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PROMOTING AN ENERGY SAVING TECHNOLOGY IN TURKEY: THE CASE OF GREEN ROOF SYSTEMS

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Abstract

A green roof is a roof of a building that is partially or completely covered with vegetation and a soil (growing media) as its outermost surface, planted over a waterproofing membrane. There are several reasons for implementing green roof systems on top of buildings such as mitigation of urban heat island effect and rainwater, carbon sequestration, aesthetic appeal, creating a habitat, increasing agricultural space, and so on. The objective of this paper is to develop and test a theoretical model grounded in the Technology Acceptance Model (TAM) to investigate key factors that affect behavioral intention to implement a green roof system. Together with the basic structure of TAM, we take into account additional constructs such as self-efficacy, perceived behavioral control and government support. The hypotheses were tested using questionnaires on green roof systems collected from 204 citizens across Turkey. The Structural Equation Modeling (SEM) methodology was implemented by using SmartPLS 3.2.7 software to evaluate the obtained data and test the proposed hypotheses. The results indicated that behavioral intention to implement was affected significantly by attitude, subjective norm, and perceived behavioral. Moreover, self-efficacy and government support have significant effects on perceived behavioral control; and perceived usefulness has significant effect over attitude. The implications of the results are reviewed, and the recommendations are provided for the further studies. This study provides new practical insights for authorities seeking to implement green roof systems.

Key words: energy, government support, green roof systems, structural equation modeling, technology acceptance model

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1. Introduction

Urban population has been growing rapidly for a few decades, and it is anticipated that it will grow over 70% by 2030 (United Nations, 2007). With such high growth rates in urban populations, comes several destructive impacts on the climate and the ecological systems balance, particularly in developing countries. Because of high-density urban development, biological habitats are substituted by urban zones, isolating individuals from natural ecosystems (Bonoli et al., 2013; Li et al., 2005). Rapid urbanization restricts the availability of green areas and demands an exploration for novel and innovative alternatives such as green roofs.

A green roof is a roof of a building that is partially or completely covered with vegetation and a soil (growing media) as its outermost surface, planted over a waterproofing membrane. In cities of Turkey, many green roof systems have been installed not only publicly but also privately for the last 10 years (Beyhan and Erbas, 2013), most notably the green roof at Zorlu Center Shopping Mall with an area of 60,000 m2 and the green roofs on top of the Turkcell R&D Building in Istanbul with an area of 2.500 m^2 (Kulekci, 2017). In 2014, a public bus with a green roof garden hit the roads in Istanbul, Turkey to raise awareness of problems related to the environment (Hurriyet Daily News, 2014). Apart from the attractive appearances of green roof systems, there are also a lot of solid economic and ecological benefits including mitigation of the urban heat island effect and rainwater, carbon

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sequestration, growth in biodiversity and habitats, and decrease in air conditioning energy requirements (Fernandez-Cañero et al., 2013).

Despite the increasing usage of green roof systems and few earlier researches on the individuals' perception of them (Carlet, 2015; Hamzah et al., 2016; Kalantari et al., 2016) no earlier studies explored acceptance of green roof systems in Turkey. Therefore, this study aims to fill the gap by exploring key factors affecting users' green roof systems acceptance in Turkey. The individuals are a highly important element, and their inclination to use green roof systems will direct its future. In order to construct a strong theoretic base to explore the green roof system acceptance, this study proposed a novel theoretical model by extending the Technology Acceptance Model (TAM).

2. Background and hypotheses development

TAM was proposed by Davis (1989). It is a popular methodology for measuring acceptance of novel tools in various fields; for example, information technology, construction, education, etc. The TAM consists of the factors of actual use, behavioral intention to use, attitude toward use, perceived usefulness and perceived ease of use. Based on the TAM, perceived usefulness and perceived ease of use are the primary antecedents predicting attitude towards use and behavioral intention to use. This study extended the TAM by incorporating additional constructs including self-efficacy, perceived behavioral control, and government support to better explain the acceptance of green roof systems. The proposed theoretical model is provided in Fig. 1.

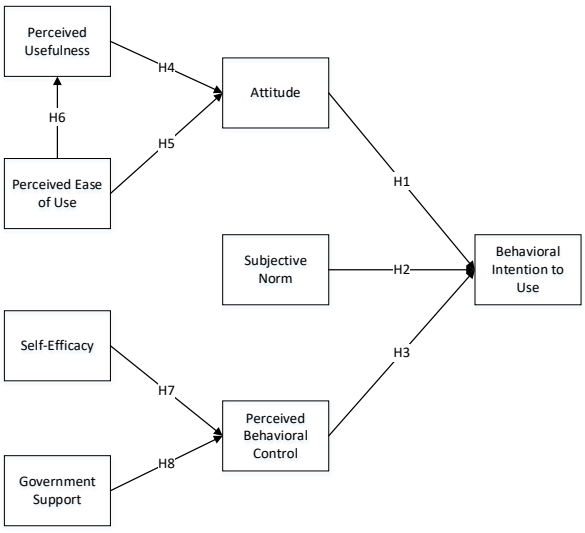

Fig. 1. Research model

2.1. Behavioral intention to use (BIU)

Behavioral intention is *'the degree to which a person has formulated conscious plans to perform or not perform some specified future behavior'* (Warshaw and Davis, 1985). It assesses the intent of the user, while giving an idea about the level of acceptance of this technology by an organization (Mahindrooa et al., 2012).

2.2. Attitude (ATT)

Attitude means *'the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question'* (Ajzen, 1991). It defines the individuals' behavior for a service or product. Earlier works show the significant effect of ATT on BIU (Ho, 2010, Lee, 2010, Wu and Chen, 2017). Therefore, we proposed the following hypothesis:

H1: Attitude is positively related to the behavioral intention to use green roof systems.

2.3. Subjective Norm (SN)

Subjective norm refers to *'a person's perception that most people, who are important to him, think he should or should not perform the behavior in question'* (Fishbein and Ajzen, 1975). Previous studies indicate that SN affects BIU positively (Kwak et al., 2012, Venkatesh, 2000). Therefore, the following hypothesis was proposed:

H2. Subjective norm is positively related to the behavioral intention to use green roof systems.

2.4. Perceived behavioral control (PB)

Perceived behavioral control is "people's perception of the ease or difficulty of performing a behavior" (Ajzen, 1991). It is one of the predictors of behavior according to the theory of planned behavior. The earlier studies show that impact of PB on BIU is positive (Hansen et al., 2018, Kang et al., 2006, Liew et al., 2017, Ramayah et al., 2009). Hence, we proposed the following hypothesis:

H3. Perceived behavioral control is positively related to the behavioral intention to use green roof systems.

2.5. Perceived usefulness (PU)

Perceived usefulness means "the degree to which an individual believes that using a particular system would enhance his or her job performance" (Davis, 1989). According to the TAM, perceived usefulness influences the attitude positively. In this study, a person who intends to utilize a green roof system believes that it would improve their living standards. Therefore, we developed the following hypothesis:

H4. Perceived usefulness is positively related to the attitude to use green roof systems.

2.6. Perceived ease of use (PEOU)

Perceived ease of use is *'the degree to which a person believes that using a particular system would be free of effort'* (Davis, 1989). The level of usability

affects end-user's behavior towards system use. If it is low, the users are affected negatively. Hence, the positive insights of end-users to use a new technology will facilitate the use of the system (Hamad et al., 2017, Liu et al., 2018). TAM claims that PEOU affects ATT and PU positively. Hence, the following hypotheses were proposed:

H5. Perceived ease of use is positively related to the attitude toward using green roof systems.

H6. Perceived ease of use is positively related to the perceived usefulness of using green roof systems.

2.7. Self-efficacy (SE)

Self-efficacy means "the people's judgments about their capabilities to perform, organize and manage a particular task, that is, perceptions of people about what they can do with their capabilities" (Bandura, 1977). Previous studies show that SE positively impacts PB (Ajzai and Madden, 1986, Ajzen, 1985, Ajzen, 1991, Ajzen and Driver, 1992). Therefore, we proposed the following hypothesis:

H7. Self-efficacy is positively related to the perceived behavioral control of using green roof systems.

2.8 Government support (GS)

Governments may affect the acceptance of novel systems, depending on the amount of support they offer. Government support is important in the circulation of novel technologies (Lee-Partridge and Ho, 2003, Tan and Teo, 2000). Earlier research indicates that GS has a positive effect on PB (Nasri and Charfeddine, 2012; Zolait, 2014). The more government support an individual receives; the more likely this individual would adopt a green roof system. Hence, we developed the following hypothesis:

H8. Government support is positively related to the perceived behavioral control of using green roof systems.

3. Methodology

3.1. Survey design

The obtained data was collected through an online questionnaire via Google Forms. A pilot version of the survey was face-validated and revised based on the suggestions from a group of respondents. The aim and context of this research were provided to the participants. The questionnaire consisted of three sections. The covering letter and informed consent form were included in the first section. The next section included the demographic inquiries; for instance, age, marital status, etc. The third section was related to the scales (items) of the green roof system acceptance. Since the literature-based model was used in this study, the items which measures the constructs, were obtained from the literature. Table 1 shows the constructs and their items along with source references. A five-point Likert scale was used to measure participants' opinions on each item. This five-point scale ranges *'from strongly disagree'* =1 to *'strongly agree'* =5. The questionnaire included no personal details that could possibly indicate a specific respondent's identity. In order to determine acceptance towards green roof systems, it was recommended to have a survey with a diverse participant group. The sample involved respondents from various background who were interested in knowing more about green roof systems, including people who have already experienced or will probably experience green roof systems.

3.2. Data analysis

A multivariate analysis model, Partial-Least-Squares Structural Equation Modeling (PLS-SEM), was employed to validate the proposed research model. This displaying method empowers scholars to elucidate moderately novel situations even in the absence of a hypothetical foundation.

The PLS-SEM, which was utilized in the existing studies, gives precise estimations even if the distribution of the data is not normal (Bayraktar et al., 2017). The SmartPLS 3.2.7 programming was utilized as the analytical tool.

4. Results

The findings of this paper consist of results of descriptive analysis, measurement model and structural model.

4.1. Descriptive analysis

A number of 204 questionnaires were completed in total, which is satisfactory to conduct Partial Least Squares-Structural Equation Modeling methodology (Hair et al., 2006).

About 67% of the respondents were male, 45% of them being between the age of 30 and 39. When we look at the marital status, 68% were married. The majority of the respondents had an undergraduate degree, with at least 54%; and 71% of them are employed. Around 65% had their own home, and majority of them, 79%, lived in an apartment. 69% stated the 'distance between their homes to nearest green space less than 2 km'. Moreover, 79% '*spend some time in public green spaces'*. The details of the demographics are summarized in Table 2.

4.2. Measurement model

The overall validity and reliability are measured by the values of factor loadings, Cronbach's alpha, composite reliability (CR), average variance extracted (AVE) and Fornell & Larcker criterion. According to Table 3 and Table 4, those measures were found to be greater than their acceptable threshold values (Agarwal and Karahanna, 2000;

Amoako-Gyampah and Salam, 2004; Fornell and Larcker, 1981; Hair et al., 2006; Jaafar et al., 2018; Mishra and Akman, 2014; Nwankpa and Roumani, 2014; Sheikh et al., 2017), meaning that the data is valid and reliable.

4.3. Structural model

The model is evaluated via the bootstrapping technique by calculating the path coefficient (β), t-statistics, p-values and coefficient of determination (R-Square) (Hair et al., 2016). Hypotheses with a p-value lower than 0.05 (t>1.96) were supported. The output of the model was summarized in Table 5; based on the analysis results, seven of the eight hypotheses were supported significantly.

Attitude, subjective norms and perceived behavioral control all had a positive influence on the behavioral intention to use green roof systems, thereby Hypotheses 1, 2, and 3, were supported. Perceived usefulness of green roof systems appeared to be the only attribute that had a direct positive effect on respondents' attitudes toward acceptance, thereby Hypothesis 4 was supported. Perceived ease of use predicted perceived usefulness; hence, Hypothesis 6 was supported; whereas, its effect on attitude toward accepting green roof systems was not significant, thereby Hypothesis 5 was not supported. Government support respondents' self-efficacy to acceptance had positive influences on the perceived behavioral control of green roof systems, thereby Hypothesis 7 and 8 were supported.

Table 1. Constructs, codes, references and items

Construct	***Code***	***Items***	***Reference***
Perceived Ease of Use	PEOU1 PEOU2 PEOU3	"Green Roof systems are ease to learn and implement." "It is easy to use the Green Roof systems." "My interaction with the Green Roof systems is clear and understandable."	Carlet (2015), Hamzah et al. (2016); Ndubisi (2006)
Perceived Usefulness	PU1 PU2 PU3 PU4 PU5 PU6	"Using Green Roof systems enables me to improve my productivity." "Using Green Roof systems enables me to enhance my effectiveness." "Integration of traditional grey infrastructure with Green Roof systems could help my jurisdiction to better manage storm water proof." "Adoption of Green Roof systems complementing traditional storm water management system in my jurisdiction would reduce runoff pollution." "Green Roof systems retrofitting could enhance the effectiveness of storm water infrastructure in my jurisdiction." "Overall, I believe using Green Roof systems is useful in my job."	Carlet (2015); Huh et al. (2009)
Attitude	ATT1 ATT2 ATT3 ATT4 ATT5 ATT6	"Considering the pros and cons of Green Roof systems for storm water management, I believe adoption of the tools in my jurisdiction in the near future would be...[a]" "Considering the pros and cons of Green Roof systems for storm water management, I believe adoption of the tools in my jurisdiction in the near future would be...[b]" "I have no doubts adoption of Green Roof systems would provide multiple benefits to my community." "Using Green Roof systems is a good idea." "Using Green Roof systems is a wise idea." "Using Green Roof systems is a pleasant."	Carlet (2015); Huh et al. (2009)
Government Support	GS1 GS2 GS3	"The government endorses Green Roof systems in Turkey." "The Turkish government is active in setting up the facilities to enable Green Roof systems." "The Turkish government promotes the use of the Green Roof systems."	Nasri and Charfeddine (2012)
Subjective Norms	SN1 SN2 SN3	"People who are important to me would think that I should use Green Roof systems." "People who influence me would think that I should use Green Roof systems." "People whose opinions are valued to me would prefer that I should use Green Roof systems."	Ndubisi (2006)
Self-efficacy	SE1 SE2 SE3	"I would feel comfortable using Green Roof systems on my own." "I would be able to use Green Roof systems reasonably well on my own." "I would be able to use Green Roof systems reasonably well on my own."	Huh et al. (2009)

Perceived Behavioral Control	PB1 PB2 PB3 PB4	"I have the resources necessary to use the Green Roof systems." "I have the knowledge necessary to use the Green Roof systems." "Given the resources, opportunities and knowledge it takes to use the Green Roof systems, it would be easy for me to use the system." "I have control over using the Green Roof systems."	Ndubisi (2006)
Behavioral Intention to Use	BIU1 BIU2 BIU3 BIU4	"I intend to use Green Roof systems more in the future." "I want to use Green Roof systems for my everyday living." "It is likely that I will use Green Roof systems for my future everyday living." "Using the Green Roof systems is something I would do."	Huh et al. (2009)

"[a] Respondents were asked to complete the statement choosing from a scale of 1–5, with 1 = extremely good and 5 = extremely bad."; "[b] Respondents were asked to complete the statement choosing from a scale of 1–5, with 1 = extremely beneficial and 5 = extremely harmful."

Table 2. Demographic characteristics of the respondents

Variable	***Range***	***Values***
Gender (%)	Female	33
	Male	67
Age (%)	<20	1
	20-29	23
	30-39	45
	40-49	25
	50-59	5
	>59	1
Marital status (%)	Single	32
	Married	68
Educational status (%)	Primary school	6
	High school	22
	Undergraduate	54
	Postgraduate/PhD	18
Occupation (%)	Employed	71
	Self-employed	19
	Student	8
	Retired	2
Home ownership (%)	Freehold	65
	Rental	35
Living place (%)	Apartment	89
	House	11
Distance between home and nearest green place (km)	<2	69
	2-5	21
	6-10	6
	>10	4
Spend some time in public green spaces (%)	Yes	79
	No	21

Table 3. Reliability and validity analyses

Construct	***Item***	***Factor Loadings***	***Cronbach's Alpha***	***Composite Reliability***	***Average Variance Extracted (AVE)***
Perceived Ease of Use	PEOU1	0.926	0.925	0.952	0.869
	PEOU2	0.948			
	PEOU3	0.922			
Perceived Usefulness	PU1	0.882	0.953	0.963	0.813
	PU2	0.921			
	PU3	0.933			
	PU4	0.921			
	PU5	0.925			
	PU6	0.823			
Attitude	ATT1	0.972	0.987	0.989	0.940
	ATT2	0.964			
	ATT3	0.979			
	ATT4	0.975			
	ATT5	0.978			
	ATT6	0.948			
Government Support	GS1	0.965	0.969	0.980	0.942
	GS2	0.983			
	GS3	0.964			
Subjective Norms	SN1	0.966	0.974	0.983	0.950
	SN2	0.983			

	SN3	0.974			
Self-efficacy	SE1	0.956	0.947	0.966	0.903
	SE2	0.964			
	SE3	0.931			
Perceived Behavioral Control	PB1	0.896	0.939	0.956	0.846
	PB2	0.934			
	PB3	0.921			
	PB4	0.926			
Behavioral Intention to Use	BIU1	0.967	0.971	0.979	0.920
	BIU2	0.964			
	BIU3	0.954			
	BIU4	0.953			

Table 4. Fornell-Larcker criterion

	ATT	***BIU***	***GS***	***PB***	***PEOU***	***PU***	***SE***	***SN***
ATT	0.969							
BIU	0.907	0.959						
GS	0.651	0.688	0.971					
PB	0.627	0.770	0.722	0.920				
PEOU	0.755	0.757	0.659	0.667	0.932			
PU	0.933	0.895	0.671	0.680	0.802	0.901		
SE	0.897	0.919	0.684	0.784	0.771	0.900	0.950	
SN	0.819	0.856	0.736	0.759	0.722	0.828	0.869	0.975

Table 5. Test results

Hypothesis	***Standard Deviation***	***β Coefficient***	***t-Statistics***	***p-value***	***Supported?***
H1: ATT -> BIU	0.047	0.621	13.306	0.000	Yes
H2: SN -> BIU	0.069	0.138	2.008	0.045	Yes
H3: PB -> BIU	0.053	0.275	5.164	0.000	Yes
H4: PU -> ATT	0.041	0.917	22.597	0.000	Yes
H5: PEOU -> ATT	0.052	0.020	0.384	0.701	No
H6: PEOU -> PU	0.037	0.802	21.649	0.000	Yes
H7: SE -> PB	0.061	0.545	8.877	0.000	Yes
H8: GS -> PB	0.069	0.350	5.104	0.000	Yes

Fig. 2 illustrates the structural model with path coefficients. The R-Square (R^2) value indicates the level overall variance of a variable. For instance, attitude, subjective norms and perceived behavioral control explains almost 90% of the total variance of behavioral intention to use ("R-square = 0.893").

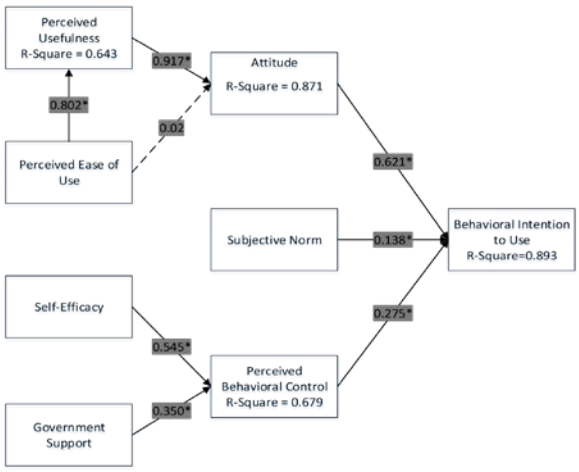

Fig. 2. Research model results

5. Conclusions

Due to quick urbanization, and therefore the vertical growing of the cities, and the limited capacity of green spaces, green roof systems seem to be a good alternative to a dedicated green space such as a public park. Some of the many benefits that green roof systems may provide to urban areas are increases in biodiversity, habitats and air quality, mitigations of the heat island effect in cities and rainwater, reduction of energy requirements for air conditioning.

This study represents a contribution to the literature on green roof systems policy and practice by incorporating theoretic perceptions on technical novelty to detect factors that impact intention to accept green roof systems usage. To the best of information, this empirical research is the initial extensive research that incorporates the factors stated earlier to observe the antecedents of green roof system acceptance in Turkey. Hence, the findings of this study will prove to be an important source of information to green roof systems users, investors, entrepreneurs, landscape architects, regulators, governments and scholars since they can help in understanding what motivates people

to adopt green roof systems and, thereby, the findings can make future forecasts on green infrastructure and its diffusion possible.

The proposed model explains almost 90% of total variance of behavioral intention to use green roof systems, which is relatively high. The path analysis implied that the outputs were similar to the earlier TAM literature by presenting perceived ease of use predicted perceived usefulness. Moreover, attitude, perceived behavioral control and subjective norms being significant antecedents of behavioral intention to use. Further, government support and self-efficacy were significant determinants of perceived behavioral control.

The results imply that people's likelihood of implementing green roof systems into their lives relies heavily on their belief that there will be governmental support behind it, as well as the system will prove to be affecting the general functioning and efficiency positively. Along with these results, it can be said that prospective users will take into account the opinions of those around them, especially their friends', families', and peers' in deciding whether or not to implement to such a system. An obstacle that needs to be overcome on the path to installation of green roof systems is the lack of information on the potential benefits of these systems. Which leads us to the belief that with a higher public awareness, governments and individuals will be more inclined to be working with green roof systems. The public motivation towards these systems will also be positively affected by the appreciation and validation the designers and the users receive from the rest of the society.

As it is the case with any newly-introduced system that promises resources to a certain audience, it is crucial to ensure the availability of that resource to the intended user to encourage adoption, which in this case, the green roof system itself. On that note, it can be conveyed that the system itself will create availability of and access to green spaces within residential and municipal buildings, hospitals, or schools, to strengthen the perception of such systems that would ultimately lead to increased interest in them.

Despite the above-mentioned contributions of the study, some limitations should be considered for further studies. First, the observations provided in this paper should not be generalized, as this study is isolated within Turkey. The results may differ if the same research model is tested in another country or culture. Hence, as a further study, researchers may test the model with diverse participants in another country, and thereby, the results can be compared. Second, the model did not take the demographics data collected through the questionnaire as a factor. Hence, as a future study, the role of gender, age, education level, etc. can be incorporated and tested with the model. Third, the proposed constructs explained 89.3% of the variance in the behavioral intention to use. Therefore, additional domain specific constructs can be included in the model and tested in a future research. Lastly, for a better understanding of green roof systems acceptance, qualitative data can be used in a future study.

References

Agarwal R., Karahanna E., (2000), Time flies when you're having fun: cognitive absorption and beliefs about information technology usage, *MIS Quarterly*, **24**, 665-694.

Ajzai L., Madden T.J., (1986), Prediction of goal-directed behavior: attitudes, intentions, and perceived behavioral control, *Journal of Experimental Social Psychology*, **22**, 453-474.

Ajzen I., (1985), *From Intentions to Actions: A Theory of Planned Behavior*, In: *Action Control*, Kuhl J., Beckmann J. (Eds.), Springer, Berlin, Heidelberg, New York, 11-39.

Ajzen I., (1991), The theory of planned behavior, *Organizational Behavior and Human Decision Processes*, **50**, 179-211.

Ajzen I., Driver B.L., (1992), Application of the theory of planned behavior to leisure choice, *Journal of Leisure Research*, **24**, 207-224.

Amoako-Gyampah K., Salam A.F., (2004), An extension of the technology acceptance model in an ERP implementation environment, *Information and Management*, **41**, 731-745.

Bandura A., (1977), Self-Efficacy: toward a unifying theory of behavioral change, *Psychological Review*, **84**, 191-215.

Bayraktar C.A., Hancerliogullari G., Cetinguc B., Calisir F., (2017), Competitive strategies, innovation, and firm performance: an empirical study in a developing economy environment, *Technology Analysis and Strategic Management*, **29**, 38-52.

Beyhan F., Erbas M., (2013), A study on green roofs with the examples from the World and Turkey, *Gazi University Journal of Science*, **26**, 303-318.

Bonoli A., Conte A., Maglionico M., Stojkov I., (2013), Green roofs for sustainable water management in urban areas, *Environmental Engineering and Management Journal*, **12**, 153-156.

Carlet F., (2015), Understanding attitudes toward adoption of green infrastructure: a case study of us municipal officials, *Environmental Science and Policy*, **51**, 65-76.

Davis F.D., (1989), Perceived usefulness, perceived ease of use, and user acceptance of information technology, *MIS Quarterly*, **13**, 319-340.

Fernandez-Cañero R., Emilsson T., Fernandez-Barba C., Machuca M.Á.H., (2013), Green roof systems: a study of public attitudes and preferences in southern Spain, *Journal of Environmental Management*, **128**, 106-115.

Fishbein M., Ajzen I., (1975), *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*, Addison-Wesley, Reading, MA.

Fornell C., Larcker D.F., (1981), Evaluating structural equation models with unobservable variables and measurement error, *Journal of Marketing Research*, **18**, 39-50.

Hair J.F., Hult G.T.M., Ringl C., Sarstedt M., (2016), *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, 2nd Edition, Sage Publications, Los Angeles.

Hair J.F., Black B., Babin B., Anderson R.E., Tatham R.L., (2006), *Multivariate Data Analysis*, 7th Edition, Pearson Prentice-Hall, Upper Saddle River.

Hamad A.A.A., Petri I., Rezgui Y., Kwan A., (2017), Towards the innovation of an integrated 'one-stop-

shop' online services utility management: exploring customer' technology acceptance, *Sustainable Cities and Society*, **34**, 126-143.

Hamzah Z., Jaafar M., Yusoff W., Nor M.I.M., (2016), Transforming terrace housing rooftop to green roof in Kuala Lumpur–a study on its constructs and variables, *Journal of Design+ Built*, **9**, 62-75.

Hansen J.M., Saridaki, G., Benson V., (2018), Risk, trust, and the interaction of perceived ease of use and behavioral control in predicting consumers' use of social media for transactions, *Computers in Human Behavior*, **80**, 197-206.

Ho C.H., (2010), Continuance intention of e-learning platform: toward an integrated model, *International Journal of Electronic Business Management*, **8**, 206-215.

Huh H.J., Kim T.T., Law R., (2009), A comparison of competing theoretical models for understanding acceptance behavior of information systems in upscale hotels, *International Journal of Hospitality Management*, **28**, 121-134.

Hurriyet Daily News, (2014). Public bus with green roof takes to Istanbul's streets, On line at: https://www.hurriyetdailynews.com/public-bus-with-green-roof-takes-to-istanbuls-streets-72444.

Jaafar N.I., Sulaiman A., Ali S.M., (2018), Pro-environmentalism behavior, organizational pressure, sustainable information technology initiatives and financial performance of Malaysian service firms, *Environmental Engineering and Management Journal*, **17**, 43-52.

Kalantari M., Ghezelbash S., Yaghmaei B., (2016), People and green roofs: expectations and perceptions of citizens about green roofs development, an Iranian case study, *Mediterranean Journal of Social Sciences*, **7**, 138-147.

Kang H., Hahn M., Fortin D.R., Hyun Y.J., Eom Y., (2006), Effects of perceived behavioral control on the consumer usage intention of e-coupons, *Psychology and Marketing*, **23**, 841-864.

Kulekci E.A., (2017), Green roof systems from past to today and study on the determination of quality standards in the green roof, Journal of ATA Planning and Design, **1**, 35-53.

Kwak Y.H., Park J., Chung B.Y., Ghosh S., (2012), Understanding end-users' acceptance of enterprise resource planning (ERP) system in project-based sectors, *IEEE Transactions on Engineering Management*, **59**, 266-277.

Lee-Partridge J.E., Ho P.S., (2003), *A Retail Investor's Perspective on the Acceptance of Internet Stock Trading*, Proc. of the 36th Annual Hawaii International Conference On System Sciences, Big Island, HI, USA, 6-9 January 2003, 1-11.

Lee M.C., (2010), Explaining and predicting users' continuance intention toward e-learning: an extension of the expectation–confirmation model, *Computers and Education*, **54**, 506-516.

Li F., Wang R., Paulussen J., Liu X., (2005), Comprehensive concept planning of urban greening based on ecological principles: a case study in Beijing, China, *Landscape and Urban Planning*, **72**, 325-336.

Liew C.S., Ang J.M., Goh Y.T., Koh W.K., Tan S.Y., Teh R.Y., (2017), *Factors Influencing Consumer Acceptance of Internet of Things Technology*, In: *Handbook of Research On Leveraging Consumer Psychology for Effective Customer Engagement*, Suki N.M.(Ed.) IGI Global, Hersey, Pennsylvania, 186-201.

Liu Y., Hong Z., Zhu J., Yan J., Qi J., Liu P., (2018), Promoting green residential buildings: residents' environmental attitude, subjective knowledge, and social trust matter, *Energy Policy*, **112**, 152-161.

Mahindrooa A., Singh H., Samalia H.V., (2012), Factors impacting intention to use of ERP systems in Indian context: an empirical analysis, *Global Journal on Technology*, **3**, 1626-1635.

Mishra A., Akman I., (2014), Green information technology (GIT) and gender diversity, *Environmental Engineering and Management Journal*, **13**, 2999-3007.

Nasri W., Charfeddine L., (2012), Factors affecting the adoption of internet banking in Tunisia: an integration theory of acceptance model and theory of planned behavior, *The Journal of High Technology Management Research*, **23**, 1-14.

Ndubisi N., (2006), Factors of online learning adoption: a comparative juxtaposition of the theory of planned behaviour and the technology acceptance model, *International Journal on E-Learning*, **5**, 571-591.

Nwankpa J., Roumani, Y., (2014), Understanding The link between organizational learning capability and ERP system usage: an empirical examination, *Computers in Human Behavior*, **33**, 224-234.

Ramayah T., Rouibah K., Gopi M., Rangel G.J., (2009), A decomposed theory of reasoned action to explain intention to use internet stock trading among malaysian investors, *Computers in Human Behavior*, **25**, 1222-1230.

Sheikh A.I.Y., Mukthar E.K., Kayode M.L., (2017), University students' intention of smartphone adoption for academic activities: testing an extended TAM model, *Media Watch*, **8**, 208-221.

Tan M., Teo T.S., (2000), Factors influencing the adoption of internet banking, *Journal of the Association for Information Systems*, **1**, 1-44.

United Nations, (2007), State of World Population 2007: Unleashing the Potential of Urban Growth, New York: UN, On line at: http://www.unfpa.org/swp/2007/presskit/pdf/sowp2007_eng.pdf.

Venkatesh V., (2000), Determinants of perceived ease of use: integrating control, intrinsic motivation, and emotion into the technology acceptance model, *Information Systems Research*, **11**, 342-365.

Warshaw P.R., Davis F.D., (1985), Disentangling behavioral intention and behavioral expectation, *Journal of Experimental Social Psychology*, **21**, 213-228.

Wu B., Chen X., (2017), Continuance intention to use MOOCs: integrating the technology acceptance model (TAM) and task technology fit (TTF) model, *Computers in Human Behavior*, **67**, 221-232.

Zolait A.H.S., (2014), The nature and components of perceived behavioural control as an element of theory of planned behaviour, *Behaviour and Information Technology*, **33**, 65-85.