ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2016; 2(5): 361-367
www.allresearchjournal.com
Received: 11-03-2016
Accepted: 12-04-2016

Adai Mohammad Al-Momani
Adai is a Master Student at The Department of Software Engineering, College of Computer Science & Information Technology, Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, 43009 Kajang, Selangor, Malaysia.

Moamin A Mahmoud
Dr. Moamin is a lecturer at The Department of Software Engineering, College of Computer Science & Information Technology, Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, 43009 Kajang, Selangor, Malaysia.

Mohd Sharifuddin Ahmad
Professor at The Department of Software Engineering, College of Computer Science & Information Technology, Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, 43009 Kajang, Selangor, Malaysia.

Correspondence
Adai Mohammad Al-Momani
Department of Software Engineering, College of Computer Science & Information Technology, Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, 43009 Kajang, Selangor, Malaysia.

Modeling the adoption of internet of things services: A conceptual framework

Adai Mohammad Al-Momani, Moamin A Mahmoud, Mohd Sharifuddin Ahmad

Abstract
Internet of Things (IoT) is a new emerging technology, investment on which is expected to reach more than three thousand billions dollars in 2020. The literature focus on the technical aspects of the IoT services and less attention on the behavioral studies that clarify the perception of customers about the adoption and usage of the IoT services. Consequently, the purpose of this paper is to develop a conceptual model of the adoption of IoT services. The model is built based on the theory of Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT) and supplemented by a critical review of nine related articles. The outcome of this paper is a conceptual framework that links the ease of use and usefulness in TAM with social influence of UTAUT and other factors such as cost, trust, IT knowledge, and security and privacy for the IoT services.

Keywords: Internet of Things (IoT), TAM, UTAUT, Usefulness, Trust, Conceptual Framework

Introduction
The Internet of Things (IoT) is a new paradigm which has been mentioned for the first time by Ashton in 1999 (Gao & Bai, 2014) [16]. It is defined as the networking of physical objects through the use of embedded sensors, actuators, and other devices that can collect or transmit information about the objects (McKinsey, 2014). It consists of three levels that include the hardware in the first level followed by the infrastructure in the second level and the third level is the application and services level (Gu & Liu, 2013; Gómez *et al*., 2013) [18, 17].
Previous studies have mostly focused on the technical issues of using IoT. Such as, architectural elements (Gubbi *et al*., 2013) [19], attribute-based signature (Su *et al*., 2014) [33], and wireless sensor network (Turkanović, Brumen & Hölbl, 2014) [35]. However, less attention has been paid to users of IoT and their perceptions about the technology. In addition, previous studies use the Technology Acceptance Model (TAM) to assess the users' perception about the adoption (Gao & Bai, 2014) [16]. Nevertheless, the unified theory of acceptance and use of technology (UTAUT) is proven to be more powerful and able to explain the variation in the acceptance of technology better than TAM and any other theoretical model and it is not deployed effectively in the literature (Alharbi, 2014; Chang *et al*. 2015; Mathur & Dhulla, 2014) [5, 8, 27].
The literature in the technical aspects of IoT outnumber the behavioral and attitudinal aspects. Few studies have examined the acceptance of IoT by consumers (e.g. Gao & Bai, 2014) [16]. Since the IoTs industry are growing rapidly and estimated to reach $3,010 billion by 2020 with $1,534 billion for consumer segment (Gartner, 2015) [15], there is a potential need to establish frameworks that strengthen consumers' perception about the technology. Consequently, the purpose of this paper is to develop a conceptual framework for the adoption of IoT services by consumers.
The next section reviews and analyzes the literature on IoT services. In the third section we present the proposed conceptual framework. The fourth section details out the framework components and Section 5 concludes the paper.

2. Literature Review

2.1 IoT Technology

Cisco defined IoT as the smart links of objects to the Internet that enables an exchange of available data and brings users information in a more secure way (Cisco, 2015) [9]. Other definitions have focused on the functionality of the IoT and widened the stakeholders to include governments, companies, individuals, and societies. In this study, the IoT is simply defined as a mechanism for automating devices that are used by consumers. The IoT describes objects that are able to communicate via the internet (Uckelmann *et al*., 2011) [36]. Many areas use the technology such as home automation, mobile payment, warehouse management, healthcare and the private domains (Ding, 2013) [13]. The IoT technology provides efficiencies across many industries and their benefits to consumers are substantial (Uckelmann *et al*., 2011) [36]. For example, users may benefit from the IoT technologies used in smart fridges that autonomously monitor the consumption of food and beverages and re-order goods (Sundmaeker *et al*., 2010) [34]. In this context, the IoT technologies affect consumers' behavior on several aspects of their daily life (Li & Wang, 2013) [26].

Current studies have examined the technical issues of implementing the IoT technology (Shang *et al*., 2012) [32]. For example, researchers identified the security and privacy issues as the major challenges for consumer acceptance of the IoT technology's user-oriented IoT applications (Medaglia & Serbanati, 2010) [30]. Uckelmann *et al*. (2011) [36] systematically discussed the architecture of IoT. Guinard *et al*. (2011) [20] described the IoT's best practices. Previous studies focused on the design and usage of IoT technologies from the organization's or industry's point of view (Schlick *et al*., 2013) [31], while little attention has been devoted to understanding the acceptance of the IoT technology from the perspective of individual consumers (Li & Wang, 2013) [26]. Furthermore, research have yet to investigate the impacts of technology characteristics, social context and individual user characteristics on consumer acceptance of the technology. Given the high practical relevance and dearth of prior empirical work, this research aims to develop a framework of factors determining consumers' acceptance of the IoT technology.

2.2 Technology Acceptance Model (TAM)

A number of theoretical models have been proposed to facilitate the understanding of factors influencing the acceptance of information technologies (Davis 1989; Venkatesh and Davis 2000) [11, 37]. Among these studies, TAM is one of the most influential in explaining information technology adoption behavior. The key purpose of TAM is to provide a basis for discovering the impact of external variables on internal beliefs, attitudes, and intentions (Marchewka *et al*., 2007) [28]. Figure 2.1 shows the conceptual model of TAM.

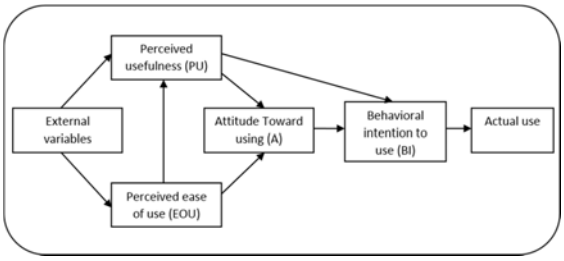

Fig 1: Technology Acceptance Model (Davis, 1989) [11]

TAM assumes that beliefs about usefulness and ease of use are always the primary determinants of information technologies adoption in organizations. According to TAM, these two determinants serve as the basis for attitudes toward using a particular system, which in turn determines the intention to use, and then generates the actual usage behavior. Perceived usefulness is defined as the extent to which a person believes that using a system would enhance his or her job performance. Whereas, perceived ease of use refers to the extent to which a person believes that using a system would be free of mental efforts (Davis 1989) [11].

TAM has been widely used by researchers to examine the acceptance of new technology. For example, many studies have incorporated the model in electronic government, electronic learning, mobile learning, and cloud computing studies. This paper utilizes the key variables of TAM such as the usefulness and the ease of use because they are essential for the adoption of new technology.

2.3 Unified Theory of Acceptance and Use of Technology (UTAUT)

User acceptance research covers one of the most important issues in information system (IS) management. Many competing models have been proposed to understand various IT acceptance behavior: the TAM, the theory of reasoned action (TRA), the theory of planned behavior (TPB), and the diffusion of innovation (DOI) among others (Venkatesh *et al*., 2003) [38]. A comprehensive model is needed to aid in understanding user acceptance of a new technology.

Venkatesh *et al*. (2003) [38] proposed the UTAUT model to integrate the findings of previous studies on the acceptance of new technology. The UTAUT includes four critical antecedents (performance expectancy, effort expectancy, social influence, and facilitating conditions) which affect both behavioral intention and actual behavior. Gender, age, experience, and voluntariness have been found to moderate the above relationships (Venkatesh *et al*., 2003) [38]. These relationships are also confirmed by Weerakkody, El-Haddadeh, Al-Sobhi, Shareef, and Dwivedi (2013) [39] in the context of electronic government, or electronic learning (Wang *et al*., 2009) [45], cloud computing (Lian, 2015) [43], and electronic commerce. Figure 2 shows the conceptual model of UTAUT.

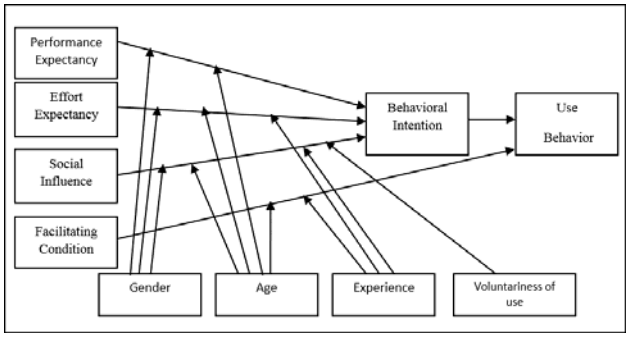

Fig 2: Unified Theory of Acceptance and Use of Technology (Venkatesh *et al*., 2003) [38]

The key variables of UTAUT is developed based on the similarities with other variables from other theories and models. For example, performance expectancy is considered similar to perceived usefulness in TAM. Table 1 shows the core variables of UTAUT.

Table 1: The Core Variables of UTAUT (Venkatesh *et al*., 2003) [38]

Variables	Sources
Performance expectancy	Perceived usefulness, extrinsic motivation, job-fit, relative advantage.
Effort expectancy	Perceived easy to use; Complexity.
Social influence	Subjective norm, social factors; Image.
Facilitating Conditions	Perceived behavioral control, Facilitating conditions; Compatibility.

Venkatesh *et al*. (2003) [38] combined the previous models of technology adoption to come up with UTAUT which is design specifically to investigate users' acceptance of a new technology and it has explanatory power higher than previous models such as TAM. Thus, the UTAUT model is suitable for understanding the acceptance of IoT services.

2.4 Critical Review

Researchers have attempted to identify the factors that affect the acceptance of IoT by customers. For example, Gao and Bai (2014) [16] investigated the factors that affect the acceptance of IoT in China. Mainly, their study used the factors of TAM such as perceived ease of use and perceived usefulness along with other factors such as trust, social influence, perceived enjoyment, and perceived behavioral control. A total of 368 respondents have participated in the study. The results indicate that perceived usefulness, perceived ease of use, social influence, perceived enjoyment and perceived behavioral control have significant effect on behavioral intention to use the IoT. Acquity Group, (2014) [1] investigated the concerns of customers to adopt the IoT. A total of 2000 customers in US have been surveyed. The findings showed that awareness of the technology, usefulness, price (cost), security, privacy are the main concerns of the customers.

Since the IoT concept is still new, researchers attempted to conduct qualitative studies to identify the factors that affect the intention to use the new technology. For example, Kowatsch and Maass (2012) [24] investigated the intention to use IoT service in Spain. The study interviewed 31 experts in IoT to validate a conceptual model that include perceived IoT privacy, expected usefulness, trust in IoT services, personal interest in IoT. The findings show that the intentions to use IoT services are influenced by perceived privacy risks and personal interest, legislation, data security, and transparency of information use. In a similar approach, Coughlan *et al*. (2012) [10] conducted an exploratory study on the adoption of IoT. The study collected data using the mix approach. Quantitative and qualitative data were collected from 35 respondents. The findings show that the most important factors are usefulness, ease of use, privacy, knowledge and awareness of the technology. Another exploratory studies by Alolayan (2014) [6] in UK attempted to discover the adoption of one kind of IoT which is a smart fridge. The findings were based on interviews with 35 students. The findings indicate that there are social factors such as cost, technology anxiety, and social influence. Technical factor includes perceived usefulness, and perceived ease of use.

Other studies attempted to review and integrate the literature to find the factors that affect the acceptance of IoT services. For instance, the literature review of Evans (2015) [14] found that the barriers for effective adoption of IoT are slow technology adoption rate, issues with interoperability, the collection and impactful use of big data, a lack of regulations and privacy concerns, messaging design, consumer perception, and finally, cost of implementation. Another study by Abu *et al*. (2015) [46] in Malaysia discovered the factors that affect the adoption of technology. The result is a conceptual model that include the factors of ease of use, usefulness, and the attitude toward the technology.

Due to the fact that the studies in IoT adoption are still limited, other studies in similar field, such as the adoption of technologies in general, are investigated. For example, Kin and Shin (2015) [23] investigated the intention to use smart watches in Taiwan. Data was collected from 363 students. The findings show that the affective quality and relative advantage of smart watches are found to be associated with perceived usefulness, while the sense of mobility and availability induced by smart watches led to a greater perceived ease of the technology's use. The results also indicate that the device's subcultural appeal and cost are notable antecedents of user attitude (AT) and intention to use, respectively. Similarly, a study by Han and Windsor (2014) [21] in US attempted to find the intention to adopt third party application. The study used a questionnaire and 269 students were the respondents of the study. The findings indicate that users' technology awareness and trust in security apps have significant effects on adoption intention. In addition, trust plays a moderator role in the security apps.

To simplify the presentation of the factors that have been extracted from the previous studies, Table 2 provides a summary of the factors and their frequencies. Frequencies refer to the times that the variables have been used in the nine reviewed studies.

Table 2: Frequency of the Factors

Model/theories	Variables	Frequency
TAM	Perceived usefulness	7
TAM	Perceived ease of use	5
TAM/TPB	Attitude	2
Literature	Trust	4
UTAUT	Social influence	2
Literature	Perceived enjoyment	1
TPB	Perceived behavioral control	1
Literature	Privacy risk	1
Literature	Privacy concern	4
Literature	Personal Interest	1
Literature	Awareness	3
Literature	Price	1
Literature	Security	1
Literature	Knowledge	1
Literature	Cost	**3**
Literature	Technology anxiety	1
Literature	Threat awareness	1
Literature	Interoperability	1
Literature	Collection and impactful use of big data	1
Literature	Regulation	1
Literature	Messaging design	1
Literature	Consumer perception	1
Literature	Affective quality	1
DOI	Relative advantage	1
DOI	Availability	1
Literature	Mobility	1
Literature	Subcultural appeal	1

Table 2 shows the factors that have been extracted from nine studies that are related to the IoT. The merging of models and theories is one of the approaches to develop a new

framework such Venkatesh *et al*. (2003) [38]. The following section presents the conceptual framework of this study.

3. The Conceptual Framework

When Venkatesh *et al*. (2003) [38] developed the UTAUT, they considered the similarities between the factors (see Table 1). In a similar approach, this research considers the similarity between the factors found from the previous research. Thus, based on the previous research including the understanding of the words and functions as well as the definitions of the variables, and the conceptualization of the TAM and UTAUT, the conceptual framework of this study is constructed as shown in Figure 3. The framework consists of seven independent variables that are extracted from the literature and the supporting theories. The seven independent variables are expected to affect the behavioral intention which in turn is expected to affect the use behavior of the IoT services.

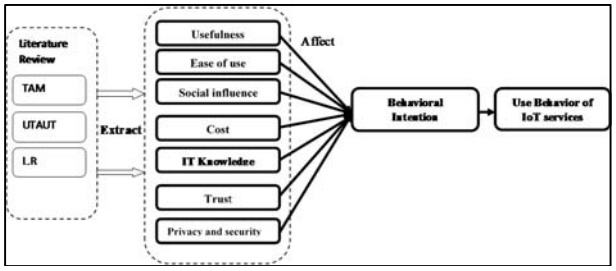

Fig 3: The Proposed Conceptual Framework

3.1 Behavioral Intention and use Behavior

The ultimate dependent variable of this study is the use behavior and it is defined as the individual's positive or negative feeling about performing the target behavior. For example, using a system is a behavior (Venkatesh *et al*. 2003) [38]. Behavioral intention is defined as the degree to which a person has formulated conscious plans to perform or not to perform some specified future behavior (Venkatesh *et al*. 2003) [38]. Venkatesh *et al*. (2003) [38] pointed out that behavioral intention and user behavior are variables that predict the adoption of a new technology. Earlier theorist such as Ajzen (1991) [2] who developed the theory of planned behavior, believed that behavioral intention is a motivational factor for the adoption of a new technology. For example, Ajzen (1991) [2] highlighted that if a customer perceives a new technology services to be useful, his behavior intention is affected toward using the technology. This intention is translated into actual usage of the technology which becomes a pattern. TAM by Davis *et al*. (1989) [11] proposed that the behavioral intention to use affect the actual system use. Consequently, the first hypothesis of this study is:

H1: There is a significant positive effect of behavioral intention on the use behavior of IoT services.

3.2 Usefulness and Behavioral Intention

Venkatesh *et al*. (2003) [38] pointed out that perceived usefulness in TAM is similar to performance expectancy in UTAUT and relative advantage in diffusion of innovation. Benefits and advantages that are gained from the technology could enhance the perceived usefulness of customers (Venkatesh *et al*. 2003) [38]. In the context of IoT, perceived usefulness suggests that individuals will find IoT services useful because it enables them to enhance his or her overall performance in everyday situations (Kowatsch & Maass, 2012) [24]. Acquity Group (2014) [1]. found that one of the most important factors for the adoption of IoT services in US is the usefulness of the technology. Similarly, Coughlan *et al*. (2012) [10] suggested that perceived usefulness is a significant predictor of the intention to use IoT services in UK. Therefore, it is hypothesized:

H2: There is a significant positive effect of perceived usefulness on the behavioral intention to use IoT services.

3.3 Ease of Use and Behavioral Intention

Gao and Bai (2014) [16] pointed out that perceived ease of use has significant effect on the behavioral intention to use IoT services in China. Similar findings were derived by Yong Wee *et al*. (2011) [42] who investigated the adoption of technology among students. The findings show that ease of use is one of the factors that affect the behavioral intention of student. Abu *et al*. (2015) [46] in their literature review found that ease of use is one of the most important factor for the adoption. Thus, based on the above discussion, it is expected in this study that the effect of perceived ease of use on behavioral intention is significant. Accordingly, the following is hypothesized:

H3: There is a significant positive effect of perceived usefulness on the behavioral intention to use IoT.

3.4 Social Influence and Behavioral Intention

Social influence is defined by Venkatesh *et al*. (2003) [38] as a person's perception that is important for others believe that he should use a new technology. Gao and Bai (2014) [16] investigated the effect of social influence on the adoption of IoT services. The findings showed that social influence has significant effect on the behavioral intention to adopt IoT services. Alolayan (2014) [6] pointed out that one of the most important factors for the adoption of smart fridge in UK is the social influence. Thus, it is hypothesized:

H4: There is a significant positive effect of social influence on the behavioral intention to use IoT.

3.5 Cost and Behavioral Intention

Cost is defined as the monetary value that customers pay for the service providers. Cost especially when related to individuals are one of the significant factors for making a decision. Many researchers in the IoT service adoption have found that cost is a significant factor. For example, Kin and Shin (2015) [23] found that the cost has a significant effect on the adoption of IoT services in Taiwan. Similarly, the result of the survey conducted by Acquity Group (2014) [1]. in US has found that one of the most effective concern of customers when thinking about adopting IoT services is the cost. Therefore, it is hypothesized:

H5: There is a significant negative effect of cost on the behavioral intention to use IoT.

3.6 IT Knowledge and behavioral Intention

IT knowledge is defined as the ability of customers to deal with the Internet and its applications, including the IoT services (Acquity Group, 2014) [1]. For customer to adopt a new technology, they must be aware of the technology being

used and how it can be used and utilized effectively and this reduces their anxiety (Dimitrova & Chen, 2006) [12]. Han *et al*. (2014) [21] investigated the adoption of third party apps. A total of 269 students in US were involved. The findings showed that the technology awareness is one of the most important factor for the adoption. A study conducted in Jordan to investigate the intention to adopt electronic government services has found that there are issues related to the computer literacy and it plays a major role in the adoption of the technology by Jordanian (Khasawneh *et al*., 2011) [22]. Thus, it is hypothesized:

H6: There is a significant positive effect of IT knowledge on the behavioral intention to use IoT.

3.7 Trust and Behavioral Intention

Trust is defined as the one's perceptions regarding the integrity and ability of the agency providing the service (McKnight *et al*. 2002) [44]. Many researchers have criticized UTAUT and TAM and urge the future studies to include the variable trust (Alghamdi & Beloff, 2014, Wu, 2011) [4, 40]. Gao and Bai (2014) [16] found that trust in the IoT services is a significant factor that affects the behavioral intention to adopt the services. In addition, trust also is an important factor for the adoption of IoT services in Spain by (Kowatsch & Maass, 2012) [24]. Similarly, the study of Han and Windsor (2014) [21] pointed out that trust in the operation system and in the apps is essential for the adoption of third party apps. Thus, the following is hypothesized:

H7: There is a significant positive effect of trust on the behavioral intention to use IoT

3.8 Security and Privacy, and Behavioral Intention

Security is defined as the extent to which a person believes that using a particular application will be risk free (Xu *et al*., 2003) [41]. While privacy is defined as the potential loss of control over personal information (Akturan & Tezcan, 2012) [3]. Privacy and security are major concerns of customer when adopting a new technology and it has significant influence on the adoption of technology (Lee, 2009) [25]. In order to increase the adoption and usage level of information systems and applications, users need to feel safe when interacting with such systems (Alghamdi & Beloff, 2014) [4]. Transaction security is critical for users when making online activities. (Berdykhanova, Dehghantanha & Hariraj, 2010) [7]. Lack of security and privacy are among the issues that prevent customers from adopting the IoT services in US (Acquity Group, 2014) [1]. In addition, Kowatsch and Maass (2012) [24] pointed out that security and privacy are among the factors that affect the intention and the willingness to provide personal information for IoT services. Coughlan *et al*. (2012) [10] in UK found that privacy and security are important factors for the adoption of IoT in the country. Accordingly, the following is hypothesized:

H8: There is a significant positive effects of security and privacy on the behavioral intention to use IoT.

4. Conclusion, Limitation and Future Work

The purpose of this paper is to develop a conceptual model of the adoption of IoT services. A review of the literature showed that research in this field are still in their infancy and there is a need for more research. Based on the theory of TAM and UTAUT and a critical review of nine articles, a new conceptual framework for the adoption of IoT services is proposed. The study contributes to the literature by providing a new conceptual model and filling the gap of incorporating trust and IT knowledge as well as security and privacy into a framework.

The conceptual framework is built based on nine studies because these are the only related articles that we identified. In addition, the study deployed other related studies due to the fact that few studies have been conducted in this field. Thus, as a way forward, this study will empirically test the conceptual framework by collecting data using a questionnaire. The future research is recommended to conduct more empirical studies in this field. They are recommended to test the conceptual framework in different developed and developing countries so that the results can be compared between researchers.

5. References

1. Acquity Group. The Internet of Things : the continuation of the internet, (January), 2014, 8-9.
2. Ajzen I. The theory of planned behavior. Organizational behavior and human decision processes 1991; 50(2):179-211.
3. Akturan U, Tezcan N. Mobile banking adoption of the youth market: Perceptions and intentions. Marketing Intelligence & Planning 2012; 30(4):444-459.
4. Alghamdi S, Beloff N. Towards a comprehensive model for e-Government adoption and utilisation analysis: The case of Saudi Arabia. In Computer Science and Information Systems (FedCSIS), 2014 Federated Conference on, 2014, 1217-1225. IEEE.
5. Alharbi ST. Trust and Acceptance of Cloud Computing: A Revised UTAUT Model. In Computational Science and Computational Intelligence (CSCI), 2014 International Conference on 2014; 2:131-134. IEEE.
6. Alolayan B. Do I Really Have to Accept Smart Fridges ? An empirical study. ACHI 2014 : The Seventh International Conference of Advances in Computer-Human Interactions, (c), 2014, 186-191. Retrieved from http://www.iaria.org/conferences2014/ACHI14.html
7. Berdykhanova D, Dehghantanha A, Hariraj K. Trust challenges and issues of e-government: E-tax prospective. In Information Technology (ITSim), 2010 International Symposium in 2010; 2:1015-1019. IEEE.
8. Chang SS, Lou SJ, Cheng SR, Lin CL. Exploration of usage behavioral model construction for university library electronic resources. The Electronic Library 2015; 33(2):292-307.
9. Cisco. Internet of things, 2015. Available at:http://www.cisco.com/c/en/us/solutions/internet-of-things/overview.html
10. Coughlan T, Brown M, Mortier R, Houghton RJ, Goulden M, Lawson G. Exploring Acceptance and Consequences of the Internet of Things in the Home. 2012 IEEE International Conference on Green Computing and Communications, 2012, 148-155. http://doi.org/10.1109/GreenCom.2012.32
11. Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS quarterly, 1989, 319-340.
12. Dimitrova DV, Chen YC. Profiling the Adopters of E-Government Information and Services the Influence of Psychological Characteristics, Civic Mindedness, and

Information Channels. Social Science Computer Review 2006; 24(2):172-188.
13. Ding W. Study of smart warehouse management system based on the IOT. In Intelligence Computation and Evolutionary Computation. Springer Berlin Heidelberg, 2013, 203-207.
14. Evans HI. Barriers to Successful Implementation of the Internet of Things in Marketing Strategy, 2015, 5(9).
15. Gartner. Gartner Says 6.4 Billion Connected "Things" Will Be in Use in 2016, Up 30 Percent From 2015. Available at http://www.gartner.com/newsroom/id/3165317.
16. Gao L, Bai X. A unified perspective on the factors influencing consumer acceptance of internet of things technology. Asia Pacific Journal of Marketing and Logistics. 2014; 26(2):211-231. http://doi.org/10.1108/APJML-06-2013-0061
17. Gómez J, Huete JF, Hoyos O, Perez L, Grigori D. Interaction system based on Internet of things as support for education. Procedia Computer Science, 2013; 21:132-139. http://doi.org/10.1016/j.procs.2013.09.019
18. Gu Y, Liu Q. Research on the application of the internet of things in Reverse Logistics Information Management, 2013; 6(4):963-973. http://doi.org/10.3926/jiem.793
19. Gubbi J, Buyya R, Marusic S, Palaniswami M. Internet of Things (IoT): A vision, architectural elements, and future directions. Future Generation Computer Systems 2013; 29(7):1645-1660.
20. Guinard D, Trifa V, Mattern F, Wilde E. From the internet of things to the web of things: Resource-oriented architecture and best practices. In Architecting the Internet of Things. Springer Berlin Heidelberg, 2011, 97-129.
21. Han B, Wu Y Andy, Windsor J. User' S Adoption of Free Third-Party Security Apps. The Journal of Computer Information Systems. 2014; 54(3):77-86.
22. Khasawneh S, Jalghoum Y, Harfoushi O, Obiedat R. x E-government program in Jordan: from inception to future plans. IJCSI, 2011.
23. Kim KJ, Shin DH. An acceptance model for smart watches: implications for the adoption of future wearable technology. Internet Research. 2015; 25(4):527-541.
24. Kowatsch T, Maass W. Critical privacy factors of internet of things services: An empirical investigation with domain experts. Knowledge and Technologies in Innovative Information Systems, 2012, *129 LNBIP*, 200-211. http://doi.org/10.1007/978-3-642-33244-9_14manufacturing IoT.pdf. (n.d.).
25. Lee MC. Factors influencing the adoption of internet banking: An integration of TAM and TPB with perceived risk and perceived benefit. Electronic Commerce Research and Applications. 2009; 8(3):130-141.
26. Li XJ, Wang D. Architecture and existing applications for internet of things. In Applied Mechanics and Materials 2013; 347:3317-3321.
27. Mathur SK, Dhulla TV. Factors Influencing Professionals' Decision for Cloud Computing Adoption, 2014.
28. Marchewka JT, Liu C, Kostiwa K. An application of the UTAUT model for understanding student perceptions using course management software. Communications of the IIMA, 2007; 7(2):93.
29. McKinsey. The Internet of Things: Sizing up the opportunity, 2014. Retrieved august 25, 2015 from http://www.mckinsey.com/insights/high_tech_telecoms_internet /the_internet_ of_things_sizing_up_ the_opportunity.
30. Medaglia CM, Serbanati A. An overview of privacy and security issues in the internet of things. In The Internet of Things. Springer New York, 2010, 389-395.
31. Schlick J, Ferber S, Hupp J. IoT Applications – Value Creation for Industry, River Publisher, Aalborg, 2013.
32. Shang X, Zhang R, Chen Y. Internet of things (IoT) service architecture and its application in e-commerce. Journal of Electronic Commerce in Organizations (JECO). 2012; 10(3):44-55.
33. Su J, Cao D, Zhao B, Wang X, You I. ePASS: An expressive attribute-based signature scheme with privacy and an unforgeability guarantee for the Internet of Things. Future Generation Computer Systems, 2014; 33:11-18.
34. Sundmaeker H, Guillemin P, Friess P, Woelffle S. Vision and Challenges for Realising the Internet of Things: CERP-IoT – Cluster of European Research Projects on the Internet of Things, European Commission – Information Society and Media DG, Brussels, 2010.
35. Turkanović M, Brumen B, Hölbl M. A novel user authentication and key agreement scheme for heterogeneous ad hoc wireless sensor networks, based on the internet of things notion. Ad Hoc Networks 2014; 20:96-112.
36. Uckelmann D, Harrison M, Michahelles F. An architectural approach towards the future internet of things. In Architecting the internet of things, 2011, 1-24. Springer Berlin Heidelberg.
37. Venkatesh V, Davis FD. A theoretical extension of the technology acceptance model: Four longitudinal field studies. Management science 2000; 46(2):186-204.
38. Venkatesh V, Morris MG, Davis GB, Davis FD. User acceptance of information technology: toward a unified view, MIS Quarterly, 2003; 27(3):425-478.
39. Weerakkody V, El-Haddadeh R, Al-Sobhi F, Shareef MA, Dwivedi YK. Examining the influence of intermediaries in facilitating e-government adoption: An empirical investigation. International Journal of Information Management. 2013; 33(5):716-725.
40. Wu WW. Developing an explorative model for SaaS adoption. Expert systems with applications. 2011; 38(12):15057-15064.
41. Xu S, Fang X, Chan S, Brzezinski J. What tasks are suitable for handheld devices? Proceedings of HCI international 2003, human computer interaction: Theory and practice, 2003; 2:333-337.
42. Yong Wee S, Siong Hoe L, Kung Keat T, Check Yee L, Parumo S. Prediction of user acceptance and adoption of smart phone for learning with technology acceptance model. Journal of Applied Sciences. 2011; 10(20):2395-2402.
43. Lian, J. W. Critical factors for cloud based e-invoice service adoption in Taiwan: An empirical study. International Journal of Information Management. 2015, 35(1):98-109.

44. McKnight DH, Choudhury V, Kacmar C. Developing and validating trust measures for e-commerce: An integrative typology. Information systems research 2002; 13(3):334-359.
45. Wang W. Interactive decision aids for consumer decision making in e-commerce: The influence of perceived strategy restrictiveness. MIS quarterly, 2009, 293-320.
46. Abu F, Yunus AR, Jabar J. Modified of UTAUT theory in adoption of technology for Malaysia Small Medium Enterprises (SMEs) in food industry. Australian Journal of Basic and Applied Sciences. 2015, 9(4):104-109.