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E-Government Acceptance and Intention to Use: Analyzing Adoption Factors in the Belizean Context Using an Extended Technology Acceptance Model.

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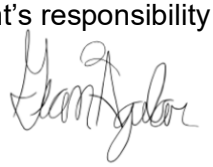
Signature: 

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Abstract

In a delicate economy and during uncertain times, people need government and public services that are convenient, accessible, and safe. More than ever, the solution seems to be digital or electronic government, or simply, E-Government. The online delivery of the most important citizen services could solve many of the most common grievances of public transactions: long wait and travel times, limited transparency, and unequal access. The Government of Belize (GOB) is aware of this fact, and in 2020, it launched a large-scale electronic project for the purpose of providing COVID-related unemployment relief. This online platform received an overwhelming 44,000 applications within the first three days[1], suggesting that E-Government is here to stay.

However, as convenient as E-Government might be, many projects still fail when they are never fully adopted by citizens. In light of immediate plans by GOB to expand E-Government services, the aim of the present study was to investigate the most important factors that influence the intention of adopting E-Government services in Belize. From a sample of 900 households, 606 were interviewed and important perceptions and attitudes related to E-Government were captured. The collected data was analysed in the context of a validated theoretical framework based on the technology acceptance model (TAM). A unique analytical approach called factor score regression (FSR) within a generalized linear model provided the statistical engine. The current paper presents and discusses the results of this exercise.

Overall, the belief that a service is useful was the most important factor driving people towards adoption. The second most important factor was the actual and perceived control that a person had over being able to use E-Government services. This second finding is key, because if E-Government aims to reduce inequality and improve equitable access to public services, then it cannot forget those who, often being the most vulnerable, are unable to access electronic services due to personal or external obstacles. Likewise, just a little bit of trust is necessary to be inclined towards using E-Government services, but there exists a small segment of those who were surveyed who have very low trust and very little intention to use E-Government. The complete results, analysis and insights are presented within this work, which contributes to contemporary acceptance literature in the country and region and hopes to prove useful in the present and short-term plans for E-Government in Belize.

Word count: 15,205

[1] Government of Belize Press Office (2020, April 6). *Update on COVID-19 Unemployment Relief Program*. Retrieved from: https://www.pressoffice.gov.bz/update-on-covid-19-unemployment-relief-program/

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I must thank the E-Government and Digitalization Unit of the Belize Ministry of Youth, Sports and E-Governance for providing insight crucial to conceptualising the project and especially for liaising with the Inter-American Development Bank (IDB, who I also want to thank) to facilitate the funds used for the data collection. Particularly, CEO Jose Urbina and Project Officer Alexia Peralta who diligently followed up with the project and the IDB, as well as key experts at the IDB who offered feedback on key questionnaire items.

Finally, I thank my family and friends for providing their unconditional support and without whom I could not have completed this task.

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Abbreviations

ATB: Attitude Towards Behaviour

BI: Behavioural Intention

ICT: Information and Communication Technologies

CFA: Confirmatory Factor Analysis

EGDI: E-Government Development Index

FSR: Factor Score Regression

GLM: Generalized Linear Model

PBC: Perceived Behavioural Control

PEOU: Perceived Ease of Use

PU: Perceived Usefulness

PPS: Probability Proportional to Size (Sampling)

SIB: Statistical Institute of Belize

SN: Subjective Norm

TAM: Technology Acceptance Model

TEG: Trust in E-Government

TPB: Theory of Planned Behaviour

TRA: Theory of Reasoned Action

1. Introduction

E-Government refers to the use of information and communication technologies (ICT) to engage in the digital transformation of government operations and the services provided to the public (Twizeyimana & Andersson, 2019). This usually entails using the internet for the digital delivery of traditionally in-person services such as identity and civil registration, vehicle licensing, filing taxes, starting a new business or accessing social programs (Crane Williams & Marius, 2016; Roseth & Reyes, 2012). The promise of E-Government is a great one both for citizens and the government itself (ECLAC, 2013; Twizeyimana & Andersson, 2019). These promises become especially resonant in the age of COVID-19. Not only are there restrictions limiting physical transactions, but governments must be ready to provide essential services to its citizens while providing timely, reliable and potentially critical information (Ceesay & Bojang, 2020; United Nations, 2020).

Yet, the benefits of E-Government are not automatic and investment does not guarantee results (Dada, 2006), which in developing countries is especially costly (Rubino-Hallman, 2002). Consequently, the present study will focus on one of the most important factors for E-Government success: acceptance and use. The rest of this chapter will provide a relevant justification grounded both on contemporary literature and the local context. The main research aim and hypotheses will be outlined, and the methodology and analytical approach will be presented.

1.1 Research background and model

In a study carried out by Heeks (2003), he concluded that about 85% of all E-Government efforts in developing countries resulted in either partial or total failures, attributed to a lack of acceptance by the intended users (Dada, 2006; Heeks, 2003). Although several years have passed since Heeks' study, the topic of E-Government acceptance is as relevant as ever. In Belize, this is underscored by the fact that the government is making recent strides towards improving and expanding E-Government related services (Directorate General for Foreign Trade Belize, 2020), going so far as establishing a formal E-Government Task Force to guide short and long-term strategies (Belize Press Office, 2021).

Moreover, despite E-Government and digital transformation in the Caribbean region receiving much attention in recent years (Crane Williams & Marius, 2016; ECLAC, 2013; Roseth & Reyes, 2012; Warf, 2014), acceptance studies are scarce. This study aims to contribute to this area of research and provide value by being the first study of its kind in Belize.

The main question for the study is presented as: **what are the factors associated with E-Government acceptance and adoption in the Belizean context?** This question is to be answered within a theoretical framework primarily derived from the Technology Acceptance Model (Davis, 1989).

The Technology Acceptance Model (TAM) was developed by Davis (1989) as an adaptation of the theory of reasoned action (TRA), one of the most popular behavioural frameworks in psychology (Fishbein & Ajzen, 1977; Trafimow, 2009). Davis proposed two main perceptual constructs that greatly influence

information system acceptance: **Perceived Usefulness (PU)** and **Perceived Ease of Use (PEOU)** (Davis, 1989b). For this study, the TAM was extended with two additional relevant constructs drawn from extant E-Government research: **Trust in E-Government (TEG)** and **Perceived Behavioural Control (PCB).** Trust in E-Government is defined as having confidence in the integrity, security and reliability of electronic government services (ELKheshin & Saleeb, 2020), while perceived behavioural control is defined as an individual's personal assessment of having the required skills (computer literacy) and resources (access to the internet) needed to engage in E-Government usage (Ajzen, 1991). Together, it is proposed that these four constructs influence the **Behavioural Intention (BI)** to use E-Government services, which elicits the four research hypotheses that follow:

H1: Perceived usefulness is positively associated with the intention to use E-Government services.

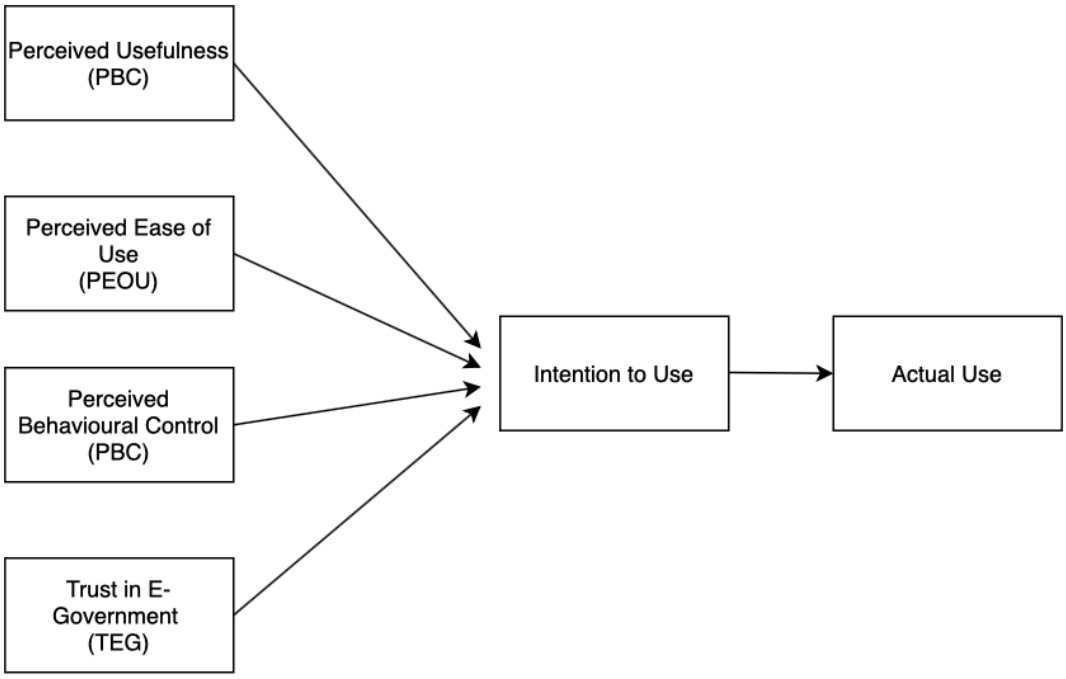
H2: Perceived ease of use is positively associated with the intention to use E-Government services.

H3: Trust in E-Government services is positively associated with the intention to use E-Government services.

H4: Perceived behavioural control is positively associated with the intention to use E-Government services.

A conceptual map of this proposed model is illustrated in Figure 1.1.

Figure 1.1 Conceptual research model, adapted from the TAM (Davis, 1989)



1.2 Methodology

The philosophical approach to the study is a pragmatic one (Ellis & Levy, 2008), as the research will build upon existing work in the field of E-Government acceptance. Data for this purpose will be collected via a national sample survey and analysed using a statistical technique known as factor-score regression (FSR).

The survey questionnaire will contain four Likert-type scale items for each of the four model constructs, resulting in 16 total items which will measure the perceptions of each respondent towards the constructs. A final item, 'intention to use E-Government services' will be included to serve as the outcome variable for analysis.

A national sample of households will be obtained with the assistance of the Statistical Institute of Belize (SIB), extracted from the institute's register of households. Due to the data-collection design, only households with a recorded telephone number will be selected. The sample will be selected using a two-stage design, combining probabilistic (PPS) and systematic sampling to ensure that the resulting sample is independent, well-distributed and approximately representative of Belizean households that possess a telephone number.

Data collection will be carried out over a period of 10 days from June 28 to July 7, 2021. The survey will be administered via the telephone modality with the assistance of ten data trained data collectors.

Subsequently, the collected data will be undergo rigorous analysis. A confirmatory factor analysis (CFA) will validate the internal factor structure proposed by the research model and produce 'factor scores' on each of the four constructs (PU, PEOU, TEG, PBC) for each respondent. These factor scores will be extracted and used within a binary logistic regression framework to test the research hypotheses and to model acceptance behaviour. This technique is known as factor score regression (Devlieger, Mayer, & Rosseel, 2016)

1.3 Limitations

1. Although the selected sample will employ a robust design and be independent and well distributed, the advanced statistical techniques necessary to make precise generalizations to the Belizean population are out of the scope of the study.
2. Telephone call quality and clarity might affect the proper comprehension of the survey questions, which could affect data quality under certain scenarios.

3. Non-response, which is typically high in telephone surveys might introduce bias into the results.
4. Human and social behaviour is a complex issue and remains a challenge to study. While the study aims to answer important questions and shed light on the impact of perceptual factors on E-Government acceptance, there will be variation on an individual basis.

1.4 Structure of Dissertation

The remainder of this paper is structured into chapters as follows:

Literature review. This chapter provides formal definitions for E-Government and situates the current study within regional and national contexts. The current state E-Government acceptance research is discussed, competing theoretical models are compared and the conceptual model for the study is derived.

Methodology. Formally introduces and justifies the research philosophy and provides detailed information about the research methods, sampling, data collection and analytical approach.

Findings, Analysis and Discussion. This chapter begins by presenting sample and descriptive statistics from the data collection. Then, the data is analysed using factor-score regression within a generalized linear model, which allows the hypotheses to be tested. The results of this analysis and testing are discussed and contextualized with relevant literature.

Conclusion. This chapter summarises the results of the study, outlining key outcomes and presenting relevant recommendations.

2. Literature Review

2.1 Introduction

This chapter presents a review and evaluation of the literature surrounding the research topic. First, the growing importance of E-Government will be discussed within a regional context, a working definition for E-Government will be presented and the issue of acceptance will be highlighted. Subsequently, the history and landscape of information systems acceptance will be explored, before delving into contemporary E-Government acceptance research. Finally, the theoretical research model for the study will be introduced. The existing gap in literature will be identified in the regional and national context.

2.2 The rise of E-Government

E-government has been receiving a growing amount of attention in the recent years. This may be seen as a logical consequence of the increasing permeation of digitalisation and the Internet through modern society. According to the World Bank (2020), almost half (47%) of all individuals on earth were considered Internet users as of 2017. This was a significant increase over the 2010 figure, which stood at around 28% (World Bank, 2020). In developing countries, digitisation efforts are further incentivized by the United Nation's Sustainable Development Goals, which lists as part of goal 9 the importance of broad and affordable access to the internet (Assembly, 2015). In its latest worldwide E-Government survey, the United Nations emphasizes (2020) the potential benefits of investing in electronic and digital services in the public sector while noting that such initiatives are on the rise worldwide.

The potential public value of E-Government services is well established and includes improved efficiency, equity, accessibility and transparency both in the delivery of public services and in government administration itself (Twizeyimana & Andersson, 2019). These potential benefits become especially resonant in the era of COVID-19. Online alternatives to citizen services can satisfy public demand where social and physical restrictions are in place, and the availability of reliable online channels can allow governments to share important and timely public health information (Ceesay & Bojang, 2020). However, any potential benefits are not automatic nor are they guaranteed. E-Government projects, initiatives and investments will ultimately fail to produce any value if the intended users fail to accept such services (Dada, 2006; Heeks, 2003; Kanat & Özkan, 2009). The issue of E-Government acceptance and the factors that influence acceptance will thus be the central focus of this study. First, however, it is worth arriving at a practical definition for ‘E-Government’.

2.2.1 Concept, meanings and adopted definition of E-Government

In both in practice and literature, definitions by practitioners and academics for “E-Government” or “digital government” are varied and broad. The Commonwealth Secretariat defines E-Government as “the use of information technologies to transform relations with citizens, businesses, and other sectors of governments” (2013). This is a very broad definition as it covers many of the channels through which digital government may be deployed: between governments and citizens (G2C), government and businesses (G2B) and the within government itself (G2G). Some authors further expand the definition to include digital channels between citizens (C2C) (Fang, 2002; Yildiz, 2007). Williams and Marius (2016) constrict the definition by specifying that the

information flow must be bi-directional (e.g.: C2G) as well. This leads to the key aspect of modern definitions for E-Government: the concept of engagement, participation and interaction between government and its citizens and other stakeholders (Almarabeh & AbuAli, 2010; Crane Williams & Marius, 2016; Fang, 2002; Yildiz, 2007). This differs from older definitions of E-Government where the concept could be applied to the mere delivery of information by governments through electronic means (Rorissa, Demissie, & Pardo, 2011; United Nations, 2002). Horst, Kuttschreuter & Gutteling (2007) elegantly summarise this dimension by stating that “electronic services [had] finally arrived at the transaction level”.

For the purposes of this study, the primary focus will be on government-to-citizen (G2C) and citizen-to-government (G2C) services, of both informational and especially transactional nature, delivered through online channels such as websites and internet-connected applications. In the Caribbean region, the most common transactions of this type include identity and civil registration services, vehicle transactions, tax-filing, business registration and real-estate transactions (Roseth & Reyes, 2012).

2.3 E-Government in the Caribbean

Even though E-Government can be defined in a variety of ways and can be context-specific for each country, it is universally seen as a crucial step towards achieving digital and political transformation, particularly in developing nations (United Nations, 2020). In its 2013 report, “Plan of Action for the Information and Knowledge Society in Latin America and the Caribbean”, ECLAC (2013) lists achieving a “transactional and participatory E-Government” as the second

largest informational priority in the region, behind broad and equitable access to the Internet. Achieving this level of digital government would lead to a transformation of the public sector. Indeed, services would become more accessible and equitable, government operations more efficient, and there would be greater transparency and accountability in government, leading to a "deepening democracy" (ECLAC, 2013).

Similar sentiments were echoed by Williams & Marius (2016), but they note that E-Government development in the Caribbean had achieved mixed results in the recent years, for example, by not keeping up with similar regions in the UN's ranking of E-Government development. They even express concern that the UN's general E-Government indicator, the E-Government Development Index (EGDI), might be over-rating the development of digital government in the region, given that this indicator lends a heavy weight to unrelated or indirect indicators such as education, literacy and mobile penetration (Crane Williams & Marius, 2016). There are, however, more specific indicators that can provide a more accurate picture of E-Government development. The first is the OSI (online services index) and the second is the EPI (e-participation index), which measure the level of digital transactional services provided by a government and the level of online citizen participation in democratic and political processes, respectively. Caribbean countries such as Belize rank relatively low in these, despite having a higher rating for the more general EGDI score (United Nations, 2020).

It is ironic that the same small and developing nations who would most greatly benefit from the transformational power of E-Government are those that face

the largest obstacles and have the most to lose. Economies of scale often prohibit the necessary investment in the infrastructure and resources necessary to deploy large scale digital projects and thus make any major E-Government effort inherently risky (Crane Williams & Marius, 2016; ECLAC, 2013; Warf, 2014). As previously noted, however, the current global atmosphere demands increased development and digitalisation. Therefore, as developing countries such as those in the Caribbean, intensify their efforts towards E-Government and digital transformation, it becomes very appropriate to look deeper into perhaps the most salient current issue facing E-Government: acceptance.

Acceptance has always been one of the greater concerns in information systems research (Al-Mamary, Al-nashmi, Hassan, & Shamsuddin, 2016; Legris, Ingham, & Collerette, 2003; Li, 2010), and is one of the most prominent topics in contemporary E-Governance research. However, there is currently a great gap in acceptance research in Caribbean countries (Crane Williams & Marius, 2016; Warf, 2014). To current knowledge there here has been no E-Government acceptance study of this kind in the Caribbean as yet, and much less in the country of Belize, where this study takes place.

Consequently, **the value of this study is in deriving a relevant and appropriate research model for studying acceptance factors in the Belizean context**. This will provide much-needed academic support for decisions surrounding E-Government initiatives in Belize, a country with significant immediate plans for it (Belize Press Office, 2021; Directorate General for Foreign Trade Belize, 2020). Additionally, significant contributions are made to the literature, as the study is one of the first of its kind in the region.

Prior to introducing specific approaches to E-Government acceptance research and the adopted theoretical model, it is now appropriate to explore existing theories and frameworks in general information systems acceptance research.

2.4 Information System Acceptance Theories

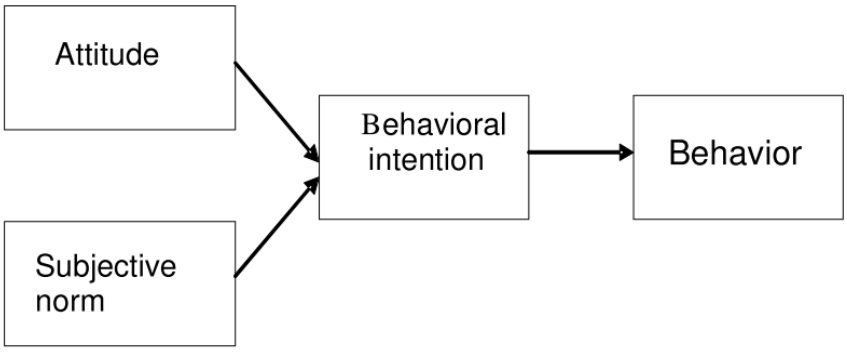
Information systems acceptance has long been one of the most predominant subjects in IS research. After all, what is the use of developing programs, applications, websites or software systems in general if the intended users will not adopt or utilize them? Consequently, there have been a wide variety of theoretical frameworks and models that have emerged from this ripe area of study. This section will examine several of the most prominent theories in IS acceptance and discuss the relative strengths and disadvantages of each, especially as they relate to E-Government research. The underlying **constructs** within the theories or frameworks will be of particular interest. Some constructs might only work in certain contexts, such as within organizations or workplaces, or perhaps only in the context of either mandatory or voluntary systems (but not both), and some of the constructs make assumptions about the user that are not always generalisable. Therefore, as the different acceptance models are introduced, they will be evaluated using the mentioned criteria.

Interestingly, some of the earliest theories utilized in information system acceptance were not pioneered specifically within the IS/ISM field, but rather in the social sciences. Two foundational theories that were developed in the field of psychology but that provide the pillars for a variety of modern IS-specific acceptance frameworks are the theory of reasoned action (TRA) and the theory of planned behaviour (TBP)

2.4.1 The Theory of Reasoned Action

The theory of reasoned action was developed by Fishbein & Ajzen (1977) as a general framework for predicting any volitional individual behaviour. The TRA posits that the construct of behavioural intention (BI) is the strongest predictor for behaviour, but that it is itself influenced by two main underlying constructs: the attitude towards behaviour (ATB) and the subjective norm (SN) (Fishbein & Ajzen, 1977; Trafimow, 2009). The attitude towards behaviour is defined as the internal evaluation of engaging in a specific behaviour, based on personal beliefs about the positive or negative effects of performing an action (Madden, Ellen, & Ajzen, 1992). The subjective norm, on the other hand, is an extrinsic factor defined as the belief that performing a certain action will be seen as either a good or bad thing in the eyes of other people who are important to the subject (Trafimow, 2009). ATB can be seen as an intrinsic, personal belief while SN is an extrinsic social influence (Wahdain & Ahmad, 2005). The TRA and its constructs are represented in Figure 2.1 below.

Figure 2.1 The Theory of Reasoned Action (Ajzen & Fishbein, 1975)



Although the TRA has been successfully used on its own in technology acceptance research (Huh, Kim, & Law, 2009; Mishra, Akman, & Mishra, 2014; Oni, Oni, Mbarika, & Ayo, 2017), it was not designed specifically for information

systems. Moreover, the TRA ignores environments where behaviour (or system usage) is mandatory, a shortcoming that was addressed with the Theory of Planned Behaviour (Madden et al., 1992).

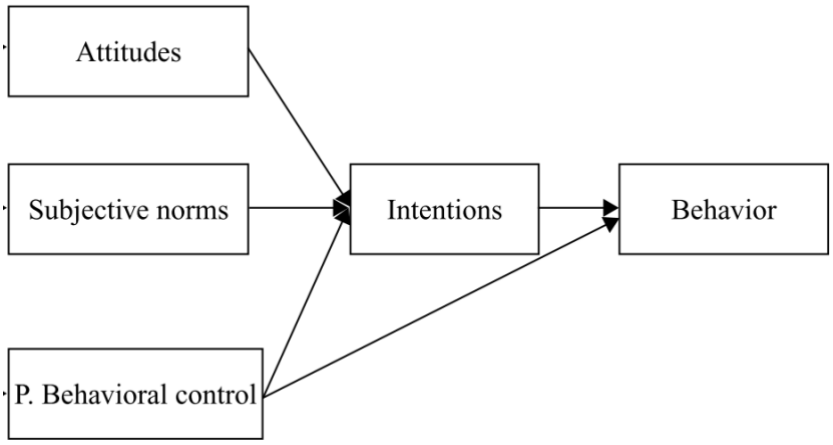
2.4.2 Theory of Planned Behaviour

Building upon the TRA, Ajzen (1991) proceeded to expand the model into what he called the theory of planned behaviour (TPB). The TPB distinguishes itself from the TRA by adding the construct of perceived behavioural control (PCB). Ajzen (1991) notes that strong intentions towards a behaviour do not always translate into actions, as certain actions might be outside of a person's capabilities due to either intrinsic or extrinsic factors. Generally, persons can assess their level of control towards engaging in a particular action or behaviour by evaluating their abilities and their environment. Using Ajzen's example (Madden et al., 1992), students might have every intention of wanting to obtain an A in a particular course, but they might know that they are unlikely to actually obtain such a grade for a subject they personally find particularly challenging. Ajzen found that this extra dimension provided the TBP with better predictive power as compared to the TRA (Ajzen, 1991; Madden et al., 1992; Momani & Jamous, 2017). Conceptually, the TPB is represented in Figure 2.2.

As with the TRA, the TBP theory can be classified as a general theory of human behaviour. As such, researchers have also used the TBP for predicting user acceptance of information systems (Kanat & Özkan, 2009; Li, 2010; Lu, Huang, & Lo, 2010; Madden et al., 1992; Momani & Jamous, 2017). Most importantly, these two theories and their underlying constructs have been adopted,

deconstructed, expanded and incorporated into more IS-specific acceptance models.

Figure 2.2 The Theory of Planned Behaviour (Ajzen, 1991)



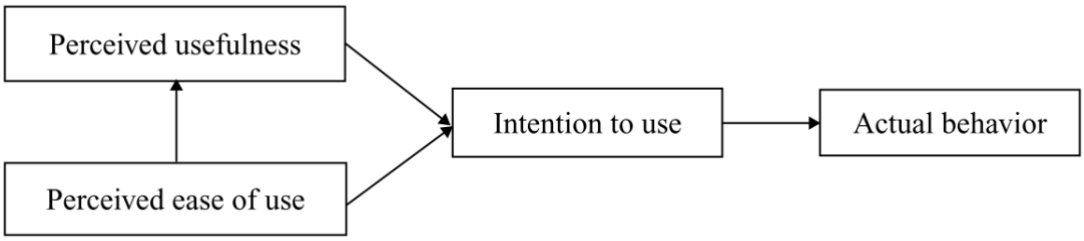
2.4.3 The Technology Acceptance Model (TAM)

The technology acceptance model, or TAM, was developed by Davis (1989) using the theory of reasoned action as a foundation. The original TAM primarily focused on only one of the TRA's main constructs: Attitude Towards Behaviour (ATB). Davis (Davis, 1989) deconstructs ATB into two related constructs that are more applied to the IS field: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). Perceived usefulness is defined as the extent to which using a system provides benefits and advantages over other alternatives, resulting in increased productivity. Perceived ease of use is defined as the extent to which using a particular system is "free of effort"; in other words, the perception of how easy it is to learn and operate a system (Davis, 1989). Davis posits that PU and PEOU have a direct influence in behavioural intention (BI) to use a system, while PEOU also has a direct influence on PU (Venkatesh, Morris, Davis, & Davis, 2003). Since its development, TAM has been the most widely used and

validated acceptance model in IS research primarily due to its parsimony: its ability to explain a lot of the variance in acceptance behaviour with very few constructs (Huh et al., 2009; Mahadeo, 2009; Momani & Jamous, 2017; Venkatesh & Davis, 2000).

It is this same parsimony, ironically, that has also lent the most critique to the TAM, often resulting in expanded versions of the model in attempts to capture additional behavioural factors related to system use and acceptance (Li, 2010; Venkatesh et al., 2003). In a critical review, Legris, Ingham & Collerette (2003) thoroughly reviewed empirical research performed with the TAM and obtained inconclusive results about its predictive ability and the statistical significance of its constructs. However, they did note that it was one of the most robust models in research, despite results being somewhat inconsistent in their review. A conceptual model of the TAM is presented by Figure 2.3 below.

Figure 2.3 The Technology Acceptance Model (Davis, 1985)

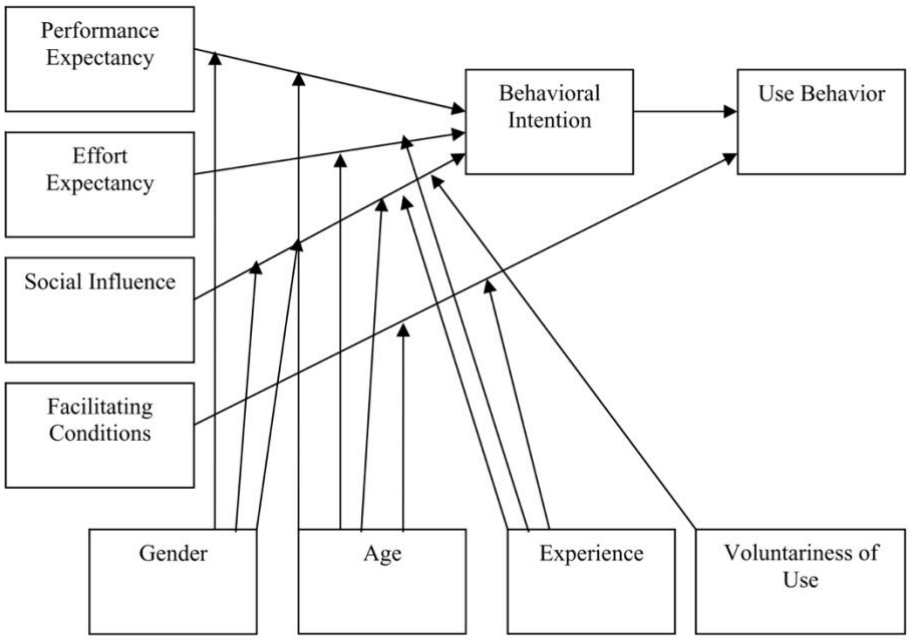


2.4.4 Extended TAM and UTAUT

In an effort to improve the statistical and predictive ability of the TAM, there have been extensions and modifications to the core model. Taylor & Todd (1995) highlighted the importance of social influence, or subjective norm (SN), on the acceptance of information systems under certain scenarios and

especially in the early stages of system implementation. Venkatesh & Davis (2000) himself have since created an expanded “TAM2” model incorporating SN. Meanwhile Venkatesh et al. (2003) proposed the Unified Theory of Acceptance and Use of Technology (UTAUT), which tries to unify constructs from several acceptance models and explores the effect of four moderating variables: age, sex, experience and voluntariness on each of the main constructs (Venkatesh et al., 2003). This results in a somewhat complicated model, illustrated by Figure 2.4.

Figure 2.4 The Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003)



Nevertheless, Venkatesh & Davis (2000) argue that SN as a predictor is inconsistent and perhaps more useful in ‘mandatory use’ settings. Therefore, models that incorporate subjective norm or related constructs may be better suited for environments where social influence and expectations from

supervisors, co-workers and others have significant influence on system use; for example, within organizations (Al-Mamary et al., 2016; Ramayah & Jantan, 2010; Taylor & Todd, 1995). On the other hand, some authors (Dishaw & Strong, 1998; Legris et al., 2003) doubt the role of social influence in IT acceptance and believe other variables play a much greater role than subjective norm.

2.4.5 The Diffusion of Innovations Theory

The Diffusion of Innovations Theory (DOI) by Rogers (1995) is another long-standing theoretical framework in innovation and adoption research. This theory has found applications in a vast number of different fields, including communications, economics and education research (Sahin & Rogers, 2006). The DOI seeks to understand how innovations propagate through cultures and groups. It is a very comprehensive framework with many constructs and dimensions, including communication channels, time and social systems (E. Rogers, 1995). DOI proposes that innovations diffuse through social systems via communication channels and at different rates over time. Each 'innovation' in turn, can be measured by five different attributes that ultimately determine its success: relative advantage, compatibility, complexity, trialability, and observability (E. Rogers, 1995; E. M. Rogers, 2010).

Just as with the other models, there have been criticisms of the DOI (Li, 2010). Oliveira & Martins (2011) note that DOI research often ignores the environmental factor, and they posit that the framework is better used to evaluate adoption at the firm-level and not the individual level. Other authors are likewise concerned that the complexity of the DOI often leads researchers

to over-simplify it for their research and subsequently ignore important factors, affecting the results (Al-Mamary et al., 2016).

2.5 E-Government and Selecting an Acceptance Model

E-Government initiatives are not immune to the issues of user acceptance and adoption. Although many countries in the world, including developing nations, are investing significantly in E-Government (United Nations, 2020), success is not guaranteed. Heeks (2003), conducted a study in which he states that up to 85% of E-Government initiatives in developing countries had been partial or total failures, a general conclusion which was also shared by Dada (2006), and which has likewise been highlighted by the UN (2008). Why are E-Government initiatives failing so often? According to Kanat & Ozkan, the key determinant of failure is the lack of adoption (2009). Consequently, there has been plenty of applied research in recent years on E-Government acceptance factors (Hofmann, Räckers, & Becker, 2012; Mahadeo, 2009; Yildiz, 2007).

The general IS acceptance theories and models that were presented in the earlier sections have also been widely applied towards E-Government research. Among these, The Theory of Reasoned Action (TRA) appears to be the least directly applied theory, perhaps because it has already been extended through other more specialized models. Oni, Oni, Mbarika & Ayo (2017) did utilize a modified version of the model in a research related to e-democratic participation. However, they did not directly employ the general constructs of the TRA. Due to the over-generality of this framework and the lack of E-Government acceptance research surrounding it, the TRA was deemed not suitable for the purposes of this study.

The Theory of Planned Behaviour (TPB) is the second general behavioural thoery that has been widely used in both general IS acceptance research as well as in the realm of E-Government. Kanat & Ozkan (2009) present a compelling study on the acceptance of government-to-citizen services using an extended TPB model. In their study, they highlight the shortcomings of the TAM as an 'overly-simplistic' model. However, the TPB served as a good theoretical framework for their study due to the decomposable nature of the main constructs. Kanat & Ozkan (2009) incorporated perceived usefulness (PU) and perceived ease of use (PEOU) from the TAM, while highlighting importance of perceived behavioural control (PBC) in research of voluntary acceptance behaviours. The extended research model also included dimensions of trust in the internet (TOI) and the government (TOG). The model proved to be valid and useful for predicting intention towards use, although there were issues with the validity of some of constructs such as trust (TOI, TOG), which did not properly load unto their intended constructs (Kanat & Özkan, 2009). Other researchers who have combined TAM and TPB in the context of E-Government include Lu, Huang & Lo (Lu et al., 2010) in a study of online tax-filing acceptance. They combined PU and PEOU from the TAM, with PBC, ATB and SN from the TBP to construct a model with good predictive ability towards acceptance.

One caveat with using the TPB in E-Government research is the inclusion of the subjective norm (SN) construct, which is one of the three foundational constructs of the TPB. Davis did not find SN to be a significant predictor of behaviour (Legris et al., 2003), and as researchers have indicated, SN appears to have more weight in organizational settings where the opinions of superiors or co-workers on using a particular system becomes important (Ajzen, 1991;

Ramayah & Jantan, 2010). Given that E-Government systems are, for the most part, more voluntary in nature (Crane Williams & Marius, 2016; United Nations, 2020) and used on an individual and per-case basis, using an unmodified version of the TPB for the present research study was not optimal. Ideally, constructs from TPB and the TAM could be unified and validated for a relevant applied acceptance model for E-Government (Huh et al., 2009; Lu et al., 2010; Safeena, Date, Hundewale, & Kammani, 2013). This would essentially lead to an extended TAM model.

Horst, Kuttschreuter & Gutteling (2007) were among the first researchers to explore E-Government acceptance factors in the context of an extended TAM model. As they explain, the TAM mainly focuses on perceived benefits of system usage, meanwhile there might exist both positive and negative feelings and outcomes associated with usage – something the TPB accounts for. Therefore, they extended the TAM by including the additional dimensions of trust in government (TOG), risk perception (RP), subjective norm (SN) and perceived behavioural control (PBC) (Horst et al., 2007). Lu, Huang & Lo in their aforementioned E-Tax study also used an extended model combining TAM and TPB. The current study proposes to do the same by adopting relevant constructs from recent research.

Constructs that arise in contemporary research but have been considered inappropriate for the current study include items such as information quality (Lin, Fofanah, & Liang, 2011), management support (Sebetci, 2015), website design (Alomari, Woods, & Sandhu, 2012; ELKheshin & Saleeb, 2020), and facilitating conditions (Mahadeo, 2009). Based on the expounded theoretical

frameworks, the researcher believes that perceptions related to information quality may be captured under the PU construct, perceptions related to support and design may be captured under PEOU and facilitating conditions may be captured under PBC. The constructs that were adopted and the resulting research model are now presented.

2.6 A TAM-based Conceptual Model

The technology acceptance model (TAM) has several crucial advantages over competing acceptance frameworks. It is the most widely-validated model for IS research (Al-Mamary et al., 2016; Huh et al., 2009; Li, 2010; Momani & Jamous, 2017), it employs a small number of constructs (parsimony), it was specifically developed to measure attitudes towards information systems and is the most common framework in E-Governance acceptance research. For all these reasons, it was the most appropriate acceptance framework for the present study. This final section of the literature review will elaborate into the decisions involved in selecting and extending the TAM model and the resulting elicted hypotheses.

As previously discussed, the Technology Acceptance model relies on two main constructs: perceived usefulness (PU) and perceived ease of use (PEOU) to predict behavioural intention (BI) to use or accept an information system (Davis, 1989a). In existing E-Government acceptance research, these two main constructs have frequently been validated and proven statistically significant in their prediction. Sebetci (2015) observed that PU had a significant, “direct and positive effect on use” of E-Government systems in Turkey. Similar results were discovered by Alomari, Woods & Sandhu (2012), where PU was observed to be

a strong predictor of behavioural intention (BI) towards adopting E-Government services in Jordan. According to the authors, people were more willing to use government websites or electronic services if these were perceived to "increase the effectiveness and efficiency of conducting different transactions." (Alomari et al., 2012). Likewise, Mahadeo (2009) investigated the acceptance factors for E-Tax filing in Mauritius and concluded that PU was a significant predictor in the decision to adopt the system. As it relates to the construct of perceived ease of use (PEOU), literature is also supportive of its validity. Lu, Huang & Lo (2011) found PEOU to be significantly correlated to both behavioural intention to use (BI) and perceived usefulness. This correlation of PEOU towards predicting PU was also observed by Horst, Kuttschreuter & Gutteling (2007) in one of the earliest-conducted TAM-based E-Government studies.

Consequently, contemporary E-Government research validates the usefulness of the two main TAM constructs: PU and PEOU. This leads to the first two hypotheses for this research:

> *H1: Perceived usefulness is positively associated with the intention to use E-Government services.*
>
> *H2: Perceived ease of use is positively associated with the intention to use E-Government services.*

However, most researchers have noted that the base two-construct TAM model, might not always be sufficient to explain user behaviour in acceptance studies (Horst et al., 2007; Li, 2010; Venkatesh & Davis, 2000). Therefore, the decision

was taken to extend the TAM model for the purposes of this study based on validated constructs available in current E-Government acceptance literature.

One of the most salient constructs in E-Government acceptance research, and one which is often used to extend the TAM, is the construct of trust. Different researchers have taken varied but related approaches towards this specific construct. Alomari, Woods & Sandhu (2012) measure trust as two separate components: Trust in Government (TOG) and Trust in the Internet (TOI), which were hypothesized to account for general trust in E-Government services. Their results indicated that trust in government was a significant predictor for adoption. ELKheshin & Saleeb (2020) employed this same two-component approach to trust and discovered that both trust in government and trust in the internet were positively associated with E-Government adoption. Trust was also found to be significantly associated with intention to use E-Government by Horst, Kuttschreuter & Gutteling (2007) and Mahadeo (Mahadeo, 2009).

In developing countries such as in the Caribbean and Latin America, trust in the government can have important implications (Rubino-Hallman, 2002; Warf, 2014). Consequently, trust is seen as an important construct for this present study and will be the final construct adopted in extending the TAM model. It will be constructed by combining elements of both trust in government and trust in the internet as one construct: Trust in E-Government (TEG). This relationship of TEG and intention to use (BI) is hypothesised as:

> *H3: Trust in E-Government services is positively associated with the intention to use E-Government services.*

The resulting theoretical model for this study is an extension of the TAM with the additional constructs of perceived behavioural control (PBC) and trust in E-Government (TEG). These, along with the core constructs of perceived usefulness (PU) and perceived ease of use (PEOU) are hypothesised to predict the intention to use (BI) and adopt E-Government services. This model is presented in Figure 2.5.

Another common way in which the TAM is extended by researchers is by utilising constructs from the Theory of Planned behaviour (TPB). TBP captures behavioural dimensions not present in the TAM but that are often useful for predicting acceptance and use, namely subjective norm (SN) and perceived behavioural control (PBC) (Ajzen, 1991; Lu et al., 2010; Susanto & Goodwin, 2011). While the reasons for not including SN have been discussed at length, there are good reasons to include PBC.

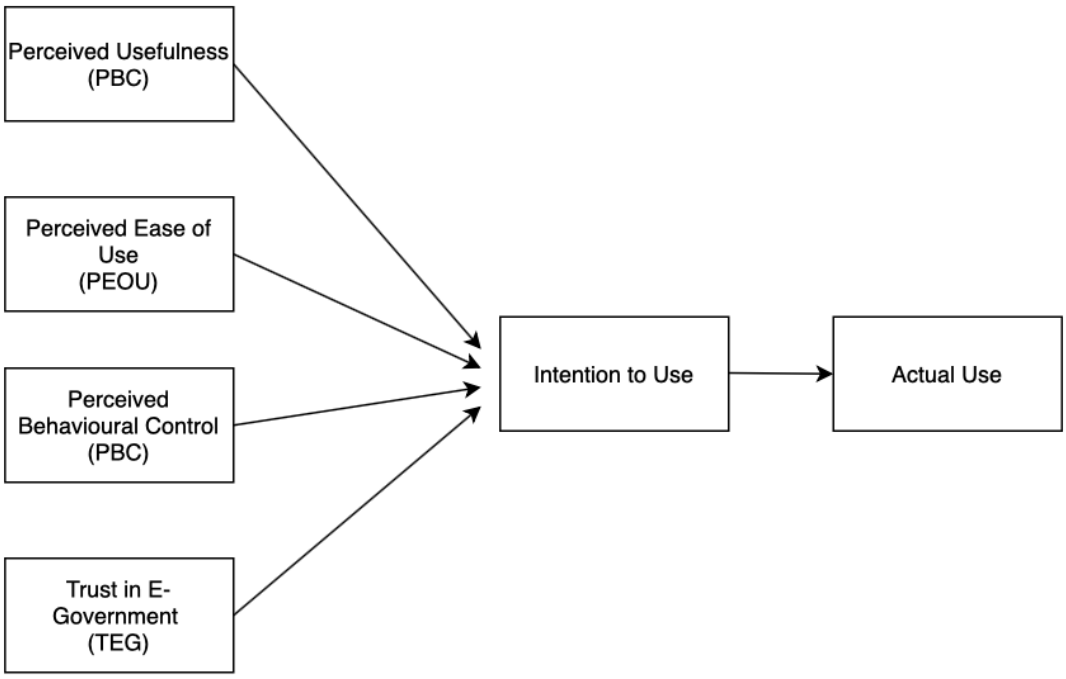
Perceived behavioural control (PBC) measures a person's own perceptions of power towards engaging in a particular behaviour, based on their abilities and resources. Ozkan (2009) emphasizes the importance of considering the availability of the skills, opportunities and resources required for using the system in question. Lu, Huang & Lo (2010), likewise found it necessary to account for "uncontrollable factors" in their study of online tax-filing acceptance.

Given that E-Government systems are by nature composed of software and hardware components and mediated via an electronic channel (the internet), there is a certain amount of technical literacy required to operate it. Moreover, online services also necessitate access to the internet, which is not always guaranteed in developing nations such as Belize. Only about 47% of Belizean

individuals are considered to be “internet users” (World Bank, 2020), which is likely a result of incomplete broadband coverage, cost of access, and lack of technical literacy (Crane Williams & Marius, 2016). Therefore, it is important to measure personal perceptions of abilities and opportunities to use E-Government. This will be achieved in the present study by extending the TAM model to include PBC. The resulting hypothesis is declared as:

> *H4: Perceived behavioural control is positively associated with the intention to use E-Government services.*

Figure 2.5 The resulting Extended TAM research model, adapted from Davis (Davis, 1989)



With the theoretical conceptual model in place, the research philosophy, design and methods will now be presented.

3. Methodology

This study seeks to answer the main question “what are the factors that influence the intention to use E-Government services in Belize?”. This research question is to be investigated, analysed and evaluated in the context of the Technology Acceptance Model, which is one of the most validated and commonly applied acceptance models in information systems research (Al-Mamary et al., 2016; Davis, 1989; Momani & Jamous, 2017). This chapter in methodology will outline the research philosophy, design and methods utilized in seeking to answer the research question. Special attention is provided to the data collection methods and data analysis procedures, as well as ethical considerations.

3.1 Research Philosophy

Underpinning every research study is a set of implicit and explicit assumptions on the part of the researchers, informed by an underlying philosophy. Per Holden & Lynch (2004), one of the core assumptions every researcher has to make relates to the nature of science and reality. The philosophical assumptions about science will inform the researcher’s stance on the nature of reality (ontology) and the adequate ways of measuring or learning from this reality (epistemology). These will, in turn, underpin his or her research approach, design, and consequently the research tools and methods (Duffy & Chenail, 2009; Saunders, Lewis, & Thornhill, 2009). The two predominant research philosophies may be classified as either subjectivist or objectivist (Saunders, Lewis, & Thornhill, 2009).

Objectivism is characterized by an empirical approach to science, referred to as positivism (Saunders et al., 2009). Positivism usually employs quantitative research methods such as sample surveys. These methods assume an objectivity in the collected data that may be analysed using statistical methods (LeTourneau University, 2020). Subjectivism, conversely, holds that reality is subjective and constructed from individual perceptions, social norms and local context. Epistemologically, this is referred to as interpretivism (Saunders et al., 2009). Interpretivist approaches are characterized by qualitative research methods such as case studies and interviews, with a focus on understanding human experiences and perceptions within specific social contexts (Nicholls, 2008).

However, Ellis and Levy (2008), while recognizing the importance of philosophy, posit that research design must be problem-driven. In choosing the right tool for the job, a researcher will select the research design and research methods that are best suited to answer the question at hand (Ellis & Levy, 2008). Conventionally, this is referred to as a pragmatic research approach (Saunders et al., 2009). Ellis and Levy (2008), recognize that research is an iterative exercise and that research problems often appear within a large body of existing literature with validated methods and approaches.

The current study employed this pragmatic research approach within the context of the Technology Acceptance Model and all its related literature, which has traditionally been employed and validated through the use of quantitative, survey-based methods (Davis, 1989; Horst et al., 2007; Sebetci, 2015; Venkatesh & Davis, 2000).

3.2 Research Design

3.2.1 Questionnaire

Since the introduction of the TAM by Davis, the psychometric constructs in the model have been measured by a set of scale items within a questionnaire (Davis, 1989), now a standard practice in TAM research (Alomari et al., 2012; Lu et al., 2010; Sebetci, 2015). Existing literature was the primary foundation for developing the questionnaire for this study. Table 4.1 presents the core questionnaire items[2]. The 'Intention to Use' item was included to be analysed as the outcome variable.

As it can be observed from the Table 1, each construct in the study's extended TAM model has been assigned four items, measured on a 5-point Likert scale. The respondent was asked to specify the extent to which they agreed or disagreed with each of the item statements. Subsequently, there were two ways in which the items were reviewed, tested, and improved.

Firstly, the initial items were submitted for review to research and methodology experts at the Statistical Institute of Belize (SIB) and the Inter-American Development Bank (IDB) who provided guidance in improving the clarity and precision of key items. Secondly, a pilot test was conducted on June 22, 2021, in which 10 persons were surveyed. Feedback from this exercise was used to improve the wording of several items, leading to the final version of the questionnaire that was used for data collection.

[2] See Appendix for full items, including background and demographic questions. Items with no attribution are the author's own.

Table 3.1 Core E-Government acceptance questionnaire items

Perceived Ease of Use
PEOU1: Interacting with online E-Government services would require a lot of mental effort from me. (Davis, 1989)
PEOU2: It will be easy for me to become skilful at using online E-Government services. (Davis, 1989)
PEOU3: It would be difficult for me to submit forms and perform transactions using online E-Government services (Lu et al., 2010)
PEOU4: I believe that my interactions with online E-Government services will be clear and understandable (Davis, 1989)
Perceived Usefulness
PU1: Online E-Government will allow me to be more productive (Davis, 1989)
PU2: Online E-Government services will provide valuable services to me. (Davis, 1989)
PU3: Online E-Government services will save me time (Davis, 1989)
PU4: Online E-Government services will make it more difficult to accomplish the tasks I want to complete (Davis, 1989)
Trust in E-Government
TEG1: The government can be trusted to carry out my transactions reliably (Alomari et al., 2012)
TEG2. I am confident that the forms I submit through government websites would be processed in a timely and accurate manner (Alomari et al., 2012)
TEG3. I am confident that the information provided by the government online, via websites or mobile apps are reliable and up to date (Alomari et al., 2012)
TEG4. I believe that personal or sensitive information I provide to the government via online means will be properly handled (Pikkarainen, Pikkarainen, Karjaluoto, & Pahnila, 2004)
Perceived Behavioural Control
PBC1: I would be able to properly utilize transactional E-Government services delivered through websites or applications
PBC2: If I wanted to use Electronic Government systems, I would be fully able to do so (Lu et al., 2010)
PBC3: I have the necessary resources, knowledge and abilities to be able to use E-Government systems through online and electronic means (Ajzen, 1991)
PBC4: There are things outside of my control, such as limited access to the internet, that will prevent me from fully utilising E-Government services
Intention to Use E-Government
BI: If the government of Belize introduced new E-Government services such as those listed at the beginning of this section, how likely is it that you would use those services in the near future?

3.3 Research Hypotheses

As presented in the conceptual model for this research, research questions are formulated as hypotheses. Each hypothesis and its corresponding mathematical regression notation are presented below.

H1: Perceived usefulness (PEOU) is positively associated with the intention to use (BI) E-Government services.

$$BI = \beta_0 + \beta_1 PEOU + \varepsilon$$

H2: Perceived ease of use (PU) is positively associated with the intention to use (BI) E-Government services.

$$BI = \beta_0 + \beta_2 PU + \varepsilon$$

H3: Trust in E-Government services (TEG) is positively associated with the intention to use (BI) E-Government services.

$$BI = \beta_0 + \beta_3 TEG + \varepsilon$$

H4: Perceived behavioural control (PBC) is positively associated with the intention to use (BI) E-Government services.

$$BI = \beta_0 + \beta_4 PBC + \varepsilon$$

3.4 Data Collection Methods

The initial target of the study were persons over the age of 18 who reside in the country of Belize. To be able to reach out to such a target population, convenience sampling, the preferred approach by many acceptance researchers (Alomari et al., 2012; Horst et al., 2007; Pikkarainen et al., 2004), was not a viable option. Therefore, the Statistical Institute of Belize (SIB) was approached[3] and their assistance was requested in obtaining an approximately representative sample from their existing household frame, which they graciously agreed to do, in accordance with some important considerations.

Due to the ongoing COVID-19 pandemic and ongoing social and physical restrictions (Government of Belize, 2021a, 2021b) during the period of study, a physical or face-to-face data collection was not appropriate. In addition, because internet penetration in Belize is not high enough (World Bank, 2020) or equally distributed for any sort of representative survey, web-based collection was quicky discarded as an option. Therefore, telephone collection was selected as the most appropriate modality for data collection.

The final sampling consideration was the use of confirmatory factor analysis (CFA). This method was used in the study both for validation and analysis. Consequently, the selected sample size had to satisfy requirements for this type of statistical method.

[3] The SIB is the researcher's employer and was willing to provide support.

3.4.1 Sample

The sampling that was facilitated by the Statistical Institute of Belize was obtained from their register of households with contact numbers. For CFA with a small number of factors (constructs), MacCallum, Widaman, Zhang and & Hong recommend a sample size of greater than 300. In addition, Recent experience at the SIB indicates that response rates using the telephone modality stand at around 50%.

In light of this and to ensure a good distribution of households throughout the country a sample of **N = 900** was selected from SIB's household register via SPSS software using two-stage sampling. At the first stage of sampling, the primary sampling units (PSU) called 'clusters' (geographical groupings of ~150 households) were selected using Probability Proportional to Size (PPS) sampling. At the second stage, simple systematic sampling was used within each cluster to obtain 15 households per cluster.

This robust method of sampling was employed to approximate a good level of representativeness as well as to eliminate common pitfalls of convenience sampling such as selection bias. The resulting sample was spread across the six districts of Belize as shown in Table 2.

Table 3.2 Distribution of sampled households throughout the country of Belize.

District	**n**
Corozal	135
Orange Walk	135
Belize	150
Cayo	165
Stann Creek	165
Toledo	150

3.4.2 Data Collection

Data collection happened during a period of ten days between June 27, 2021 and July 6, 2021. Due to the large sample size (N = 900), the telephone modality and the short dissertation period, it was seen appropriate to acquire assistance from data collectors, which was done with assistance of the SIB. Ten data collectors, who had previously worked with the SIB for telephone surveys, were hired and trained on the background and purpose of the study, the questionnaire tool and participant information and consent.

Although the sampling was done at the household level, only one person was required to answer per household. Wherever possible, attempts were made to get the head/reference person or their spouse to respond, as they would more accurately reflect the views of the household (as opposed to an adult child, sibling or some other relative).

Data capture was done using the digital survey platform Survey Solutions, developed by the World Bank (2021), which was installed on a secured and

encrypted server belonging to the SIB, to which the captured data would be submitted each day. Each data collector was equipped with a tablet computer[4] through which they received and submitted their assigned cases. For quality assurance, the recording software Cube ACR[5] was utilized to record the survey interviews, for which permission was obtained from the respondent. The recordings were only available to the researcher and were reviewed regularly to ensure the integrity and quality of the data collection. At the end of the collection, a total of **606 complete cases** were obtained, for a response rate of 68%.

3.5 Data Analysis[6]

Data was analysed using factor-score regression (FSR), which is an analysis technique that has been developing as an alternative to full SEM-modelling (DiStefano, Zhu, & Mîndrilă, 2009; Sakar, Keskin, & Unver, 2011). This analysis was carried out in two steps. First, a confirmatory factor analysis model was defined and fit to the data, after which the individual scores for each of the four latent factors (constructs) were extracted. Subsequently, these scores were used within a binary logistic regression for hypotheses testing and analysis.

[4] Loaned from the SIB

[5] https://cubeacr.app

[6] Full R code and syntax used for analysis can be found at https://github.com/gaguilar2015/dissertation

Though some researchers have concerns about bias when using this approach (Beauducel, 2011; Kelcey, Cox, & Dong, 2021), it was found appropriate for this study. For example, Devlieger, Mayer & Rosseel (2016) note:

> When using the regression FSR method, there is only bias when factor sores are used for the dependent variable. With regard to bias, it is acceptable to use the regression FSR method if only the independent variables are factor scores.

In the study, these criteria are met, as only the independent variables were the latent factors derived through CFA, while the dependent variable was an observed one. Moreover, the sample in this study is large (606) and all indicators in the factor model load very strongly into their proposed factors, which reduce other possible concerns (Beauducel, 2011; Eichhorn, 2014).

3.5.1 The predictors

The four perceptual factors in the research model are each measured by four items on the survey questionnaire. CFA was used to obtain values for the underlying factors represented by the survey items. This ‘factor score’ was extracted for each respondent and resulted in the four predictor variables for analysis: peou, pu, teg and pbc. Furthermore, for ease of interpretability, these variables were converted from continuous to ordinal categorical. Thus, each factor had four levels, indicating the perceptual strength on each for each respondent: ‘Low’, ‘Moderate’, ‘High’ and ‘Very High’.

3.5.2 The outcome variable

The outcome variable is present in the questionnaire as a 5-point scale item that measures personal intention towards using E-Government services in the

near future. In order to run a binary logistic regression, this variable was dichotomised in the following way: responses from 1 to 3 were coded as ‘Low’ intention, and responses of 4 and 5 were coded as ‘High’ intention. Thus, everything was in place for the regression analysis and hypotheses testing.

3.6 Reliability and Validity

Confirmatory factor analysis (CFA) was performed for construct validity to ensure that the items were appropriately measuring the underlying constructs (PEOU, PU, TEG, PCB). The first factor model had an unsatisfactory fit to the data, so the two lowest-performing items were dropped to create an improved model. This second model satisfied all theoretical criteria and displayed excellent factor loadings, indicating that each factor was being appropriately measured by its corresponding items. The extracted factors from this second model were used for further analysis.

Cronbach’s alpha was used to ensure internal reliability of the results. A cut-off of 0.7 was proposed, but no item loaded lower than 0.85, signifying excellent data reliability.

3.7 Ethical Considerations

Ethical approval was sought and granted by the University of Salford. Informed consent was obtained from each participant in the survey. Although no sensitive data was collected, data confidentiality and privacy were ensured through the use of a private, encrypted server where each completed questionnaire was submitted immediately after collection. No data remained on the data collection devices, which belonged to the SIB. Only the researcher had access to the collected survey data. Moreover, data collectors had all worked with the SIB

and have signed a legally binding and lifelong Oath of Secrecy, as a protection against any potential breach of confidentiality.

3.8 Limitations

Although the sample obtained from the Statistical Institute of Belize was pulled using probabilistic techniques, generalisation to the Belizean population is out of the scope and duration of the study[7]. In addition, households without a contact number are not represented in the study. Due to resource limitations, only one household member was surveyed.

The non-response rate was at 32% and was more pronounced in certain areas of the country, which may introduce bias. Furthermore, call-clarity and hearing problems might have prevented the respondent from understanding the questions properly, which might reduce the quality of the collected data.

The outcome variable was converted from a 5-point scale item to a dichotomous item, with a cut-off for ‘Low’ intention at 3, and 4-5 coded as ‘High’ intention. It is possible that some information might be lost when coding the value 3 as ‘Low’ intention.

Finally, although using the Technology Acceptance Model to analyse perceptions and behavioural intentions provides a solid foundation for understanding acceptance phenomena, human behaviour is complex and there might be many other factors at play.

[7] This would require the use of household weights, non-response adjustments and population calibration, for example.

4. Findings and Analysis

This chapter presents the principal results obtained from the primary research conducted to answer the main research question: “what are the factors that influence the intention to adopt E-Government services in Belize?”. This research question was investigated within the framework of an extended Technology Acceptance Model (TAM) which proposed four main factors that influence acceptance: perceived ease of use (PEOU), perceived usefulness (PU), trust in E-Government (TEG) and perceived behavioural control (PCB). Thus, the research question was disaggregated into four separate hypotheses corresponding to the association between each factor and the outcome variable: intention to use (BI) E-Government services. The findings of the data collection activity that took place to answer the research questions are presented, the data is analysed, and the hypotheses are tested with a technique called factor-score regression (FSR) using a generalized linear model (GLM).

Sample and descriptive statistics are now presented to provide an overview of the results of the data collection and the main characteristics of the resulting data.

4.1 Sample and Descriptive Statistics

A sample of 900 households was selected with the assistance of the Statistical Institute of Belize (SIB) from a register that is representative of Belizean households in possession of a telephone number. This resulted in an independent and well-distributed sample of households across Belize. There were 610 administered surveys, of which four cases were discarded due missing variables, resulting in a final dataset of 606 complete cases. It is worth

reiterating that only one person was interviewed per household. The full descriptive statistics for the resulting dataset are presented in Table 4.1.

Geographically, the respondents were well distributed among the six districts in Belize, each accounting for 14-17 percent of respondents; except for the Toledo district, which accounted for 21 percent. Moreover, the majority of respondents (62.2%) lived in rural areas, although the urban area (37.8%) is still well represented. The distribution of households by the district and area is displayed in Figure 4.1.

Figure 4.1 Stacked bar chart of respondent households by district and area

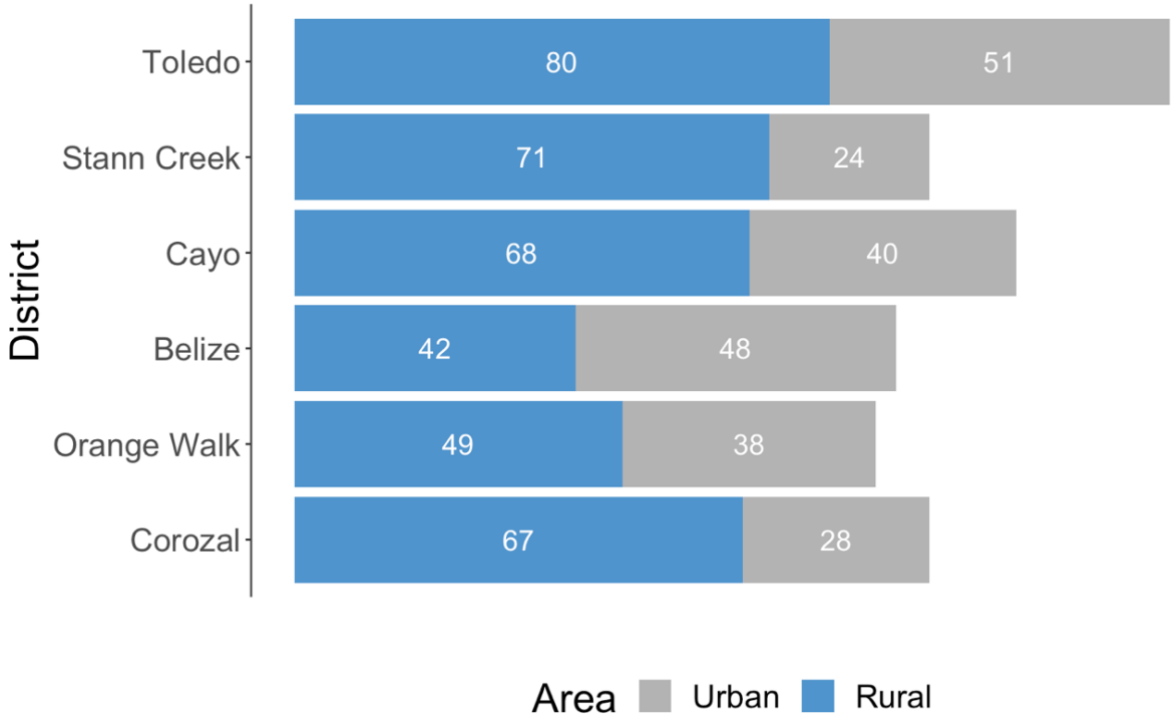
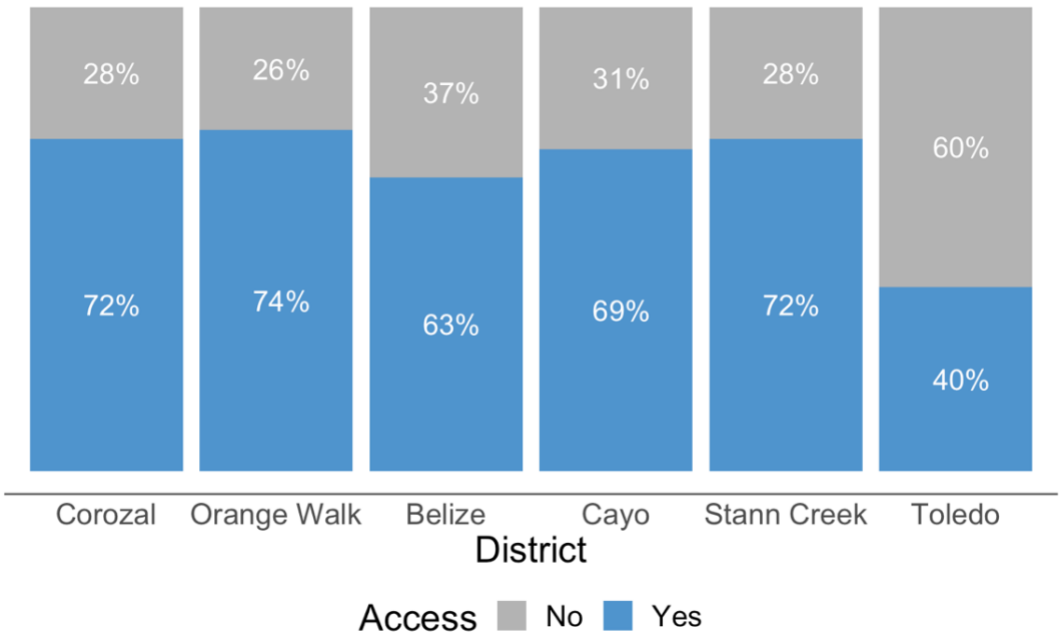


Table 4.1 Demographic and background characteristics of the survey dataset.

Variable	N	%	Cum. %	% Likely to adopt E-Gov
Sex				
Male	258	42.6	42.6	71.3
Female	348	57.4	100.0	59.5
Age Group				
18-29	140	23.1	23.1	78.6
30-39	178	29.4	52.5	62.9
40-49	128	21.1	73.6	62.5
50-59	87	14.4	88.0	62.1
60-69	51	8.4	96.4	54.9
70+	22	3.6	100.0	31.8
Highest Education Level				
None or Some Primary	91	15.0	15.0	45.1
Primary	273	45.0	60.1	61.2
High School	118	19.5	79.5	72.9
University	115	19.0	98.5	79.3
Other	9	1.5	100.0	77.8
Internet Access				
At home	384	63.4	63.4	68.8
Elsewhere	75	12.4	75.8	69.3
None	147	24.2	100.0	51.0
District				
Corozal	95	15.7	15.7	68.4
Orange Walk	87	14.4	30.0	72.4
Belize	90	14.9	44.9	71.1
Cayo	108	17.8	62.7	66.7
Stann Creek	95	15.7	78.4	69.5
Toledo	131	21.6	100.0	46.6
Area (Urban/Rural)				
Urban	229	37.8	37.8	64.2
Rural	377	62.2	100.0	64.7
Intention to Adopt E-Gov				
Low	215	35.5	35.5	0
High	391	64.5	100.0	64.5
N = 606				

Females comprised the larger share, 57.4 percent (348), of the respondents. In terms of age distribution, the largest age group was the 30-39 years group, which accounted for 178 (29.4%) of all respondents, followed by the 18-29 age group (23.1%). Altogether, persons 18-59 made up 88 percent of all respondents. As it relates to education, 15% of respondents did not complete any formal schooling[8]. The most common highest completed level of education was 'primary school', reported by 45 percent of respondents. This was followed by 'high school' and 'university', each reported as the highest level of education by approximately 19 percent of respondents. Another notable characteristic was that most of the respondent households (75.8%) had regular internet access, either at home (63.4%) or elsewhere (12.4%). As observed in Figure 4.2, Internet access at home was similar across all districts except for Toledo, which had a notably lower proportion (39.7%).

Figure 4.2 Proportion of households with internet access at home, by district.



[8] They might have started – but not completed, primary school.

As it relates to main scale-items used to measure perceptions, the mean and median scores were relatively high across the four core groups[9]. Reliability, measured using the `alpha` function (Cronbach's alpha) of the *psych* package in R, proved to be very good ($\alpha > 0.8$) across all item groups.

Table 4.2 Descriptive and reliability statistics of scale items

Item Group	*N*	*M*	*SD*	*MED*	*alpha*
peou	606	13.49	3.35	15	0.90
pu	606	14.92	2.67	16	0.89
teg	606	13.74	2.88	15	0.84
pbc	606	13.65	3.11	15	0.85
N = 606					

Finally, 64.5 percent of all respondents (391) expressed a high intention towards adopting E-Government services, while the remaining 35.5 percent expressed low intention.

4.2 Confirmatory Factor Analysis

Confirmatory factor analysis' (CFA) is statistical method used to test or 'confirm' the presence of latent factors which are proposed to exist in data based on theory (Bean, 2021; DeCoster, 2011). It performs construct validity by comparing the covariance matrix of the observed data with the hypothetical covariance matrix of the proposed model, and comparing how similar or different they are (similar is good). After validation, the underlying factors can be extracted and used for analysis in place of individual or grouped items.

[9] Perceived usefulness (pu), perceived ease of use (peou), trust in E-Government (teg) and perceived behavioural contrl (pbc).

For the present study, the TAM framework was utilized and extended with constructs present in contemporary E-Government acceptance literature. To validate that each item is measuring the intended construct and corresponding latent factor, CFA was performed using the R statistical software and the package *lavaan*.

4.2.1 Model fit and factor loadings

There are two important components in CFA: the overall model fit (goodness of fit), and the 'loadings' of each item into the latent factor, which help assess how well each item is measuring the intended underlying construct. The first factor model was defined and specified in R and ran with the `cfa` function of the *lavaan* package. However, the model fit was not optimal. Particularly, the absolute fit measures of RMSEA (0.107) and Chi-Square (7.9) exceeded the recommended maximum measures of <0.08 and <5 respectively(Sun, 2005; UCLA: Statistical Consulting Group, 2021). An RMSEA above 0.1 is often considered an unacceptable model (Sarmento & Costa, 2019; UCLA: Statistical Consulting Group, 2021).

Table 4.3 Goodness-of-fit measures for the theoretical factor models

Model			**Fit Measures**		
	χ^2/df	**RMSEA**	**SRMR**	**CFI**	**TFI**
Recommended	**< 5**	**< 0.08**	**< 0.08**	**> 0.9**	**> 0.9**
First Model	7.9	0.107	0.054	0.97	0.97
Improved Model	5.0	0.081	0.041	0.99	0.99

To improve model fit, a second model was created by dropping the two items with the lowest factor loadings (Lu et al., 2010; Pikkarainen et al., 2004). The dropped items were PEOU1 (Interacting with online E-Government services

would require a lot of mental effort from me) and PBC4 (There are things outside of my control that will prevent me from fully utilising E-Government services). The second model satisfied all recommended goodness of fit measures. Table 4.3 displays the model fit for the first model and the improved model. Here, the adjusted Chi-square and RMSEA values were satisfactory at 5.1 and 0.81, respectively. Moreover, the incremental fit indices (CFI and TFI) were excellent at 0.99, exceeding the recommendations of >0.9 values for good fits.

Table 4.4 Factor loadings for the improved model.

Factor	Indicator	SE	Z	p	Std. Loading
PEOU	eou2	0.0093	99.6	<0.0001	0.928
	eou3	0.0203	35.6	<0.0001	0.723
	eou4	0.0093	99.1	<0.0001	0.926
PU	pu1	0.0117	79.7	<0.0001	0.936
	pu2	0.0107	85.8	<0.0001	0.922
	pu3	0.0111	81.9	<0.0001	0.906
	pu4	0.0189	45.3	<0.0001	0.856
TEG	t1	0.0200	40.8	<0.0001	0.816
	t2	0.0176	46.3	<0.0001	0.813
	t3	0.0171	49.6	<0.0001	0.847
	t4	0.0167	51.5	<0.0001	0.858
PBC	pbc1	0.0145	61.8	<0.0001	0.895
	pbc2	0.0095	98.7	<0.0001	0.938
	pbc3	0.0148	57.8	<0.0001	0.856
Between-Factor Correlations					
PEOU	PU	0.0130	64.7	<0.0001	0.843
PEOU	TEG	0.0326	15.3	<0.0001	0.501
PEOU	PBC	0.0106	85.5	<0.0001	0.906
PU	TEG	0.0262	21.5	<0.0001	0.562
PU	PBC	0.0147	56.3	<0.0001	0.828
TEG	PBC	0.0271	23.6	<0.0001	0.639

N = 606 *Note:* R code and full output in appendix

The factor loadings also improved in the second model, with all items across all factors having a standardized loading higher than 0.8. The standardized factor loading describes the expected change in an indicator expected from a one-unit change in the factor (Brown, 2015, p. 15). The square of the factor loading also indicates how much variance the factor explains in each indicator; for example: the factor PU explains $0.856^2 = 73\%$ of the variance in item *pu4*.

The between-factor correlations are very good in both models, with all correlations being >0.5. However, the correlation between PEOU and PBC is >0.85, which Brown (2015) lists as a cut-off point to avoid multi-collinearity issues. This indicates that there might be significant overlap between what is measured by the PEOU and PBC constructs. Overall, however, it is concluded that the extended-TAM conceptual model proposed and utilized in this study is theoretically sound.

4.2.2 The latent factors and factor-score regression

Traditionally, CFA has been performed by researchers as a building step towards hypothesis testing with structural equation modelling (SEM) and path analysis. However, the factor score regression (FSR) method has been gaining popularity an alternative approach (Devlieger, Talloen, & Rosseel, 2019; DiStefano et al., 2009). In this method, the factor scores from the fitted CFA model are first extracted and thereafter used in regression analysis, taking advantage of the latent interrelationship between the constructs.

The factor-scores were extracted using the `lavPredict` function from the *lavaan* package. This command returned a dataset of 606 rows (equal to the number of respondents) and 4 columns: PEOU, PU, TEG and PBC. The first

five records of the output are displayed in Table 4.5 These scores were then merged to their corresponding records in main dataset using the `cbind` function in R. For clarity, these factor scores represent the relative perceptual strength of each respondent towards the corresponding factors or constructs.

Table 4.5 Factor scores for the first 5 respondents in the dataset

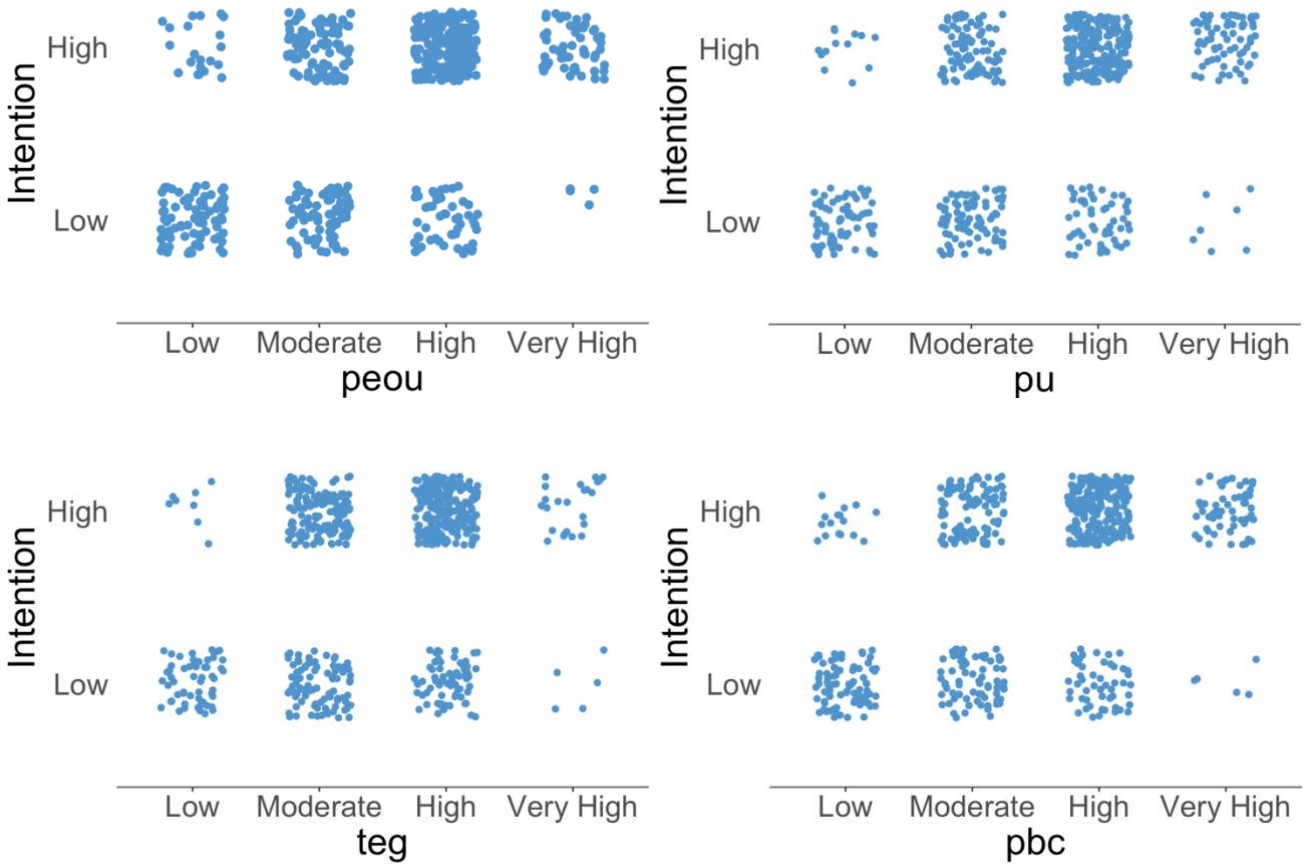
i	PEOU	PU	TEG	PBC
1	-1.578	-1.776	-1.366	-1.575
2	1.558	1.690	0.817	1.431
3	-1.578	-1.776	-1.365	-1.575
4	0.992	1.137	1.844	0.978
5	0.488	0.427	0.558	0.490

Frequency diagnostics indicated that most factor scores were distributed between -2 and 2, centred around 0. For interpretability of analysis, it was seen appropriate to transform this continuous variable into an ordinal variable consisting of four levels, corresponding to strengths of perception. This resulted in the four categorical variables (*peou, pu, teg, pcb*) which will serve as the predictors in the regression model[10].

Jitter-plots of these factors against the binary intention variable demonstrate that a logistic analysis was appropriate, as there is an evident pattern in the dot density suggesting that high intention is more likely as the level of the predictor increases. These can be observed in Figure 4.3.

[10] The decision to label the categories as 'Low', 'Moderate', 'High' and 'Very High' as opposed to a more "balanced" convention such as 'Low', 'Low-Moderate', 'High-Moderate' and 'High' is due to the fact that as seen in table 4.2, responses skewed to the high end of the scale, and an 'average' response already reflected a high perceptual score.

Figure 4.3 Jitter-plots of factors against intention to use E-Government services.



4.3 Logistic Regression

Binary logistic regression is a type of generalized linear model used for analysis of data with a dichotomous outcome. In regular linear models, where the outcome variable is continuous, a straight line can be fit to the data, which can theoretically range from negative to positive infinity. In a binary logistic model, the range of the outcomes can only take values from 0 to 1, representing the probability of the outcome event occurring, or the probability of success. In order for the regression line to stay within the bounds of probability, binary logistic regression uses a transformation function, called the logit, to link

between a linear combination of predictors and the corresponding probabilities. The logit is the natural log of the odds and is expressed with the following equation

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \ldots + \beta_k X_k \quad (1)$$

where the right hand side is the linear combination of predictors expressed in terms of log odds. Thus, the log odds can be converted back to odds and probability as shown in equations (2) and (3).

$$\frac{p}{1-p} = e^{\beta_0 + \beta_1 X_1 + \ldots + \beta_k X_k} \quad (2)$$

$$p = \frac{e^{\beta_0 + \beta_1 X_1 + \ldots + \beta_k X_k}}{1 + e^{\beta_0 + \beta_1 X_1 + \ldots + \beta_k X_k}} \quad (3)$$

Alternatively, the results of a logistic regression can be expressed in terms of odds ratios. Odds are defined as the probability of an event occurring divided by the probability of the same event not occurring. An odds ratio, then, is a ratio between two odds, as expressed in the below equation.

$$odds = \frac{p}{1-p}, \qquad odds\ ratio = \frac{odds\ 2}{odds\ 1}$$

For example, if the odds for a particular event improve from 2:1 to 5:1 as a result of a predictor, then the odds ratio is 2.5, indicating that the odds of success have improved by 150%. This concept becomes very useful when analysing how each predictor term in a model influences the chances of success.

4.3.1 Competing regression models and a multicollinearity issue

The conceptual model for this study was therefore defined by the equation

$$logit(p) = \beta_0 + \beta_1 PEOU + \beta_2 PU + \beta_3 PBC + \beta_4 TEG + \varepsilon \qquad (4)$$

where p is the probability of the intention (BI) to use E-Government services being high. This formula was defined and run in R using the `glm` function and the results are presented in Table 4.6.

Table 4.6 Model 1: Logistic regression analysis of intention to use E-Government services using the four model constructs as predictors.

Predictor	β	SE β	Z	p	e^{β} (Odds ratio)
(Intercept)	-3.054	0.488	-6.3	3.9e-10***	0.05
peouModerate	0.197	0.476	0.4	0.6787	1.22
peouHigh	0.496	0.618	0.8	0.4220	1.64
peouVeryHigh	1.248	1.128	1.1	0.2683	3.48
puModerate	0.989	0.391	2.5	0.0113*	2.69
puHigh	1.350	0.507	2.7	0.0078**	3.86
puVeryHigh	1.788	0.716	2.5	0.0125*	5.98
tegModerate	1.407	0.468	3.0	0.0026**	4.08
tegHigh	1.527	0.480	3.2	0.0015**	4.61
tegVeryHigh	1.071	0.752	1.4	0.1543	2.92
pbcModerate	0.728	0.500	1.5	0.1458	2.07
pbcHigh	1.304	0.616	2.1	0.0344*	3.68
pbcVeryHigh	1.391	1.062	1.3	0.1902	4.02
Test					
Overall model evaluation		χ^2	*df*	p	
Model χ^2 (F statistic)		198.7	12	7.2e-36***	
Likelihood ratio		198.7	12	2.2e-16***	
Goodness of Fit Tests					
McFadden's R^2	0.251				
Nagelkerke R^2	0.384				

Note. R Programming code: `model1 <- glm(intention_bin ~ peou + pu + teg + pbc, data = eafs, family = "binomial")` Full code in appendix.

'Low' is the reference level (intercept) for each predictor.

* p < 0.05; ** p < 0.01; *** p < 0.001

The results of the fitted logistic model indicate that, overall, the model is statistically significant $(\chi^2 = 198.7, df = 12, p < 0.001)$ and represented a good fit to the data (McFadden R^2 = 0.251; Nagelkerke = 0.384)[11]. However, a first look at the coefficients indicated some potential issues, as the levels of peou predictor had large standard errors associated with it, rendering them non-significant within the overall model.

PEOU was the most notable non-significant predictor, and acknowledging that this factor has been previously noted to be overly correlated with PBC, further tests were needed. A Wald test indicated that as a whole, the peou variable was significant $(\chi^2 = 39.3, df = 3, p < 0.001)$. However, the result of a likelihood-ratio test ($p = 0.71$), which compared the fitted model with one where PEOU is not present, suggested that the contribution of PEOU to the model is non-significant. This second test points to an issue of possible **multicollinearity**.

Multicollinearity happens when two or more predictors in a regression model are highly correlated with each other. This means that it is likely that the two variables are measuring much of the same thing. When this happens, standard errors are inflated and the model may become unreliable (Daoud, 2017). A variance inflation factor (VIF) test was performed, which measures how much the variance in a model is inflated due to correlation between factors. The results indicated that PEOU and PBC had very high VIF scores, at 27.0 and 20.5 respectively. Researchers advise that VIFs higher than 5 (Daoud, 2017), or

[11] In logistic regression, Goodness-Of-Fit measures should be used as comparative values to assess competing models, as opposed to absolute measures such as R^2 in linear models.(Smith & McKenna, 2013)

10 (Frank, 2000; Paul, 2006) can be problematic and make the model difficult to interpret. The choice was made to remove one of the two from the model.

Table 4.7 Model 2: Logistic regression analysis of intention to use E-Government services using three model constructs and excluding PEOU.

Predictor	β	SE β	Z	p	E^{β} (Odds ratio)
(Intercept)	-3.051	0.489	-6.2	4.5e-10***	0.05
puModerate	1.042	0.379	2.8	0.0059**	2.84
puHigh	1.551	0.446	3.5	0.0005***	4.72
puVeryHigh	2.113	0.665	3.2	0.0015**	8.27
tegModerate	1.403	0.468	3.0	0.0027**	4.07
tegHigh	1.480	0.477	3.1	0.0019**	4.39
tegVeryHigh	0.965	0.746	1.3	0.1961	2.62
pbcModerate	0.887	0.360	2.5	0.0136*	2.43
pbcHigh	1.618	0.444	3.6	0.0003***	5.04
pbcVeryHigh	2.257	0.748	3.0	0.0026**	9.56
Test					
Overall model evaluation		χ2	*df*	*p*	
Model χ^2 (F statistic)		197.3	9	1.2e-37***	
Likelihood ratio		197.3	9	2.2e-16***	
Goodness of Fit Tests					
McFadden's R^2	0.251				
Nagelkerke R^2	0.383				

Note. R Programming code: `model2 <- glm(intention_bin ~ pu + teg + pbc, data = eafs, family = "binomial")` Full code in appendix.

'Low' is the reference level (intercept) for each predictor.

* p < 0.05; ** p < 0.01; *** p < 0.001

To decide which of the two correlated factors to remove from the model, likelihood ratio tests were performed. The tests revealed that pbc ($p = 0.19$) was more significant than peou ($p = 0.71$) and therefore contributed more to the model and was selected as the predictor to keep. A second model was thus specified with just three predictors: pu, teg and pbc. See Table 4.7.

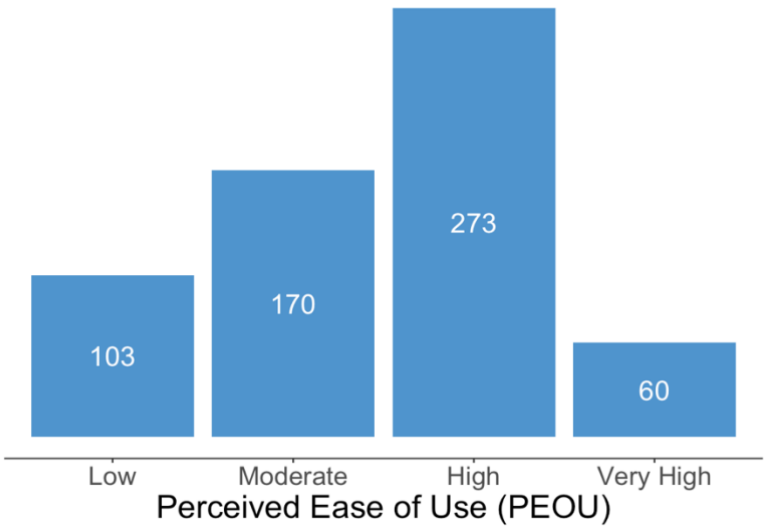
Model 2 proved to be more significant ($\chi^2 = 197.3, df = 9, p < 0.001$) than the first. In terms of goodness of fit, model 2 scored the same as Model in

McFadden's R^2 (0.251), slightly lower in the Nagelkerke score (0.383). McFadden (1978) suggests that a McFadden's R^2 value of 0.2-0.4 represents a an excellent fit. The measures, therefore, indicate that the model fits the data very well. More importantly, there was no multicollinearity present in model 2 and all standard errors in the coefficients were low and stable. Having arrived at a reliable model, the research hypotheses are now revisited.

4.4 Perceived Ease of Use (PEOU)

The first factor hypothesised to be positively associated with the intention to adopt E-Government services was perceived ease of use (PEOU). PEOU is defined as to which performing an action is seen as "free of effort". Respondents who scored high on PEOU believed that using E-Government services would be easy, clear and understandable. This was important to measure, as a specific set of abilities are needed to utilize the devices and channels for E-Government. As it can be seen in Figure 4.4, most respondents had high perceived ease of use. In all, 503 of the 606 respondents (83%) had moderate to very high scores for PEOU.

Figure 4.4 Factor score distribution for Perceived Ease of Use (PEOU)



The null and alternative hypotheses for this factor can be formulated as:

> *$H1_0$: There is no relationship between Perceived Ease of Use (PEOU) and the intention to use (BI) E-Government services.*
>
> *$H1_A$: Perceived Ease of Use (PEOU) is positively associated with the intention to use (BI) E-Government services.*

Although a Wald test on the first model indicated that PEOU was significant as an overall predictor $(\chi^2 = 39.3, df = 3, p < 0.001)$, a likelihood ratio test indicated that containing PEOU did not perform significantly different ($p = 0.71$) than a model which excluded it. Given PEOU's high correlation with PBC, it is possible that these two variables are **confounders** of each other. In regression, a confounder is a variable that is related to and affects both the outcome variable and one or more of the predictors, lowering the reliability of the relationships between predictors and the outcome and increasing the chances of multicollinearity (Frank, 2000). Further statistical tests would need to be done to determine which variable is the confounding one, but the choice was made to keep PBC in the model and remove PEOU, as per reasons previously provided.

Therefore, the null hypotheses $H1_0$ ***cannot*** *be rejected.*

This result is in conflict with findings from other E-Government studies that found a significant relationship between PEOU and intention (Hofmann et al., 2012; Lu et al., 2010), but it is not unprecedented.

PEOU as a non-significant factor was also reported by Woods, Alomari & Sandhu (2012), who used the TAM to investigate E-Government acceptance factors in Jordan. In a similar TAM study focused on online banking, Pikkarainen, Pikkarainen, Karjaluoto & Pahnila (2004) reported that PEOU was

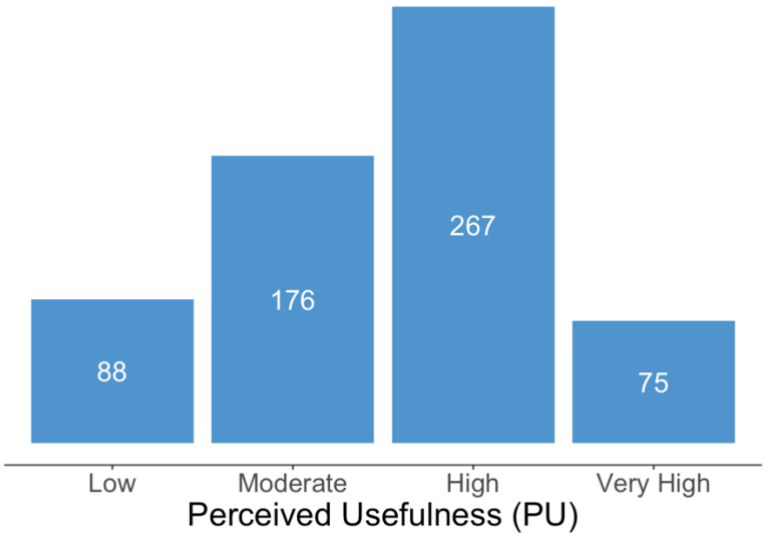
found to be a significant predictor for PU, but it did not have much effect on intention to use. Some critical researchers have gone as far as question PEOU's role in the TAM, given that although it tends to be a predictor of PU, it fails to be consistently significant (Li, 2010). For this same reason, Horst, Kuttschreuter & Gutteling (Horst et al., 2007) did not include PEOU in their TAM model when investigating E-Government acceptance in the Netherlands, citing similar literature which casted doubt on PEOU's effect on intention.

In summary, it is difficult to assess the true relationship between PEOU and intention to use E-Government in the present research model, given the multicollinearity issues and possible confounding with PBC. Nevertheless, the null hypotheses could not bet rejected.

4.5 Perceived Usefulness

Perceived usefulness (PU) is defined as the extent to which a person believes that performing an action will be of benefit to them and increase their productivity. As it relates to E-Government services, persons with high PU believed E-Government would make them more productive, save them time and provide advantages over the alternative. The distribution of factor scores for this construct is displayed in Figure 4.5. Over 85 percent of respondents scored 'moderate' to 'very high' on PU, indicating that E-Government was seen as useful and beneficial, overall.

Figure 4.5 Factor score distribution for Perceived Usefulness (PU)



Perceived usefulness was hypothesised to have a positive association on the intention to use E-Government systems, expressed as:

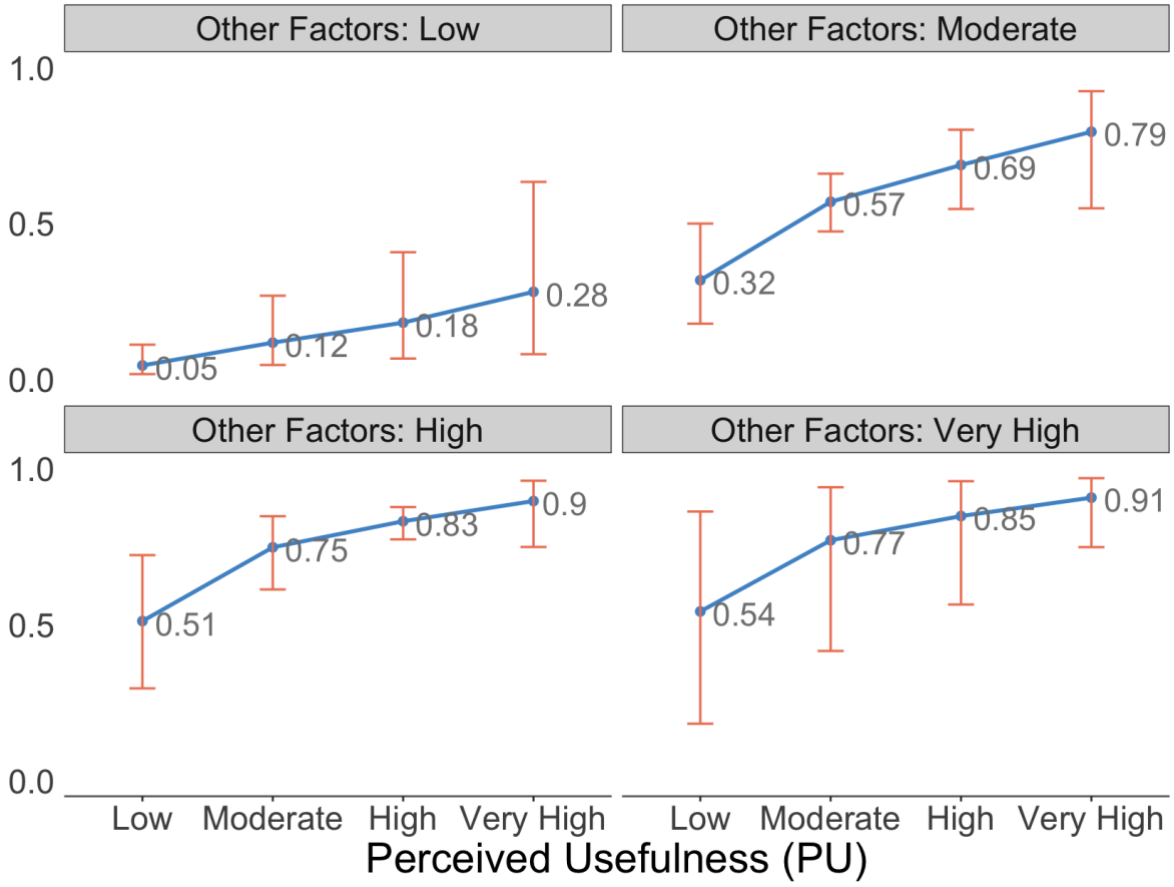
> *$H2_0$: There is no relationship between Perceived Usefulness (PU) and the intention to use (BI) E-Government services.*
>
> *$H2_A$: Perceived Usefulness (PU) is positively associated with the intention to use (BI) E-Government services.*

This hypothesis was tested using regression model 2, which was deemed as a more reliable, stable model after the removal of the problematic PEOU variable. It was observed that positive association with intention grows as the strength of PU increases. A Wald test for the overall significance of PU ($\chi^2 = 42.9, df = 3, p < 0.001$), along with a likelihood ratio test comparing a model with and without PU ($p = 0.002$), confirmed the significance and importance of PU in the model.

Therefore, the null hypotheses $H2_0$ ***was rejected*** *in favour of the alternative hypothesis $H2_A$.*

The log-odds (β) coefficients demonstrate the change on the probability of intention to use as the strength of PU increases. Converting these to odds-ratios gives a more intuitive interpretation. According to the model, the odds of using E-Government services increases by 2.84 times, on average, when comparing a respondent with 'moderate' PU as compared to someone with 'low' PU, all other factors being held constant. Perhaps most notably, the odds for intention increase by 8.27 times, or 727%, on average, when comparing someone with 'very high' PU to someone with 'low' PU, all other factors held constant.

Figure 4.6 Effects plot for PU at different constant values for the other factors.



The effect of predictors in binary logistic regression is perhaps most clearly demonstrated through probabilities. Using equation (2), the probabilities for the outcome (intention to use) as predicted by PU can be obtained. In R, these probabilities can likewise be obtained by using the `predict` function and providing the values at which to measure each predictor. Figure 4.6 provides the probability plot, also called an 'effects plot', for PU. Each 'facet' or grid panel on the chart represents a state (level or strength) at which the other factors besides the specific predictor (in this case PU) are being held, and plots the predicted probability of intention against the values of PU. The red error-bars represent 95% confident intervals for the predicted probabilities. Model error is large where the sample size at a specific value is small.

From this plot, it can be seen that when all other factors are held at a constant value, PU has a significant effect on the intention to use E-Government. For instance, when all other factors are low and PU is 'very high', there is still a 28% probability of 'high intention' to adopt[12]. If all other factors are *at least* moderate, then the level of PU has a larger effect on the intention. For example, a respondent with 'high' values for other factors but 'low' PU is predicted to have just a 51% probability of having high intention to use, but a probability 90% when PU is 'very high'.

These results are in accordance with most acceptance research that utilise TAM models. From its inception, Davis has always considered PU as the most important predictor of intention – the one that accounts for the most variance

[12] The reader is reminded that the binary outcome variable is coded as 'Low' and 'High' intentions to adopt.

(Davis, 1989). This is backed up by evidence in E-Governance acceptance research. Belanche, Casaló, & Flavián found PU to be the most significant determinant of intention, which they attributed to the perceived benefits derived from E-Government usage. Several other studies in E-Government research have similarly found PU to be the most significant determinant of intention to use (Alomari et al., 2012; Mahadeo, 2009; Pikkarainen et al., 2004; Sebetci, 2015). Moreover, perceived usefulness is such a consistent predictor that it appears in several other behavioural and acceptance models (Huh et al., 2009). Although Li (2010), in a critical review of acceptance research, cited some studies where PU was inconsistent or even failed as a predictor of intention, this was not the case in the current study.

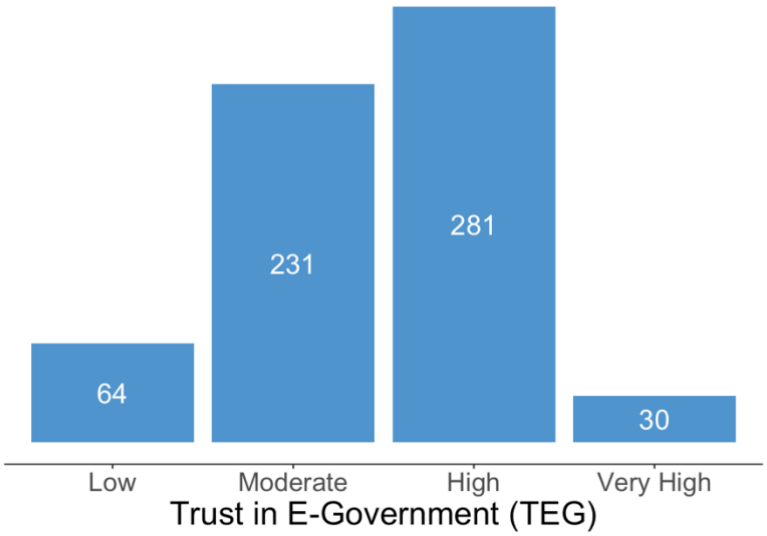
The discussed results point to the fact that, despite possible influence from other factors, if a person believes that E-Government is providing value, usefulness and convenience, then the probabilities of their intention to use are likely to be high. The results also indicated that overall, persons in Belize perceive E-Government to be useful.

4.6 Trust in E-Government

Trust in E-Government (TEG) was measured by a set of items that tap into respondents' confidence in the integrity and reliability of the services that the E-Government would provide. A respondent with high trust in E-Government is one who deems the electronic, transactional and informational services provided by the government as trustworthy, reliable and secure. Figure 4.6 shows the score distribution for this factor, where it is seen that most respondents (84.5%) fell in the 'moderate' and 'high' groups. TEG was the

factor with the fewest amount extreme scores. In accordance, only 5% of respondents scored ‘very high’ in trust.

Figure 4.7 Factor score distribution for Trust in E-Government (TEG)



It was hypothesized that the level of trust in E-Government was positively associated with the intention to use E-Government. The competing hypotheses are presented as:

> *$H3_0$: There is no relationship between Trust in E-Government (TEG) and the intention to use (BI) E-Government services.*
>
> *$H3_A$: Trust in E-Government (TEG) is positively associated with the intention to use (BI) E-Government services.*

The proposed relationship was tested using the logistic regression model 2. The results demonstrated a significant, positive association between TEG and high intention of use. Although not all levels (or categories) were significant in the model, a Wald test confirmed the overall significance of TEG $(\chi^2 = 20.6, df = 3, p < 0.001)$ as a predictor. Similarly, a likelihood ratio test comparing a model

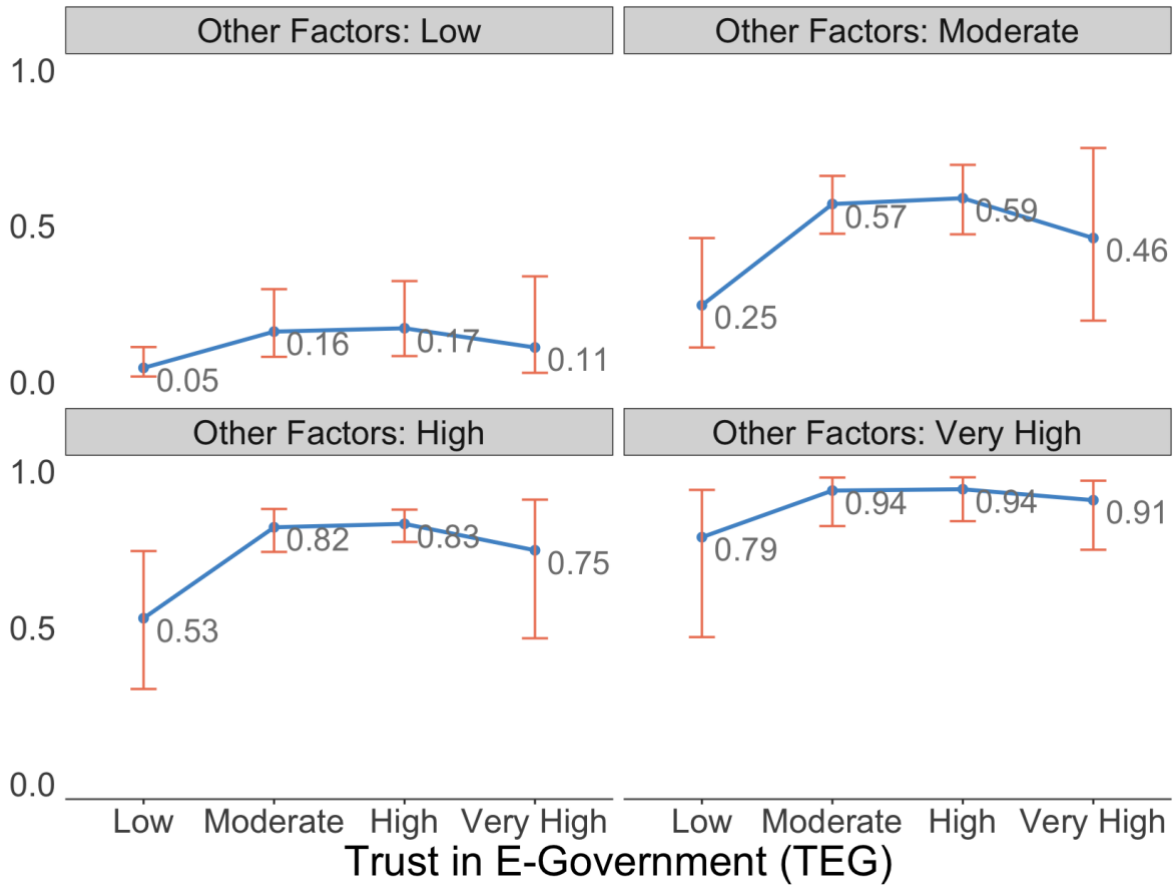
with and without TEG ($p = 0.01$) indicated that TEG contributes significantly to fit of the model.

Therefore, the null hypotheses $H3_0$ ***was rejected*** *in favour of the alternative hypothesis, $H3_A$.*

Inspecting the coefficients of TEG and its categories in the model reveals a positive overall association with intention. The odds-ratio between a low score for TEG and moderate and high scores are 4.1 and 4.4 respectively. This means that the odds for using E-Government services for a person possessing moderate or high trust are around 4 times greater than those for someone with low trust. Surprisingly, the direction of the association reverses at the 'very high' category when compared to the moderate and high categories. However, the coefficient associated with this category is non-significant and has a high standard error, making the estimate unreliable. This is mostly due to the low sample size (30) of respondents who fell in this category. A larger sample size of 'high TEG' respondents would be needed for a more robust estimate.

Once again, an effects plot of probabilities better illustrates this relationship of TEG as a predictor of intention. As observed in Figure 4.6, when all other factors are held at a constant level, TEG has a positive association with the probability towards using E-Government, except for when TEG is 'very high'. When TEG is 'very high', the probabilities are slightly lower than when TEG is 'moderate' or 'high' but still much higher than when TEG is 'low'. Again, this estimate is most likely unreliable because very few persons fell into the 'very high' category, leading to the correspondingly high standard error. Perhaps most importantly it can observed that only a moderate amount of trust is needed to dramatically increase the probabilities of the intention to use E-Government.

Figure 4.8 Effects plot for TEG at different constant values for the other factors.



Conversely, 'low' trust bodes badly, except when all other factors are 'very high'. Even when other perceptual factors are all 'high', having low trust would barely cross 50% probability towards having high intention of use. These results indicate that there exists a certain segment of the population where trust towards government is very low. It follows that their attitude towards E-Government service is similarly negative. TEG is the factor that most negatively impacts intention.

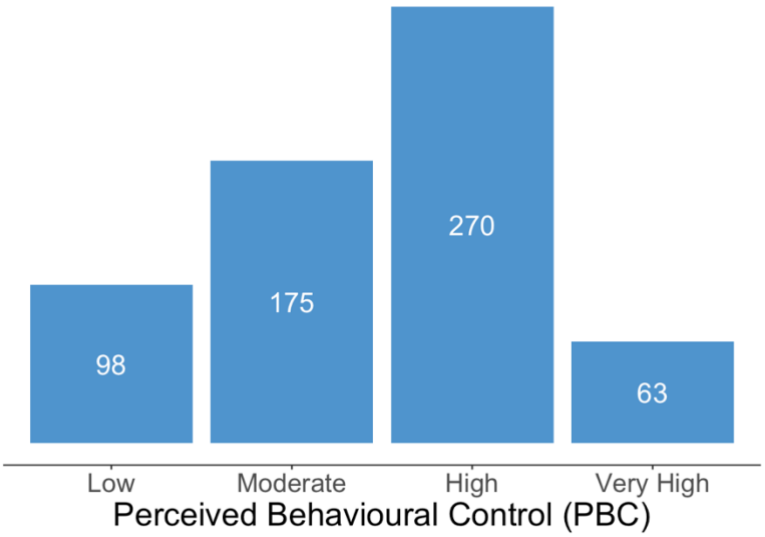
A variety of researchers have approached the construct of 'Trust' in different ways, and many have found it to be a good determinant of intention towards use of E-Government (Mahadeo, 2009; Pratap Rana, Dwivedi, Lal, Williams, & Pratap, 2015). ElKeshin & Saleeb (2020) measured both trust in government

and trust in the internet and found both to be significantly associated with intention. In their words, “if the e-government services are not trustworthy, there is no reason why the citizens should anticipate getting any usefulness from using them.” This sentiment was evidenced in the present study: when trust was low, intention of use was low, regardless of the strength or level of the other factors. Alomari, Woods & Sandhu (2012) also found trust to be a significant predictor, and noted that governments can increase trust by “providing up-to-date information” to its citizens.

4.7 Perceived Behavioural Control (PBC)

Perceived Behavioural Control (PBC) is defined as the extent to which a person believes that they possess the necessary capabilities and resources for performing an action. It is an important construct because possible obstacles might lower the probabilities of intention even if all other factors are high. A person with high PCB believes that they have both the resources and the skills for a specific behaviour. As seen in Figure 4.9, 175 (29%) of respondents scored moderately on PCB, while 333 (55%) scored ‘high’ or ‘very high’.

Figure 4.9 Factor score distribution for Perceived Behavioural Control (PBC)



The hypothesized positive relationship between PBC and intention to use E-Government is expressed as follows:

> *$H2_0$: There is no relationship between Perceived Usefulness (PU) and the intention to use (BI) E-Government services.*
>
> *$H2_A$: Perceived Usefulness (PU) is positively associated with the intention to use (BI) E-Government services.*

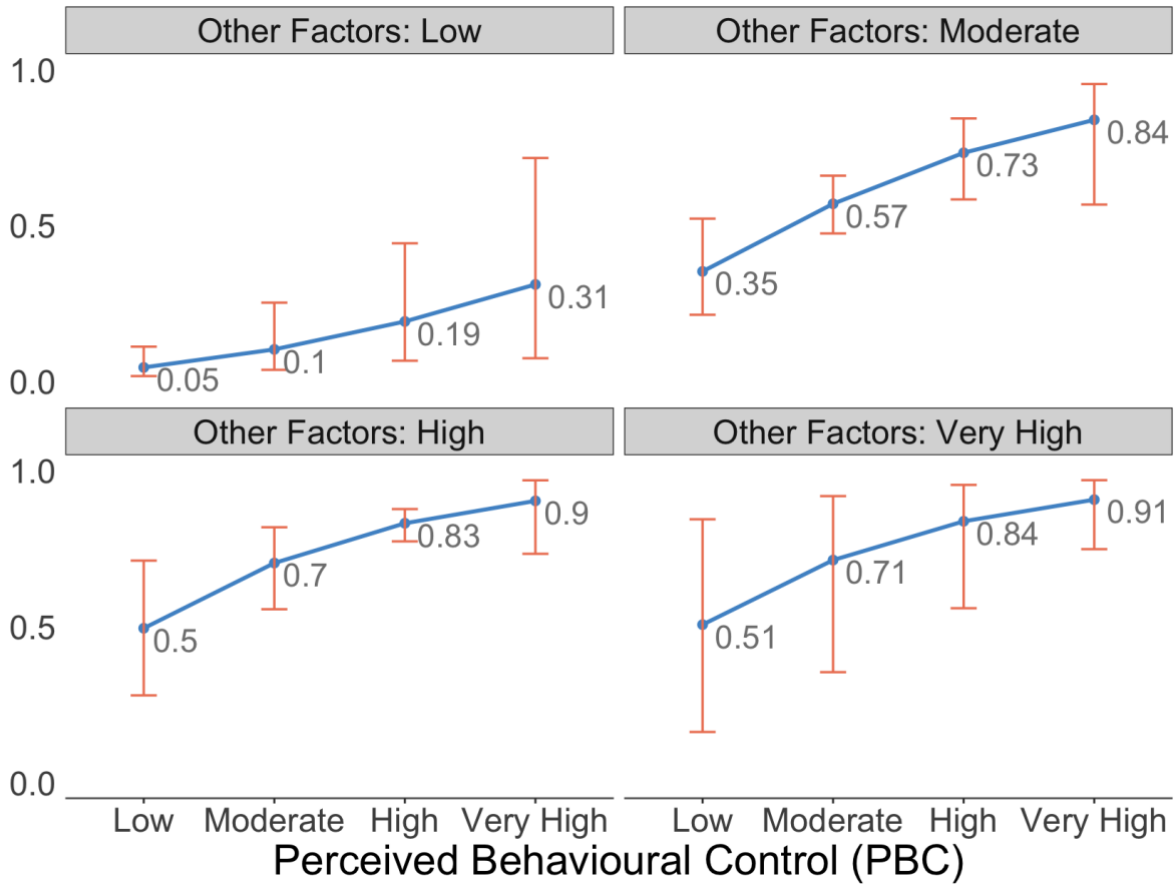
This relationship was tested using the regression model 2, after detecting serious multicollinearity issues between PBC and PEOU. A note on the implications will follow towards the end of this subsection. Nevertheless, the results indicate PBC is one of the stronger predictors of intention to use. The Wald test confirmed its significance ($\chi^2 = 16.7, df = 3, p < 0.001$), and the likelihood ratio test ($p = 0.002$) established its contribution towards the overall fit of the model.

Therefore, the null hypotheses $H4_0$ ***was rejected*** *in favour of the alternative hypothesis, $H4_A$.*

The coefficients for PBC were the largest of all predictors. The odds-ratios indicate that, when compared to someone with 'low' PBC and all other predictors held constant, then someone with 'moderate' PBC has odds 2.4 times higher of having high ntention to use E-Government. Under the same conditions, the odds of having high intention to use E-Government increase by 5 and 9.6 times in persons who score 'high' and 'very high' on PBC, respectively. These results are converted to probabilities and displayed in the effects plot of Figure 4.10. As observed, when PBC is 'low' the probability of intention to use never goes above 51%, once more emphasizing the importance

of PBC. When the strength of all other factors is moderate, a ‘high’ PBC is required to notably increase the probability of intention.

Figure 4.10 Effects plot for PBC at different constant values for the other factors.



The importance of this construct in light of the observed results is extensively supporting by literature. PBC was originally proposed by Ajzen (1991) in his Theory of Planned Behaviour, based on the concept of “self-efficacy” by Bandura. Per Ajzen, an individual’s behaviour “behaviour is strongly influenced by their confidence in their ability to perform it” (Ajzen, 1991). If a person believes that they do not have the required abilities or opportunities to perform an action, such as using E-Government systems, then it follows that they will not engage in it. In the context of TAM, Lu, Huang & Lo (2010) integrated PBC

into their research model and their results show that PBC significantly influences the intention to use E-Government. Similar positive results have been obtained by other researchers (Mahadeo, 2009; Pratap Rana et al., 2015), while Horst, Kuttschreuter & Gutteling discovered “no direct path” from PBC towards intention.

Although, overall, PBC was moderate-to-high among the respondents, the ‘Low’ category is the second highest among factors, after PEOU. This indicates that there are persons who lack the abilities (computer literacy, physical disabilities) or resources (devices, access to the internet) to properly access E-Government. This can be observed by the fact that almost a quarter (24.2%) of all respondents reported having no access to internet at all (Table 4.1). As displayed in Figure 4.2, this issue disproportionately affects the Toledo district, where only 40% of respondents reported having internet access at home.

4.8 PEOU and PBC

On a final note, the relationship between PEOU and PBC might need to be further investigated, either through deeper statistical analysis of the data in the current study or through a subsequent study. Given that these two factors were found to be very correlated, it is possible that they were measuring the same attitudes and perceptions. This is entirely possible, as the TAM and other acceptance models were originally developed to compare preference between software systems (Davis, 1989). At least, the studies were done in professional or technical settings (Atif, Richards, & Bilgin, 2012; Huh et al., 2009; Oliveira & Martins, 2011). Consequently, any difference in Perceived Ease of Use would stem from a comparison between competing software and by persons who are

already computer literate. Conversely, this research was a general-population study. Moreover, the alternative to E-Government is not another electronic tool, but rather physical government and services. Therefore, it is possible that persons were measuring perceived ease of use (PEOU) and perceived behavioural control (PBC) by the same metric: existing familiarity and skill when using electronic tools or doing online transactions. However, PBC seemed to capture this and more, as it also tapped into external factors such as lack of resources. This is another reason why PBC was kept in the model as opposed to PEOU. Nevertheless, further research might decide on combining both factors into a single factor.

4.9 Analysis Wrap-up

The results of the data analysis and subsequent statistical tests have answered the research question “what are the factors that influence the intention to adopt E-Government services in Belize?”, using the technology acceptance model (TAM). Factor-score regression with a binary logistic regression model confirmed hypotheses 2, 3 and 4 (rejecting the null hypothesis). Perceived usefulness (PU), trust in E-Government (TEG) and perceived behavioural control (PBC) were found to be positively and significantly associated with the intention to use E-Government services. Perceived ease of use (PEOU) was not found to be a significant predictor.

Relevant implications in the local context were also discussed. Data analysis issues were identified and diagnosed and analysis decisions were justified. In summary, the adopted conceptual model of the research study was validated.

The final conclusions and recommendations are now made.

5. Conclusion and Recommendations

The present study set out to provide answers to an important question of topical and national relevance: what are the factors that influence the intention to adopt E-Government services in Belize? This research question was investigated within the framework of an extended Technology Acceptance Model (TAM) (Davis, 1989). The conceptual research model proposed four factors which were posited to influence the intention of accepting and using E-Government services, derived from relevant and contemporary acceptance literature: perceived usefulness (PU), perceived ease of use (PEOU), trust in E-Government (TEG) and perceived behavioural control (PBC). Each of these constructs was hypothesised to have a direct and positive relationship with the intention to use E-Government.

To answer the research question and test the proposed hypotheses, a primary data collection activity was carried out. A literature-based questionnaire was developed to measure the perceptual constructs and the intention to use E-Government services in the short-term. This primary research happened within a unique context: it sought to be a general population study and it had to overcome obstacles presented by the ongoing COVID-19 pandemic. Consequently, the Statistical Institute of Belize assisted in obtaining a sample of 900 households with telephone numbers. Doing the data collection by telephone proved to be an astute decision given the public health regulations in place.

Factor score regression was used as the analytical method for testing the research hypotheses and evaluating the research model. This approach

combined confirmatory factor analysis (CFA) and a generalized linear model (binary logistic regression) to yield robust results.

Three of the four research hypotheses were verified, and the corresponding constructs were found to be positively associated with the intention to use E-Government services. Perceived usefulness (PU), trust in E-Government (TEG) and perceived behavioural control (PBC) were all found to be significant predictors of intention. Of these, PU and PBC were found to be the strongest predictors: persons who deemed that E-Government was beneficial and advantageous *and* who had the necessary skills and resources to utilise it were the most likely persons to have high intention of use. TEG provided interesting results, the key takeaway being that “Low” TEG was associated with *very* low acceptance intention. When TEG was at least ‘Moderate’, intention dramatically improved. A little trust goes a long way.

The fourth construct, whose association with the intention to use E-Government could not be validated during analysis, is perceived ease of use (PEOU). PEOU was found to be highly correlated with PBC and was removed from the original regression model. Although various researchers have used these two constructs within the same acceptance model (Kanat & Özkan, 2009; Sebetci, 2015), statistical tests confirmed that in the present study, PEOU and PBC had significant overlap in measurement. PBC was kept in the model due to being more significant and capturing more of the variance in the intention to use.

This result was unexpected at first, but it is found to be logical. The current E-Government research differed from traditional information systems research in one key aspect: it was a general population study, where computer literacy is

not guaranteed, as opposed to the typical office research environment (Atif et al., 2012; Huh et al., 2009; Oliveira & Martins, 2011). Moreover, while traditional acceptance studies are centred around comparing competing software and tools (Davis, 1989), the alternative to E-Government in the current study is physical government. As a result, personal perceptions of both ease of use (PEOU) and behavioural control (PBC) appear to both be measuring, to a large extent, the level of computer literacy and level of comfort with internet-based tools. Still, PBC also measures available resources and opportunities necessary for E-Government use, such as an internet-enabled device and an internet connection, and thus proved to be statistically significant in the model.

5.1 Contributions of study

These results of the present study are in line with much of the current E-Government research which employed similar theoretical models (Alomari et al., 2012; Kanat & Özkan, 2009; Mahadeo, 2009; Sebetci, 2015). The proposed conceptual research model was therefore validated based on literature and based on analysis. This valid theoretical framework can therefore be used for acceptance research in Belize and the Caribbean. Furthermore, being the first study of its kind in the country and one of the first in the entire Caribbean region, this study provides valuable contribution to existing acceptance literature, particularly on the subject of E-Government.

Another important contribution of this study relates to modality of the research and the resulting implications. E-Government researchers should keep in mind that if the target users are all the citizens of a nation, then there will be differences as compared to traditional office-oriented research. The constructs

used in the study must be carefully selected and justified. For instance, the current study suggests that PEOU is likely not a useful predictor of intention in a general population research, given that there are other factors that influence PEOU that are more important, such as computer literacy and internet access – items that are measured under other constructs. Future related research should take this into consideration.

5.2 Recommendations

5.2.1 Recommendations for future research

Despite this study making use of a well-distributed and relatively large sample, there were still limitations. Primarily, only households with a telephone number were sampled given the modality of data collection. In the Belizean context, this might result in the under-representation of rural areas and low-income households that do not possess and active telephone number. Therefore, it is recommended that if future research wishes to make generalisations applicable to the entire population, a fully representative sample be used for the study, and that all household members above the age of18 are interviewed. Furthermore, non-response adjustments and weighting techniques should be performed on the data to allow for this kind of population inference.

The data collection for a fully representative study would ideally involve ground collection. This will be necessary to survey the households without a contact number, but it might also improve the quality of the collected data, as call clarity and spotty telephone service will not be a concern.

The constructs of PEOU and PBC were found to share a significant amount of variance[13], which suggests both constructs were measuring much of the same perceptions. Future research should likely merge both constructs into a singular one that measures perceptions related to ease of use, personal skills and abilities, and external factors. This will result in a single construct that will measure the perceived degree of total ease or difficulty a person associates with using the system under investigation and likely yield a more robust model and better predictions.

Although this study measured what are proposed to be the most important perceptual factors associated with the intention to use E-Government services, there is still the question as to what, in turn, influences *those* factors. Further study should engage in deeper analysis and focus on those external factors which influence the main perceptual factors. This can be done based on the same data of the current study, which collected several relevant background and demographic variables.

5.2.2 Recommendations for practitioners and policy makers

The most important perceptual factor unearthed by the analysis in the current study is the perceived usefulness (PU) of E-Government services. Even when other factors, such as perceived control (PBC) were low, someone with high PU was likely to have high intention of use. It is recommended that the Government of Belize and the E-Government and Digitalisation Unit focus on emphasising the benefits and advantages of using E-Government over the alternative. To

[13] This correlation was observed both in the confirmatory factor analysis and in the regression analysis.

achieve this, the available E-Government service must itself be useful and beneficial, providing net advantages over in-person services and transactions. Therefore, it is recommended that the focus for E-Government be on the services that are most in-demand in the country and those that are challenging to carry out in person, perhaps due to the wait-time, amount of paperwork, or complexity of the task.

Although the current research did not establish a direct relationship between perceived ease of use (PEOU) and intention, previous research suggests that perceived ease of use influences the perceived usefulness of a system or service. Therefore, one way to increase the perception of usefulness of an E-Government service is to highlight how easy or effortless it is to perform the involved transactions.

Trust in E-Government (TEG) was measured with items targeting both trust in government processes and trust in electronic transactions. Although most surveyed persons had ‘Moderate’ or ‘High’ trust in E-Government, having ‘Low’ trust impacted intention negatively and notably, while even a ‘Moderate’ amount of trust is enough to significantly improve intention. It is recommended that attention be given as to the factors which lead to low trust so that this segment of the population can also benefit from E-Government.

The construct of perceived behavioural control (PBC) was the second most influential predictor of intention to use E-Government services, after PU. This factor is focused on both internal and external obstacles towards using E-Government. Persons who ranked low on this factor might be those who fall into the disadvantaged side of the digital divide: those who lack computer skills,

without reliable internet access or without having the required assets for E-Government use (Robinson et al., 2020). These populations would already be disadvantaged as is, so care must be taken that the implementation of E-Government does not further marginalize them. It is recommended that further research be done to diagnose the subpopulations who would meet these criteria to better strategize as to how to bridge the divide (e.g.: improving access to the internet in rural areas).

Finally, and as previously mentioned, it is recommended to engage in further research related to the external factors that influence the perceptions that were measured in the study. This will allow to more accurately identify population and demographic characteristics associated with the current findings. Some of this can be obtained from the data of the current study.

5.3 Final Words

Using a validated theoretical framework based on the technology acceptance model, the present study sought to identify factors influencing E-Government adoption and acceptance. This research was conducted in the national Belizean context and the greater regional Caribbean context. The relevant insights and recommendations based on the analysis and results have been made and presented. It is the hope of the researcher that the study contributes positively to this active area of research and especially to the development of E-Government strategy in Belize.

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Appendix 1: Ethical Approval Form

FIRST STAGE

Students engaging in any research activity should read the *Guidance Notes for Ethical Applications – Taught Programmes* and complete the *Ethics Approval of Taught Programmes Application Form* and **submit this, along with all relevant supporting documentation, to their supervisor**. The supervisor will then assess the application for any significant ethical issues. Please refer to the Guidance for Supervisors and the guidance notes for the students.

If there are no significant ethical issues to be considered and/or any minor issues have been fully resolved, the supervisor will sign off the ethics approval form, which should then be included with the final dissertation.

However, if the supervisor feels that the application falls outside the scope of supervisory approval i.e. the issues involved are considered to have a significant ethical dimension, then the application will be referred for review to the Ethics Approval Panel for Taught Programmes (**Second Stage**).

SECOND STAGE (Only applies to projects/dissertations with significant ethical issues)

The application will be reviewed independently by two members of the Ethics Approval Panel for Taught Programmes. One reviewer will be selected from the same subject area as the proposed dissertation and the other reviewer from outside this area.

Second Stage Applications should be sent via email to: SBS-TaughtEthics@salford.ac.uk

Following review, one of the following recommendations will be made:

(a) **Application is approved with no changes**;

(b) **Application is approved subject to conditions which must be approved by supervisor.** Applicant make the appropriate changes to the application and resubmits to their supervisor for approval;

(c) **Application is approved, subject to conditions, which must be approved by committee chair.** The applicant makes the appropriate changes to the application and resubmits to the committee chair for approval;

(d) Application is rejected and applicant requested to resubmit to committee.

In cases where the reviewers offer different final recommendations the committee chair will act as the final arbiter in the decision process.

The normal turnaround time for applications is approximately two weeks following submission. However, this can be longer, depending upon the complexity and the time of year the application has been submitted. If the application is not approved and changes need to be made the overall process will take longer.

Instructions for use
Most applications for ethics approval will be able to be granted by the supervisor. **Students should just complete the Checklist and Part A below and forward to their supervisor, who will complete Part B.** In some cases, if the supervisor believes the proposal should be sent to the Ethics Approval Panel for Taught Programmes for guidance and clearance, Part C should be completed and sent to the email address provided above. Supervisors should send Parts A, B and C to the panel in these cases. The following checklist is to help students and supervisors easily identify projects which may be designated as one with significant ethical dimensions.

SECTION I: CHECKLIST (select as appropriate)	
Does the project/dissertation involve work with human tissue/body fluids? If **'NO'** skip to section (II)	No
Does the project involve work with animals and/or animal tissue? If **'NO'** skip to section (III)	No
Does the project involve any of the following: • Recruitment of volunteers? • Questionnaires or interviews? • Observations of Participants? If **Yes** for either please complete the **sections (IV)-(VI)** below If **No** please complete **section (VI)** only	**Yes. The research involves questionnaire based survey.**
SECTION II – RISK OF HARM AND RELATED ISSUES (select as appropriate)	
Is there any realistic risk of any participants experiencing either physical or psychological distress or discomfort?	No
Are drugs, placebos or other substances (e.g. food substances, vitamins) to be administered to study participants?	No
Is there any possible psychological risk to the researcher? **(Note:- physical risks to the researcher are considered in the Risk Assessment not in this form)**	No
Will participants undergo sound exposure beyond the Lower Action Level of the Physical Agents Directive?	No
Does the project require the use of hazardous substances?	No
Is the use of radiation (if applicable) over and above what would normally be expected (for example) in diagnostic imaging?	No

SECTION III – VULNERABLE GROUPS AND FINANCIAL INDUCEMENTS (select as appropriate)	
Will financial inducements (other than reasonable expenses and compensation for time) be offered to participants?	No
Will participants fall into any of the following special groups?	
• Children (under 18 years of age);	No
• People with learning difficulties or communication difficulties;	No
• People who speak a different language;	No
• Patients or clinical populations and/or their carers;	No
• Pregnant women or research on conception or contraception;	No
• People in custody or any form of detention;	No
• People engaged in illegal activities (e.g. drug-taking)	No
SECTION IV – OTHER (select as appropriate)	
Are there any other potential significant ethical issues not covered above? If **Yes**, please give details below:	No

PART A – To be completed by Student

Full Programme Title:	UoS - MSc in Information Systems Management	**Award**
Title of Research Project:	E-Government Acceptance and Intention to Use: Analyzing Adoption Factors in the Belizean Context Using an Extended Technology Acceptance Model	
Has this project received external funding?	If **YES**, please provide name of Research Council or other funding organisation:	
Do you use non-human genetic materials from outside UK for your research?	**No.** If **YES**, has this been collected since the 12th October 2014?	
Does your study involve a clinical trial?	**No.** If **YES**, do you intend to register your trial on a clinical database? Please note that most academic journals will **not** publish trials which have not been registered on a clinical trial registry before the onset of patient enrolment. For the purposes of registration, a clinical trial is any research study that prospectively assigns human participants to one or more health-related interventions to evaluate the effects on health outcomes. "Interventions" covers any treatment which can affect an individual's health, e.g. medical devices, behavioural treatments, dietary interventions, etc. For more details, see: http://www.icmje.org/recommendations/browse/publishing-and-editorial-issues/clinical-trial-registration.html	

1. Project Aims and Objectives:

AIM: To determine the factors associated with the acceptance of E-Government services in the Belizean population, using the Technology Acceptance Model.

Objectives:

- Determine the association between perceived usefulness (PU) and the intention (BI) to use e-government services.
- Determine the association between perceived ease of use (PEOU) and the intention (BI) to use e-government services.
- Determine the association between perceived behavioural control (PCB) and the intention (BI) to use e-government services

2. Research Methodology:

Research Type: Quantitative Research

Research Method: Questionnaire-based survey, using existing TAM questionnaire tools.

Sample Size: ~ 240

Sample type: Probabilistic.

Participant characteristics: Persons 18-year and older living within Belize. No minors, people with disability or other vulnerable persons will be surveyed.

Sample details: The Statistical Institute of Belize (SIB) has been contacted and they have agreed to pull a random sample from their Household Frame. This sample would be representative to the two major 'areas' in the Belizean population: Urban and Rural. The SIB would assist in pulling and providing a sample of 900 households to the researcher, with the expectation of obtaining 500 successes. The researcher is an employee of the Statistical Institute of Belize and has signed a legally-binding Oath of Secrecy that relates to data confidentiality and protection. In addition, the sample of households that the SIB would provide would only contain the following information:

- Phone number
- First name
- District (similar to 'state', 'region' or 'county'.
- Area (urban or rural)

The formal, legal document signed between the researcher and SIB covers legal and ethical issues for data and participant protection within Belize.

Collection Modality: Via telephone calls from the obtained sample, recording responses to the survey questions on a mobile device using Survey Solutions. (see Approaching Individuals section)

3. Organisational Agreement (If applicable):

NA

4. Approaching Individuals (If applicable):

Individuals will be contacted via telephone using the information provided by the SIB and they will be invited to participated in the survey.

The purpose of the study and the method of their selection will be explained, reading from the "Participant information Sheet", before getting consent to continue with the survey.

The items in the survey tool will be read to the participants and their answers will be captured using a device (such as a computer or tablet) equipped with Survey Solutions (info link here), a digital survey tool that will be linked to the secure, encrypted server.

5. How will you ensure 'informed consent' is gained from anyone involved in the research?

After briefing potential respondents on the purpose of the survey using the Participant Information Sheet, they will be asked for consent using the "Research Participation Consent Form". Their responses will be truthfully and accurately captured.

If consent is not given, the person will be thanked for their time and survey will not continue.

6. How will you approach General Data Protection Regulation issues during your research?

Sampling Information: Sampling information will be obtained within the regulatory framework of the Statistical Institute of Belize, who have agreed to provide the researcher with a probabilistic and representative sample for the research. The researcher has signed a legally-binding Oath of Secrecy with the SIB to ensure data confidentiality and participant protection.

Collected Data: Data will be collected using **Survey Solutions,** a free and secure data-collection platform from the World Bank. This platform will be running on a secured Amazon Web Services (AWS) server instance. This platform will be secured with software encryption and with a secret password only possessed by the researcher (See general information here and information about AWS hosting and security here). Data will be collected using secured devices that are equipped with the Survey Solutions collector application and linked to the central Survey Solutions server.

The only personal information collected would be first name, age, sex and locality. Of these, the name will be stripped before any analysis. This means the data will be anonymized. Throughout the process, all data will be stored in the secure, encrypted AWS server and only accessed by the researcher.

All data, including raw and anonymised, will be permanently deleted along upon successful completion of dissertation and only the anonymized dataset will be stored by the researcher.

Although the Oath of Secrecy also covers data collected from the sample provided, all additional measures will be taken to comply with local data collection and protection laws:

- Storage: On an encrypted and secure AWS server.
- Analysis: Only using anonymised data.
- Access: Only by the researcher.
- Use: Only for this current research.
- Transparency: Informed consent before survey collection.
- Permanence: To be completely deleted upon awarding of dissertation grade.

7. Does this project require that the researcher applies for a Disclosure Barring Service (DBS) check?

No.

If you have answered **YES** above, please cite the code and either include it as an appendix to this application or provide details below about where it can be consulted electronically.

8. What other ethical issues should you consider when conducting this research and how will potential ethical risk/harm be avoided?

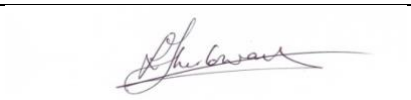
NA

9. Does the project involve human subjects (e.g. as volunteers or to take part in interviews/questionnaires) and/or animals and/or human tissue and/or animal tissue?
No. If **YES**, please give details: The research is survey-based. A generic survey-tool using examples from literature on the Technology Acceptance Model will be used. These are general attitude and perception-based questions measured on a 5-point Likert scale. The survey tool will contain around 15-18 Likert-scale questions, derived from existing academic literature, regarding their general attitudes and perceptions towards E-Government services, such as perceived usefulness and ease-of-use, as well as their personal intentions towards using any such service. In addition, basic demographic data such as age, sex and education level will be collected to produce descriptive statistics and to aid in analysis.

PART B – Application Form for Ethics Approval for Taught Programmes

To be completed by Supervisor

To be completed by the supervisor by ticking the relevant box. If ethics approval is granted the supervisor should give this form to the student to include in their dissertation, along with Part A. Nothing further needs to be done with the application at this point. **However, if ethics approval is rejected by the supervisor they should consult with the student as to the required changes and complete Part C.**

Student's Full Name:	Gian Aguilar
Title of Research and Project Focus:	E-Government Acceptance and Intention to Use: Analyzing Adoption Factors in the Belizean Context Using an Extended Technology Acceptance Model
Supervisor's Name:	Dr Lynn Thurloway 
Data application received by supervisor:	23 May 2021

Ethics Approval Granted	Please send copy of form to student to include in their dissertation	
Ethics Approval Rejected	If rejected please consult with student as to the required changes	
Ethics Approval Referred	If supervisor has queries or concerns in relation to this application, please fill in Part C below and forward to the School Ethical Approval Panel for Taught Programmes	

PART C – To be completed by Supervisor

To be completed by the supervisor if significant ethical issues are identified, with an indication of the key issues and areas for approval, and forwarded, to the Research Centres Support Team (SBS-TaughtEthics@salford.ac.uk). The application will then go through the formal ethics approval process.

Title of Research and Project Focus:	
Supervisor's Name:	

Please provide a brief description of the key issues and areas within this application that you would like the Ethics Approval for Taught Programmes to consider:

Appendix 2: E-Government Acceptance Questionnaire Items

Demographic and Background
P1: What is your relationship to the head of this household?
P2: What is your age?
P3: What is your sex?
P4: To which ethnic group do you belong?
P8: What was the last standard, form or level you have completed at school?
IA1: Does your household have internet access at home?
IA3: Does your household have internet access elsewhere?
IA4: During the past 3 months, have you personally used mobile data or mobile internet on your mobile device?
HH1: How many male members are there in your household?
HH2: How many female members are there in your household?
IA5: How often do you use mobile data on your device?
Perceived Ease of Use
PEOU1: Interacting with online E-Government services would require a lot of mental effort from me. (Davis, 1989)
PEOU2: It will be easy for me to become skilful at using online E-Government services. (Davis, 1989)
PEOU3: It would be difficult for me to submit forms and perform transactions using online E-Government services (Lu et al., 2010)
PEOU4: I believe that my interactions with online E-Government services will be clear and understandable (Davis, 1989)
Perceived Usefulness
PU1: Online E-Government will allow me to be more productive (Davis, 1989)
PU2: Online E-Government services will provide valuable services to me. (Davis, 1989)
PU3: Online E-Government services will save me time (Davis, 1989)
PU4: Online E-Government services will make it more difficult to accomplish the tasks I want to complete (Davis, 1989)
Trust in E-Government
TEG1: The government can be trusted to carry out my transactions reliably (Alomari et al., 2012)
TEG2. I am confident that the forms I submit through government websites would be processed in a timely and accurate manner (Alomari et al., 2012)
TEG3. I am confident that the information provided by the government online, via websites or mobile apps are reliable and up to date (Alomari et al., 2012)
TEG4. I believe that personal or sensitive information I provide to the government via online means will be properly handled (Pikkarainen et al., 2004)
Perceived Behavioural Control

PBC1: I would be able to properly utilize transactional E-Government services delivered through websites or applications
PBC2: If I wanted to use Electronic Government systems, I would be fully able to do so (Lu et al., 2010)
PBC3: I have the necessary resources, knowledge and abilities to be able to use E-Government systems through online and electronic means (Ajzen, 1991)
PBC4: There are things outside of my control, such as limited access to the internet, that will prevent me from fully utilising E-Government services
Intention to Use E-Government
BI: If the government of Belize introduced new E-Government services such as those listed at the beginning of this section, how likely is it that you would use those services in the near future?

Appendix 3: Factor Analysis Output

First Model

```
> summary(full_fit, standardized=TRUE, fit.measures=TRUE)
lavaan 0.6-9 ended normally after 48 iterations

  Estimator                                         DWLS
  Optimization method                           NLMINB
  Number of model parameters                        86
  Number of observations                           606

Model Test User Model:
                                              Standard      Robust
  Test Statistic                               532.320     775.773
  Degrees of freedom                            98          98
  P-value (Chi-square)                          0.000       0.000
  Scaling correction factor                                 0.720
  Shift parameter                                          36.163
       simple second-order correction

Model Test Baseline Model:

  Test statistic                             83033.193   29600.473
  Degrees of freedom                           120         120
  P-value                                       0.000       0.000
  Scaling correction factor                                 2.812

User Model versus Baseline Model:

  Comparative Fit Index (CFI)                   0.995       0.977
  Tucker-Lewis Index (TLI)                      0.994       0.972

  Robust Comparative Fit Index (CFI)                           NA
  Robust Tucker-Lewis Index (TLI)                              NA

Root Mean Square Error of Approximation:

  RMSEA                                         0.086       0.107
  90 Percent confidence interval - lower        0.079       0.100
  90 Percent confidence interval - upper        0.093       0.114
  P-value RMSEA <= 0.05                         0.000       0.000

  Robust RMSEA                                                 NA
```

```
  90 Percent confidence interval - lower                         NA
  90 Percent confidence interval - upper                         NA

Standardized Root Mean Square Residual:
  SRMR                                            0.054       0.054

Parameter Estimates:
  Standard errors                             Robust.sem
  Information                                   Expected
  Information saturated (h1) model          Unstructured

Latent Variables:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
  PEOU =~
    eou1              1.000                               0.796    0.796
    eou2              1.197    0.026   46.612    0.000    0.952    0.952
    eou3              0.966    0.027   35.631    0.000    0.769    0.769
    eou4              1.184    0.028   41.887    0.000    0.942    0.942
  PU =~
    pu1               1.000                               0.931    0.931
    pu2               0.992    0.018   56.520    0.000    0.923    0.923
    pu3               0.965    0.018   55.081    0.000    0.898    0.898
    pu4               0.936    0.027   34.937    0.000    0.871    0.871
  TEG =~
    t1                1.000                               0.816    0.816
    t2                0.988    0.030   33.058    0.000    0.806    0.806
    t3                1.041    0.033   31.452    0.000    0.849    0.849
    t4                1.057    0.032   32.736    0.000    0.862    0.862
  PBC =~
    pbc1              1.000                               0.892    0.892
    pbc2              1.049    0.021   48.863    0.000    0.936    0.936
    pbc3              0.979    0.022   43.590    0.000    0.873    0.873
    pbc4              0.733    0.030   24.462    0.000    0.654    0.654

Covariances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
  PEOU ~~
    PU                0.582    0.018   32.855    0.000    0.786    0.786
    TEG               0.305    0.024   12.953    0.000    0.470    0.470
    PBC               0.616    0.018   33.939    0.000    0.868    0.868
  PU ~~
    TEG               0.427    0.025   17.025    0.000    0.562    0.562
    PBC               0.683    0.020   33.651    0.000    0.823    0.823
  TEG ~~
    PBC               0.453    0.027   16.628    0.000    0.622    0.622
```

Improved Model

```
> summary(lean_fit, standardized=TRUE, fit.measures=TRUE)
lavaan 0.6-9 ended normally after 48 iterations

  Estimator                                         DWLS
  Optimization method                           NLMINB
  Number of model parameters                        76

  Number of observations                           606

Model Test User Model:
                                              Standard      Robust
  Test Statistic                               214.499     356.037
  Degrees of freedom                               71          71
  P-value (Chi-square)                          0.000       0.000
  Scaling correction factor                                 0.645
  Shift parameter                                          23.255
       simple second-order correction

Model Test Baseline Model:

  Test statistic                             68849.110   25943.931
  Degrees of freedom                               91          91
  P-value                                       0.000       0.000
  Scaling correction factor                                 2.660

User Model versus Baseline Model:

  Comparative Fit Index (CFI)                   0.998       0.989
  Tucker-Lewis Index (TLI)                      0.997       0.986

  Robust Comparative Fit Index (CFI)                           NA
  Robust Tucker-Lewis Index (TLI)                              NA

Root Mean Square Error of Approximation:

  RMSEA                                         0.058       0.081
  90 Percent confidence interval - lower        0.049       0.073
  90 Percent confidence interval - upper        0.067       0.090
  P-value RMSEA <= 0.05                         0.071       0.000

  Robust RMSEA                                                 NA
  90 Percent confidence interval - lower                       NA
  90 Percent confidence interval - upper                       NA
```

Standardized Root Mean Square Residual:

SRMR	0.041	0.041

Parameter Estimates:

Standard errors	Robust.sem
Information	Expected
Information saturated (h1) model	Unstructured

Latent Variables:

	Estimate	Std.Err	z-value	P(>|z|)	Std.lv	Std.all
PEOU =~						
eou2	1.000				0.928	0.928
eou3	0.779	0.023	33.250	0.000	0.723	0.723
eou4	0.998	0.015	68.558	0.000	0.926	0.926
PU =~						
pu1	1.000				0.936	0.936
pu2	0.985	0.017	58.865	0.000	0.922	0.922
pu3	0.967	0.017	58.217	0.000	0.906	0.906
pu4	0.915	0.026	35.430	0.000	0.856	0.856
TEG =~						
t1	1.000				0.816	0.816
t2	0.996	0.029	34.806	0.000	0.813	0.813
t3	1.038	0.032	32.035	0.000	0.847	0.847
t4	1.052	0.031	33.660	0.000	0.858	0.858
PBC =~						
pbc1	1.000				0.895	0.895
pbc2	1.048	0.022	48.088	0.000	0.938	0.938
pbc3	0.956	0.023	41.577	0.000	0.856	0.856

Covariances:

	Estimate	Std.Err	z-value	P(>|z|)	Std.lv	Std.all
PEOU ~~						
PU	0.732	0.018	40.027	0.000	0.843	0.843
TEG	0.378	0.028	13.634	0.000	0.499	0.499
PBC	0.753	0.018	42.714	0.000	0.906	0.906
PU ~~						
TEG	0.429	0.025	17.173	0.000	0.562	0.562
PBC	0.694	0.020	33.862	0.000	0.828	0.828
TEG ~~						
PBC	0.467	0.027	17.013	0.000	0.639	0.639

Appendix 4: Analysis R Code

```
#Read data file from local machine
eafs <- './egovfiles/egov.sav'

#' ----- 4. Analysis: CONFIRMATORY FACTOR ANALYSIS
#' A. DEFINE two models:
#'    * A full model with all items in the questionnaire
#'    * A lean model removing the items with lowest factor loadings
#' B. Fit and summarize each model
#' C. Predict and save individual factor scores using each model
#' D. Append individual factor scores to the main eafs object
#'    * Save each model prediction in different objects

#Define full (model 1) and lean (model 2) models
full_model <- '
  PEOU =~ eou1 + eou2 + eou3 + eou4
  PU =~ pu1 + pu2 + pu3 + pu4
  TEG =~ t1 + t2 + t3 + t4
  PBC =~ pbc1 + pbc2 + pbc3 + pbc4
'
lean_model <- '
  PEOU =~ eou2 + eou3 + eou4
  PU =~ pu1 + pu2 + pu3 + pu4
  TEG =~ t1 + t2 + t3 + t4
  PBC =~ pbc1 + pbc2 + pbc3
'

# Fit and summarize models
full_fit <- lavaan::cfa(full_model, data=eafs)
summary(full_fit, standardized=TRUE, fit.measures=TRUE)

lean_fit <- lavaan::cfa(lean_model, data=eafs)
summary(lean_fit, standardized=TRUE, fit.measures=TRUE)


#Extract standardized paramters and fit measures and write to Excel
lavaan::fitMeasures(lean_fit, c("chisq.scaled", "df.scaled",  "rmsea.scaled","srmr",
"cfi.scaled", "nfi.scaled")) %>% as.data.frame()


#Predict individual factor scores from model 2 to use
factor_scores <- lavaan::lavPredict(lean_fit, method = 'regression')


#Append to main eafs file
eafs <- cbind(eafs, factor_scores)
```

```
#' ----- 5. REGRESSION PREPARATION
#' A. Create two grouping variables for each construct, based on individual factor
scores:
#' B. Run frequencies on each grouping variable
#' C. Convert grouping variables to factor

eafs <- eafs %>%
  mutate(
    peou = case_when(
      PEOU <= -1 ~ 1,
      PEOU <=  0 ~ 2,
      PEOU <=  1 ~ 3,
      PEOU  >  1 ~ 4,
    ),
    pu = case_when(
      PU <= -1 ~ 1,
      PU <=  0 ~ 2,
      PU <=  1 ~ 3,
      PU >  1 ~ 4,
    ),
    teg = case_when(
      TEG <= -1 ~ 1,
      TEG <=  0 ~ 2,
      TEG <=  1 ~ 3,
      TEG  >  1 ~ 4,
    ),
    pbc = case_when(
      PBC <= -1 ~ 1,
      PBC <=  0 ~ 2,
      PBC <=  1 ~ 3,
      PBC  >  1 ~ 4,
    ),
    intention_num = as.numeric(intention),
    intention_bin = ifelse(
      as.numeric(intention) >= 4, 1, 0
    )
  )
# Convert all grouping variables to factors
eafs$peou <- factor(eafs$peou)
levels(eafs$peou)[levels(eafs$peou)==1] <- "Low"
levels(eafs$peou)[levels(eafs$peou)==2] <- "Moderate"
levels(eafs$peou)[levels(eafs$peou)==3] <- "High"
levels(eafs$peou)[levels(eafs$peou)==4] <- "Very High"

eafs$pu <- factor(eafs$pu)
levels(eafs$pu)[levels(eafs$pu)==1] <- "Low"
levels(eafs$pu)[levels(eafs$pu)==2] <- "Moderate"
levels(eafs$pu)[levels(eafs$pu)==3] <- "High"
levels(eafs$pu)[levels(eafs$pu)==4] <- "Very High"
```

```
eafs$teg <- factor(eafs$teg)
levels(eafs$teg)[levels(eafs$teg)==1] <- "Low"
levels(eafs$teg)[levels(eafs$teg)==2] <- "Moderate"
levels(eafs$teg)[levels(eafs$teg)==3] <- "High"
levels(eafs$teg)[levels(eafs$teg)==4] <- "Very High"

eafs$pbc <- factor(eafs$pbc)
levels(eafs$pbc)[levels(eafs$pbc)==1] <- "Low"
levels(eafs$pbc)[levels(eafs$pbc)==2] <- "Moderate"
levels(eafs$pbc)[levels(eafs$pbc)==3] <- "High"
levels(eafs$pbc)[levels(eafs$pbc)==4] <- "Very High"

eafs$intention_bin <- factor(eafs$intention_bin)
levels(eafs$intention_bin)[levels(eafs$intention_bin)==0] <- "Low"
levels(eafs$intention_bin)[levels(eafs$intention_bin)==1] <- "High"


#' ----- 6. LOGISTIC REGRESSION
#' BASE PREDICTORS TO USE: grouping variables for the constructs (peou_group, pu_group,
etc.)
#' A. Run logistic regression using 'Full' model:
#'    * Full model uses all constructs (peou, pu, teg, pbc) as predictors
#'    * Run fit and diagnostic tests on full model
#' B. Run logistic regression on 'lean' model:
#'    * Better model removes PEOU to improve model and fit
#'    * Run fit and diagnostics and compare with full model
#' C. Run significance tests, diagnostics and goodness of fit tests, for all predictors
#' D. Make predictions and create Effects, plot for all predictors



###
### Model 1: PEOU + PU + TEG + PBC
###

#1. Fit the model
#2. Output logit summary
#3. Expoentiate to get odds ratio of coefficients
model1 <- glm(intention_bin~ peou + pu + teg + pbc,
                  data = eafs, family = "binomial")
summary(model1)
exp(coef(model1))

#4. Significance tests
with(model1, pchisq(null.deviance - deviance, df.null - df.residual, lower.tail =
FALSE))
lrtest(model1)
```

```
#GOODNESS OF FIT TESTS
#Log likelihood, hoslem and nagelkerke tests
nullmod_peou <- glm(intention_bin~1, data = eafs, family="binomial")
1-logLik(model1)/logLik(nullmod_peou)

hoslem.test(model1$y, fitted(model1), g=10)
NagelkerkeR2(model1)

#Significance test for PEOU
wald.test(b = coef(model1), Sigma = vcov(model1), Terms = 1:3)
#Overall significance of PEOU in the model
noPeouMod <- glm(intention_bin~ teg + pbc + pu, data = eafs, family = "binomial")
anova(model1, noPeouMod, test="LRT")

#Overall significance of PBC in the model
noPbcMod <- glm(intention_bin~ teg + peou + pu, data = eafs, family = "binomial")
anova(model1, noPbcMod, test="LRT")

#Variance Inflaction Factor
vif(model1)



###
### MODEL 2: PU + TEG + PBC
###

#1. Fit the model
#2. Output logit summary
#3. Expoentiate to get odds ratio of coefficients
model2 <- glm(intention_bin ~ pu + teg + pbc,
                  data = eafs, family = "binomial")
summary(model2)
exp(coef(model2))

#4. X^2 significance test
with(model2, pchisq(null.deviance - deviance, df.null - df.residual, lower.tail =
FALSE))
anova(model1, noPbcMod, test="LRT")

#GOODNESS OF FIT TESTS
#5a: Log likelihood (better)
#5b. Hoslem-Lemeshow test (not as good)
nullmod_peou <- glm(intention_bin ~ 1, data = eafs, family="binomial")
1-logLik(model2)/logLik(nullmod_peou)

hoslem.test(model2$y, fitted(model2), g=10)
NagelkerkeR2(model2)
```

```
#Variance Inflaction Factor
vif(model2)


####
### PU ANALYSIS, PREDICTIONS AND EFFECTS PLOT (APPLIES FOR ALL OTHER FACTORS AS WELL)
##

### SIGNIFICANCE AND FIT
#significance test for PU
wald.test(b = coef(model2), Sigma = vcov(model2), Terms = 1:3)
#likelihood ratio test for PU
noPuMod <- glm(intention_bin~ teg + pbc, data = eafs, family = "binomial")
anova(model2, noPuMod, test="LRT")

### PREDICTIONS
#Extract inverse logit function to convert logodds to probabilities
ilink <- family(model2)$linkinv

#New data setting other factors to 'Low' and variable values for PU
newdata_pu_low <- with(eafs, data.frame(
                        pbc = "Low",
                        teg = "Low",
                        pu = factor(c('Low', 'Moderate', 'High', 'Very High'),
                             levels = c('Low', 'Moderate', 'High', 'Very High'))
))

##Predictions (other factors 'Low')
newdata_pu_low <- add_column(newdata_pu_low, fit = predict(model2, newdata =
newdata_pu_low, type = 'response'))
pred_pu_low <- bind_cols(newdata_pu_low, setNames(as_tibble(predict(model2,
newdata_pu_low, se.fit = TRUE)[1:2]),
                                    c('fit_link','se_link')))
## confidence intervals
pred_pu_low <- mutate(pred_pu_low,
                fit_resp  = ilink(fit_link),
                right_upr = ilink(fit_link + (2 * se_link)),
                right_lwr = ilink(fit_link - (2 * se_link)),
                other_factors = 'Other Factors: Low')

#New data setting other factors to 'Moderate' and variable values for PU
newdata_pu_mod <- with(eafs, data.frame(
                        pbc = "Moderate",
                        teg = "Moderate",
                        pu = factor(c('Low', 'Moderate', 'High', 'Very High'),
                             levels = c('Low', 'Moderate', 'High', 'Very High'))))
```

```
##Predictions (other factors 'Moderate')
newdata_pu_mod <- add_column(newdata_pu_mod, fit = predict(model2, newdata =
newdata_pu_mod, type = 'response'))
pred_pu_mod <- bind_cols(newdata_pu_mod, setNames(as_tibble(predict(model2,
newdata_pu_mod, se.fit = TRUE)[1:2]),
                                                  c('fit_link','se_link')))

## confidence intervals
pred_pu_mod <- mutate(pred_pu_mod,
                      fit_resp  = ilink(fit_link),
                      right_upr = ilink(fit_link + (2 * se_link)),
                      right_lwr = ilink(fit_link - (2 * se_link)),
                      other_factors = 'Other Factors: Moderate')

#New data setting other factors to 'High' and variable values for PU
newdata_pu_high <- with(eafs, data.frame(
                   pbc = "High",
                   teg = "High",
                   pu = factor(c('Low', 'Moderate', 'High', 'Very High'),
                        levels = c('Low', 'Moderate', 'High', 'Very High'))))

##Predictions (other factors 'High')
newdata_pu_high <- add_column(newdata_pu_high, fit = predict(model2, newdata =
newdata_pu_high, type = 'response'))
pred_pu_high <- bind_cols(newdata_pu_high, setNames(as_tibble(predict(model2,
newdata_pu_high, se.fit = TRUE)[1:2]),
                                                  c('fit_link','se_link')))
## Confidence intervals
pred_pu_high <- mutate(pred_pu_high,
                      fit_resp  = ilink(fit_link),
                      right_upr = ilink(fit_link + (2 * se_link)),
                      right_lwr = ilink(fit_link - (2 * se_link)),
                      other_factors = 'Other Factors: High')


#New data setting other factors to 'Very High and variable values for PU
newdata_pu_vhigh <- with(eafs, data.frame(
                   pbc = "Very High",
                   teg = "Very High",
                   pu = factor(c('Low', 'Moderate', 'High', 'Very High'),
                        levels = c('Low', 'Moderate', 'High', 'Very High'))))

##Predictions (other factors 'Very High')
newdata_pu_vhigh <- add_column(newdata_pu_vhigh, fit = predict(model2, newdata =
newdata_pu_vhigh, type = 'response'))
pred_pu_vhigh <- bind_cols(newdata_pu_vhigh, setNames(as_tibble(predict(model2,
newdata_pu_vhigh, se.fit = TRUE)[1:2]),
                                                  c('fit_link','se_link')))
## Confidence intervals
pred_pu_vhigh <- mutate(pred_pu_vhigh,
```

```
                        fit_resp  = ilink(fit_link),
                        right_upr = ilink(fit_link + (2 * se_link)),
                        right_lwr = ilink(fit_link - (2 * se_link)),
                        other_factors = 'Other Factors: Very High')


#Join all predictions
pred_pu_all <- rbind(pred_pu_low, pred_pu_mod, pred_pu_high, pred_pu_vhigh)
pred_pu_all$other_factors <- as.factor(pred_pu_all$other_factors)
pred_pu_all$other_factors <- factor(pred_pu_all$other_factors,
                            levels = (c('Other Factors: Low', 'Other Factors: Moderate',
                                   'Other Factors: High', 'Other Factors: Very High')))

#EFFECTS PLOT FOR PU
ggplot(pred_pu_all, aes(pu,fit_resp, group = 1)) +
  geom_line(color= 'blue', size=1) +
  geom_point(color = 'blue', size=2)+
  geom_errorbar(aes(ymin=right_lwr, ymax=right_upr), color= 'red',
      width=0.2, size=0.6, position=position_dodge(0.05)) +
  geom_text(aes(label=round(fit_resp,2)),hjust=-0.2, vjust=0.6,
      color = 'grey50', size = 6) +
  labs(y='', x='Perceived Usefulness (PU)') +
  scale_y_continuous(limits = c(0, 1), breaks = c(0, 0.5, 1)) +
  facet_wrap(~other_factors, nrow = 2)
```