Assessing Residents' Receptiveness towards Smart City Technologies

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Abstract

Technological acceptance has important implications for the development and transformation towards smart city. As sustainable development is unequivocal, Penang has embraced the concept of smart city. Before any significant investment is made, and as part of citizen engagement activity, this study aims to examine the determinants that influence the uptake and receptivity to smart city technologies among Penang residents, underpinned by the integration of technology acceptance model (TAM) and the social cognitive theory (SCT). Findings indicate that perceived usefulness, perceived ease of use, relative advantage, and reliability are the factors leading towards trust in technology. Meanwhile, trust, self-efficacy, time saving and facilitating conditions are positively associated with the intention to use smart city technologies. Overall, this study offers meaningful insights and shed light on Penang Smart City acceleration.

Keywords: Smart city, technology adoption, structural equation modelling

Introduction

Penang is a state in the northern region of Malaysia with a population of approximately 1.7 million people (Penang Institute, 2020) and perhaps considered the second busiest city after Kuala Lumpur. As the state of Penang launched the Penang 2030 initiative "A Family-Focused Green and Smart State that inspires the Nation" (Penang, 2030, 2019), a vision for the state of Penang to embark on a journey to become a family oriented, environmental friendly smart city by the year 2030. The term Smart City is one of the most frequently coined term right next to Internet of Things (IoT), AI, Big Data, and the Fourth Industrial Revolution (IR4.0). Countless projects and research have been done to move Penang closer to a smart city. Currently, there is no doubt that implementing smart cities with sensors, integrated data management, artificial intelligence to manage big data and traffic/parking management

systems would greatly help in adding value into the people's daily life. The most recent evolution in the smart city concept is the smart city 3.0. It looks at cities beyond being technology or city driven. This concept focuses on citizen co-creation. Therefore, the concept of smart city 3.0 looks at broader subjects such as social inclusion, democracy, enterprise creation and building social capital (Safesmart, 2017).

Research Model and Hypotheses Development

A smart city is the result of the efforts of many stakeholders, working together in partnerships of different shape and form. The citizen / user is at the centre of the map, indicating that successful smart cities are always user-centric (Eggers & Bellman, 2015). This research will combine the usage of TAM (Technology Acceptance Model) and SCT (Social Cognitive Theory) to extend the smart city adoption model (Habib, et al., 2020). The direct relationship between Social Cognitive Theory, self-efficacy, self-innovativeness, trust in the State Government of Penang and intention to use smart city technologies are tested. Meanwhile trust in technology is investigated as the mediating role between Technology Acceptance Model and the intention to use smart city technologies.

Technology Adoption Model

The world today revolves around technology and that also means that the government needs to evolve into the e-government services that many might consider it to be a fundamental function that the local, state and even federal government needs to adopt. Smart cities are expected to provide their services through a rise in integration between residents, community and government (AlAwadhi & Scholl, 2013). A very useful theory that can be applied to smart city technology adoption would be the TAM by Davis (1989), it has been used extensively to investigate technology's acceptance and usage (Dwivedi, et al., 2019).

Social Cognitive Theory

This theory focuses more on the social and economic aspects of tech acceptance. The social cognitive theory is the more widely used theory to explain socially oriented technology (Bandura, 2001) Individuals behaviour in regard to tech acceptance can be understood by looking into concepts that the social cognitive theory provides. It mainly investigates the social influences on the behaviour of the individual. According to Bandura (2001), it is one of the most important theories that explains human behaviour. Additionally, theory of diffusion

innovation is also important for the understanding of the social dimensions of technology acceptance.

Perceived Security

Research indicates that in developing countries the citizens have a strong need to feel secure when they use any new technology (Sepasgozar, et al., 2019). Perceived security is to what extend the users believe that the smart city technologies or services are a secure platform to store and share their data (Habib, et al., 2020). This have previously been researched before in the areas of e-governance services, e-banking line and cloud computing (Arpaci, et al., 2015; Pearson & Benameur, 2010; Sarabdeen & Ishak, 2015). It has been found that smart city technology users likely to value safety and security (Habib, et al., 2020). Therefore, this study would like to propose the following hypothesis:

H_1: Perceived security positively affect trust in technology

Relative Advantage

Relative Advantage is a way to compare new technology to current available technology (Sepasgozar, et al., 2019). There is even research that says relative advantage is probably the best way to predict the acceptance of technology usage (Lee, et al., 2015). Hence this paper would like to put forth the following hypothesis:

H_2: Relative advantage positively affects trust in technology

Perceived Ease of Use

Perceived ease of use is the degree to which the users believe that the use of smart technology requires a high level of effort. As referred to some studies (Schmidthuber, et al., 2020; Viswanath, et al., 2003), perceived ease of use is an important factor to understand the acceptance of government e-portals and other technologies. Moving forward, this research would like to propose the following hypothesis:

H_3: Perceived ease of use has a positive effect on trust in technologies

Perceived Usefulness

Perceived usefulness states that potential users may be willing to use smart city technology when they think that the technology will make their life easier. Sometimes in developing countries the bureaucracy of governments and big organisations can get quite

complicated and potentially be very time consuming with a lot of follow ups (Sepasgozar, et al., 2019). With that, this paper would like to introduce the next hypothesis:

H_4: Perceived usefulness has a positive effect on trust in technologies

Compatibility

Compatibility points to the degree to which an urban smart technology is consistent with the potential users existing behaviour (Sepasgozar, et al., 2019). What is even more important would be the compatibility of the new technology to any of the users pre-existing hardware and or software. van Oorschot, et al. (2018) discovered that the technical compatibility is a very strong predictors of technology acceptance, that research also showed that technical compatibility is the key to external technology diffusion while relative advantage would be key for internal diffusion. Hence, this research would like to propose the following hypothesis:

H_5: Compatibility has a positive effect on trust in technologies

Reliability

Reliability explains the confidence of the users to the function and accuracy of the technology service (Sepasgozar, et al., 2019). Hence, reliability is considered as an important factor for users and this paper would like to put forth the following hypothesis:

H_6: Reliability has a positive effect on trust in technologies

Self-Efficacy

Self- Efficacy explains the measure of user's capability to make use of technology to do certain task. It refers to as a user's confidence in using a technology effectively (Kabbiri, et al., 2018). It is argued that people with a high self-efficacy for technology can use digital tools with higher frequency and have less fear when using technology. As a result, the following hypothesis is proposed:

H_7: Self Efficacy has a positive effect on intention to use smart city technology

Self-Innovativeness

Previous work regarding self-innovativeness have shown that relationship do exist between technology and innovativeness especially in the context of adaptation of educational technologies (Bubou & Job, 2020). The study also discovered that individual innovativeness is

important to understanding technology receptiveness behaviour of a person. Based on that argument, the following hypothesis is proposed for further analysis in this study:

H_8: Self Innovativeness has a positive effect on intention to use smart city technology

Trust in State Government

Trust in State Government refers to the peoples trust in the Government's e-services and platforms. Refering to Almuraqab and Jasimuddin (2017), trust in government as 'the public's perception of political authorities, agencies and organizations integrity and their capability to give services to the expectations of citizen for the assessment of government'. Citizens of the city that wants to implement smart city technologies will have increased sceptic due to an increased use of technology and would question for what and why their data are being gathered (Braun, et al., 2018). Therefore, this research proposes the following hypothesis:

H_9: Trust in state government has a positive effect on intention to use smart city technology

Facilitating conditions

Facilitating conditions refer to the users believes that the technical infrastructure is at a satisfactory level to support them when the technology is being used (Sepasgozar, et al., 2019). Studies have shown that positive facilitating conditions have contributed to successful tech adoption (Legris, et al., 2003). Therefore, this paper would like to introduce the next hypothesis which is:

H_{10}: Facilitating condition has a positive effect on intention to use smart city technology

Cost Reduction

Cost reduction means that new technology brings new economic advantage due to the users feeling that they can save money on current cost (Legris, et al., 2003). According to van Oorschot, et al. (2018), the study shows that cost is an important factor for success in many technological studies. Hence, the research would like to propose the following hypothesis:

H_{11}: Cost reduction is a positive effect on intention to use smart city technology

Energy Saving

Energy saving refers to the users feeling that they get to save energy by using any smart city technologies. To prevent loss of energy this would be a key construct to relate to it (Chiu, et al., 2006). Therefore, this paper would like to put forth the following hypothesis:

H_{12}: Energy saving is a positive effect on intention to use smart city technology

Time Saving

Time saving refers to the users feeling that they get to save time by using any smart city technologies, making them more time efficient. In the research of Chiu, et al. (2006), it states that conditions that prevent time losses can influence the user's acceptance of new technology. Therefore, the following hypothesis is proposed:

H_{13}: Time saving is a positive effect on intention to use smart city technology

Trust in Technology

Trust in technology refers to an individual's analysis of technology related trust issues (Shahzad, et al., 2018). Critical factor when performing an online transaction in a business to consumer sales is trust (Ooi, et al., 2021). When an e-commerce system does not gain the consumers trust the consumers will be unwilling to give their transactional information or personal data for completing their payments online (Ooi, et al., 2021). This explains the following hypothesis:

H_{14}: Trust in technology has a positive effect on intention to use smart city technology

Research Methods

This study mainly focusses on residents that resides in Penang. Based on purposive sampling, data were collected from 458 Penang residents, and analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM). Table 1 presents the results of the structural model.

Table 1: Results of the Structural Model

Hypotheses	Relationships	Path Coefficients	Std. Errors	t-values	95% Confident Intervals
H1	Security -> Trust in Tech	-0.018	0.032	0.574	[-0.073, 0.033]
H2	Advantage -> Trust in Tech	0.215	0.048	4.494**	[0.136, 0.293]
H3	PEOU -> Trust in Tech	0.155	0.054	2.888**	[0.067, 0.243]
H4	PU -> Trust in Tech	0.189	0.049	3.893**	[0.111, 0.269]
H5	Compatibility -> Trust in Tech	-0.026	0.029	0.897	[-0.074, 0.021]
H6	Reliability -> Trust in Tech	0.356	0.043	8.270**	[0.289, 0.429]
H7	SE -> Int	0.348	0.045	7.703**	[0.274, 0.422]
H8	Innovate -> Int	0.011	0.033	0.343	[-0.044, 0.066]
H9	Trust in Gov -> Int	-0.037	0.031	1.212	[-0.090, 0.010]
H10	FC -> Int	0.102	0.049	2.078**	[0.024, 0.185]
H11	Cost -> Int	-0.056	0.037	1.510	[-0.119, 0.001]
H12	Energy -> Int	-0.042	0.03	1.398	[-0.091, 0.008]
H13	Time -> Int	0.182	0.049	3.685**	[0.100, 0.262]
H14	Trust in Tech -> Int	0.369	0.044	8.354**	[0.294, 0.439]

**p<0.01

Discussion and Conclusion

The findings of this study provide a clearer picture for scholars, practitioners, government officials, decision makers and policy makers a like that are trying to make Penang a smart city. Among the predictors, perceived usefulness, perceived ease of use, relative advantage and reliability positively and significantly influencing trust in technologies. Meanwhile, trust, self-efficacy, time saving and facilitating conditions are positively associated with the intention to use smart city technologies.

With smart cities gaining popularity worldwide, it is not uncommon that Malaysia to follow suite and especially for Penang, being the second busiest state in Malaysia it makes perfect sense for them to move this way forward. This study offers a glimpse into the receptiveness towards smart city technologies and what factors influence it.

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