Acceptance Theories and Models for Studying the Integrating Physical and Virtual Identity Access Management Systems

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Abstract

The success of any technology is not only dependent on the number of good reviews or great revenues, but also on the factors that can help one comprehend the level of acceptance that can be expected from any technology. This paper discusses the progress of acceptance theories and models, which have led to the development of an effective model that can be used to calculate the level of predicting, explaining, and understanding individuals' acceptance for a new proposed system, called Ubiquitous Identity Access Management System (UbIAMS), that provides interoperability between the physical and virtual spaces, alongside three perspectives: Security, which includes identity; User Experience, comprising Usability; and Acceptability, containing Accessibility. Existing research in this area tend to focus on one of these research perspectives. However, there is little evidence that researchers have approached the issue of an overlap and conflict between these three research perspectives with the intent of building a cohesive understanding of integrating physical and virtual Identity Access Management Systems (IAMSs) in e-government domain and the relationships that exist between the different dimensions and components. Consequently, this paper has developed a conceptual Unified Theory of Acceptance and Use of Technology (UTAUT)-based model for integrating physical and virtual IAMSs.

1. Introduction

The widespread adoption and delivery of services on the internet has created the issue of maintaining multiple identities; a user previously compelled to maintain numerous physical identities has been further burdened in remembering virtual identities. The virtual identities may be based on specific login credentials, such as username, password, and PIN(s). The ordeal of remembering various different login credentials proves tedious for users, and may pose a major security threat [24]. However, multiple physical identities also prove to be difficult to maintain since different sources require the presence of different smart cards, mobile devices or other

proofs of identity. The increasing number of proof of identity makes it stressful for users to perform operations physically, as well as virtually [24]; thus, there is the pressing need to integrate virtual and physical services on a single platform so as to ensure greater convenience for users who have the right to have multiple IDs or a single ID within physical and virtual services [2].

However, the integration of physical and virtual services proves to be a daunting task. One of the challenges in terms of the integration of such services is gaining the level of trust of users, and making them confident regarding the level of security to be provided in the proposed usage of technology. Arora states that achieving interoperability is one of the most crucial challenges to be faced by Belgian Personal Identity Card "BELPIC" [3]. Markedly, difficulties have been faced in achieving interoperability between administrative organisations in the country, including federal, municipal, and regional units. Another challenge that becomes apparent is devising a system that addresses the limitations of the existing systems. The Italian government faced a number of other interoperability issues regarding the development of a platform where all the services would be able to collaborate and become linked with each other. The centralised platform was known to be supported by only a single type of middleware—i.e. Microsoft's Internet Explorer—whereas all other platforms could not be configured to support different units within the country [3]. Undoubtedly, this was a crucial interoperability issue since the users of other browsing software were not able to utilise the integrated virtual and physical services. Therefore, the success of any IAMS is not only dependent on the number of good theories, but also on further experiments in order to ascertain users' behaviours and outcomes with the use of one of the existing acceptance models for understanding users' behaviours towards integrated physical and virtual IAMSs especially in E-Government.

This paper is organised in the following manner: firstly, a background of the relevant acceptance theories and models are clarified in *Section 2*; *Section 3* shows some applications of acceptance models in the E-Government; *Section 4* proposes the conceptual UTAUT-based model for integrating

physical and virtual IAMSs; finally, *Section 5* ends the paper with a summary and suggestions for future work.

2. Acceptance Theories and Models

The concept of evaluating acceptance of any technology was considered to be an innovative model since it brought forward aspects that had never been previously addressed and focuses on the individual acceptance of technology [8]. The following sections describe the important acceptance theories and models that have evolved over the years, and examined individual acceptance:

2.1. Theory of Reasoned Action (TRA)

The first framework utilised with the aim of explaining technology acceptance was that devised in the social psychology arena, which is a work that was carried out during 1918–1970, at which time scientists were making attempts to explain individuals' behaviours through attitude impact [4]. Their efforts resulted in contrasting explanations in terms of attitude and behaviour, with the former found to have either an indirect or direct impact on behaviour, and also being unidimensional or multidimensional in nature. In this regard, the work of Fishbein and Ajzen was also conducted following a study programme initiated during the late 1950s [4], with the scholars' effort aiming towards predicting behaviours in the context of applied and laboratory environments. Markedly, their approach acted as an amalgamation of numerous theories and study topics relating to attitudes, such as balance theory, expectancy-value theories, learning theories, theories of attribution, and theory of cognitive dissonance. Markedly, in 1975, Ajzen and Fishbein introduced the TRA framework, which had the objective to develop a theory able to estimate, describe and impact human behaviours [4].

This theory is essentially based on the postulation that individuals are logical, and will therefore make methodical and orderly use of available data prior to taking action. Individuals are recognised as taking into account potential consequences before making the decision to carry out a certain behaviour [4]. The theory can be explained by the model in Fig. 1.
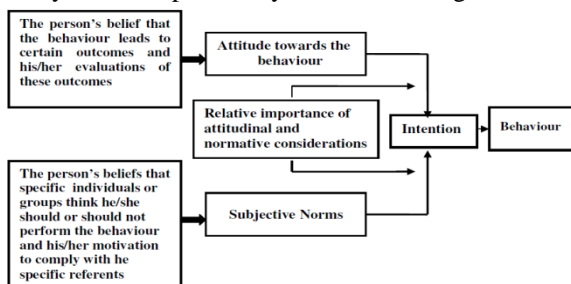

Figure 1. Factors determining a person's behaviour [4]

Importantly, as the main predictor of behaviour, the theory considers behavioural intentions as opposed to attitude. In the view of the TRA, the most valuable and fundamental of individual behaviour determinants is that of behavioural intention (BI), which is widely recognised as being an immediate precursor to the performance of B. Markedly, a combination of the following amounts to an individual's intention to conduct an action [4]:

- *Attitude towards behaviour performance*, i.e. the degree to which the conduction of a certain behaviour is considered to have a positive or negative value, as held by the individual. When forming this attitude, individuals utilise an expectancy-value framework in an attempt to assess their beliefs.
- *Subjective norms:* the perception of an individual that those around him and important to him believe he should or should not carry out a certain action. In this instance, individuals commonly multiply their belief by motivation to conduct the behaviour.

It has been acknowledged by Ajzen that the most apparent of the theory restrictions stems from the assumption that behaviours are completely conscious. Accordingly, for this task, there are two conditions: there must be the examination of intentions and perceptions of control in relation to certain behaviours and contexts; and perceptions of control and intentions must be recognised as stable during the period between behaviour observation and assessment [5]. In other words, only those behaviours consciously considered prior to being performed can be explained through the use of this theory.

2.2. Theory of Planned Behaviour (TPB)

Owing to the various TRA-related limitations, the TBP framework was introduced by Ajzen, with 'perceived behaviour control' (PBC) included as a new construct [5]. Importantly, PBC is made up of those perceptions held by an individual that a certain behaviour can be carried out. With this in mind, it may be stated that there are keen similarities between this model and the TRA, with the PBC recognised as the third antecedent of the BI. When considering the TPB model, as shown in Fig. 2, actual human behaviour variance may be rationalised and estimated when considering two factors in unison, namely our perceptions of our own behavioural control, and our intentions. Both concepts and their individual determinants are described as follows:

- Intentions are considered to be motivational factors, which thus provide an indication of the endeavours required in order to carry out a behaviour [5]. Such behavioural intentions are pertinent to conscious behaviours. Moreover, the greater the strength of an intention to conduct an

action, the greater the likelihood that such an action will then be implemented [5]. Importantly, intentions may be accurately predicted in regard to three different factors:

- o *Attitudes toward the behavior:* "the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question" [27].
- o *Subjective norms:* "perceived social pressure to perform or not to perform the behavior"[27]. In some cases, personal norms have been suggested as relevant that including feelings of moral obligation or responsibility to engage in a behaviour such as, cheating, stealing or lying [5].
- o *Perceived behavioral control:* "perceived ease or difficulty of performing the behaviour"; this variable reflects past experiences and obstacles [27],[5].

- Perceived behavioural control is an individual's consideration regarding the ease or difficulty associated with conducting an action. Markedly, this is linked with the perceived self-efficacy concept, which is linked with our own opinions and views of the way in which we carry out behaviours in potential circumstances [5].
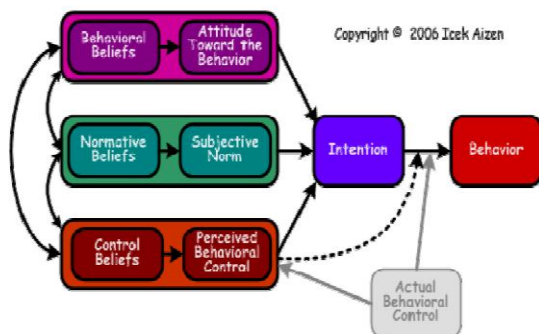

Figure 2.Theory of Planned Behaviour [5]

The TPB and TRA models have been criticised by Taylor and Todd, who emphasise that both frameworks require individuals to be motivated to conduct certain actions [6]. However, it remains that such a postulation may be challenging when considering consumer adoption behaviours, as well as the assumption of an identical belief structure amongst individuals carrying out a behaviour [6]. Moreover, TPB introduces PBC in an attempt to provide some response to the subconscious aspect of behaviours, with the belief behind the PBC combined with the aim of creating a measure for such. Such amalgamation has been criticised for failing to establish specific factors that may be able to estimate behaviours and any biases created as a result. With this in mind, the decomposed TPB was introduced by Taylor and Todd with the aim of

delivering an improved understanding of behavior [6].

2.3. Decomposed Theory of Planned Behaviour (DTPB)

As a follow-up to the TPB framework—which is known to be an enhancement of the TRA model—Taylor and Todd devised a framework whereby the TPB constructs were broken down into individual elements [6]. The subsequent model, the decomposed TPB (DTPB) is an expansion of the TBP. The constructs contained within the TPB and their decomposition can be seen in Fig. 3 which carried out previously that identified a consistent link between the three innovation characteristics, i.e. compatibility, complexity, and relative advantage, and the implementation of decisions generally and IT-use in particular [6].

Figure 3. Theory of Planned Behaviour with beliefs decomposed [6]

Through their attempt at decomposition, the scholars considered those studies carried out previously that identified a consistent link between the three innovation characteristics, i.e. compatibility, complexity, and relative advantage, and the impl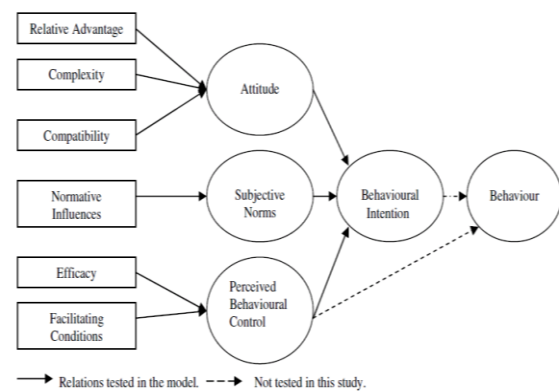ementation of decisions generally and IT-use in particular [28] (see Fig.3). Through their work, Taylor & Todd sought to analyse the suitability of TRA, TPB and DTPB as frameworks able to predict the behaviours of consumers [6]. Through the adoption of the structural equation framework, it was found that the TPB and TRA both have the capacity to predict behaviours, although the DTPB is more adept at describing and rationalising such behaviours.

Even though DTPB is a far more complicated model than TPB, DTPB has been recommended as a measure able to predict certain behavioural aspects, which may prove useful to managers seeking to implement system design- and/or marketing strategy-related changes [6].

2.4. Technology Acceptance Model (TAM)

In a further extension of TRA, Venkatesh stated that TAM was initially devised from the TRA [7], and was proposed by Davis [9]. The TAM was based

on the need to explain the behaviour of computer users [7], [30-31]. The concept aims to explain the aspects facilitating the comprehension of the level of acceptance that can be shown by the user for any specific technology. Basically, there are three different types of technology acceptance model, all of which have evolved with the passage of recent years. They are explained below:

2.4.1. TAM. It is the most commonly applied model for evaluating the level of acceptance and usage by a user. TAM is mainly based on two aspects that are directed towards evaluating the intention of a user to use a certain system or technology: perceived ease of use and perceived usefulness. Venkatesh further explained the TAM model, stating that there exists a simple relation between these two factors [7]: perceived usefulness will be influenced by perceived ease of usage since an easier technology will prove to be more useful for the user as shown in Fig. 4. Moreover, he defined these two main aspects, and stated the following definitions:

o *Perceived Ease of Use:* the perception of a technology from the perspective of the user. For example, the perception will measure the easiness of the functions that the system or technology has to offer; this easiness will result in lesser efforts to use such a technology.

o *Perceived Usefulness:* the degree to which benefits are perceived to be attained from the usage of any technology. For example, a user will evaluate the e-government service and make a perception concerning the advantages that can be attained by him.
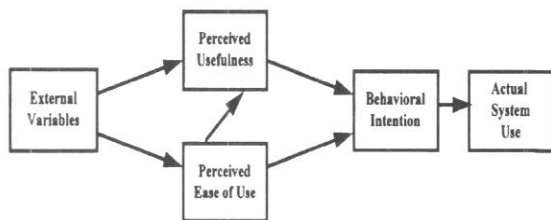

Figure 4. TAM Model [11]

Porter & Donthu state that the TAM can be adopted when research costs are required to be minimal but effective results nevertheless need to be attained [11]. This explains a greater degree of variance when the user's attitude is required to be investigated. However, Porter and Donthu state that this model was devoid of reflecting the demographic differences amongst users, and sought to measure the level of acceptance whilst assuming constant profiles related to gender, age, etc. Besides, the TAM failed to address some of the perceptions of barriers of usage in the context of computer technology [11].

2.4.2. TAM2. It was proposed by Venkatesh & Davis with the aim of overcoming the limitations in the previous model of TAM [7], [29]. Chuttur stated that their efforts (to propose a new model in place of the existing one) were initiated to address the limitations witnessed in TAM in terms of the explanation of the way in which a user perceives something as being either useful or less appealing [29]. In attempting to make the model more comprehensive, a number of new variables were proposed with the aim of attaining effective reasoning concerning the preference of any system or technology. Chuttur also stated that, in order to test the overall perceived effectiveness of the newly proposed model, Venkatesh & Davis conducted a survey in which the participants were asked to provide their feedback regarding the usage of four systems; two of them were voluntary whilst the other two were mandatory [29]. Fig.5 shows the model proposed for extending TAM and conducting the survey:
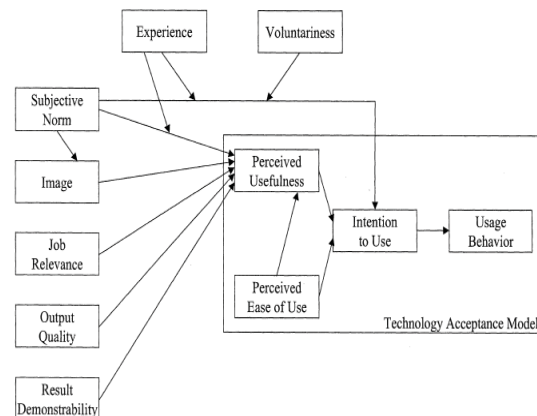

Figure 5. TAM 2 attributes

The survey concluded that the model provided satisfactory results for mandatory, as well as voluntary technology and systems; however, it also revealed that the subjective norm did not play a sound role in voluntary situations as it did in mandatory ones. The variables included in the model were social influences [29], such as:

o *Subjective norm:* a perception that is developed by an individual on the basis of other people's views (who are important to him). The views of other people will influence the relevance and usefulness of the technology for an individual. For example, a user will tend to prefer a technology if his peers also consider it beneficial.

o *Voluntariness:* defined as the degree to which the technology is considered to be used out of free will and without pressure. For example, a user will tend to use a technology out of free will at home and in a more anxious manner than a technology imposed by officials in a workplace.

o *Image:* the projection of the usage of technology on the image of the user amongst his peers. For example, the usage of social networking services has a significant effect on the image of the individual in modern times.

The definitions of other variables are as follows [11]:

o *Experience:* the degree of user experience in regard to a certain technology or system. For example, an experienced user will face fewer issues in the usage of a system compared with an inexperienced one.

o *Job Relevance:* the degree of relevance of a technology in the performance of an individual's job. For example, a system will have greater benefits for users if its scope is directed towards the job under discussion.

o *Output Quality:* the degree of relevance surrounding the execution of a task, such that it matches the goals of the assigned tasks. For example, an information system will be more suitable for an organisation if the generated reports are valuable in terms of making relevant strategic decisions.

o *Result Demonstrability:* the extent to which the result of the usage of technology can be conveyed to other people. For example, the benefits of the usage of a system can be communicated to the management in terms of improved revenues or the faster execution of tasks.

However, the domain of perceived ease of use was not addressing the variables to a thorough degree since the fears and anxieties related to computer usage were not taken into account in the model. It should be noted that computer experience is different to the fear of using computers.

2.5. Diffusion of Innovations Theory (DIT)

DIT is a framework that seeks to explain the process via which technological innovations are implemented by users. With this in mind, the term 'innovation' is described by Rogers as, 'an idea, practice, or object perceived as new by an individual or other unit of adoption' [12]. Moreover, it is highlighted that the concept of 'diffusion' may be described as the approach through which innovation is communicated via various channels over time and amongst a number of individuals within society. Accordingly, it can then be stated that Innovation Diffusion Theory places emphasis on describing the way in which new concepts and ideas achieve large-scale implementation. Furthermore, IDT takes into account a number of attributes link with technological innovations and which may impact their rate of implementation. Accordingly, these attributes are defined by Rogers [12] as:

o *Relative advantage:* "The degree to which an innovation is perceived to be better than the idea it supercedes."

o *Compatibility:* "The degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters."

o *Complexity:* "The degree to which an innovation is perceived as relatively difficult to understand and use."

o *Trialability:* "The degree to which an innovation may be experimented with on a limited basis."

o *Observability:* The degree to which the results of an innovation are visible to others."

Through his work, Rogers reviewed almost 1,500 researches through which IDT variants were adopted with the aim of examining the implementation of technological innovations in various settings, such as agriculture, city planning, economic development, and healthcare, to name a few [12]. A smaller amount of research focuses on the way in which such attributes impact behavioural intention and use. Notably, through establishing the product attributes believed to most significantly impact adoption, Rogers developed his IDT constructs. With this in mind, the innovation attributes of Rogers were phrased by Moore & Benbasat in terms of individuals' perceptions order to test the influence on behavioural intention and IT utilization [24]. This was achieved through developed reliable and sound tools able to examine and calculate the impacts of such attributes' user perceptions on use. Testing the instrument, Moore & Benbasat established that a number of Rogers' attributes could be seen in more than one construct [28]. As a result, their improved list of constructs—referred to as the Perceived Characteristics of Innovating (PCI)—comprised attributes considered almost identical to those of Rogers, although with the inclusion of a number of others:

o *Image:* "The degree to which use of an innovation is perceived to enhance one's image or status in one's social system."

o *Ease of Use :* "The degree to which an innovation is perceived as being difficult to use."

o *Compatibility:* "The degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters."

o *Results Demonstrability:* The tangibility of the results of using the innovation including their observe ability and communicability."

- *Relative Advantage:* "The degree to which an innovation is perceived as being better than its precursor."
- *Voluntariness of use:* "The degree to which the use of the innovation is perceived as being voluntary, or of free will."
- *Visibility:* "The degree to which one can see others using the system in the organization."

The alteration of IDT to PCI provides a number of contributions in the arena of product development studies, with the refinement and operationalisation of Moore's original attributes in regard to user perceptions, as implemented by Moore & Benbasat, providing a foundation for future tool development and quantification [28].

It is recognised that the theory is widely relevant and generalised, meaning that it does not deliver in-depth explanations for numerous contexts or innovations [32]. In this way, the theory fails to deliver detailed interaction-based explanations in terms of innovation and the way in which it is adapted and reinvented. Markedly, the DIT model does not provide any form of support for the way in which attitudes change and become decisions, or the way in which innovation-based characteristics fit into such a process [33].

Although it can be seen that DOI and TAM have roots in different arenas, the two theories nevertheless comprise various similarities. As can be seen in those research discussed previously as well as others, innovation comprises a relative advantage attribute is commonly viewed as being the PU construct in TAM, and the complexity attribute is not dissimilar to the TAM's PEOU concept. This emphasises the point that DOI and TAM support and complement one another [33]. On the other hand, however, numerous other theories have established DOI as being able to implement changes or devise acceptable new ideas amongst individuals.

2.6. The Social Cognitive Theory (SCT)

The SCT is mainly linked with Bandura, and is founded on the all-encompassing idea that cognitive, environmental and personal factors, in addition to behaviour, are determined mutually [13]. This aspect of Bandura's behavioural framework implies that the behaviour of an individual is shaped by not only personal factors, but also environmental factors.

Researches utilising SCT with the aim of justifying IT-use-related behaviours have placed emphasis on the way in which cognitive factors behaviour in regard to individual behaviour [13]. With this in mind, two different sets of expectations are focused on by Compeau et al. as being the main cognitive factors impacting behaviour: expected outcomes, which suggest that individuals demonstrate a greater tendency to carry out

behaviours with perceived beneficial outcomes; and self-efficacy, which considers the beliefs held by an individual in regard to their capacity to carry out certain behaviours. Importantly, SCT provides contribution in terms of the verification that computer-related self-efficacy and outcome expectations are essential aspects in the utilisation of IT [13].

2.7. The Motivational Model (MM)

The MM is believed to be useful in explaining behaviours in a number of different circumstances and environments, positing that individual behaviours are essentially based on two pivotal constructs: extrinsic and intrinsic motivation [10]. Extrinsic motivation was measured in regard to perceived usefulness, whilst intrinsic motivation was measured in regard to the degree of user enjoyment derived from IT use. With this in mind, the MM of technology acceptance was tested by Davis et al., who found both intrinsic and extrinsic motivation to be key factors in the intention to carry out a behaviour in the context of technology utilisation. Such results emphasised that the intention of individuals to utilise computers within a professional environment is influenced mainly by the way in which they view the usefulness of computers and how they can improve their overall job performance, as well as what enjoyment they derive from such use. Moreover, it was also found that usefulness has a significant impact on behavioural intention, with the subsequent impact of enjoyment on behavioural intention found to be profound; nevertheless, it was much weaker than the overall usefulness effect. In other words, enhancing the overall enjoyability of a system is recognised as similarly improving the overall acceptance of useful systems, although there is less of an effect concerning the acceptance of useless systems [10].

2.8. The Model of PC Utilisation (MPCU)

Motivated by a dearth of agreement amongst various fields in terms of defining the link between attitude, values, and other behavioural inclinations to behave or act, a model was introduced by Triandis with the aim of describing the way in which behaviours are seen, as well as what variables encourage human behaviours [14]. The model comprises a number of both general and abstract variables, ensuring relevance regardless of culture. Moreover, the concept of behaviour is described by the scholar as having objective consequences that are interpreted within individuals, subsequently inducing in them feelings of reinforcement. In addition, Triandis argues that the perceived consequences associated with behaviours are reinforced in two main ways, namely: through changing the behaviour's associated perceived probabilities; and

changing the value associated with behaviour's perceived probabilities.

2.9. Unified Theory of Acceptance and Use of Technology (UTAUT)

Based on the reviewing and testing of the previous eight models related to IT acceptance, as shown in Table I, Venkatesh developed UTAUT, which was developed by comparing the effectiveness of these eight theoretical models in four different industries' IT systems [8].

Table 1. Determinants of behaviour in acceptance models

Model	Determinants of Behaviour
TRA	Attitudes towards the behaviour+ social influences [4-5].
TPB	Attitude towards behaviour+ subject norms + PBC [5-6].
DTPB	Attitude towards behaviour (compatibility, complexity, and relative advantage)+ subject norms + PBC (Effecicy, and facilitating conditions) [6].
TAM	Perceived Usefulness +Perceived Ease Of Use [7], [11].
DOI	Innovation attributes + innovators' characteristics [12].
SCT	Self-Efficacy + outcome expectations + affect [13].
MM	Intrinsic motivation (enjoyment, and fun) +extrinsic motivation (perceived usefulness) [10].
MPCU	Beliefs + affect+ social norms+ perceived consequences+ habit+ facilitating conditions [14].
UTAUT	Effort expectancy + performance expectancy+ social influence+ facilitating conditions [8].

This comprises an extensive range of factors that are proposed to be taken into consideration in the process of evaluating the level of acceptance for a technology [8]. In this regard, there are four significant constructs for determinants of user acceptance and user behaviour [8]:

- Performance expectancy: 'The degree to which an individual believes that the use of the system will help him or her to attain gains in job performance'.
- Effort expectancy: 'Degree of ease associated with the use of the system'.
- Social influence: 'The degree to which an individual perceives that others believe he or she should use the new system'.
- Facilitating conditions: 'The degree to which an individual believes that an organisational and technical infrastructure exists to support use of the system'.

As can be seen in Fig. 6, there is a causal link between performance expectancy, effort expectancy and social influence, which are the determinants of behavioural intention. Furthermore, it is recognised that behavioural intentions and facilitating conditions are determinants of utilisation-associated behaviours. Importantly, a number of other variables moderate, which include voluntariness, experience, gender, and age [8].
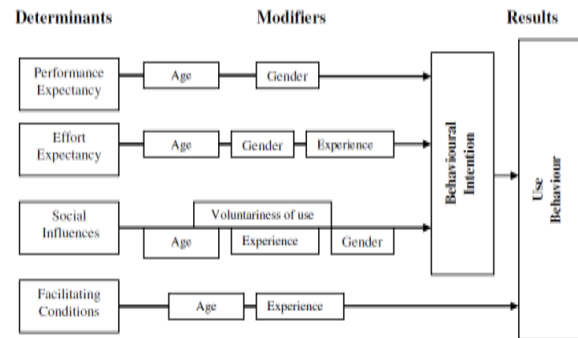

Figure 6. UTAUT attributes [8]

3. Using acceptance models in E-Government

The wide adoption of acceptance models and theories have made their mark in different domains in the world of computing. These models and theories have even made their way in e-government solutions and services. For example, Mauritian e-government services were able to evaluate the level of adoption of e-government services by using the TAM and UTAUT variables [15]. However, in Romanian e-government portal, they used TAM more than UTAUT since the authors found the TAM variables (Perceived ease of use and perceived usefulness) to be directly correlated to the actual usage of the technology [16]; however, UTAUT was not used to an extensive level by the respective government agency since the model is most suitable in the introduction of new technology in an organization.

Another research study proposed a new approach for evaluation of E-government services of health and education [17]. The sectors that were considered for this study included public, as well as private ones. This research also revealed that private sector tends to make use of TAM more than the public offices [17]. Besides, the e-government services in Tehran were evaluated on the basis of TAM's variables and approximately 350 responses were received that were tested against the hypothesis developed upon the variables in the TAM [26].

Al-adawi proposed a model to assist e-government to understand the level of acceptance that can be expected from their users [18]. It aims to identify the drivers and consequences of the adoption of e-government processes by the users. The author divided this model in two main categories; getting information from e-government sources and conducting transactions through them. It is communicated by the authors that the user is not required to give any personal information or details if he requests the acquisition of information from government agencies, but the user should be able to prove his identity if he wishes to access some e-government service.

4. Proposed Model and Hypothesis Development

Among the different types of technology acceptance models, UTAUT is considered to be the most appropriate one for the respective research study because this theory reviews and synthesises the major theories in the user acceptance of information technology. Venkatesh et al. developed this theory with the objective to address the need for a unifying perspective: for example, the authors cite diverse theories from information systems, psychology, and sociology that can explain over 40% of variance in individual intention to use technology, although no unifying theory has yet been established [8]. Besides, the UTAUT has been developed by testing and integrating eight different models in regard to information and communication technology use. Such models are: TRA, TPB, DTPB, TAM, DOI, SCT, MM, and MPCU [8].

While many studies have utilized the technology acceptance models in investigating various systems' adoption in different contexts, very few have utilized the UTAUT model. This research utilizes the UTAUT model and proposes an extension to the model that integrates a construct, which complements the IAMS framework that includes the themes for chosen attributes that have been categorised with respect to Security, Acceptability, and User experience perspectives [1], [25]. This study adopts the IAMS framework's perspectives as external variables to serve as direct determinants of intention and user behaviour in the original UTAUT model, as shown in Fig.7 .

The components of security and identity in the IAMS framework are to be included in the model as direct variables since they are not present in the original UTAUT model. The presence of items relating to security and identity will increase the level of trust and privacy for users [20]. Nevertheless, the variables of performance expectancy and effort expectancy are dual in nature since they possess qualities of both the domains of user experience, and acceptability. Therefore, the components of user experience, and acceptability in the IAMS framework are to be included in the model as indirect variables.

4.1. Selected hypotheses for the current research study

Extensive research on the chosen domain has revealed that the degree of system usage has been considered the benchmark of success in many studies, which is a conclusion similarly found by DeLone and McLean [21]. However, DeLone and McLean clarified this misconception, and stated that an isolated inclination to use a system does not suffice for the actual adoption of the technology in one's life, whereas usage behaviour tends to refer to the success of a system in a better manner [21]. Moreover, Wang and Liao stated their concern regarding the lack of measures in terms of assessing the success of e-government systems since much attention has been assigned to similar measures for information systems [22]. They also stated that system usage is used as a dependent variable in many research studies. Furthermore, they also highlighted the importance of variables 'system usage' and 'intention to use' in regard to measuring the rate of success of those applications voluntarily used by users. Alongside the arguments for the inclusion of 'system usage' and 'intention to use' in the measuring of any system by the above-mentioned researchers, most technology acceptance models support these two variables, and further consider them relevant in terms of evaluating the success rate of any system.

Adell discussed a system that is known as the driver support system; this implementation of the UTAUT model, for such a model, is evaluated in this paper [23]. Amongst the four variables of performance expectancy, effort expectancy, social influence, and facilitating conditions, the last variable is not considered relevant for the system under discussion, and so it is omitted from the formulation of the UTAUT model. In addition to the exclusion of facilitating conditions, user behaviour is also omitted since facilitating conditions directly influence user behaviour. Furthermore, Sedana and Wijaya also used UTAUT with the objective to evaluate the level of acceptance for their technology, Exelsa, which is a learning management system at Sanata Dharma University [19]. The authors of the paper explained their choice of UTAUT by stating that UTAUT tends to better facilitate understanding the level of user acceptance and the use of the technology. In an attempt to simplify the UTAUT model for their research study, the authors made behavioural intention the base of the model, thereby being influenced by performance expectancy, effort expectancy, and social influence. However, all of these models have the common base of behaviour, which signifies the use of the new technology or system.

In the light of the above findings, it can be stated that the intention to use UbIAMS may be influenced by performance expectancy, effort expectancy, social influence, and security and identity. Moreover, it may also be further stated that a strong intention to use any system is eventually translated into actual usage of the system. Likewise, further work should be conducted if there are differences recognised amongst users concerning education, languages, culture, occupation, and income, all of which may affect the adoption of UbIAMS System [1], [25]. Fig. 7 shows the hypotheses to be used to test the

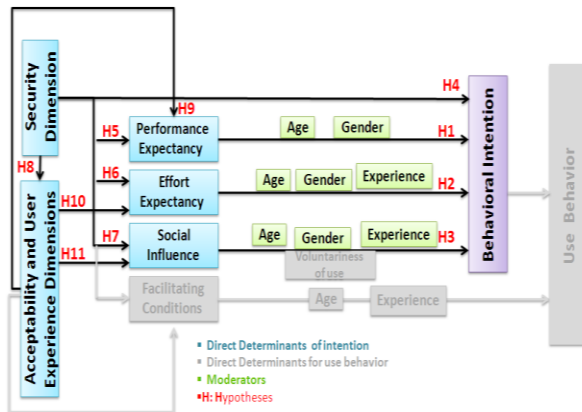system. The grey shaded boxes are not included in the current research study.

Figure 7. UTAUT-Based Model for Studying the Integrating Physical and Virtual Identity Access Management Systems

The list of hypotheses that have been selected for the research study under discussion:

- *H1:* There would be a significant positive relationship between performance expectancy and behavioural intentions to use UbIAMS, and this relationship would be moderated by gender and age.
- *H2:* There would be a significant positive relationship between effort expectancy and behavioural intentions to use UbIAMS, and this relationship would be moderated by gender, age and Internet experience.
- *H3:* There would be a significant positive relationship between social influence and behavioural intentions to use UbIAMS, and this relationship would be moderated by gender, age and Internet experience.
- *H4:* There would be a significant positive relationship between security and identity's components and behavioural intentions to use UbIAMS.
- *H5:* Security and identity's components will have an indirect effect on behavioural intentions to use UbIAMS through performance expectancy.
- *H6:* Security and identity's components will have an indirect effect on behavioural intentions to use UbIAMS through effort expectancy.
- *H7:* Security and identity's components will have an indirect effect on behavioural intentions to use UbIAMS through social influence.
- *H8:* Security and identity's components will have an indirect effect on behavioural intentions to use UbIAMS through acceptability and user experience's items.
- *H9:* Acceptability and user experience's components will have an indirect effect on behavioural intentions to use UbIAMS through performance expectancy.
- *H10:* Acceptability and user experience's components will have an indirect effect on behavioural intentions to use UbIAMS through effort expectancy.
- *H11:* Acceptability and user experience's components will have an indirect effect on behavioural intentions to use UbIAMS through social influence.

The validation of this proposed UTAUT will lead to an answer the research question: *How can the selected attributes—in the proposed conceptual model for integration of physical and virtual identity access management systems—be tested so that the best relationship will result in predicting user intention to utilise these systems?*.

5. Conclusion and Future Work

There are limited systems in the domain being discussed since the concept of IAMSs has only recently emerged in the world of computing; rather, the known publications and research studies tend to focus on the interoperability of the physical and virtual services, and ultimately neglect the other necessary aspects of usage and operations of systems. Some of those important aspects are usability, accessibility, and identity. The presence of such aspects makes the services accessible and usable by all types of users as opposed to constraining the usage to a certain set of users. It is due to this reason that this paper focused on designing an acceptance model for integrating physical and virtual IAMSs. Amongst the eight types of technology acceptance models, UTAUT is considered to be the most suitable one for the respective research study because the range of variables in UTAUT are even more compatible with the vision of the proposed system since it provides a stronger platform for catering to the unique needs of different types of user. Furthermore, it has been developed after a series of improvements on the previous eight models, and aims to predict the level of usage and acceptance that can be expected from users regarding a certain technology or system. Thus, the research proposes an extension to the UTAUT model that accounts for the utilisation of the unified model within the components of the IAMS framework.

The research findings and proposed UTAUT model shall be used to develop a prototype system (UbIAMS) that shall cater to the needs of all kinds of users in the presence of their unique traits and experiences [1], [25]. The prototype shall be tested and evaluated on the basis of the selected hypotheses. More details about evaluating the proposed UTAUT will be presented in the conference.

6. References

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