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Research paper



Wireless Communication: A Conceptual Model of IoT Services Success for Government Agencies

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Abstract

The Internet-of-Things (IoT) is a wireless technology that offers opportunities for Government-Agencies (GA) to improve services to citizens. However, the challenge is to ensure that the IoT is fully utilized as the real value of using IoT services comes from the establishments of services through effective utilization of technologies. This paper aims to develop a conceptual model for successful implementation of IoT services in GA which is one of the least essential studied aspects of utilization of Digital-Government services. This study proposes a new integrated success model that combines the dimensions of Technology-Readiness-Index (TRI) 2.0 with other success factors – service quality, information quality, system quality, user satisfaction, use (from DeLone&McLean Information-System-Success-Model), perceived usefulness (from Technology-Acceptance-Model), and trust construct to understand the determinants of IoT services success model in GA from the perspective of government officers. Interviews with Government-IoT experts are conducted to define and delineate the research problem. The proposed model could bring a better perspective of the critical factors that contribute to the success of IoT services implementation process particularly in GA as well as providing a groundwork for further empirical testing. Moreover, it will suggest an appropriate implementation mechanism to help GA increase the use of IoT services.

Keywords: *Digital Government; IoT; IoT Services; Technology Readiness; DeLone & McLean Information System Success Model*

1. Introduction

The IoT refers to objects of embedded sensors and wirelessly connected devices with the aim to bring countless benefits to citizens and organizations around the world [1]. United Nations Publications 2017 reported that 25 billion IoT devices might be deployed by the year 2020 and the costs of management and operational risk are expected to reduce [2]. IoT has been given wide attention in many fields such as in agro-industrial, environmental, transportation, healthcare and safety [1], [3], [4]. The emergence of the IoT as a new technology trend seems to offer opportunities for Government Agencies to improve both the quality and efficiency of public services. Thus, it has become a new trend in the transformation of e-Government to Digital Government [5]. IoT also plays a critical role in the revolution in Industry 4.0 as a production factor [6].

Although IoT has enormous potential to dramatically improve Government performance to provide better services and smarter decisions, the employees may underutilize this new technology. In implementing IoT, organizations are expected to face the most significant challenges in dealing with resistant employees to adapt and to changes to their regular work routines that can result in new technology remain underutilized [7]-[9]. The success of bringing about technological innovation such as IoT rests mainly on individual readiness for change, and employees' willingness to use IoT to improve public services quality.

There have been cases of the failure of new technology initiatives due to the reluctance of employees to use the systems [10]-[12]. Kukafka et al. (2003), in their studies of the systematic analysis of the implementation of new technology, mentioned that high failure rates associated with underutilized systems. Low-quality services, higher user dissatisfaction and lack of individual readiness to adopt and use the technology are known as critical reasons for new technology being underutilized [8]–[10]. Lack of trust among users with regards to the data received from the IoT services is also one of the concerns [11]. Poor usage of IoT services can lead to a massive loss of investment. Moreover, a recently published report by Baller et al. (2016) indicates that the personal usage of IoT is still one of the lowest in the world that can affect the success of the IoT services implementation. Therefore, determining the factors that can affect the successful implementation of IoT is an initial step the government should take to assure that IoT is fully utilised.

Before implementing new technology, it is crucial to make sure the employees are ready to accept and use. A large and growing literature has investigated the influence of Technology Readiness (TR) as a potential psychographic variable in the contexts of technology-based innovation on the employees' acceptance [13]–[15]. Extensive research has shown their concerns on the importance of addressing employees' acceptance, system use and technology readiness issues for the success of IoT implementation [11], [21], [22], [24]. However, much uncertainty still exists about the relationship between these issues in an integrated success model specifically in the IoT services context. It is the objectives of this study to address these issues in an integrated model and em-

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pirically test its applicability in IoT services implementation context. This study looks specifically into the factors that may affect the Government Agencies employees to adopt and use IoT services.

2. Theoretical Background

2.1. Technology Readiness Index (TRI)

Looking into user readiness and acceptance towards the newly introduced technology, TRI has received the attention among researchers to measure people's propensity to embrace and use cutting-edge technologies with 36-item scale [16]. Many studies have been conducted to examine TRI in influencing people's general beliefs about technology and its effect on behavioral intentions [14], [17]–[21]. TRI consists of four dimensions: optimism, innovativeness, discomfort, and insecurity as presented in Table 1 [25]. Figure 1 below illustrates the TRI model.

Table 1: TRI's Dimensions and Definition

Dimensions	Definition
Optimism	A positive view of technology and belief that it offers people flexibility, increased control, and efficiency in their lives.
Innovativeness	A tendency to be a thought leader and technology pioneer.
Discomfort	A perceived lack of control over technology and a feeling of being overwhelmed by it.
Insecurity	Distrust of technology, stemming from scepticism about its ability to work properly and concerns about its potential harmful consequences.

Based on Parasuraman (2000).

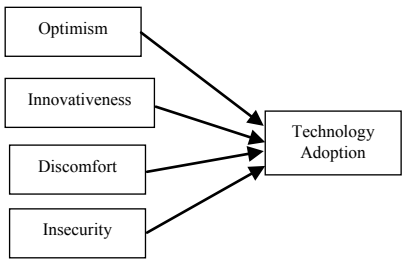


Fig. 1: The TRI Model

Due to advancement and sophisticated interaction in technologies, an update to the original TRI was performed, and 16-items scale subsequently comprise TRI 2.0. [31]. Lam et al. (2013) argued that TRI exerts the meaningful effect on technology acceptance construct by each of their distinct dimensions. They suggested that the construct should be used independently as the predictors to the acceptance of new technology. In another study, Parasuraman & Colby, (2015) conducted further research on TRI by looking at technology readiness from the perspectives of technology customers classification. They classified customers into five technology readiness segments: (i) Explorers, (ii) Pioneers, (iii) Sceptics, (iv) Paranoids; and (v) Laggards. This study followed by Lai (2008), Ling & Muhammad (2014), Rose & Fogarty (2010) and Summak et al. (2010) who also used TRI to classify the customers. These empirical studies found that the respondents had a moderate level of acceptance of new technology and the percentage of respondents in category explorers is more prominent than those in laggards.

Researchers also attempted to evaluate the impact of TRI, which issued as the predictor or antecedent of the adoption of new technology (e.g., [22], [24]–[30]. For instance, Liljander et al. (2006) and Lin (2007) explored the impact of TR on users' attitudes towards new technology product in self-service technologies (SST). Liljander et al. (2006) have conducted a study among loyalty program customers of a European airline in Finland, having access to Internet check-in. The data collected from 1258 useable samples and the analysis of the data revealed that only optimism and innovativeness formed unique individual dimensions. The authors claim that TR had a surprisingly little impact on customer attitudes towards SST. In other studies in SST, Lin (2007) tested the model with a sample of 413 consumers in Taiwan.

Interestingly, only Lin (2007) examine the effect of TR on different variables: satisfaction and behavioral intention on SST. The study found that the more customer satisfaction experience using self-service technologies, the more likely they use it again and also recommend it to other consumers. Vize et al. (2013) used TRI as moderate variables in their research framework in the business-to-business (B2B) context. The study examined the crucial factors that impact the retailer's TR and explain the outcomes of TR which are service quality and satisfaction. This study surveyed 133 small retailers with online presences in the retail industry. The findings showed that TR had the significant positive effect on satisfaction and service quality, and service quality has the significant positive influence on satisfaction.

Previous research on TRI emphasizes integrating TR into technology acceptance. C. Lin & Sher (2007) developed an integrated Technology Readiness and Acceptance Model, which is called the TRAM Model. This model used TR to examine the adoption of consumers innovations. The results show that the TRAM can become a better way to gauge technology adoption. Several studies have used TRAM to examine the effect of TR on technology acceptance (for example, [22], [28], [34], [37], [40] – [43]). Many studies have used TRI in a wide range of contexts. Table 2 listed the studies that proved the role and impact of TRI.

Table 2: The Role and Impact of TRI

Role and Impact of TRI	Author, Year
TRI effect on behavioural intentions	Badri et al. (2014); Ling & Muhammad (2014); Lu, Wang, & Hayes (2012).
TRI on technology customer classification	Ling & Muhammad (2014); Rose & Fogarty (2010); Summak et al. (2010)
TRI as a predictor or antecedent of the adoption of new technology	Napitupulu (2017); Lam et al. (2013); Rojas-Mendez, Parasuraman, & Papadopoulos (2016); Son & Han (2011); Vize et al. (2013).
TRI effect on technology acceptance	Adiyarta et al. (2018); Brantes & Ferreira (2014); Iyer et al. (2015); Kuo et al. (2013); Rojas-Mendez et al. (2016); Vize et al. (2013);

Overall, these studies focus on the critical role of TR in technology adoption and acceptance. Nevertheless, such studies remain narrow by focusing only on dealing with pre-adoption of new technology. According to Son & Han (2011), the role of TRI in post-adoption behavior is rare. Badri et al. (2014), believes that it is worth to extend the investigation of TRI into the post-adoption behavior. Furthermore, personal and technological innovativeness were found to be related to IoT services in past studies [22], [44].

According to Parasuraman (2000), the use of new technology is related to the user positive attitude and belief. Hence, it is critical to facilitate understanding behind IoT services adoption by expanding the conceptual model. As IoT is a new technology, understanding the readiness of individuals in using IoT is essential. Besides, the use of TRI 2.0 still lacks in the measure of the technology readiness [31]. As mentioned above, TRI 2.0 is the updated version of TRI. Therefore, the effect of TRI 2.0 on the use of IoT needs to further explored as part of the contributing factors affecting the success of IoT implementation. This study will use TRI 2.0 to match technology with the recent changes in the technology environment.

2.2. DeLone & McLean Information System Success Model (D&M ISSM)

Measurement of success in IoT services (as an information system (IS)) is critical to understand the real value or effectiveness of the new technology. Therefore, the IS success model is another useful theoretical framework to study the effective use of IoT services.

DeLone & McLean (1992) proposed a useful model between six IS success factors: Information Quality, System Quality, IS Use, User Satisfaction, Organization Impact, and Individual Impact (see Figure 2). In Table 3 are shown the definitions of the dimensions IS success. Seddon (1997) recommended a re-specification and extension of the D&M ISSM model by focusing on the clarification the meaning of 'IS Use' as an indicator of IS success. The author introduced four new variables (expectations, consequences, perceived usefulness, and the net benefit to society) and reassembled the inter-relationship among the variables. Later, DeLone & McLean (2003) revised their model and added the "service quality" to measure the service provider performance (see Figure 3). The main argument of the model is that, once the users realize the benefits of using the system, the system can be considered as successful.

Table 3: D&M ISSM (1992) Construct and Definition

Construct	Definition
System Quality	Quality of information processing system and measurement aspects such as response time, reliability, and ease of use.
Information Quality	Quality of information system output and measurement aspects such as accuracy, currency, relevance, and completeness.
User Satisfaction	A response from the recipient to the use of the output of an information system and measurement aspects such as enjoyment and effectiveness.
Information Use	Consumption from the recipient of the output of an information system and measurement aspects such as frequency of use, the motivation of use; and use or non-use of data.
Individual Impact	The effect of information on the behaviour of the recipient and measurement aspects such as user confidence, and interpretation accuracy.
Organizational Impact	The effect of information on organizational performance and measurement aspect such as cost reductions, and contribution to company profits.
Based on DeLone and McLean (1992)	

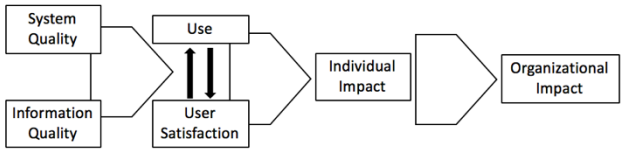


Fig. 2: The D&M ISSM Model (1992)

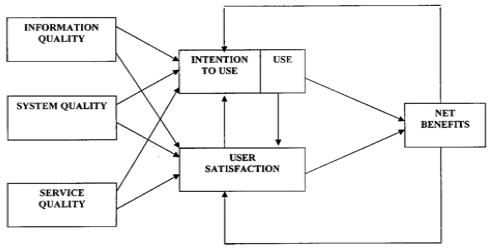


Fig. 3: The D&M ISSM Model (1992)

DeLone & McLean (1992, 2003) support the importance of the model to specific IS contexts by adding other constructs relevant. Therefore, some studies have used and supported the validity of the D&M ISSM framework to measure IS success in different applications, as summarized in Table 4.

Table 4: Application of D&M ISSM

Authors	Model D&M ISSM	System/ Industry	Country
Ramdan et al. (2014)	2003; interpret net benefit as e-Government system success	Education Portal/ Government	Malaysia
Mardiana et al. (2015)	2003; modified to include perceived usefulness (from TAM) and performance expectancy (from UTAUT).	Information System/ Government	Indonesia
Kutlu & Alkaya (2015)	2003; interpret net benefit as IS the success of the banking sector.	Investment/ Banking	Turkey
Chu & Lin (2016)	2003; modified to replace intention to use or use with perceived usefulness, user satisfaction with perceived ease of use and add a new construct which are relationship quality and usage intentions.	Medical Material Management Cloud/ Telecommunications	Taiwan
Carlos Tam & Tiago Oliveira (2017)	2003; modified to include context and time perception (from Hall's cross-culture dimensions).	Mobile Banking/ Business	Portugal
Shin & Hwang (2017)	2003; modified to include sustainability, organizational issues and organizational readiness (from sociotechnical system theory).	Internet of Medical Things (IoMT)/ Healthcare	Korea
Aldholay et al. (2018)	2003; modified to include transformational leadership.	Online Learning/ Education	Yemen
Chatterjee, Kar, & Gupta (2018)	2003; modified to replace intention of use or use with perceived intention to use IoT, user satisfaction with perceived users' satisfaction using IoT, net benefit with the perceived net benefit of IoT, and add new construct which called actual usage of IoT.	IoT in Smart Cities/ Government	India
Veeramootoo et al. (2018)	2003; modified to include perceived risks, habit, and confirmation.	e-Filling/ Government	Mauritius

Based on Table 4, the 2003 version of D&M ISSM model has been recognized and extensively used as an appropriate framework to formulate IS success measurements. Considering a recent study by Salahshour, Mehrbakhsh, & Dahlan (2018), measuring IS success especially in perspective of the actual system utilization is essential to assess the success of new systems or technologies such as IoT services. Hence, the factors to determine IoT services success need to explore. In doing so, DeLone and McLean Information Systems Success Model (D&M ISSM) is proposed to be adopted in this study by considering the fact that users' perceptions towards new technology mainly influenced by the technical factors such as system quality, information quality, and service quality as well as user satisfaction. Besides, D&M ISSM has gained strong theoretical and empirical support in the study of new technology success especially in IoT [36]. Integrating these con-

structs with TRI is possible because user satisfaction and service quality found related to TRI in past studies [49].

2.3. Perceived Usefulness (PU).

Perceived Usefulness (PU) in the Technology Acceptance Model (TAM) has widely used in past research. PU is another critical factor that needs to consider in ensuring that IoT implementation is successful. The definition of PU is "the degree to which an individual believes that using a particular system would increase his or her job performance" [50], [87].

Mardiana, Tjakraatmadja, & Aprianingsih (2015) attempted to validate the DeLone & McLean (2003) and verified that PU is the most important contributor to forecasting intention to use. PU as an IS success measure has accumulated ample empirical support [38]–[40]. PU has also been the factor influencing users' decision to use new technology and strongly affect the user's willingness to use new technology such as IoT [41]–[44]. Moreover, PU is found associated with TRI in the study of the adoption of IoT in healthcare technology products [45] and electronic book reader [46]. Therefore, it will be essential to investigate the effects of individual IS success factors and technology readiness on PU in the IoT services context.

2.3. Trust

Trust is another construct to be incorporated in this study. Trust is an essential aspect of human interactions and mutual relationship [47]. The applicability of trust on TAM has widely established [44], [48]. For example, George & Pandey (2017), analyzed the adoption of e-government services and proposed that the variable of trust and personal values contribute to the understanding of the adoption. This study integrated trust into TAM due to uncertainty in online services. Trust was found to have a significant positive effect on PU. In the same vein, Aloudat et al., (2014) conducted a study of the viability of location-based mobile emergency services and found that trust is a determinant of individual perception of the usefulness of the mobile government services. Besides, Stergiou et al. (2016) revealed that trust enhanced the level of adoption of e-Government. They further asserted that a lack of trust could inhibit individuals' decision to use new technology.

While in the IoT context, Gao & Bai, (2014) found that trust is a significant factor that affects the behavioral intention to adopt the IoT services. Similarly, trust is also an essential factor for the adoption of IoT techno-service system in New Zealand [52].

3. Research Methodology

The preliminary information is gathered by a comprehensive literature review (LR) and an interview with Government IoT experts to ensure that our findings are as close to reality. This essential technique was performed at the initial phase to identify and narrow down the specific issues regarding IoT services. The technique adopts preliminary information gathering guidelines from Sekaran (2013). The same technique has also been applied in quantitative research by Teo, Lin, & Lai (2009) to gain real problem about Singapore's adopters and non-adopters of e-procurement.

Fig. 4 illustrates the research design adopted in this study. First, a comprehensive literature review of concepts and theoretical frameworks on IoT adoption and e-Government services conducted. The literature includes critical evaluation of IoT definitions, architecture, issues and challenges of IoT adoption.

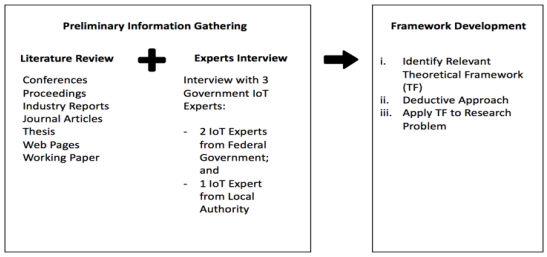


Fig. 4: Research Design and Methodologies

Second, interviews with three Government IoT experts are conducted to seek some specific issues and factors of IoT services utilization. All the experts have working experience more than ten years in Government and three years in the field of IoT services. Besides, the selection criteria of Government IoT experts based on their significant involvement and role in the current implementation of the Government IoT services project. Table 5 stated the justification of reliable expert's selection.

Table 5: Justification of Government IoT Expert's Selection

Experts	Years' Experience		Justification Selection
	Government	IoT Services Project	
Expert 1	20 years	4 years	a representative of Chief Information Officer (CIO), Ministry of Housing and Local Government (KPKT) who responsible to encourage ICT acculturation in the Public Sector service delivery system.
Expert 2	12 years	4 years	a leader of IoT service developer team who was involved with the project since its inception and responsible for satisfying user requirements.
Expert 3	10 years	3 years	a representative of the Melaka Historical City Council (MBMB), Malaysia Local Authorities who achieved the highest rank using IoT services for 3 consecutive years.

The interviews conducted a one-to-one conversation with time allocation approximately 20 to 30 minutes. The numbers of experts involved considered sufficient when the research problem clearly define, and all factors affecting the successful implementation of IoT services have confirmed. Lastly, the development of the research framework based on the identified factors from the comprehensive process analysis of preliminary information gathering.

4. A Proposed Conceptual Model, Hypotheses, and Discussion

Considering that it is important to include four potential factors affecting the successful implementation of IoT services (individual IS success dimensions, perceived usefulness, technology readiness, and trust), the selection of theoretical constructs in this model determined through an extensive preliminary information gathering. While these factors were found to be critical in the success of IoT services implementation, none of them was empirically tested in the form of an integrated model, particularly in Government Agencies even though technology readiness and technology acceptance integrated into the prior research. All four potential factors were not empirically tested in the form of an integrated model, particularly in Government Agencies even though technol-

ogy readiness and technology acceptance integrated into the prior research.

To develop more comprehensive perspectives of the factors that may affect the success of IoT services implementation, the following factors are identified: perceived usefulness from TAM; information quality, system quality, service quality, user satisfaction and use from D&M ISSM; optimism, innovativeness, discomfort, and insecurity from TRI 2.0; and trust that is based on Gefen (2000) and Yoon (2002). Table 6 stated the summary of the identified factors.

Table 6: Factors that affect the success of IoT Services implementation

		LR								Informal Conversation			
Factors	**Context**	Lin & Shen, (2007)	Son & Han, (2011)	Lu, Hwang & Hayes, (2012)	Hsu et al., (2015)	Shin & Hwang, (2017)	Caro et al., (2018)	Chatterjee et al., (2018)	Napitupulu (2017)	Adiparta (2018)	Expert 1	Expert 2	Expert 3	Total
Optimism	Technology	/	/	/				/	/	/	/	/	8
Innovativeness	Redness	/	/	/			/	/	/		/	/	8
Discomfort	Dimensions	/	/	/				/	/	/	/	/	8
Insecurity		/	/	/				/	/			/	6
Perceived Usefulness	User Acceptance	/			/		/	/	/	/	/		7
Trust	Human Interaction			/				/			/	/	4
Information Quality	IS Success Factors					/		/	/			/	4
Service Quality						/		/	/		/	/	5
System Quality						/		/	/			/	4
User Satisfaction			/			/	/	/			/		5
Use			/		/			/			/	/	5
Total		5	6	5	2	4	3	5	9	5	6	7	7	64

As the summary, the research model shown in Figure 5.

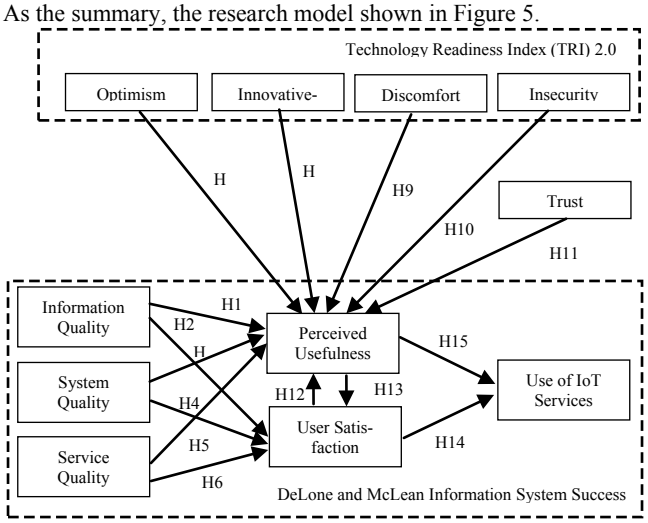


Fig. 5: Model of IoT Services Success for Government Agencies

4.1. Hypothesis Development

The research hypotheses were classified by individual IS success dimension, technology readiness, and trust context variables. The theoretical model consists of 10 factors that are hypothesized to have a direct influence on the use of IoT services. The hypothesis development is essential to test factors towards IoT Services implementation as follows:

4.1.1. Individual IS Success Dimension

Information quality is the desirable characteristics of system outputs [57] and used to measure technical success [34]. Information quality is defined by Kutlu & Alkaya (2015) as an output of the system quality. Gable et al., (2003) include that availability, usability, understandability, relevance, format, and conciseness are significant validated measures for information quality. According to Seddon (1997) in his refinement of DeLone and McLean IS success model, information quality is influenced directly by perceived usefulness and user satisfaction. If the information quality is high, then employees more likely to perceive and satisfy that IoT services contribute to enhanced job performance. Floropoulos, Spathis, Halvatzis, & Tsipouridou (2010) had supported the argument.

Some of the early studies have identified the relation between information quality and user satisfaction. For example, Ajoye (2014) and Ramdan et al. (2014) raised that information quality is an important predictor and had a positive effect on user satisfaction. In contrast to earlier findings, however, Marble (2003) found significant differences between information quality and user satisfaction when the organizational priority is only to focus on the implementation project by top management in two organizations in Omaha, USA.

High quality of real-time information processing is critical in IoT services because it affects employees' decisions that may have serious implications for citizens' well-being [11]. In this study, it argued that high information quality affects employees' perceptions of the usefulness of IoT services and thus influences them to use IoT services to improve their job performance. Given the discussion above, the following hypotheses are justified:

H1: Higher information quality leads to the higher perceived usefulness of IoT services.
H2: Higher information quality leads to higher user satisfaction with IoT services.

IoT services system quality is a factor relevant to IoT services success in the context of Digital Government services. It is necessary to ensure an end to end (E2E) system quality in IoT architecture [64]. A delay in any layer can lead to unacceptable system quality for safety-critical application such as IoT Emergency Management System which relies on wireless communication infrastructure and accurate information about the disaster area [65].

Previous studies have proved the influence of system quality on perceived usefulness [33], [60], [66]. To better understand the influence of system quality and its effects, Floropoulos et al. (2010) analyzed the citizen adoption of e-Government initiatives in Greek. The result demonstrated that the system quality of Greek Taxation Information System (TAXIS) had significant influences on the user perceived usefulness but has seen a non-positive effect on user satisfaction.

Contradictari[67]–[70][68]–[71]ly to similarity between Ramdan et al. (2014) and four studies on effect of user quality on user satisfaction [67] - [70], an empirical analysis of the success of IoT smart cities in India surprisingly did not find a statistically significant association between these two constructs of IoT technology and system quality.

In this study, it argued that Local Authorities employees work under competitive pressure to ensure the efficiency and effectiveness of public complaints services. Therefore, any glitches in the IoT system environment are likely to have particularly strong effects in the context of Digital Government services. Because of the discussion above, the following hypotheses are justified:
H3: Higher system quality leads to the higher perceived usefulness of IoT services.
H4: Higher system quality leads to higher user satisfaction with IoT services.

DeLone & McLean (2003) updated their model that includes service quality as one of the independent variables in the model. Service quality was an essential factor to gain citizens' trust in Government based IoT services context [71], [72]. High level of satisfaction from employees is related to support provided when IoT services problems occur [73]. Extensive research has examined the relationship between service quality, perceived usefulness and user satisfaction. However, the findings suggested

mixed support for these relationships. For example, Floropoulos et al. (2010) discovered that service quality had a significant impact on perceived usefulness while Colesca and Liliana (2008) found there were irrelevant effects between service quality and perceived usefulness.

Similarly, studies investigating the relationship between service quality on user satisfaction have shown mixed results. Halawi et al., (2016) in their knowledge-management studied found a significant correlation between service quality and user satisfaction. Some empirical evidence also has shown that service quality influences user satisfaction respectively in e-commerce and e-Government [61], [76]. In contrast to earlier findings, Ramdan et al., (2014) discovered that service quality e-Government in Malaysia is not significant for user satisfaction. Given the discussion above, the following hypotheses are justified:

H5: Higher service quality leads to the higher perceived usefulness of IoT services.
H6: Higher service quality leads to higher users' satisfaction of IoT services.

An empirical study that conducted by Mahmood, Burn, Gemoets, & Jacquez (2000) have shown that perceived usefulness affects user satisfaction. The result from the previous study by Kulkarni et al. (2006) indicates that perceived usefulness reinforces user satisfaction. The argument is also supported by Colesca & Liliana (2008) who writes that perceived usefulness affects satisfaction while operating an e-Government service. Thus, the following hypothesis is justified:

H12: Higher users' perceived usefulness leads to the higher users' satisfaction of IoT services.

An empirical study that was conducted by Lodhi et al. (2016) has shown that user's satisfaction is a good predictor of perceived usefulness in Pakistan public sector service-based organizations. Similarly, Akça et al. (2017) found that a user's satisfaction has a positive effect on perceived usefulness. Unlike Akça et al. (2017) and Lodhi et al. (2016), Helia et al. (2018) found that user's satisfaction has the adverse effect on perceived usefulness in Turkey Education. From the justification above, the following hypothesis justified:

H13: Higher users' satisfaction leads to the higher perceived usefulness of IoT services.

Past research highlighted the importance of system usage and user satisfaction in evaluating a system concerning its success [81]. On the other hand, Wu & Wang (2006) indicated that user satisfaction had a significantly positive effect on system use in a context of knowledge management system. Ives, Olson, & J.Baraudi (1983) argued that user information satisfaction (UIS) could lead to enhanced system usage. In the context of IoT services, previous studies mentioned that employees would use a service if they can see the benefit of the service, in particular if they can see that the service can facilitate their job performance and satisfaction [73]. Hence, the hypothesis proposed:

H14: Higher users' satisfaction leads to the higher use of IoT services.

Previous research by Davis (1989) has established that the role of perceived usefulness correlated with system usage. Chen et al. (2002) reported that reduced perceived usefulness would directly affect the lower of actual use. Nevertheless, as to studies in the context of e-Government, Ozkan & Kanat (2011) found that perceived usefulness has a positive effect on the attitude regarding the use of e-Government service. Thus, the following hypothesis is justified:

H15: Higher users' perceived usefulness leads to the higher use of IoT services.

4.1.2. Technology Readiness (TR)

An optimist employee perceives new technology like IoT services being more useful because they worry less about possible adverse outcomes [31]. Optimism relates to a positive interpretation and belief that new technology may offer people to increased control, flexibility, and efficiency in life. Walczuch et al. (2007) who examined the effect of employees' TR on technology acceptance found that optimism as a component of TR influenced perceived usefulness of technology. Moreover, Erdo & Esen (2011) found that optimism has a significant effect on perceived usefulness in explaining the effects of TR on technology acceptance in e-HRM. In the area of healthcare, Kuo, Liu, & Ma (2013) found that optimism has a significant effect on perceived usefulness towards mobile electronic medical record systems.

Innovativeness is the contributors that may increase an individual's TR where the employees tend to be a new technology pioneer among themselves [20]. Many recent studies (e.g., S. C. Chen & Chen, 2009; Erdo & Esen, 2011) have shown that innovativeness has a positive effect on perceived usefulness in e-HRM. Surprisingly, a study made by Walczuch et al. (2007) demonstrated that innovativeness has a no significant impact on perceived usefulness. The result is similar to those reported by Kuo et al. (2013) found that the effect of innovativeness on the perceived usefulness of the mobile electronic medical record system is not significant. Unexpected results by Walczuch et al. (2007) and Kuo et al. (2013) are so contradict with the previous studies.

Similarly, in the context of IoT services, Karahoca et al. (2018) found that personal innovativeness had no affected to perceives usefulness. In this study, it argued that employees react differently while adopting IoT services because of personal differences such as personal optimism and innovativeness. Thus, the hypotheses proposed as follow:

H7: Higher optimism leads to the higher perceived usefulness of IoT services.
H8: Higher innovativeness leads to the higher perceived usefulness of IoT services.

Optimism and innovativeness are drivers of TR, whereas insecurity and discomfort are inhibitors. Discomfort is a perception of unable to control the technology and a feeling of being overwhelmed by it [25]. Accordingly, the person scoring high on the discomfort scale suffer from a perceived lack of control and a sense of being overwhelmed by technology. Hence, people perceive technology as more difficult and less perceived usefulness when their score high on discomfort traits. Walczuch et al. (2007) found that discomfort has a significant positive influence on perceived usefulness. However, Endogmus and Esen (2011) discovered that the positive influence of discomfort on perceived usefulness is not substantial on e-HRM. Similarly, the results of Kuo et al. (2013), on the study of nurse TR, found that discomfort has an adverse effect on perceived usefulness but not significant.

In the IoT services context, data collection or use by various IoT devices are most likely to cause employees' discomfort [88]. In this study, it argued that employees with the high score on the discomfort scale suffer from a perceived lack of control and a sense of being overwhelmed by new technology.

Insecurity is a feeling of distrust and skepticism about its ability to work correctly [89]. Walczuch et al. (2007) and S. C. Chen & Chen (2009) identified that lower insecurity has a significant

adverse effect on perceived usefulness. However, Erdo & Esen (2011) found the result of that insecurity has a negative impact on perceived usefulness but not significant in e-HRM. Similarly, Kuo et al. (2013) found that insecurity has no significant effect on perceived usefulness.

High connectivity of intelligent objects, the quantity and nature of data to be collected and transmitted lead to many security challenges in the context of IoT services implementation. In this study, it argued that employees with a sense of insecurity are skeptical about IoT services and feel uncomfortable with them. Consequently, the employees become suspicious of IoT services new functions and reduce trials to accept and use them. Because of the discussion above, the following hypotheses are justified:

H9: Higher discomfort leads to the lower perceived usefulness of IoT services.
H10: Higher insecurity leads to the lower perceived usefulness of IoT services.

4.1.3. Trust

The IoT complex ecosystem was surrounding with hyper-distributed and hyper-connected devices. To better use IoT services, employees need to trust them [65]. In the context of e-Government implementation, trust becomes a factor relevant to IS success, and previous research has established that trust is directly affected by perceived usefulness [47], [74], [90]. Thus, the hypotheses suggested is:

H11: Higher users' trust leads to the higher perceived usefulness of IoT services

4.2. Discussion

Studying the links between IoT, TRI and IS success factors are essential because the conflict of new technology being underutilized associating too many undesirable impacts such as huge loss of investment, waste of resources, and insufficient services or maintenance [91]–[94]. Many researchers have started giving attention to the relationship between 'TRI and user acceptance' ([26], [31], [39], [44]) also between 'IS success factors and user acceptance' [74], [97]. However, very few studies have attempted to investigate the relationship between TRI and IS success factors (i.e., user satisfaction) [26].

Despite this initial stream of research, there are still several gaps in the existing literature. Table 7 listed the research gaps and the conclusions. For instances, various models have been presented to show the role of TRI as a predictor or antecedent of the adoption of IoT ([44], 22]) but none of the reviewed research specifically examined the role of TRI 2.0 in the relationship with individual IS success factors in IoT services utilization context.

Table 7: Research Gaps and Conclusion

Authors	Gaps Statement	Conclusion
Xu et al., (2014)	"Quite a few IoT applications are being developed…"	IoT services or application are still in early stage, primitive, limited and a few being developed.
Atzori et al., (2010)	"Potentialities offered by the IoT make possible the development of a huge number of applications, of which only a tiny part is currently available to our society."	
Bi et al., (2016)	"The exploration of IoT applications is still at its early stage.."	
Miorandi et al., (2012)	"..IoT applications, it brings alongside a risk of fragmentation and lack of adoption of adequate standards. IoT would require, as the technology gets mature.."	
S. Chen et al., (2014)	"At the early stage of IoT deployment, driving of domain-specific applications is the main development strategy."	
Hsu et al., (2015)	"...only a few studies have examined intention to use and the actual usage of IoT systems."	'Actual system use' is essential to measure the individual effectiveness of success
Salahshour et al., (2018)	"The 'actual system use,' which is a dependent variable, recorded the lowest frequency of use in the reviewed papers on IS adoption..."	
DeLone & McLean, (2003)	".. 'use', 'user satisfaction', 'individual impacts', and 'organizational impacts' measure effectiveness success."	
Baller et al., (2016)	"Malaysia ICT Infrastructure Readiness Subindex 2017 is ranked 73 out of 139 countries."	It is essential to understand the link between TRI and D&M ISSM in the context of user acceptance of new technology.
Son & Han, (2011)	"the research on the role of TR in post-adoption behaviour beyond technology adoption is rare."	
Badri et al. (2014)	"Future research could also consider showing how the TRI might influence teachers' post-adoption behaviour."	
Lin & Hsieh, (2006)	"TR is positively related to satisfaction with self-service technologies (SSTs)."	

Although TRI 2.0 and D&M ISSM identified as essential theories or model in the adoption and implementation of new technology, none of the existing IoT services success models include these factors in the same model. Thus, more researches are required to examine the relationship between the aspect of TRI 2.0 and individual IS success factors in other new technology settings like IoT services, particularly in Government Agencies implementation.

5. Conclusion

All possible factors affecting the use of IoT services are determined based on a comprehensive literature review as well as interviews with Government IoT Experts. This research process begins with examining the individual IS success factors and TR. As the use of IoT services involves technology acceptance, we include perceived usefulness and trust as the factors often appear in the literature.
This study proposes a new integrated success model that combines the individual dimensions of TRI 2.0 by Parasuraman & Colby (2015) (i.e., innovativeness, optimism, insecurity, and discomfort) with three other success dimensions – individual technology acceptance behaviour (i.e., perceived usefulness) by Davis (1989b); individual IS success factors (i.e., service quality, information quality, system quality, user satisfaction and use) by DeLone & McLean (2003); and as well as individual attitude (i.e. trust) by Gefen (2000) and Yoon (2002). This research is among the first study that attempts to integrate all these dimensions into one model for the success of use IoT services implementation in Government Agencies.
The planned research work is to do an empirical analysis. The study will adopt the survey research using a questionnaire (hardcopy and online) as a method for data collection to test the proposed research model. Data collected will be tested using Partial Least Square Structural Equation Modelling (PLS-SEM) approach,

which is a second-generation data analysis technique. Then, we determine the factors influencing IoT services implementation in Government Agencies. The results of this study can help the government to promote the use of IoT Services among Government Agencies employees' and to increase the effectiveness.

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