

The effect of technological context on smart home adoption in Jordan

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ABSTRACT

This research examines the use of internet of things (IoT) smart home technologies in Jordan, using the technologies-organization-environment (TOE) framework and social exchange theory (SET). This study investigates the influence of security and privacy considerations on the behavioral intention to embrace IoT smart home solutions. The research examines the function of trust (TR) in service providers as a mediator and investigates how information technology (IT) knowledge acts as a moderator between technological elements and behavioral intention. Analyzed using smart partial least squares (PLS), data from 315 responses of executives in both listed and non-listed businesses were examined. The results highlight the need of giving priority to technological factors and building TR in service providers to ensure the effective implementation of IoT smart home technology in Jordan.

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1. INTRODUCTION

The internet of things (IoT) is a groundbreaking idea that aims to link items at all times and in any location, enabling the development of novel applications and services [1]–[3]. Advocates see it as a significant industrial transformation that is expected to increase productivity, enhance public health, improve transportation efficiency, decrease energy use, and address problems related to climate change, security (SE), and safety. The main goal of this project is to promote sustainable production and consumption behaviors, as explained in previous research [4]–[7]. The IoT is a complex system that effortlessly combines actual things with software and hardware components [8]–[12]. The IoT is very adaptable and may be used in a wide range of fields, including industrial, manufacturing, and healthcare sectors [13]–[15]. This technology has the potential to transform and improve processes in several industries by combining physical and digital aspects. It aims to promote sustainability in both production and consumption, leading to significant advancements.

Although anticipated to see tremendous expansion, the smart home (SH) industry, which is a subset of IoT applications, has encountered obstacles and is still in its nascent phase [16]. The sluggish advancement may be attributed to factors such as challenges in user acceptance, limited levels of information technology (IT) expertise, and apprehensions about privacy (PV) and SE. Although the majority of research on SH has been concentrated on industrialized nations, there are local enterprises in less developed countries, such as

Jordan, that provide IoT SH technology [17]–[19]. Nevertheless, the continued prevalence of low adoption rates may be attributed to several causes, including a lack of widespread understanding, worries over technology (specifically related to SE, PV, and availability (AVA), and a deficiency in IT knowledge (ITK) [20].

Despite the AVA of IoT SH services from many firms in Jordan, the adoption rates among Jordanians are low owing to concerns around PV, SE, trust (TR), ITK, and attitudes towards IoT SH [20]. Notwithstanding these obstacles, the IoT SH industry is forecasted to expand in Jordan. This research aims to examine the effect of technological factors (TC) on the adoption of IoT SH [21]. It specifically explores the function of TR as a mediator and the impact of ITK as a moderator in this context.

2. LITERATURE REVIEW

This section presents a succinct exploration of the IoT SH. It aims to delve into the key aspects of IoT-enabled SH, providing a comprehensive understanding of the subject. Additionally, the section introduces the theoretical foundation that underpins the study and expands on the construction of the conceptual framework, offering a detailed insight into the framework’s formulation.

2.1. IoT smart home

The IoT SH is a developing technology that aims to improve the quality of life for people and families. This cutting-edge technology is based on the interconnectivity of various home equipment, giving them the potential to be controlled remotely and perform intelligent tasks [16]. The scope of its application extends to several fields, including household appliances, e-health, entertainment, communication, assisted living, safety and security, energy efficiency, and general ease. SH consist of four essential components, as identified by scholars in the field: a communication network that allows devices to interact smoothly, intelligent controls that enable efficient system management, sensors that collect relevant data diligently, and smart features that respond dynamically to sensor data, user commands, and inputs from the system provider [16], [22], [23]. The complex incorporation of various elements not only establishes the structure of IoT SH but also emphasizes its capacity to provide a highly sophisticated and networked living environment that greatly enhances the everyday lives of inhabitants.

2.2. Conceptual framework

The technologies-organization-environment (TOE) framework, renowned for its comprehensive viewpoint, is used, while disregarding human, environmental, and organizational elements, with a specific emphasis on the setting of IoT SH. The social exchange theory (SET) is proposed to include further contextual factors, including TR in service providers [24], [25]. The research suggests that there is a direct impact of TC on BI, with TR in service providers acting as a mediator and ITK playing a moderating role. The conceptual framework of this research demonstrates the expected impact of behavioural intention (BI) on the adoption of IoT SH in Jordan, as shown in Figure 1.

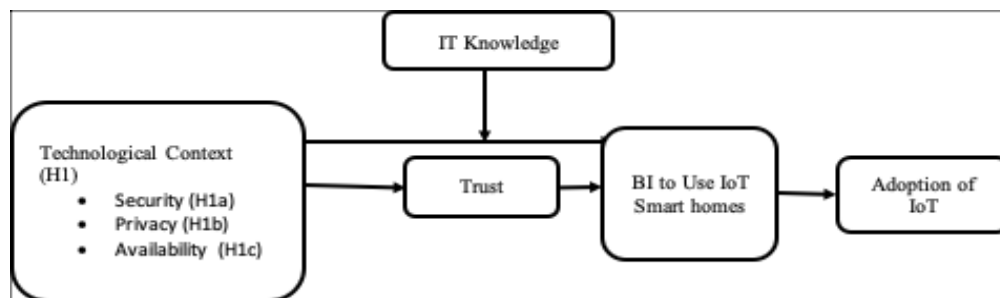


Figure 1. Conceptual framework

2.3. TC and BI to use IoT

The TC comprises SE, PV, and AVA, which are fundamental elements of TOE. Numerous studies have explored their impacts on various technology adoptions. In the realm of IoT, a study conducted by [26] shown a notable and favorable impact on the technology aspect on the acceptance and implementation of IoT smart farming in Korea. Similarly, the research carried out by [27] in Spain showed a clear and substantial impact of the technical environment on the acceptance of IoT by small and medium enterprises (SMEs). Therefore, this research expects that the TC will have a beneficial impact on the BI to utilize IoT SH in

Jordan. Therefore, the hypothesis is expressed in the following manner: H1: The TC has a favorable impact on the use of IoT SH in Jordan.

2.3.1. SE and BI

The issue of SE is of utmost importance when it comes to the use of technology, particularly in the field of IoT SH. Prior research [28]–[32] emphasized that SE is a crucial element in the adoption of IoT. The study conducted by [33] emphasized the crucial importance of IoT SE in terms of its adoption and repurchase intention. Similarly, [34] showed that SE has a substantial impact on the level of resistance towards smart services. In the United States, [35] SE was considered as essential for the ownership of IoT SH. Thus, the hypothesis is formulated as: H1a: SE has a substantial impact on the adoption of IoT SH.

2.3.2. PV and BI

With a significant amount of research emphasizing the crucial importance of PV in the realm of the IoT, particularly regarding data collection [28], it is becoming increasingly clear that PV considerations have a substantial impact on different aspects of IoT adoption. The empirical research carried out by Hsu and Lin [36] highlights the complex relationship between PV concerns and the collection and use of personal data in the IoT environment. Their results emphasize that PV has a crucial role in defining user attitudes and actions, which in turn affects the overall adoption of IoT devices. Building upon this viewpoint, a research conducted by [37] explores the precise mechanisms of PV concerns in relation to the deployment of IoT SH in China. The study demonstrates a significant connection between consumers' worries about their PV and their readiness to accept IoT-enabled household surroundings.

Consequently, PV issues have practical consequences for people's choices to employ SH technology, extending beyond just theoretical concerns. Furthermore, the observations presented by [30] emphasize the global importance of PV concerns in the wider context of accepting and implementing IoT technology. The results indicate that users are more inclined to interact with and embrace IoT technology when their PV concerns are effectively resolved. This emphasizes the intricate correlation between PV guarantees and the overall effectiveness of IoT projects in various settings. In addition, [38] provides insight into the particular situation in South Korea, where PV concerns have emerged as the primary factor influencing the acceptability of IoT-enabled smart dwellings. The geographical variation highlights the importance of understanding PV dynamics in a given environment, suggesting that cultural and socioeconomic aspects significantly influence consumers' views towards PV in the IoT field. Thus, the following is proposed: H1b: PV has an impact on the BI to use IoT SH.

2.3.3. AVA and BI

Tornatzky and Fleischer [39] developed the TOE model, which includes the importance of technology availability as a key technological factor. In a study conducted by Mashal and Shuhaiber [20], the importance of IoT smart home availability was emphasized in relation to the successful adoption of the technology. A study conducted among SMEs in Spain found that the AVA of resources plays a crucial role in influencing the adoption of IoT technology by SMEs. As a result, this study presents the following hypothesis: H1c: AVA has a significant impact on BI to use IoT SH.

2.4. BI and the adoption of IoT

Historically, theories in the field of technology adoption have consistently connected BI to actual usage behaviors [40]–[42]. Several previous studies have found a clear link between BI and use behavior [43]–[45]. A study conducted by [37] found that the intention to use IoT smart homes had a positive impact on the actual utilization of this technology. Thus, this study presents the following hypothesis: H2: the adoption of IoT smart homes is greatly influenced by behavioral intention.

2.5. The role of TR as a mediator

Establishing TR and promoting technology adoption relies heavily on the perception of service providers as reliable, ethical, and in sync with users' needs [46]. In the field of technology adoption, a study by [47] proposed a typology that highlights the significance of TR. It suggests that TR plays a crucial role as a mediator between the factors that contribute to successful adoption and the intentions to use technology. TR is a crucial factor in determining individuals' intentions to take action, as proposed by SET. A study conducted by [48] utilized SET to examine the impact of TR on a group's intention to make purchases in an online setting. The study highlighted the importance of TR in influencing behavioral intentions and user satisfaction in online transactions. Furthermore, TR has been recognized as a key determinant of purchase intention in various studies on e-commerce [49].

The study examined the role of TR in cloud adoption and found that TR played a mediating role in the relationship between perceived quality and user satisfaction with cloud adoption in Taiwan [50]. In a similar vein, a study discovered that TR played a mediating role in the relationship between technological and environmental factors and the intention to adopt cloud transformation [51]. Therefore, the following hypothesis is proposed: H3: TR mediates the effect of TC on BI to use IoT SH.

2.6. ITK on moderation

ITK plays a crucial role in the widespread adoption of IoT smart homes. In a study, the importance of ITK in the adoption of IoT in the farming industry in South Korea was highlighted [52], [53]. Additionally, a study discovered that ITK had a moderating effect on the connection between individual factors and behavioral intentions towards using cloud computing e-learning. A study conducted by [27], delved into the impact of experience and education on the adoption of IoT smart homes in China within the context of the IoT. The findings emphasized the crucial role played by a strong educational background and ample experience in enhancing the adoption of IoT smart homes [37]. Therefore, it is expected that a strong understanding of IT in managing IoT SH will have a positive impact on the adoption of such homes, as indicated in this study. Therefore, the following hypothesis is proposed: H4: the impact of TC on the BI to use of IoT SH is influenced by ITK.

3. RESEARCH METHOD

This research utilizes a quantitative methodology, using a questionnaire as the principal instrument for data collection. The questionnaire is considered to be the most effective method for collecting data quickly within a restricted time period [54], [55]. The research examines affluent people in Jordan, including both publicly traded and family-owned enterprises. The population consists of about 192 executives from publicly traded corporations and an estimated 500 executives from family-owned businesses, for a total population of 6,920 affluent persons. Random sampling is used to study the adoption of executive-level individuals who have comparable income and lifestyles. The sample size, computed using the method [53], is determined to be 364 respondents, given a population size of 6,920. After considering the possibility of people not responding and extreme data points, the sample size is increased by following the suggestions from reference [56]. As a consequence, there are now 728 questionnaires in the distribution.

The questionnaire is comprised of questions sourced from several references. It includes 3 items on SE and 4 items on PV from [57], 4 items on TR from [20], ITK from [27], 4 items on AVA from [58], 5 items on BI from [59], [60], and 3 items on user behavior from [40], [61]. The questionnaire underwent validated by three experts and a pilot study was done prior to the collection of field data. It is accessible in both English and Arabic. A grand number of 724 questionnaires were sent out to participants using the database of registered and privately-owned businesses in Jordan. Utilizing follow-up and reminders effectively increased the response rate, yielding a total of 341 answers. After excluding 11 replies with missing data and 15 responses with outliers, the research got a total of 315 valid, complete, and useable responses. The data had a normal distribution, and there were no detected concerns of collinearity among the variables.

4. FINDINGS

4.1. Profile of the respondents

A total of 315 participants were included in this investigation. 80.3% of the sample consisted of individuals aged 41 to 50 years. The majority of respondents were males, comprising 65.1% of the pool, and 76.2% of them had a bachelor's degree. The respondents exhibited a high level of skill in using IoT applications, with their expertise including SH (15.4%), manufacturing (43.3%), and healthcare IoT (28.4%).

4.2. Model for measurement

The The assessment model of the research received thorough examination, including assessments of factor loading, validities, and measurement reliabilities. Several components were excluded from this method, including item 3 from TR, as well as one item from PV, BI, and ITK, respectively. Table 1 shows that the calculated Cronbach's Alpha (CA) exceeds 0.70. In addition, the composite reliability (CR) is over the criterion of 0.70, and the average variance extracted (AVE) is higher than 0.50. The numerical findings are consistent with the advice given by statisticians [62]. Confirming the distinctiveness of the variables, the square root of the AVE is greater than the values indicating the extent to which the variables load on other factors, as shown in Table 1.

Table 1. Measurement model assessment

	CA	CR	AVE	AVA	BI	ITK	PV	SE	TC	TR	UB
AVA	0.91	0.94	0.78	0.88							
BI	0.88	0.93	0.81	0.44	0.89						
ITK	0.94	0.93	0.91	0.13	0.43	0.95					
PV	0.78	0.88	0.70	0.33	0.31	0.21	0.83				
SE	0.89	0.91	0.81	0.41	0.33	0.31	0.21	0.90			
TC	0.85	0.88	0.54	0.43	0.41	0.34	0.34	0.12	0.86		
TR	0.87	0.92	0.79	0.41	0.64	0.41	0.41	0.13	0.34	0.88	
Use behaviour (UB)	0.83	0.90	0.74	0.31	0.14	0.53	0.41	0.44	0.14	0.34	0.86

4.3. Structural model and hypotheses testing

The structural model was evaluated by analyzing the R-square (R2), F-square (F2), predictive relevance, and path coefficients. The R-square of the model is 0.50, indicating that 50% of the variation in IoT adoption can be explained by technical background. The F-square values are modest across all pathways, and the predictive significance is more than zero. These measurements adhere to the permissible ranges as suggested by [60]. Figure 2 clearly depicts the structural model.

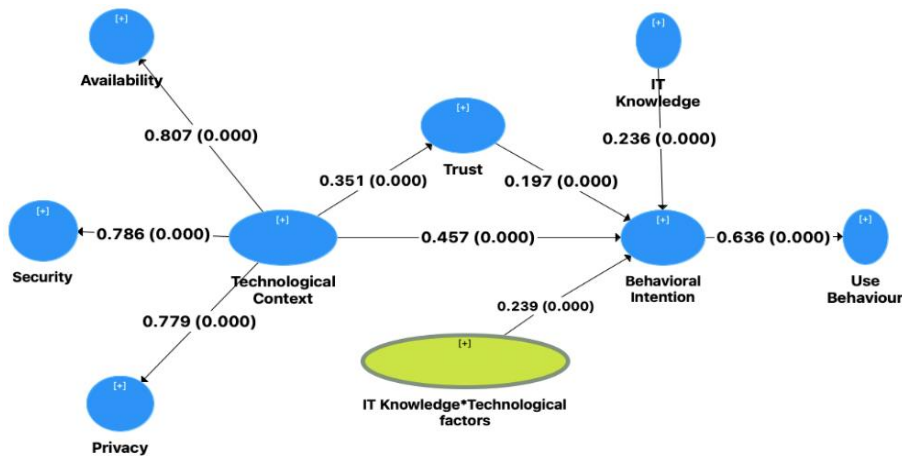


Figure 2. Structural model

The path coefficient of the model, as presented in Table 2, offers valuable insights into the structural relationships within the study. The coefficient includes the value (B), standard deviation (STDEV), T-values (T), and P-values (P). The B coefficient represents the strength and direction of the relationship between the variables, while the standard deviation indicates the level of variability in the data. The T-values for each coefficient provide a measure of the statistical significance of the relationships. Higher T-values indicate greater significance. P-values are useful for evaluating the likelihood of obtaining results that are as extreme as the ones observed. They assist in determining the statistical significance of the coefficients.

Table 2. Path coefficient and result of hypotheses

H	Path coefficient	B	STDEV	T	P	R2	F2
H1	TC ->BI	0.45	0.05	9.84	0.00	0.50	0.34
H1a	SE ->BI	0.18	0.05	3.71	0.00		
H1b	PV ->BI	0.40	0.06	7.18	0.00		
H1c	AVA ->BI	0.15	0.06	2.74	0.01		
H2	BI ->UB	0.63	0.05	13.11	0.00	0.40	0.68
H3	TC -> R	0.35	0.05	6.51	0.00		0.14
	TR ->BI	0.19	0.04	4.45	0.00		0.07
H4	TC-> TR->BI	0.06	0.02	3.72	0.00		
	ITK ->BI	0.23	0.05	4.74	0.00		0.10
	ITK*TC ->BI	0.23	0.04	6.12	0.00		0.12

The results of the hypothesis testing provide insight into the linkages within the analyzed model. Firstly, H1 proposed that the TC has a favorable and substantial impact on BI, and the findings confirm this claim. The observed phenomenon indicates that the TC significantly influences individual's inclination to embrace IoT SH. Expanding on certain elements of the TC, H1a, H1b, and H1c examined the impacts of SE, PV, and AVA on BI, respectively. The actual data, as shown in Table 2, confirms the importance of these parameters. The sub-hypotheses are supported by the important factors of SE (H1a), PV (H1b), and the AVA of IoT technology (H1c), which shape users' BI. H2, which examines the relationship between BI and use behavior, the results demonstrate a clear and substantial positive association. This indicates that people who have a positive inclination towards adopting IoT SH are more inclined to convert that inclination into real use behavior, hence offering empirical evidence in support of H2.

H3 posited that TR functions as a mediator between TC and BI. The analysis of direct and indirect impacts, as shown in Table 2, demonstrates that TR plays a mediating role in affecting BI in the context of adopting IoT SH. This implies that the level of confidence in the service provider plays a vital role in determining users' BI, which are impacted by TC. Finally, H4 investigated the influence of ITK on the connection between TC and BI, specifically examining its moderating impact. The findings demonstrate a favorable and substantial interaction, verifying the existence of moderation. Essentially, individuals with advanced ITK demonstrate an enhanced connection between the TC and BI, emphasizing the moderating influence of ITK.

5. DISCUSSION

The objective of this research was to evaluate how the TC influences the acceptance of IoT SH in Jordan. The technological elements considered were SE, PV, and AVA. The study also investigated the mediating function of TR and the moderating impact of ITK. The findings emphasized the crucial significance of TC as a deciding element in the acceptance of IoT SH in Jordan. The results emphasized that PV had a greater impact than SE and AVA, indicating a heightened awareness of the possible PV issues connected with using SH apps. Therefore, it is crucial to prioritize the protection of PV in IoT SH. These results are in line with previous studies that continually highlight the importance of the TC and its elements, such as SE, PV, and AVA [26]–[30], [33]–[38]. Moreover, the research found that TR acts as a mediator in the connection between TC and the BI of IoT SH. This highlights the crucial need of building TR in service providers in order to increase the BI of IoT SH. The role of TR in mediation suggests that TR plays a part in explaining how the TC affects the adoption of IoT SH. This finding aligns with other studies that recognized TR as a crucial mediating factor between the TC and the BI of technology [49]–[51].

Furthermore, the research examined the influence of ITK as a moderating factor. The findings indicated that the level of ITK has a moderating effect on how the TC impacts the acceptance of IoT SH. More precisely, an enhancement in ITK as a moderator was linked to a favorable influence on the relationship between TC and the acceptance of IoT SH in Jordan. This underscores the significance of ITK in influencing the patterns of technology integration within the framework of IoT SH.

6. IMPLICATIONS

This research has significantly contributed to the existing body of literature, specifically in the context of developing nations and the use of IoT technology in SH. The research has used the TOE framework and SET to determine the influence of the TC. Furthermore, the examination of the mediating influence of TR and the moderating influence of ITK has yielded a thorough comprehension of the aspects that impact the BI of IoT SH. The research has effectively elucidated a significant proportion of the uptake of IoT SH in Jordan.

Decision-makers should prioritize enhancing PV in IoT SH. The need of PV has become paramount in influencing customers' willingness to use IoT SH technology. Decision-makers were urged to prioritize the establishment of safe and easily accessible IoT applications due to the critical importance of SE and AVA. It is essential to guarantee the reliability of service providers, and it is necessary to establish stringent regulations to deal with any violations of TR. Proficiency in IT is crucial, and decision-makers are recommended to organize seminars and courses to instruct users, hence enhancing their acceptance and utilization.

7. CONCLUSION

This research aimed to investigate the influence of TC on the adoption of IoT SH, taking into account the mediating effect of TR and the moderating effect of ITK. The results emphasized the crucial importance of PV, SE, and AVA as technical contextual variables that have a favorable impact on the

adoption of IoT SH. TR was recognized as a component that mediates the connection, whereas ITK has a function in moderating this relationship. Decision-makers should emphasize the improvement of PV and cultivate TRworthy connections between users and service providers. This study, carried out among high-ranking personnel in both publicly traded and privately held enterprises in Jordan, establishes the groundwork for future investigations into the adoption of IoT in other industries and among different nations and groups of participants.

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