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INNOVATIVE TECHNOLOGY FOR SUSTAINABLE BEHAVIOR – INVESTIGATING PREDICTORS OF CONSUMER INTENTION TO USE SMART WATER METERS

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Purpose: Smart water meters (Internet of Things based) are technologically advanced tools delivering precise data on water consumption in a household. However, it has not been examined yet what influences consumer intention to adopt smart water meters. The study objective is to investigate predictors of consumer intention to install smart water meters. The Technology Acceptance Model was applied as the main theoretical framework.
Design/methodology/approach: Data were collected from 366 respondents through an online survey conducted in 2021. Structural equation modeling was used for hypotheses verification.
Findings: The intention to adopt smart water meters was mainly predicted by attitude towards the use of smart water meters. which, in turn, was predicted both by perceived ease of use and by perceived usefulness of these devices. The direct positive impact of perceived ease of use on the intention to adopt smart water meters was also found, whereas the direct relation between perceived usefulness of smart water meters and the intention for the adoption turned out to be statistically insignificant.
Research limitations/implications: One research limitation is the probable lack of smart water meter usage among the responders, which may have affected their perception on how these devices are useful and easy to use. Additionally, only the main variables of TAM were applied, thus, other variables were not considered that may have had impact on perceived usefulness and perceived ease of use or usage behavior.
Social implications: Considering practical implications, by analyzing what may influence consumers to adopt smart water meters, we are able to apply this knowledge in real life and increase the amount of smart water meters in households, which may lead to household water reduction.
Originality/value: In previous research. what influences consumers to apply smart water meters has not been examined. This research indicates variables (adopted by TAM) influencing consumers to apply smart water meters, potentially leading to reduction in household water consumption.

Keywords: smart water meter, intention to adopt innovative technology, water, Technology Acceptance Model, sustainable consumption

Category of the paper: Research paper

1. Introduction

Good water quality o is vital for human society. Yet, water scarcity is a global problem; about 500 million people live in countries where water resources are not sufficient for the local population (Evans, Sadler, 2008). The increase of the global population has caused an increase in water demand, both for domestic and also industrial purposes, which together with climate change, stress the global water supply (Evans, Sadler, 2008). According to the United Nations, water usage has been constantly increasing by about 1% per year since 1980, and it is expected to keep rising (WWAP, 2019). Water scarcity and its predictors have been well-documented. Predictions suggest that the main drivers for the increase in water demand will be the domestic and industrial sector (Pimenta, Chaves, 2021). Therefore, the importance of efficient water uses and sustainable water management is crucial.

Although technological advancement is occurring, in many cases, it is not possible to precisely measure the real-time domestic water consumption in order for it to be monitored and water conservation behaviors implemented. Most countries rely on analogue and manual water-metering systems which are cost-effective, but cannot provide consumers with real-time and precise data. Applying automatic reading devices that have the ability to measure real-time water consumption can provide enormous potential both for the end users and also the environment (Pimenta, Chaves, 2021). These automatic water meters, so-called smart water meters or IoT (Internet of Things based) meters, are devices that are linked to home appliances and record the water consumption while they automatically transmit the data in a remote device (smartphone etc.) (Meyer, Nguyen, Beal, Jacobs, Buchberger, 2021). The smart water meter is connected to a remote device via WiFi for remote control (Hsia, Wang, Hsu, 2021). The main aim of smart water meters is to provide information to the consumer about her/his water usage, which can lead to water consumption reduction or to detect any possible leaks (Mudumbe, Abu-Mahfouz, 2015). Thus, as the interest in sustainable water consumption is increasing, it is noted that the interest in smart water meters is also rising (Pimenta, Chaves, 2021).

One of the ways to reduce water consumption may be achieved by individual efforts in the household (Larrabee Sonderlund, Smith, Hutton, Kapelan, 2014).In past research, the positive effects of smart water meters on reducing water consumption in households have been proven. Erickson et al. (2012) conducted research in order to evaluate the effectiveness of the Dubuque Water Portal which included a real-time consumption feedback recorded by smart-water meters that were given to households. The results indicated a 6.6% decrease in water consumption during the first 9 weeks. Petersen, Shunturov, Janda, Platt, and Weinberger (2007) also conducted research on smart water meters and water consumption: smart water meters were installed in college dormitories, the group of students who got feedback from the smart-water meters reduced their water consumption by about 3% per person. Larrabee Sonderlund et al. (2014) conducted a review on smart water meters and the influence of feedback on water consumption. These authors came to the conclusion that in studies focusing on this area, a water reduction between 3% and 53.4% what observed when information about water consumption was fed back to consumers. Cominola et al. (2021) carried out a study on long-term changes in the behavior of consumers who installed smart water meters and received feedback regarding their water consumption. They recorded a long-term decrease in volumetric water consumption by 8%. Further research was conducted by Daminato, Diaz-Farina, Filippini, and Padrón-Fumero (2021) who examined annual consumption data from approximately 51,000 households during the timeline of 10 years and concluded that due to applying smart water meters, a decrease by about 2% was noted for water consumption. Although the reductive effect of smart water meter application on water consumption was proven, in a study conducted by Montginoul and Vestier (Montginoul, Vestier, 2018), it was shown that the level of consumers' willingness to adopt this technology was low, even when they were offered smart water meters for free by water utility companies. This leads to the conclusion that attention should be focused not only on the results of smart water meter usage concerning water consumption, but also on the intention to adopt this technology by consumers as well as the predictors of this intention.

Despite the fact that there is much research regarding the effect of smart water meters on the reduction of water consumption, in not many papers has it been examined what influences the consumers to install smart water meters in their households. In a precedent study focused on the future acceptance of smart water meters by consumers based on their beliefs and expectations towards them, it was found that the majority of consumers had a positive attitude towards accepting smart grids in their households (Chang, Nam, 2021; Krishnamurti et al., 2012). In a previous study focused on consumers' perceptions of smart home devices, such as smart water meters, it was also concluded that consumers had a positive perception of smart home consumption devices (Paetz, Dütschke, Fichtner, 2011). However, past research was not focused on factors influencing consumer intention to apply smart water meters in their households. It is very important to examine these determinants in order to find effective ways of making consumers adopt sustainable lifestyles and, in particular, decrease water usage. There is still a research gap related to factors influencing these pro-environmental behaviors that lead consumers to care about the environment and that will make them act accordingly (Obery, Bangert, 2017), such as installing smart water meters in order to reduce their household water consumption. In this research, to investigate the motivation of consumer intentions to apply smart water meters, the Technology of Acceptance Model (TAM) was applied as the main theoretical framework. TAM, introduced by Davis (1989), is still one of the most frequently applied and influential models in numerous studies on the adoption of various technologies, such as: cloud e-learning applications (Wang, Lew, Lau, Leow, 2019), driverless cars (Koul, Eydgahi, 2018), smart homes (Hubert et al., 2019). TAM was proposed for information technology adoption but is currently being used in many other disciplines and fields, such as examining the intention to use a smartwatch for medical purposes (Elnagar et al., 2022).

Although TAM is a model that is nowadays used in order to examine consumer acceptance of technology, there are not many studies in which this model has been adopted to examine the acceptance of smart water meters. Park, Kim, and Kim (2014) examined the technological acceptance of smart grids, i.e., energy smart meters, and noted a positive relationship between perceived ease of use and perceived usefulness towards intentions to use energy smart grids, however, they did not examine smart water meters. Thus, it is noted that there is a research gap concerning determinants affecting the intention to apply smart water meters, specifically. By finding out the mechanism as to how TAM variables predict consumers' intentions to apply smart water, a possibility to more effectively promote the application of smart water meters in households will emerge. The aim of this paper is not only to bridge this gap but also, to practically apply its results in order to find ways to encourage consumers to use smart water meters in order to reduce their household water consumption and introduce a water conservation strategy.

The paper is structured as follows; the first part is devoted to a literature review, where hypotheses are developed on the basis of TAM and previous studies on the investigated area of research. The second part is focused on the methodology of the current study. The third part contains a presentation of the results achieved in our empirical research. The last part is focused on discussion of the results, directions of further research as well as practical applications of our results. Last but not least, a conclusion is given, in which the key findings and the limitations of our research paper are included.

2. Literature background and hypotheses development

Innovative technologies are currently developed very rapidly due to the fact that technological limitations have been successfully overcome in numerous sectors. However, in the case of various technologies, the willingness to apply them by potential users remains the most important barrier in launching them onto the market. In previous research, predictors of technology acceptance were examined both in the case of institutional entities, such as enterprises (Andaregie, Astatkie, 2021; Bruque, Moyano, 2007), and also consumers (Chan, Yee-Loong Chong, 2013; Nguyen, Borusiak, 2021). Numerous theoretical frameworks have been applied in these studies (Lai, 2017; Marangunić, Granić, 2014; Taherdoost, 2018). Two groups of them may be distinguished. The first one consists of universal models widely applied for any type of research on consumer behavior, mainly focused on behavioral intention predictors, i.e. Theory of Reasoned Action (Fishbein, Ajzen, 1975), Theory of Planned Behaviour (Ajzen, 1991), Theory of Interpersonal Behaviour (Moody, Siponen, 2013), or Social Cognitive Theory (Schunk, 2012). The other set includes theories strictly dedicated to the process of examining the adoption of new technologies, such as: Technology Acceptance Model (Davis, Bagozzi, 1989), Diffusion of Innovation theory (Dingfelder, Mandell, 2011), or Unified Theory of Acceptance and Use of Technology (Venkatesh, Morris, Davis, Davis, 2003).

Technology Acceptance Model (TAM) has become one of the most widely-used theories in the examination of technology adoption processes (King, He, 2006; Svendsen, Johnsen, Almås-Sørensen, Vittersø, 2013; Yousafzai, Foxall, Pallister, 2007a). This is mainly due to its simplicity, understandability and robustness (Gao, Bai, 2014). It was proposed by Davis in 1986 (Davis et al., 1989) for modeling user acceptance of information systems. TAM is based on the Theory of Reasoned Action - one of the most popular theories explaining people's behavioral intentions and their actual behavior predicted by the intention which, in turn, is determined by two other variables: attitude towards a given behavior and subjective norm concerning this behavior. TAM posits that intention to adopt an innovative technology is chiefly predicted by attitude towards using a technology which, in turn, is driven by behavioral beliefs. These beliefs in TAM are expressed by two key variables: perceived ease of use and perceived usefulness, which - directly or indirectly - explain outcomes (Marangunić, Granić, 2014; Scherer, Siddiq, Tondeur, 2019). Perceived ease of use is the degree to which the consumers believe that the use of a particular technology will be effortless. Perceived usefulness is defined as a potential user's probability that using a given technology will increase her/his task performance. Both perceived ease of use and perceived usefulness have positive effects on the attitude of the consumers towards the examined technology and they further positively affect consumer intentions to use and apply the particular technology.

Previous studies using TAM for explaining the predictors of technologies were mainly connected with computers and the Internet, such as: personal computers, electronic mail, voice mail, word processor, graphic software, the world wide web, smart cards, online shopping, virtual stores, digital libraries and Internet banking (Yousafzai et al., 2007a). It was also applied for technologies which are, in some ways, related to the smart water metering technology. Gao and Bai (2014) examined factors influencing consumer acceptance concerning the 'Internet of Things' technology, whereas Park et al. (2014) focused their research on smart grid technology acceptance. Both studies proved that two basic motivation variables - perceived ease of use and perceived usefulness - are related to the intention to apply smart solutions.

In the current study, TAM was implemented to explain the intention to apply smart (IoT) water meters. In order to build hypotheses, the following variables were used: intention to apply a smart (IoT) water meter in a consumer's household, attitude towards smart (IoT) water meters use, perceived ease of use and perceived usefulness of smart (IoT) water meters. The following hypotheses were constructed expressing relations proved by previous TAM-based studies:

H1: Perceived ease of IoT water meter use (PEOU) is positively related to attitude towards smart (IoT) water meter use (ATW).

H2: Perceived usefulness of IoT water meter (PU) is positively related to attitude towards smart (IoT) water meter use (ATW).

H3: Perceived ease of IoT water meter use (PEOU) is positively related to perceived usefulness of smart (IoT) water meters (PU).

H4: Attitude towards IoT water meters use (ATW) is positively related to intention to apply smart (IoT) water meters (IAW).

H5: Perceived ease of IoT water meter use (PEOU) is positively related to intention to apply smart (IoT) water meters (IAW).

H6: Perceived usefulness of IoT water meter (PU) is positively related to intention to apply smart (IoT) water meters (IAW).

All hypotheses are presented in the research model (Figure 1).

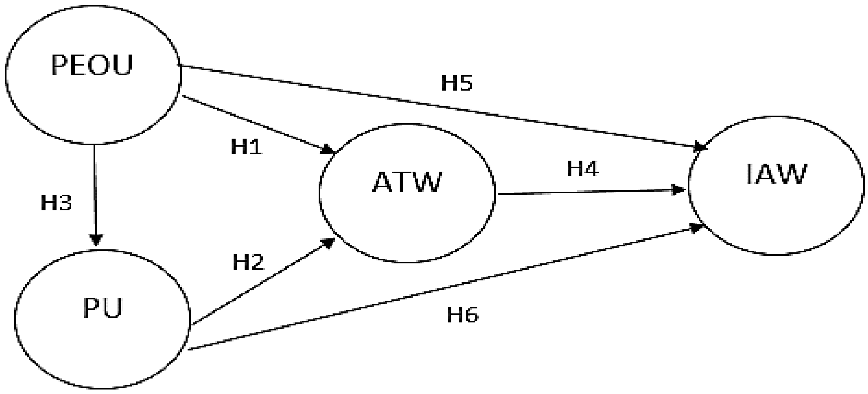

Figure 1. Research Model.

3. Methods

In order to collect data, a survey was conducted using a self-administered questionnaire – the Computer-Assisted Web Interview (CAWI) method. The participants responded to the statements on a 7-point scale (1 – 'I strongly disagree'; 7 – 'I strongly agree'). Validated scales were used to measure latent variables: Perceived usefulness of IoT water meters (PU), Perceived ease of IoT water meter use (PEOU), Attitude towards IoT water meter use (ATW) and Intention to apply IoT water meters (IAW). The full list of statements and sources is presented in Table 1.

Table 1.
Measures

Variable	Statements	Source
Perceived usefulness of IoT water meters	PU1. Using an IoT water meter in my household would allow me to measure water usage more precisely. PU2. Using an IoT water meter in my household would improve knowledge on my water usage. PU3. Using an IoT water meter in my household would enhance my effectiveness in water usage management.	Davis, F.D. (1989) Tsourela, M., Nerantzaki, D.M. (2020) Gao, L., Bai, X. (2014)
Perceived ease of IoT water meter use	PEOU1.Learning to operate IoT-based water meters would be easy for me. PEOU2. I would find it easy to get IoT-based water meters to do what I want them to do. PEOU3. My interaction with IoT-based water meters would be clear and understandable. PEOU4. I would find IoT-based water meters to be flexible in interaction. PEOU5. It would be easy for me to become skillful at using IoT-based water meters. PEOU6. I would find IoT-based water meters easy to use.	Davis, F.D. (1989)
Attitude towards IoT water meter use	ATW1. Using IoT water meters is a good idea. ATW2. Using IoT water meters is wise. ATW3. Using IoT water meters is beneficial. ATW4. Using IoT water meters is interesting.	Schierz, P.G., Schilke, O., Wirtz, B.W. (2010)
Intention to apply IoT water meters	IAW1. I plan to apply IoT-based water meters in my household. IAW2. I am willing to apply IoT water meters in my household. IAW3. I will make an effort to apply IoT water meters in my household.	Han et al. (2010) Chen, Tung (2014)

The study was conducted on the Amazon Mturk platform. In order to ensure the credibility of the provided answers, an answer selection step was performed. In the survey, attention-checking questions were used. The answers of people who passed this test were accepted for analysis. In addition, the answers of people who gave unreliable responses to the question about age, e.g., 2222, were eliminated. Moreover, the time of answering was considered and people who gave them in less than 3xSD from the mean were not taken into account because this may indicate lack of time to thoroughly read the statements. The final number of participants was 366, which exceeds the recommended 300 for structural models. The number of participants was 22 times greater than the number of statements, which allows us to assume that the sample was sufficient. In total, 56.56% of respondents were women and 43.43% comprised men. The mean age was 41 years (min. 18, max. 76, SD 14.09). The full characteristics of the sample is presented in Table 2.

Table 2.
Characteristics of the sample

Variable		Frequency	Percentage
Sex	Female	207	56.557
	Male	159	43.443
Education	Bachelor's degree	190	51.913
	Doctorate	8	2.186
	High school degree or equivalent	83	22.678
	Master's degree	76	20.765
	Other	9	2.459
Income	$20.000 - $29.999	36	9.836
	$30.000 - $39.999	45	12.295
	$40.000 - $49.999	42	11.475
	$50.000 - $59.999	45	12.295
	$60.000 - $69.999	70	19.126
	$80.000 - $89.999	32	8.743
	$90.000 ≥	65	17.760
	≤ $19.999	31	8.470
Status	Employed full-time	213	58.197
	Employed part-time	51	13.934
	Retired	31	8.470
	Self-employed	25	6.831
	Student	9	2.459
	Unable to work	13	3.552
	Unemployed	24	6.557
Residence	Apartment	108	29.508
	Multi-family home	8	2.186
	Single-family home	250	68.306
	Total	366	100.000

4. Results

First, confirmatory factor analysis was performed to test the method of measuring the variables. For all variables, the loading values exceeded the recommended 0.6, ranging from 0.72 to 0.94. Moreover, the values of Cronbach's α and CR also exceed the recommended 0.7 for all variables and ranged from 0.79 to 0.93. The AVE analysis showed recommended internal consistency among the variables ranging from 0.58 to 0.76. In the next sequence, HTML analysis demonstrated that none of the variables correlated with each other above the recommended 0.85, reaching a maximum of 0.71. On this basis, it was found that there was no common method bias and the model was assessed using bootstrapping at the level of 2000 repetitions. The RMSEA value was 0.065, chi^2/DF did not exceed 3 and was 2.54. Other parameters were also below the cut-off level: CFI 0.968, GFI- 0.29, TLI 0.958 and NFI- 0.948. This indicates that the theoretical model is correctly constructed and individual relations have been analyzed.

The analysis of direct effects showed that all except one relationship was significant at the level of $p < 0.001$. In the case of PEOU, both the influence on PU (b=0.51, $p < 0.001$) and ATW (b = 0.24, $p < 0.001$) turned out to be significant, which confirms the adopted H1 and H3 hypotheses. PU affected ATW (b = 0.62, $p < 0.001$), which is in agreement with H2, however, the effect of PU on IAW turned out to be statistically insignificant (b=-0.3, ns), indicating that there is no basis for confirming hypothesis H6. IAW was significantly influenced by PEOU (b = 0.42, $p < 0.001$) and ATW (b = 0.63, $p < 0.001$), which is a confirmation of H5 and H4, respectively. All SEM analysis values are presented in Table 3.

Table 3.
SEM Results

Endogenous variable	**Exogenous variable**	**Beta**	**B**	**SE**	***p*-value**	**CI lower**	**CI upper**
ATW	PEOU	0.24	0.37	0.10	***	0.17	0.55
ATW	PU	0.62	0.83	0.18	***	0.55	1.26
PU	PEOU	0.51	0.60	0.07	***	0.46	0.76
IAW	ATW	0.63	0.60	0.14	***	0.37	0.93
IAW	PEOU	0.42	0.61	0.13	***	0.37	0.91
IAW	PU	0.30	0.38	0.20	*ns*	-0.88	-0.10

5. Discussion

The objective of this study was to extend our knowledge regarding predictors of consumer intention to apply IoT water meters in their households, which may lead to a better understanding of how to reduce household water consumption. Based on TAM, intention to adopt a new technology is predicted by attitude towards using a certain technology, which is further influenced by the belief of perceived ease of use and perceived usefulness of the technology. The findings of this study are consistent with previous TAM- based research. The majority of hypotheses (H1-H5) posed in the current study are supported.

Consistent with TAM, our results allowed to verify that the behavioral intention to use smart water meters is determined by positive or negative attitude towards using smart water meters, thus, one of the predictors of the intention to apply smart water meters is attitude towards using them. In previous studies, it was found that attitude affects behavioral intention of consumers. Robles-Gómez, Tobarra, Pastor-Vargas, Hernández, and Haut (2021) found that attitude towards IoT cloud platforms affects the intention of using this platform. The research results obtained by Kranz, Gallenkamp, and Picot (2010) are also in line with ours, as their findings suggest that attitude towards using energy smart meters mediates the intention to use smart meters. In addition, based on our results, attitude, compared to other variables, has the strongest influence on intention (b = 0.63, $p < 0.001$).

In addition to our finding that attitude towards using smart water meters influences consumer intention of using them, determinants that impact the consumers' attitude towards using IoT water meters were also examined. Consistent with previous research based on TAM, our result allowed to verify that perceived ease of use and perceived usefulness of the technology positively impact attitudes towards the technology. Chen, Xu, and Arpan (2017), while investigating what has impact on consumers towards accepting renewable energy, it was found that both perceived ease of use and perceived usefulness are predictors of consumer attitudes towards using renewable energy. Zhang, Guo, and Chen (2007) noted that the attitude of consumers towards e-learning services is affected by perceived usefulness and perceived ease of use. In the present study, perceived usefulness has stronger impact on attitude (b = 0.62, $p < 0.001$) than perceived ease of use (b = 0.24, $p < 0.001$). Thus, future research, policymakers and IoT water meter producers need to focus on perceived ease of use and perceived usefulness of smart water meters as they are positively related to attitude which can affect the intention to apply smart water meters.

Based on the current study, perceived ease of use does not only influence attitude towards using smart water meters, but it also has impact on consumer intention to apply smart water meters. Our research supports previous results achieved by Taylor and Todd (1995) who investigated different models regarding technology acceptance of the Computer Resource Center facility. They found that consumer intention can be predicted by the facility's level of perceived ease of use. In addition, Kuo and Yen (2009) also noted that perceived ease of use affects consumer intention to use 3G mobile services. Thus, it is important for future strategies that focus on water conservation by applying smart water meters to aim on explaining the ease of use of smart water meters as it can, directly and indirectly, influence consumer intention to apply them in their households. An interesting finding is that although the TAM model and previous research suggest a rather positive connection between perceived usefulness and intention (Davis, 1989; Moon, Kim, 2001; Taylor, Todd, 1995; Yousafzai, Foxall, Pallister, 2007b), in our study, no such significant, direct relationship was found between perceived usefulness and intention to apply smart water meters. It should be also noted that in the quantitative meta-analysis of TAM conducted by Yousafzai et al. (2007b), for 8 trials out of 89, no significant relationship was indicated between perceived usefulness and intention, while in 19 out of 60, there was no proven significant relationship between perceived ease of use and intention.

In the current study, positive relationships both between perceived usefulness and attitude towards using smart water meters, as well as between attitude and intention to apply smart water meters, were found. Thus, attitude towards using IoT water meter use was proved to mediate the relationship between perceived usefulness of IoT water meters and intention to adopt them. This can be explained with a different valuation of these two beliefs, depending on the stage of action: at the level of attitude foundation, usefulness expressing outcome evaluation, i.e., the benefits of using a smart water meter delivered a potential user good rationale, whereas at the stage of behavioral intention, perceived ease of IoT water meters use turned out to be a more important predictor than perceived usefulness, actually - the only significant predictor. Thus, the most important management implication is that IoT water meters should be as easy to use as possible. To achieve this, user experience studies at the stage of a particular model of IoT water meter design could be quite helpful.

Based on the TAM model, and proved by our result, perceived ease of use can explain the perceived usefulness of IoT water meters. Based on our results, consumers will find IoT more useful if they can use it without difficulties. Past research supports our results, for instance, Gao and Bai (2014), when examining the factors that influence consumer acceptance of IoT mobile terminals, found that perceived ease of use is strongly connected with perceived usefulness, as consumers will not find it useful to use IoT mobile terminals with poor and difficult to use interfaces. Liao, Tsou, and Huang (2007), while researching mobile services, concluded that perceived ease of use directly influences perceived usefulness. Lee, Park, Chung, and Blakeney (2012) conducted research focused on acceptance of mobile financial services and verified a positive relationship between perceived ease of use and perceived usefulness. Our study also supports the results of the previous research, thus, consumers will perceive IoT water meters as more useful if they are able to use them without difficulties.

6. Conclusion

The objective of the current study was to examine the intention to apply IoT water meters using Technology Acceptance Model variables: perceived ease of use, perceived usefulness, and attitude towards IoT water meters. Based on the analysis, the intention to use smart water meters is highly explained by attitude towards the use of these devices. This conclusion is in line with the majority of studies on consumer behavioral intention based on such theories as TAM, but also on others, including the relationship between attitude towards a given behavior and behavioral intention, such as TRA and TPB. In the study, it was also found that attitude towards IoT water meter use is more strongly predicted by perceived usefulness of IoT water meter than by perceived ease of smart water meter use, intention to use smart water meters is predicted directly only by perceived ease of smart water meter use. Attitude towards IoT water meters turned out to be both mediators regarding the influence of perceived usefulness on intention to use IoT water meters and of the impact concerning perceived ease of use on the same intention. Therefore, it was noted that here, attitude towards smart water meters plays a key role as a determinant of intention with regard to smart water meter application. Based on the results of the study, 5 out of 6 posed hypotheses are supported. To be more precise, perceived ease of use and perceived usefulness of IoT water meters are positively related to attitude towards smart water meter use. At the same time, perceived ease of use is positively related to perceived usefulness of IoT water meters, while attitudes towards IoT water meters are positively related with intention to apply smart water meters and perceived ease of using IoT water meters is connected with intention to apply smart water meters. On the other hand, perceived usefulness of IoT water meters is not related to intentions to apply smart water meters.

The current study has several limitations. One of them is related to the potential lack of smart water meter usage experience among respondents, as this technology is at the initial stage of its market life cycle. This fact could, to some extent, cause bias regarding both perceived usefulness and perceived ease of IoT water meter use. Another limitation of the current study is connected with the fact that only basic TAM variables were applied in order to examine predictors of intention to use smart water meters. In this research, neither the variable predicting both perceived usefulness and perceived ease of use nor of usage behavior were considered.

Despite these limitations, this study has many scientific and practical contributions. First of all, the results and understanding of determinants concerning consumer intention to apply smart water meters can be used to increase IoT smart water meter application in households. This, based on previous research, will lead to a reduction in water consumption (Sønderlund, Smith, Hutton, Kapelan, 2014). As in this study the existing TAM model was used and evaluated, future research could be focused on its extension by examining moderating effects of such variables, i.e. frugality, personal innovativeness and environmental concern, to find effective ways of influencing consumer intentions to apply smart water meters. Other directions of further studies could be related to actual behaviors and examination of predictors. Thirdly, the results of our study allow to state that policymakers, smart water meter producers and researchers should focus on improving information on how to use smart water meters, as perceived ease of use both directly and indirectly influence intentions to apply smart water meters, but also they should pay attention to providing consumers with more information about the usefulness of smart water meters in their everyday life to potentially increase the possibility of consumers adopting this technology. Moreover, based on the results of the current study, ways of influencing consumers to install smart water meters in their households, which could potentially lead to household water reduction, are identified. Thus, in this study, implications were given and more information was provided, both on the theoretical and empirical grounds which can be used to promote individuals' application of smart water meters in their households.

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