

Analysis of factors for the acceptance and use of technology for the design of digital services in Ecuador

Pablo Pintado^{1,2}(✉) [0000-0002-1356-0248] and Elsa Estevez³(✉) [0000-0002-2596-4397]

¹ Universidad del Azuay, Cuenca, Ecuador
ppintado@uazuay.edu.ec

² Facultad de Informática, Universidad Nacional de la Plata (UNLP), La Plata, Argentina

³ Departamento de Ciencias e Ingeniería de la Computación, Universidad Nacional del Sur (UNS), Instituto de Ciencias e Ingeniería de la Computación (UNS-CONICET), Bahía Blanca, Argentina
eestevez@gmail.com

Abstract. The adoption of digital services depends on different factors related to the acceptance and use of technologies. Despite a variety of research on techniques and models for technology acceptance and use, scarce research explores the factors of acceptance and use of technologies depending on the digital service's economic activity and the user's demographic characteristics in the Ecuadorian context. This article presents and analyzes a conceptual framework of the factors of acceptance and use of digital services in the Ecuadorian context. Its main contribution is to serve as a guide identifying major factors that policy makers and software developers need to consider when planning and designing digital services in Ecuador, so to facilitate their usage and adoption.

Keywords: Conceptual framework for technology acceptance and use; acceptance and use factors; digital services in Ecuador.

1 Introduction

According to the United Nations 2030 Agenda for Sustainable Development, Ecuador has a high rate of online services. However, for them to be successful, users must adopt them. Thus, it is necessary to consider the factors of acceptance and use of technologies and certain software development practices used as part of government digital transformation efforts. There is literature related to acceptance and usage factors, like [1], which proposes a conceptual model that integrates concepts from the technology acceptance model (TAM); the technology, organization, and environment (TOE) framework; institutional theory and the institutionalization change model. In [2], they propose a conceptual model based on trust, technology acceptance, and empowerment theory to understand the digital citizen participation of Filipinos. In [3], they examine the factors affecting teachers' intention in training and use of mobile augmented reality

(MAR) in teaching through the mobile augmented reality acceptance model (MARAM).

As part of our research work, in [4], we propose taxonomies of the factors of acceptance and use of technologies of digital services, both following a general approach and refined by economic activity. In [5], we propose a characterization that represents how the priority factors of acceptance and use of technologies are differentiated by economic activity of the digital service and by demographic characteristics of the user in the context of Ecuador.

From our literature review related to conceptual frameworks on acceptance and use of technologies, we observe that most studies focus on specific areas, such as education, citizen participation, and augmented reality, among others; and they only consider specific models of acceptance and use. Therefore, we understand that there is a gap in the state of the art for studying such factors in the Ecuadorian context. For this reason, in this paper, we propose a conceptual framework of the factors of acceptance and use of digital services in Ecuador.

The remainder of this paper is structured as follows. Section 2 presents a literature review on related work. Section 3 explains the research methodology applied for this study. Section 4 introduces the proposed conceptual framework, while Section 5 discusses its validation. Finally, section 6 summarizes conclusions and recommendations.

2 Related literature

A selective literature review was conducted in IEEE Xplore and Springer to identify research papers on conceptual frameworks for the acceptance and use of technologies. For this purpose, we searched in February 2024 on papers published in the last five years containing the following keywords in the abstract:

("Abstract":Acceptance and use of technology) AND ("Abstract":Framework))

As result of the search, we reviewed 178 publications in IEEE Xplore and 303 in Springer. We selected papers after reading the abstract and considering their relevance to our research. From this, we identified eight articles. In the following, we provide a summary of the selected articles.

In [1], they authors propose a conceptual model that integrates concepts from TAM, TOE, institutional theory, and the institutionalization change model. The paper in [3] examines factors affecting teachers' intention to use MAR in teaching through MARAM proposed based on TAM. The model comprises four components: perceived relative advantage, perceived enjoyment, facilitating conditions, and mobile self-efficacy. In [6], they explore the relationship between acceptance and adoption of metaverse (AAM) and e-Learning adoption using TAM on users' behavioral intention toward AAM.

In [7], they propose an integrated framework to investigate the impact of security and privacy with technology familiarity to measure users' trust in the use of IoT in healthcare services in Oman. In [2], through a survey and machine learning algorithms,

they propose a conceptual model based on trust, technology acceptance, and empowerment theory to understand digital citizen participation in the Philippines.

Upon reviewing existing studies on conceptual frameworks for the acceptance and use of technologies, we observed a shared focus on specific areas such as education, IoT, citizen participation, and augmented reality, among others, using specific models of acceptance and use. This led us to identify a gap in the state of the art. Drawing from the taxonomies [4] and characterization of the priority factors of acceptance and use of digital services in Ecuador [5], in this paper, we propose a novel conceptual framework for the factors of acceptance and use of digital services in Ecuador.

3 Research methodology

The research methodology used, as adopted in [8], was the foundation of our previous research [4] [5]. This approach helped us to identify the models and theories of acceptance and use of technologies such as TAM*, UTAUT*, ISO 9241-210, ISO-IEC-25010; certain software development practices for digital transformation such as problem identification and resolution, agile development methods, process simplification and automation [4]; and user demographic attributes, like gender, age, education level, place of residence, and digital channels used for digital services [5].

This research focuses on two main questions, explored in two phases: 1) *¿What are the models for assessing the acceptance of technologies and certain software development practices for digital transformation applied for designing digital services?* and 2) *¿What are the main factors of acceptance and use of technologies for digital services in Ecuador?* The former question has been explored through a systematic literature review (SLR), documented in [4]. We addressed the latter through analyzing a case study and a survey, both based on the Ecuadorian context, explained in [5].

In phase one, as mentioned, we conducted a SLR, validated with Cohen Kappa, yielding reliable results. In phase two, we used a case study [9] and a survey [10] validated with Spearman-Brown, ensuring the reliability of our findings.

The data analysis from phase I encompassed 55 primary studies identified through the SLR. We used a quantitative analysis of descriptive statistics to identify the relevant factors and practices using a general approach and another refined by economic activity. The results produced two taxonomies [11]: 1) Taxonomy of factors of acceptance and use of technology and certain Digital Transformation (DT) practices with a general approach, and 2) Taxonomy of factors of acceptance and use of technology and DT practices by economic activity [4].

The data analysis from phase II [5] was done based on the 420 replies received from the survey. Through them, we detected differences in the priority factors according to approaches of the digital service's economic activity and the user's demographic. We documented such differences in characterization [10]. Based on the results achieved, we proceeded to synthesize a conceptual framework for the acceptance and use of technologies for digital services in Ecuador, which is presented in the following section.

4 Conceptual framework

A conceptual framework is an organizational structure of concepts for solving a particular problem. It organizes and makes sense of key concepts related to each other. It guides the stages of an investigation, from formulating research questions to the coherent interpretation of results [8].

On the one hand, the SLR unveiled ten relevant factors and practices of acceptance and use of technology following a general approach. These factors include: 1) perceived usefulness, 2) interaction ergonomics, 3) performance expectation, 4) facilitating conditions, 5) effort expectation, 6) ease of use, 7) usability, 8) design thinking, 9) Business Process Management (BPM), and 10) SCRUM. Additionally, the economic activity of the digital service revealed five cross-cutting factors such as 1) perceived usefulness, 2) interaction ergonomics, 3) effort expectation, 4) ease of use, and 5) usability. On the other hand, the study of the case study and the survey focusing on the economic activity of the services identified 18 relevant factors: 1) to 7) as in the general approach, plus 8) security, 9) accessibility, 10) digital culture, 11) habit, 12) behavior intention, 13) usage behavior, 14) adoption, 15) hedonic motivation, 16) perceived enjoyment, 17) operability, and 18) social influence. Considering the user's demographic aspects, we discovered some were important and others not, depending on the aspect.

Figure 1 synthesizes our findings. For each of the identified factors, it includes the reference to the model or theory in which the factor is described and includes an "*" in the case that the factor is relevant to the analysis of the generic approach, to the economic activity of the service, and each of the user's demographic characteristic. If the cell is in grey, the factor is irrelevant to such approach/characteristic. For example, security, accessibility, digital culture, habit, hedonic motivation, perceived enjoyment, and social influence are not relevant factors for accepting and using technology, considering a general approach. In the case of demographic characteristics, while age and gender are relevant for all factors, the rural location does not affect operability and social influence; also, PhD and primary education level do not influence effort expectation, ease of use, and usability.

5 Validation

Our research, which involved validations in each phase, i.e., in the SLR [4], case study and survey [5], was further strengthened by the use of an empirical methodology of focus groups with 31 experts over three sessions [12]. The results of this validation were compelling. In particular, 98% of the experts agree that the factors of acceptance and use, as well as specific software development practices used in digital transformation, exhibit differences between approaches based on the economic activity of the digital service and the demographic characteristics of the users, when considering the acceptance and use factors of digital services in Ecuador.

Factor / Constructor	Models / Theories	Generic approach	Economic activity	User demographics							
				Age	Gender	Location	Rural location	Education	PhD education	Basic education	
Security			*	*	*	*	*	*	*	*	*
Accessibility	WCAG 2.1 Accessibility		*	*	*	*	*	*	*	*	*
	ISO 9241 Accessibility		*	*	*	*	*	*	*	*	*
Perceived usefulness	UTAUT* Perceived usefulness	*	*	*	*	*	*	*	*	*	*
	TAM* Perceived usefulness	*	*	*	*	*	*	*	*	*	*
Interaction ergonomics	ISO 9241 Interaction ergonomics	*	*	*	*	*	*	*	*	*	*
Performance expectation	UTAUT* Performance expectation	*	*	*	*	*	*	*	*	*	*
	ISO 9241 Productivity	*	*	*	*	*	*	*	*	*	*
	ISO-25010 Performance efficiency	*	*	*	*	*	*	*	*	*	*
Digital culture	UTAUT* Experience		*	*	*	*	*	*	*		
	TAM* Experience		*	*	*	*	*	*	*		
	ISO 9241 Improve user experience		*	*	*	*	*	*	*		
Habit	UTAUT* Habit to use		*	*	*	*	*	*	*	*	*
Behavior intention	UTAUT* Behavior intention	*	*	*	*	*	*	*	*	*	*
	TAM* Behavior intention	*	*	*	*	*	*	*	*	*	*
Usage behavior / adoption	UTAUT* Usage behavior	*	*	*	*	*	*	*	*	*	*
	TAM* Usage behavior	*	*	*	*	*	*	*	*	*	*
Hedonic motivation	UTAUT* - Hedonic motivation		*	*	*	*	*	*	*	*	*
Perceived enjoyment	TAM* - Perceived enjoyment		*	*	*	*	*	*	*	*	*
Facilitating conditions / Operability	UTAUT* Facilitating conditions	*	*	*	*		*			*	*
	ISO 9241 Easy understand	*	*	*	*		*			*	*
	ISO-25010 Portability	*	*	*	*		*			*	*
Effort expectation	UTAUT* Effort expectation	*	*	*	*	*					
Ease of use / Usability	UTAUT* Perceived ease of use	*	*	*	*	*	*				
	TAM* Perceived ease of use	*	*	*	*	*	*				
	ISO 9241 Easy understand	*	*	*	*	*	*				
	ISO-25010 Usability	*	*	*	*	*	*				
Social influence	UTAUT* Social influence		*	*	*	*	*	*	*	*	*

Fig. 1. Diagram of acceptance and use factors by user demographics and economic activity of the digital service – Ecuador

6 Discussion

This research aimed to synthesize a conceptual framework for the factors of acceptance and use of digital services in Ecuador. Our methodology used in previous research [4] [5] includes a selective literature review in IEEE Xplore (178 articles) and Springer (303 articles). The key inputs for our synthesis were the taxonomies explained in [4] and the characterization of the priority factors of acceptance and use of digital services in Ecuador [5].

Based on the SLR taxonomies [4] and the characterization of the case study in the Ecuadorian context [5], the differences in the priority acceptance and use factors were synthesized in Figure 1. In particular, the SLR based on the generic approach obtained ten relevant factors. In comparison, the case study obtained 18 relevant factors. With the approach by economic activity in the SLR, we obtained five cross-cutting factors: perceived usefulness, interaction ergonomics, effort expectation, ease of use, and usability, followed by five relevant factors such as behavior intention, usage behavior, adoption, facilitating conditions and operability; while the case study identified 18 relevant factors. The approach by user demographic characteristics revealed that the priority factors for digital service adoption vary by demographic characteristics from 13 to 18 relevant factors (See Fig. 1). For example, to design a digital service for a user with PhD education level is irrelevant operability, effort expectation, ease of use, and usability; while for a user with primary education is not relevant digital culture, effort expectation, ease of use, usability, and social influence; also, for a user from a rural location is irrelevant facilitating conditions, and social influence to adopt the digital service.

The conceptual framework for the acceptance and use of digital services in Ecuador proposed in this research is valuable and practical for software developers, researchers, and others interested in the relevant factors of acceptance and use of digital services in the Ecuadorian context. It provides a foundation for ensuring the successful adoption of the implemented digital services.

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