The Acceptance of IoT: Study on Consumer Behavior

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Abstract

This study aims to examine consumer acceptance of products related to the Internet of Thins (IoT). The research was conducted qualitatively by comparing the previous theory which can support the current concept. The concept is currently enforced from the point of view of consumer behavior, whereas one of the users of products related to IoT. The results of the study found that in assessing the acceptance of IoT, it can be done through the Technology Acceptance Model, while the implementation of IoT sustainability can be studied through Theory Reasoned Action. Through the Technology Acceptance Model, it is known not only the level of acceptance of IoT but also the interest of consumers in purchasing products related to IoT. This study provides initial information about the acceptance of IoT by consumers and becomes a concept for determining marketing strategies for companies.

Keywords
IoT, Consumer Behavior, Technology Acceptance Model.

1. Introduction

Many new breakthroughs have been issued by technological developments through product services, one of which is to provide satisfaction to consumers through the Internet of Things (IoT) (Nina Kurnia Hikmawati & Alamsyah, 2018; Ng et al., 2015; Setiadi et al., 2018). However, acceptance of IoT needs to be reexamined, especially in Indonesia, considering that the performance created through IoT and adapted by consumers does not have a significant impact on their daily activities (Mohammad et al., 2020). So that we need a study related to the acceptance of IoT through a study of consumer behavior.

Internet of Things (IoT) is the latest technology invention developed because it has a high function in supporting one's performance without the use of cables and is based on wireless (Aceto et al., 2020). This technology is not realized but has been inherently used by humans today, especially regarding their work and social needs (Ng et al., 2015). Basically, IoT is a concept or program where an object can transmit or transmit data over the network without the use of computer and human devices (Prahalad & Ramaswamy, 2004). Usually, IoT uses wireless technology, and its implementation is in Smart City or Smart Home (Ng et al., 2015). Regarding consumer behavior, currently IoT has indirectly been used by consumers in supporting their activities (Christiadi et al., 2018). However, the adaptation to IoT still needs to be evaluated because IoT implementation requires several supporting elements. The elements contained in IoT include artificial intelligence, connectivity, mini devices, sensors, and active involvement (Doni Purnama Alamsyah et al., 2019; N. K. Hikmawati et al., 2020; Ng et al., 2015). Of all these elements are often not understood by users, and the main thing is active involvement. The low involvement of consumers in IoT results in lower purchases or adaptations of IoT in consumers (Kesumastuti, 2020). So that it is detrimental for companies providing products or services related to IoT.

Based on the phenomenon of the adaptation of the IoT for both the public and the consumers the company is aiming for, it is necessary to study the acceptance of IoT from the point of view of consumer behavior. This aims to analyze the possibility of receiving IoT-related products or services by consumers, to stimulate a variety of IoT products and IoT implementations that support user performance. In assessing the acceptance of IoT, many models can analyze, including Theory Reasoned Action (TRA) and Technology Acceptance Model (TAM) (Qi et al., 2014; Value, 2008; Wagner & Szymura-Tyc, 2016). Examining the study of the acceptance of IoT, the focus of this study is to discuss consumer behavior in accepting technology.

2. Methods

This study aims to examine consumer acceptance of IoT, while consumers say it is because it is studied from the consumer behavior side as one of the IoT users. It is important to understand from the consumer side as information for companies that issue products or services related to IoT. The study was carried out qualitatively, namely explaining the problem phenomenon to find the facts of the acceptance of IoT by consumers as users. While the analysis is carried out based on literature reviews from previous research, to understand and ensure there is a supporting theory in analyzing consumer acceptance of IoT. There are two models that can be used in understanding IoT, in this study no comparisons were made, but a theory was sought that was closest to achieving the acceptance of IoT by consumers.

3. Result and Discussions

The implementation of the Internet of Things (IoT) has an expensive investment, with a more complex network arrangement (Ng et al., 2015). However, in some developed countries, IoT implementation is a major need. In contrast to developing countries where IoT is still not optimally implemented (Wilburn & Wilburn, 2016). The acceptance of IoT depends on the level of community needs, especially the level of IoT support for jobs that generate more economic value (Aceto et al., 2020). There are several industries currently using IoT including health, energy, transportation, and the general environment (Ng et al., 2015).
There are several benefits that are felt by both the community and the company as well as consumers when working with IoT, including facilitating the connectivity process, achieving efficiency, and increasing the effectiveness of monitoring activities within a company (Ng et al., 2015). The adaptation of IoT still needs to be developed, especially in the market in Indonesia. This can be seen from the products and services delivered by the company that have not varied. The main factor is, of course, because the acceptance of IoT and its supporting products is still not optimal (Ishaq et al., 2013). There is an adaptation or acceptance model of a running system, this is known as Theory Reasoned Action (TRA) and the Technology Acceptance Model (TAM) (Value, 2008). Both approaches seem to be useful, especially in theory it is said to be able to increase the interest of users or consumers who value them (Frambach & Schillewaert, 2002). Furthermore, the following is a study of the differences between the two models that can be used as a basis for consumer acceptance of the development of IoT.

3.1. Theory Reasoned Action (TRA)

The concept of Theory Reasoned Action was first introduced by Martin Fishbeindan Ajzen, where this theory links the beliefs, attitudes, will and behavior of consumers in adapting to an object (Chinomona et al., 2013). The behavior in TRA is based on perception, which according to previous studies has a relationship with consumer acceptance of a product or service, because TRA is related to consumer attitudes and behavior (D P Alamsyah et al., 2021; Bryce et al., 2013). In theory, TRA explains that behavior changes based on the results of behavioral intentions, and behavioral intentions are influenced by social norms and individual attitudes towards behavior, this is related to consumer behavior (S. Hong et al., 2006; Setiadi et al., 2018). Basically, the subjective norm in TRA describes consumer beliefs about normal and acceptable behavior in society, while for individual attitudes towards behavior based on individual belief in that behavior (Schierz et al., 2010). The result found in the TRA concept is consumer interest in behavior (Junadi & Sfenrianto, 2015; Othman et al., 2021), so that TRA can be used as a model capable of measuring the adaptation of consumers to a product. The conclusion from TRA is that practices or behavior according to TRA will be influenced by individual intentions, and that individual intentions are formed from subjective attitudes and norms, which in turn generate interests such as consumer interests. More clearly the stages of TRA are clearly seen in Figure 1 (Karnowski et al., 2018).

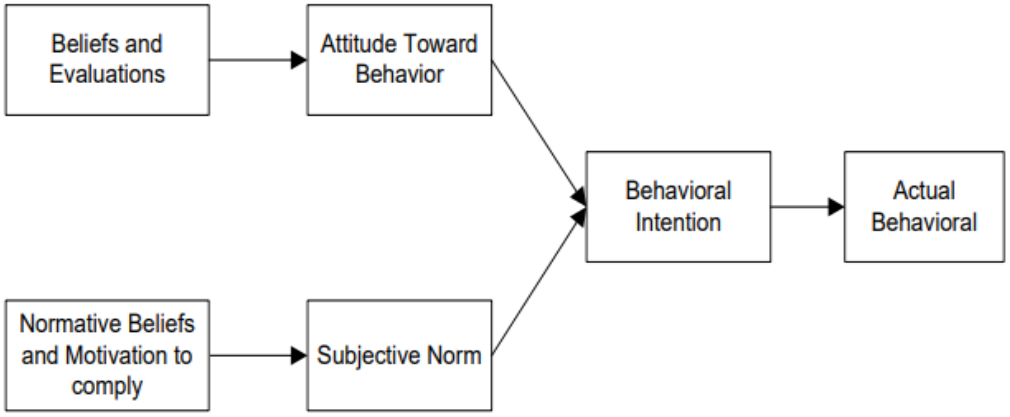

Figure 1. Theory Reasoned Action (TRA)

3.2. Technology Acceptance Model (TAM)

The Technology Acceptance Model has a different concept from Theory Reasoned Action, where TAM further explains the behavior of information system users such as consumer behavior when adapting to e-commerce (Value, 2008). The TAM model is developed from a psychological theory explaining the behavior of computer users, namely beliefs, attitudes, intentions, and user behavior relationships (Wang & Chen, 2009). This model places the trust factor of each user behavior with two variables, namely usefullness and ease of use (S. H. Hong & Yu, 2018). Empirically, this model has been shown to provide an overview of the aspects of user behavior, in this case consumers (Mulyani & Kurniadi, 2015), where consumers can easily operate with IoT, because it fits what they want. From this theory, it explains that TAM is a model related to the level of consumer acceptance of IoT implementation.
The pattern of TAM is evident in Figure 2. (Value, 2008), where the expected outcome is the consumer's behavioral intention to use. More precisely is consumer acceptance of IoT implementations.

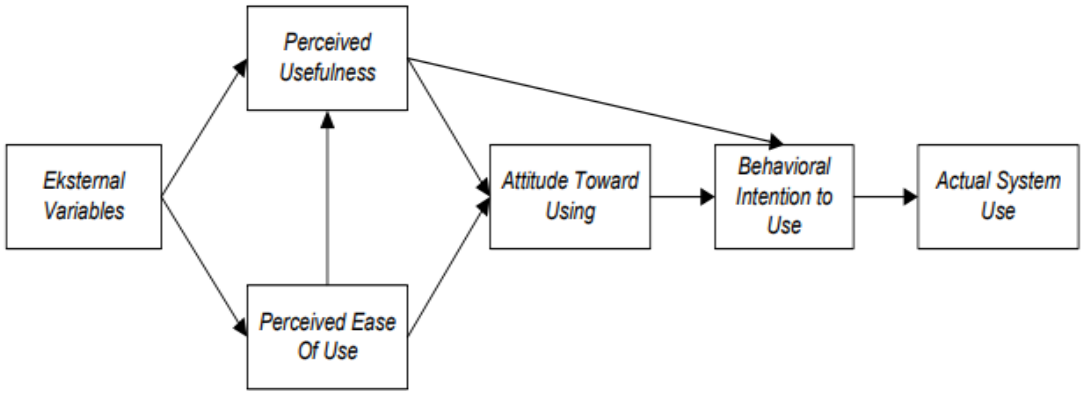

Figure 2. Technology Acceptance Model (TAM)

In a previous study, it was explained that TAM is more widely used to explore the level of consumer acceptance of information technology, in contrast to TRA, which focuses on behavior in dealing with information technology (Mulyani & Kurniadi, 2015). Based on this, it is said that TAM is more appropriate to be used as a model in evaluating the level of consumer acceptance of information technology such as IoT. TAM and TRA have little in common, where both are related to consumer behavior with the end consumer's interest to behave (Othman et al., 2021; Value, 2008). Especially in research for e-commerce, it is explained that TAM has a positive impact on consumer interest in knowledge because the information technology faced is easy to operate (Mulyani & Kurniadi, 2015).

3.3. Model of Behavioral Intention to Use

It is known in theory that TAM has a good chance of measuring the implementation of IoT. To confirm the results, a survey was conducted to consumers related to the TAM model with the aim of studying the behavioral intention to use of consumers towards IoT products. The survey was conducted on 100 respondents who have used IoT products in the education sector, namely E-Learning. The study was conducted on three variables, namely perceived usefulness, perceived use and behavioral to use. Questionnaires were distributed to students who carried out e-learning at Bina Nusantara University. The results of data processing through SmartPLS are presented in the form of the model attached in Figure 3.

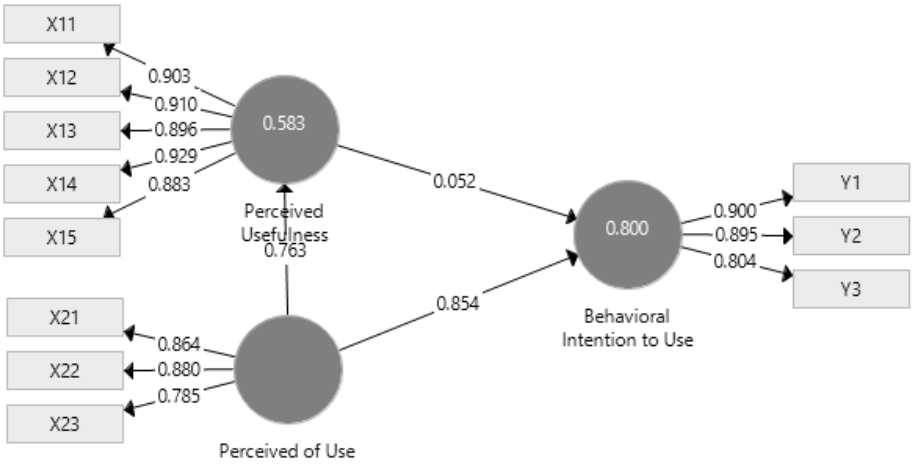

Figure 3. Model of Behavioral Intention to Use

It is known from the results of data processing that there is a relationship between perceived use and perceived usefulness (0.763) and behavioral intention to use (0.854). This means that IoT products in education, namely e-learning, can be accepted by consumers, namely students. The product can be used and has an impact on interest in subsequent use. If examined from the relationship between variables, which is quite large, it means that it has quite an impact on the acceptance of the IoT concept in e-learning. The model in Figure 1 is of course carried out with Inner and Outer tests to assess the acceptance of the model. The model test is carried out through evaluation of Outer Loading Values in Table 1, evaluation of Validity and Reliability in Table 2 and P-Values in Table 3. When examined all values are acceptable where the value of Loading Values is above 0.5 with Validity and Reliability above 0.7. Other results are confirmed by P-Values each measurement indicator has a value below 0.00.

Table 1. Outer Loading Values

Items	Behavioral Intention to Use	Perceived Usefulness	Perceived of Use
X11		0,903	
X12		0,910	
X13		0,896	
X14		0,929	
X15		0,883	
X21			0,864
X22			0,880
X23			0,785
Y1	0,900		
Y2	0,895		
Y3	0,804		

Table 2. Validity and Reliability Values

Variables	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Behavioral Intention to Use	0,834	0,833	0,901	0,753
Perceived Usefulness	0,944	0,948	0,957	0,818
Perceived of Use	0,797	0,798	0,881	0,712

Table 3. P-Values

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
X11 <- Perceived Usefulness	0,903	0,900	0,033	27,527	0,000
X12 <- Perceived Usefulness	0,910	0,905	0,029	31,418	0,000
X13 <- Perceived Usefulness	0,896	0,892	0,038	23,484	0,000
X14 <- Perceived Usefulness	0,929	0,930	0,021	44,266	0,000
X15 <- Perceived Usefulness	0,883	0,885	0,034	25,596	0,000
X21 <- Perceived of Use	0,864	0,865	0,028	31,043	0,000
X22 <- Perceived of Use	0,880	0,882	0,035	25,229	0,000
X23 <- Perceived of Use	0,785	0,787	0,071	10,975	0,000
Y1 <- Behavioral Intention to Use	0,900	0,898	0,036	24,903	0,000
Y2 <- Behavioral Intention to Use	0,895	0,896	0,027	33,627	0,000
Y3 <- Behavioral Intention to Use	0,804	0,811	0,057	14,096	0,000

In research literacy it has been explained that there are two models that can be used to measure consumer behavior, namely Theory Reasoned Action (TRA) and the Technology Acceptance Model (TAM) (Value, 2008). Theory Reasoned Action is said to be a theory that measures behavior while acting, while the Technology Acceptance Model is used to measure the level of acceptance of an object, in this case the IoT and its products (Bojei & Hoo, 2012; S. H. Hong & Yu, 2018). Through TAM, another impact can be seen, namely the consumer's interest in adapting or using technology in IoT. Information from this qualitative research is useful for companies that provide product offerings to support IoT on a Smart City or Smart Home. So that before prototyping by the company for its products, an early acceptance study by consumers is carried out. Another impact is the recognition of consumer buying interest related to products offered by the company. It is hoped that this study will support and stimulate the development of IoT in Indonesia, so that Smart City and Smart Home can be implemented properly and are beneficial in supporting the performance of all users

4. Conclusions

Based on the research results, it can be concluded that the Technology Acceptance Model (TAM) is the right method for measuring the level of consumer acceptance of IoT implementation. So that product variants related to IoT can be well received and used by consumers to support their activities. Another finding was that it turns out that TAM through its model can assess from an early age the interest of consumers in the products or services offered. However, the current study has only been discussed in theory and needs to be followed up empirically to prove that IoT is well accepted as measured by TAM.

References

Aceto, G., Persico, V., & Pescapé, A. (2020). Industry 4.0 and Health: Internet of Things, Big Data, and Cloud Computing for Healthcare 4.0. *Journal of Industrial Information Integration*, *18*, 1–14. https://doi.org/10.1016/j.jii.2020.100129

Alamsyah, D P, Othman, N. A., Indriana, & Science, E. (2021). Consumer awareness towards eco-friendly product through green advertising: Environmentally friendly strategy. *IOP Conference Series: Earth and Environmental Science*, *824*(1), 12043. https://doi.org/10.1088/1755-1315/824/1/012043

Alamsyah, Doni Purnama, Saputra, R. A., Alawiyah, T., Sutisna, H., Purni, D. S., & Adiwisastra, M. F. (2019). Pinning-Up Green IT for Competitive Advantage in Education Industries. *2018 6th International Conference*

on Cyber and IT Service Management (CITSM), 1–5. https://doi.org/10.1109/CITSM.2018.8674050

Bojei, J., & Hoo, W. C. (2012). Brand equity and current use as the new horizon for repurchase intention of smartphone. *International Journal of Business and Society*, *13*(1), 33–48.

Bryce, C., Cheevers, C., & Webb, R. (2013). Operational risk escalation: An empirical analysis of UK call centres. *International Review of Financial Analysis*, *30*, 298–307. https://doi.org/10.1016/j.irfa.2013.05.002

Chinomona, R., Pooe, D., Okoumba, L., & Pooe, D. (2013). The impact of product quality on perceived value, trust and students' intention to purchase electronic gadgets. *Mediterranean Journal of Social Sciences*, *4*(14), 463–472. https://doi.org/10.5901/mjss.2013.v4n14p463

Christiadi, H., Sule, E. T., Suryana, Y., & Febrian, E. (2018). The influence of distinctive capability and innovation management towards the performance of ISPs in Indonesia. *Journal of Advanced Research in Law and Economics*, *9*(4), 1212–1221. https://doi.org/10.14505/jarle.v9.4(34).06

Frambach, R. T., & Schillewaert, N. (2002). Organizational innovation adoption: A multi-level framework of determinants and opportunities for future research. *Journal of Business Research*, *55*(2), 163–176. https://doi.org/10.1016/S0148-2963(00)00152-1

Hikmawati, N. K., Alamsyah, D. P., & Setiadi, A. (2020). IT Implementation of Customer Relationship Management. *2020 Fifth International Conference on Informatics and Computing (ICIC)*, 1–4. https://doi.org/doi: 10.1109/ICIC50835.2020.9288549.

Hikmawati, Nina Kurnia, & Alamsyah, D. P. (2018). The digital company based on competitive strategy. *Proceedings of the 3rd International Conference on Informatics and Computing, ICIC 2018*, *2001*. https://doi.org/10.1109/IAC.2018.8780516

Hong, S. H., & Yu, J. H. (2018). Identification of external variables for the Technology Acceptance Model(TAM) in the assessment of BIM application for mobile devices. *IOP Conference Series: Materials Science and Engineering*, *401*(1), 1–6. https://doi.org/10.1088/1757-899X/401/1/012027

Hong, S., Thong, J. Y. L., & Tam, K. Y. (2006). Understanding continued information technology usage behavior: A comparison of three models in the context of mobile internet. *Decision Support Systems*, *42*(3), 1819–1834.

Ishaq, I., Carels, D., Teklemariam, G. K., Hoebeke, J., Van Den Abeele, F., De Poorter, E., Moerman, I., & Demeester, P. (2013). IETF Standardization in the Field of the Internet of Things (IoT): A Survey. In *Journal of Sensor and Actuator Networks* (Vol. 2, Issue 2). https://doi.org/10.3390/jsan2020235

Junadi, & Sfenrianto. (2015). A Model of Factors Influencing Consumer's Intention to Use E-payment System in Indonesia. *Procedia Computer Science*, *59*(Iccsci), 214–220. https://doi.org/10.1016/j.procs.2015.07.557

Karnowski, V., Leonhard, L., & Kümpel, A. S. (2018). Why Users Share the News: A Theory of Reasoned Action-Based Study on the Antecedents of News-Sharing Behavior. *Communication Research Reports*, *35*(2), 91–100. https://doi.org/10.1080/08824096.2017.1379984

Kesumastuti, T. M. (2020). The Process of Adoption Interest in Using Digital Wallet in Central Jakarta (Case Study on Go-Pay Users). *International Journal of Multicultural and Multireligious Understanding*, *7*(2), 277–286. https://ijmmu.com/index.php/ijmmu/article/download/1463/1159

Mohammad, Khan, S., Mustafa, & Yannis. (2020). An Artificial Intelligence and NLP based Islamic FinTech Model Combining Zakat and Qardh-Al-Hasan for Countering the Adverse Impact of COVID 19 on SMEs and Individuals. *International Journal of Economics and Business Administration*, *VIII*(Issue 2), 351–364. https://doi.org/10.35808/ijeba/466

Mulyani, A., & Kurniadi, D. (2015). Analisis Penerimaan Teknologi Student Information Terminal (S-IT) Dengan Menggunakan Technology Acceptance Model (TAM). *Jurnal Wawasan Ilmiah*, *7*(12), 23–35.

Ng, I., Scharf, K., Pogrebna, G., & Maull, R. (2015). Contextual variety, Internet-of-Things and the choice of tailoring over platform: Mass customisation strategy in supply chain management. *International Journal of Production Economics*, *159*, 76–87. https://doi.org/10.1016/j.ijpe.2014.09.007

Othman, N. A., Alamsyah, D. P., Aryanto, R., & Science, E. (2021). Understanding the factors of green advertising to adopt the environmental strategy. *Conference Series: Earth and Environmental Science*, *824*(1), 12042. https://doi.org/10.1088/1755-1315/824/1/012042

Prahalad, C. K., & Ramaswamy, V. (2004). Co-creating unique value with customers. *Strategy & Leadership*, *32*(3), 4–9. https://doi.org/10.1108/10878570410699249

Qi, J. Y., Qu, Q. X., & Zhou, Y. P. (2014). How does customer self-construal moderate CRM value creation chain? *Electronic Commerce Research and Applications*, *13*(5), 295–304. https://doi.org/10.1016/j.elerap.2014.06.003

Schierz, P. G., Schilke, O., & Wirtz, B. W. (2010). Understanding consumer acceptance of mobile payment services: An empirical analysis. *Electronic Commerce Research and Applications*, *9*(3), 209–216. https://doi.org/10.1016/j.elerap.2009.07.005

Setiadi, A., Doni Purnama, A., Didin, S., Didi, K., & Ema, O. (2018). Implementation of Green IT In Education

Industries. *In 2018 Third International Conference on Informatics and Computing (ICIC)*, 1–4.
Value, P. (2008). *An Empirical Study on the Integrated Framework of e-CRM in Online Shopping : Evaluating the Relationships Among Perceived Value , Satisfaction , and Trust*. *6*(3), 1–19.
Wagner, U., & Szymura-Tyc, M. (2016). A snapshot of different issues on marketing in emerging economies: Editorial to the special section. *Journal of Business Research*, *69*(9), 3617–3620. https://doi.org/10.1016/j.jbusres.2016.03.021
Wang, C., & Chen, C. (2009). *The Impact of Knowledge and Trust on E-Consumers ' Online Shopping Activities : An Empirical Study*. *4*(1), 11–18.
Wilburn, K. M., & Wilburn, H. R. (2016). Asking "What Else?" to identify unintended negative consequences. *Business Horizons*, *59*(2), 213–221. https://doi.org/10.1016/j.bushor.2015.11.006

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