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Extending the UTAUT2 Model to Understand the Entrepreneur Acceptance and Adopting Internet of Things (IoT)

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Abstract. The aim of this empirical study is to explore and discuss the factors that affect entrepreneurs acceptance and adoption of the Internet of Things (IoT) using UTAUT2 model. The study data was collected using a survey that was distributed among Omani entrepreneurs in six months period. The results showed that the relationship between information technology knowledge and entrepreneurs acceptance and adoption of the IoT was supported, like most other hypothesized relationships in the study.

Keywords: Internet of Things (IoT) · UTAUT2 · IT knowledge · Entrepreneurs · Oman

1 Introduction

1.1 Internet of Things (IoT)

The Internet of Things (IoT) also known as 'future internet' is a unique pattern with a simple idea of linking all things in the globe through the internet [1]. Defining schemes of physical objects that are independently connected together is one of IoT uses. IOT allows users to have limitless connection and linkage of physical objects to the internet in order provide better services. These linked or connected physical objects should have computation and communication abilities, such as mobile and social networks, in addition to smart elements and devices [2]. With recent developments and progresses in the internet technologies, internet of things (IoT) technology impact on our lives is increasing, and beginning to propose interesting and useful new services. The attention towards IoT technologies have been remarkably rising and with large number of applications in many different fields [3, 4]. The growing development of IoT has quickly increased in the world including Asian countries. In Oman the uses and applications of IoT can be described as primitive and still tyro, as the IoT industry is still a newfangled in the world. In addition that the individual users of IoT technologies may have some concerns related to privacy, security and data accessibility, specially collected by governments and companies [5, 6].

Modern and recent research nowadays tend to emphasis on the IoT design, architecture and implementation from the technical and practical perspective [7–10]. For example, [11] demonstrated the structure of IoT and talked about some essential

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topics and subjects of the IoT, such as its architecture and the interoperability, etc. [12] illustrated main technical topics, including internet scalability, heterogeneity, identification and addressing. Most of modern existing IoT studies have examined the application of IoT business model from the firm and government viewpoints [6, 12–14]. The research into the IoT acceptance from consumer perspective (e.g. entrepreneurs) is still in its early stages [15]. Furthermore, studies and research into the user acceptance of information technology (IT) has always been an important matter in information management [16–20].

Previous research comprehended poor insufficient fundamentals about consumer reception and acceptance of the new IT technology (i.e. IoT technology). The necessity of engaging more IoT users and maintaining them, casts the lights on identifying the influential factors of consumer acceptance of IoT applications, products and services. An overall inclusive study focusing on these factors can develop essential managerial modulations, on better, effective IoT products and services marketing to gain more consumer acceptance.

1.2 The Unified Theory of Acceptance and Use of Technology (UTAUT)

UTAUT was developed by Venkatesh in 2003 after he studied all different models that were suggested by other researchers aiming to understand users acceptance and adoption of technologies and innovation. Such models are TAM, TPB, TRA and in 2003. UTAUT was developed - which is the base model for this research, surpassed all other models- and later came UTAUT2. [21] Initially, [21] UTAUT involved four core constructs (performance expectancy, effort expectancy, social influence, and facilitating conditions), [19] reviewed and improved the model by adding more variables such as (price value, hedonic motivation and habit) in order to increase its descriptive power and named it UTAUT2. Therefore, in this study UTAUT2 was used as the base for this research for its validity and strength compared to other models.

UTAUT was criticized by different researchers such as [22] and [23] for not being tested on non-western countries such as Arab countries, which considered to show bias results through countries and contexts [24–27] testing UTAUT in this culture and situation is considered to be significant, as it can make it more strong and applicable model. [28] Reviewed the literature discussing UTAUT, and emphasized that researchers from other regions can start on original UTAUT studies related to context, since most of the studies were conducted in the USA. [28] focused on opportunities in the field for researchers to involve more and assist in improving UTAUT model, even though it has been previously developed, tested and improved by researchers, using the existing models, combining them with UTAUT, and addition of variables.

This research aims to extend the UTAUT2 model, by adding a new variable namely "IT Knowledge" in the field of technology, acceptance and adoption. This is an important consideration for a country such as Oman, in which several previous studies have clearly emphasized its significant role. For example, it has been clearly highlighted in past literature that people's lack of IT knowledge is a strong barrier to new technologies adoption in Oman [29]. The same issue has also been highlighted in other GCC countries such as Kuwait and Saudi Arabia [30, 31] making it an important variable to consider while adopting UTAUT2 in such countries.

2 Literature Review

The internet of things (IoT) is an interactive process that uses three internet layers in order to connect people with networks, smart objects and active intelligence [32, 33].

First and lowest part in the IoT structure is the device [34] it uses technologies such as RFID, NFC to collect data from substantial network and smart objects. [32, 35] and WSN [15, 34, 36] the availability of IoT services for users plays a great role in measuring how useful and valuable it's perceived.

Gateway and the main network are considered to be the second layer which is called the connection [34], the different devices and technologies at the device layer are evenly connected through the gateway, while the network provides the IP connection, which is supported by a range of different telecommunication infrastructure. using mobile devices and through cloud computing, data stored at the connection layer can be used, activated and observed by users. Services and applications used by the end user are considered to be the third layer, it can be situated at home, transportation and broader community such as retail, environment, factories and etc. [34]. The IoT concept have been described by different terms such as widespread or prevailing computing, machine to machine (M2 M), and sensor networks. [32, 34, 37].

The IoT applications are in various fields such as Health [35] logistics, [38], public services, transportations, retailing, agriculture and construction [38], manufacturing, supply chain management [34]. In order to improve operations and make them more effective, some of the applications allows gathering data on site and real-time [36, 38]. Numerous theories and models that were used to simplify and explain the relation between user acceptance and the use of technology such as the model of perceived credibility (PC), behavioral intentions (BI), theory of planned behavior (TPB), theory of reasoned action (TRA), innovation diffusion theory (IDT), technology acceptance models (TAM) [39], a hybrid model merging concepts from TAM and TPB and more, only few of them that have lead the path in investigations and results [19, 21].

Unified theory of acceptance and use of technology (UTAUT) was a result of studying and investigating different models and theories that discuss the user acceptance and its relation to the use of technology [15, 19, 35, 39, 40].

There are four main fundamentals for UTAUT that influence the behavioral intention to use technology, its performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC) [19, 21, 41]. And in 2012 UTAUT was extend to UTAUT 2 including three new fundamentals hedonic motivation (HM), price value (PV), and Experience and Habit (EH) by Venkatesh named UTAUT2 [19].

3 IT Knowledge

The way people interact with the internet and its applications including IoT services is called IT knowledge [42]. According to [43] IT knowledge includes employees' knowledge of systems analysis and design, internet security knowledge, programming, web site design and skills in developing technologies. The customers' awareness of the current used technology and how it's being used and operates is important for the

adoption of new technology and decreases their anxiety [44]. By examining the adoption of a third party apps in the US [45] concluded that technology awareness is a very significant factor for the adoption.

IT knowledge showed that it is an essential variable that influences the adoption of new technologies in Arab countries. For example, a research in Jordan was conducted on the intention to adopt electronic government services concluded that there are difficulties related to the computer knowledge and it plays a major role in the adoption of the technology by Jordanian [46]. Similarly, another study on innovation adoption in Saudi Arabia highlighted that organizations' technological willingness and employees' IT knowledge are amongst the main organizational characteristics influencing innovation adoption in Saudi Arabia [31]. Moreover, additional similar studies such as [47] and [43] emphasized that e-commerce adoption is influenced by the organizational IT readiness which denotes the technology infrastructure and employees' IT knowledge. Additionally, [48] pointed that organizational knowledge (training availability, technical expertise, and the level of knowledge) are connected to the level of e-business systems adoption (Fig. 1).

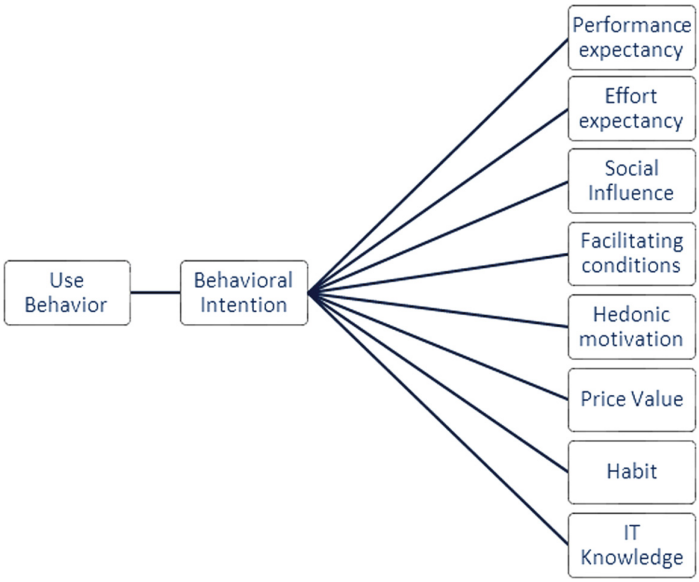

Fig. 1. Research model.

4 Methodology

This empirical study used a self-administrated questionnaire for data gathering that was distributed to Omani entrepreneurs. The questionnaire was translated from English to Arabic for more effectiveness; some alterations were done for finalization after the reliability of measurement was confirmed through pilot test. Data collection period

from February until June with a total of 110 collected questionnaires, by excluding incomplete and outlier cases, 93 questionnaires could be used. The respondents were mostly male with 56% compared to female who were 44%. In terms of marital status, most of the respondents were married (56%), followed by single (42%) and others (2.2%). With regards to education most of the respondents were educated with having bachelors (71%) and diploma (25%). All the items used in this research were adopted from previous literature.

5 Results

In order to test the significant path coefficients (relationship between variables in the model) bootstrapping with 500 sample cases was used. To find out whether the relationship is significant, we have looked at t-values derived from bootstrapping and all t-values above 1.65 were considered as significant relationships. This is based on [49] recommendation. In summary, out of 8 relationships in the model, 6 of them were supported. More specifically, the relationships between Performance Expectancy (PE), Social Influence (SI), and Facilitating Conditions (FC), Hedonic Motivation (HM), Habit (HT) and IT Knowledge (ITK) with Behavioral Intention (BI) were significant while the relationship between Effort Expectancy (EE) and Price Value (PV) with BI were not supported. Among all these significant relationships the effects of PE on BI was the strongest, implying that performance expectancy has the highest effect among all variables in UTAUT2 on intention to adopt Internet of Things (Table 1).

Table 1. Summary of relationship tests.

Relationship	t-values	Decision
PE => BI	2.420	Supported
EE => BI	0.101	Not Supported
SI => BI	1.959	Supported
FC => BI	1.865	Supported
HM => BI	1.775	Supported
HT =>BI	1.759	Supported
PV => BI	0.395	Not Supported
ITK => BI	1.648	Supported

6 Discussion and Conclusion

The aim of this study was to find the factors that influence entrepreneurs' adoption of IoT in Oman, through the use of UTAUT2 and extend the model after applying it to the study by adding a new variables. The additional variable was IT knowledge which hasn't been tested in the framework of IoT. The study results were harmonious with previous studies that applied such a model [50]. It indicated that performance expectancy is significant and powerful variable that influence the IoT adoption by

entrepreneurs. Results showed entrepreneurs will not adopt IoT unless it's beneficial of their processes and operations. Furthermore, the results of this study did not confirm the relationship between effort expectancy and behavioral intentions which contradicts previous studies such as [51]. The social influence had a major and positive influence on IoT adoption as well. Another result that corresponded with pervious study for [52] was that entrepreneurs will go toward adopting IoT if they find that their competitors are using it. Moreover, it was found through the study that the simpler and easier the conditions were the greater the intention is to adopt to IoT by entrepreneurs, this is consistent with results of [53].

The hypothesized effect of hedonic motivation, which concentrates that entrepreneurs' motivation to adopt IoT is caused by the fun and pleasure of using the technology was confirmed and is consistent with previous literature [19, 54]. The study hypothesized that there is a relationship between price value and IoT adoption, but the results showed no relationship between them, which contradicts with the result from a study by [19]. Previous studies highlighted that effort expectancy is probably has no significant effect on IoT adoption. Comparing the influences of social and individual factors on entrepreneurs' perception on using IoT with the influence of its information technology knowledge will show a main factor, as they don't see that it's expensive. On the other hand the results showed a definite strong relationship between habit and IoT adoption. It shows that entrepreneurs are more likely to adopt the technology, if using the IoT services becomes a habit, this compound with the result of [19].

Lastly, the results of studying IT knowledge and its relation to IoT adoption, found that they have a strong relationship with each other. It shows that people motivation to adopt new technologies such as IoT is related to their knowledge and awareness of information technology, which agrees with the study by [55] in the field of technology adoption.

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