientific standpoint since it does not explore a particular technology using the UTAUT model; rather, it investigates the overall attitude of a community toward the technologies and applications. Due to the existence of this fact, the use of the model may be increased to investigate a greater number of situations.

Nevertheless, the practical applications of this study are where the majority of its value lies. It is something that may be done by the local government in order to improve the population's engagement in all of the activities that take place inside a smart city.

6. Analysis Data Availability

The All Analysis Data are Available to access by contact the corresponding author via e-mail address: mamhalwani@kau.edu.sa

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