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Article

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Electronic payment systems' characteristics and accounting information systems effectiveness: the moderating impact of perceived customers' uncertainty

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ABSTRACT

This study investigates the impact of security, reliability, and assurance characteristics of electronic payment service systems on the effectiveness of accounting information systems (AIS) in Jordanian governmental institutions. Additionally, it examines the moderated effect of perceived customers' uncertainty in this context. Data for this study were collected through a questionnaire distributed to employees working in the accounting and financial departments of Jordanian governmental institutions that utilize AIS. A total of 213 questionnaires were randomly distributed to a sample, resulting in the retrieval of 128 questionnaires, yielding a recovery rate of 60%. All retrieved questionnaires were deemed valid for statistical analysis. The results statistically confirm a significant effect of security, reliability, and assurance on the effectiveness of AIS. Furthermore, they indicate that perceived customers' uncertainty does not moderate the relationship between security and the effectiveness of AIS. This study contributes to enhancing the effectiveness of financial data, which benefits decision-makers, policymakers, thought leaders, and development prospects. Additionally, it underscores the potential impact on the efficiency of AIS, which influences both the foundational and promotional aspects of financial data as well as the accuracy of accounting data.

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1. Introduction

The discipline of accounting has undergone significant transformation due to the technological revolution (Dordevic et al., 2018; Afifa et al., 2023a, 2023b, 2023c). With rapid advancements in science and technology, particularly in electronic services and information technology, businesses have greatly benefited from the adoption of digital financial and accounting services. These services are characterized by their ease of use and quick access to necessary data (Abu Afifa & Saleh, 2021; Dordevic et al., 2018; Dimitriu & Matei, 2014). Current sophisticated accounting information systems (AIS) employed by institutions provide users with accurate and relevant financial information, enabling informed decision-making in managing institution finances (Qatawneh, 2023; Abu Afifa & Saleh, 2022; Al-Okaily et al., 2020a, 2020b).

The increasing implementation and utilization of electronic systems have also prompted the public sector to enhance their AIS through a broader use of information technology. There is a clear trend towards leveraging e-government offerings to harness the benefits of information systems, as exemplified by the Jordanian Ministry of Finance and other government institutions employing various computer application systems, such as the Revenue Processing and Debt Management System, based on software including Ingro, Oracle, and FoxPro, to prioritize information systems (Christ et al., 2019).

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One of the most significant financial services influenced by information technology is electronic payment systems (Al-Okaily et al., 2020a, 2020b). Institutions' computerization and establishment of payment systems enhance processes, achieve accountability, and improve efficiency and agility in payment processing, crucial for business growth (Chuen & Deng, 2017). These improvements also contribute to customer satisfaction and meet their needs while enhancing the comparability of financial statements, benefiting decision-makers (Dimitriu & Matei, 2015).

However, despite technological advancements improving payment services, recent crises like the COVID-19 pandemic have introduced market uncertainty (Abu-Mater et al., 2020, 2021). Institutions are grappling with achieving stability amidst perceived customers' uncertainty and an ever-changing business environment reliant on the security of the global economy (Abu Afifa & Saleh, 2022; Castro, 2018; Schaltegger et al., 2017). In the context of perceived customers' uncertainty in the characteristics of electronic payment services systems-AIS effectiveness nexus, previous studies (e.g. Alrabei, 2023; Al-Dmour et al., 2019) show that the characteristics of electronic payment systems (such as security, reliability, and assurance) can impact the effectiveness of AIS. For instance, a more secure and user-friendly payment system can lead to more accurate and efficient processing of financial transactions. Besides, the role of perceived customers' uncertainty is to potentially influence or modify the strength and direction of the relationship between electronic payment services systems characteristics and AIS effectiveness. When customers perceive high uncertainty about the payment system (e.g. they worry about security risks or find the system difficult to use), it may negatively impact the effectiveness of the AIS (Chandra et al., 2010). This is because uncertainty can lead to errors, delays, and reduced trust in the system. Conversely, when customers perceive low uncertainty and have confidence in the payment system, the effectiveness of the AIS can be enhanced (Pavlou et al., 2007). Customers are more likely to engage with the system efficiently, leading to more accurate and timely financial data. As a result, government bodies can focus on enhancing the characteristics of electronic payment service systems (such as improving security, reliability, and assurance) and simultaneously work on reducing customer uncertainty through education and clear communication. By addressing customers' uncertainties, government agencies can ensure that the benefits of effective electronic payment systems are fully realized, leading to more accurate and efficient financial management. For example, given cash flow's importance, the Jordanian government established the Ministry of Digital Economy and Entrepreneurship in 2019 to facilitate the use of digital financial services, closely linked to AIS to meet the customers' uncertainties (Al-Okaily et al., 2020a, 2020b).

Furthermore, the global economy is adapting to new methodologies addressing evolving customer needs, liberalizing restrictions, and removing trade barriers due to rapid technological advancement (Vo Van et al., 2024; Schulz et al., 2010; Mia & Clarke, 1999). Perceived customers' uncertainty plays a critical moderating role in the relationship between the characteristics of electronic payment systems and their effectiveness in government bodies. It influences how well the system's features translate into effective accounting information systems. Reducing customers' uncertainty can amplify the positive effects of a well-designed electronic payment services systems, leading to better outcomes for government financial management. Therefore, it is essential to explore how security, reliability, and assurance characteristics of electronic payment services systems influence AIS effectiveness in government bodies (Abu-Mater et al., 2020, 2021), moderated by perceived customers' uncertainty, particularly during the COVID-19 crisis, a topic previously underexplored in the literature. This study aims to address this gap by answering the following main questions:

Q1. Do security, reliability, and assurance characteristics of electronic payment services systems influence AIS effectiveness in governmental institutions?

Q2. Does perceived customers' uncertainty moderate the relationship between security, reliability, and assurance characteristics of electronic payment services systems and AIS effectiveness in governmental institutions?

Drawing on the acceptance and use of technology theory, diffusion of innovation theory, and existing research evidence (e.g. Jaradat et al., 2018), we posit that AIS effectiveness is particularly sensitive to the impact of security, reliability, and assurance characteristics of electronic payments systems. Utilizing electronic payment systems and perceived customers' uncertainty indicators, decision-makers can anticipate AIS efficacy. Our study administered 213 questionnaires to employees in Jordanian government

institutions, with a 60% response rate. Baseline analysis revealed a significantly positive relationship between security, reliability, and assurance characteristics and AIS effectiveness. In other words, the findings indicate that AIS efficacy in Jordanian public bodies is influenced by security, reliability, and assurance characteristics of electronic payment services systems. Additionally, perceived customers' uncertainty had no moderating effect on the relationship between security characteristic and AIS effectiveness. Therefore, this research contributes to developing a conceptual and theoretical foundation by examining perceived customers' uncertainty's moderating impact on the relationship between the characteristics of electronic payment services systems and AIS effectiveness.

Pragmatically, the findings highlight the importance of security, reliability, and assurance characteristics of electronic payment services systems and their implications for AIS effectiveness in Jordanian governmental institutions. The study offers applicable conclusions on how security, reliability, and assurance of electronic payment services systems affect AIS efficacy in public institutions. These services play a crucial role in fostering genuine engagement and contributing to the validity and accurate representation of financial data. This enhances financial declarations' comparability, benefiting decision-makers, policymakers, and development prospects, while also impacting AIS efficiency and accounting data competence.

This paper is structured as follows. [Section 2](#) shows the theoretical framework and hypotheses. [Section 3](#) presents the methodology. [Section 4](#) shows the data analysis and results. [Section 5](#) presents the discussion and a conclusion of the paper.

2. Theoretical framework and study hypotheses

2.1. Electronic payment services

The expansion and accessibility of the internet have prompted distributors to intensify their business transactions, including marketing and financial transactions, to keep pace with the world's rapid technological and scientific developments and fulfill their clients' demands (Ozdemir & Elitas, 2015). Consequently, the Internet has become a widely used channel for the exchange of knowledge and services, fulfilling its purpose by saving users time and expenses (Vasic et al., 2019).

For both customers and institutions, it is crucial that electronic payment services systems have the capability to address concerns related to internet networks and technological advancements. The previously highlighted characteristics—security, reliability, and assurance—thus become essential when implementing electronic payment services systems. Firstly, security, as defined by Kumaga (2011), involves technological safeguards that prevent unauthorized individuals from attempting to access the institution's computerized accounting system via its online platform. Secondly, reliability is described by Abu Afifa and Saleh (2021, 2022) as unbiased knowledge without discrepancies that accurately represents activities and operations. It was also described by Mansour et al. (2017) as processes associated with the consistency of information, and they confirmed that it is critical in electronic services systems. It refers to the extent to which information accurately reflects actual activities without any intentional or unintentional alterations.

Lastly, assurance, as defined by the American Institute of Certified Public Accountants (AICPA), involves techniques aimed at gathering high-quality information and providing competent services that enhance the integrity of information or its input to a level deemed satisfactory by decision-makers (Hunton et al., 2000).

2.2. Accounting information systems

In meeting the information needs of users, Al-Oleemat (2014) describes AIS as an integrated framework within the institution that utilizes available means to convert economic statistics into accounting data. AIS are systems designed to gather, store, and analyze data to provide insights for decision-makers (Romney & Steinbart, 2015). They encompass a combination of components, including groups, processes, guidelines, data, software, IT infrastructure, internal controls, and security protocols.

Given the evolving business landscape and the apparent volatility of customer preferences, public sector entities have a responsibility to provide assurances and develop systems that ensure efficacy and effectiveness in addressing citizen requests. AIS plays a crucial role in processing data to offer insights beneficial for developing, managing, and operating institution processes, making them indispensable tools for adapting to both intrinsic and extrinsic developments (Abu Afifa & Saleh, 2021, 2022; Wahyuningsih et al., 2020). Consequently, both public and private domain entities have significantly increased their expenditure on information systems (Vo Van et al., 2024).

However, despite the substantial investments, many information systems initiatives fall short, often with a high failure rate, leading to negative repercussions such as financial losses and operational challenges (Al-Okaily et al., 2020a, 2020b). Nevertheless, AIS provides institutions with a significant capability to enhance their efficiency, as the subsystems within institutions rely on AIS for their inputs and outputs, making it one of the most critical systems among the various information systems in institutions (Wahyuningsih et al., 2020).

2.3. Perceived customers' uncertainty

The perceived uncertainty of customers poses a challenge for institutions, requiring constant adaptation to technological developments through changes or improvements to services. Horvath et al. (2021) define customers' uncertainty as institutions' inability to accurately predict customers' needs and demands. This refers to the level of uncertainty or doubt customers (or citizens in the case of government bodies) feel about using the electronic payment system. This can be due to concerns about security, usability, or other factors (Maditinos et al., 2013). Despite institutions' ability to forecast and anticipate customer requirements (Irwandi et al., 2020), they must strive to provide services that meet these needs. However, the role of perceived customers' uncertainty is often overlooked in defining the role of AIS as a distinct source of information when business outcomes are uncertain.

Nevertheless, these inevitable consequences can be leveraged to provide information about uncertainty, enhancing information transfer to institutions whose customers are uncertain, thereby providing clarity and purpose in meeting the main objective of AIS (Barker & Penman, 2020). The challenge resulting from the perception of customers' uncertainty underscores the need for effective AIS. Numerous studies examine the correlation between perceived customers' uncertainty and various factors, including technology, industry uncertainty in innovation and entrepreneurship, and uncertainty in international business (Levitas & Chi, 2010; Cuypers & Martin, 2010; Oriani & Sobrero, 2008; Lee et al., 2008).

In conclusion, as institutions become more aware of customers' needs and acceptance of new products and services, it becomes imperative for them to adopt new means and methods that align with customers' preferences. Institutions must direct their efforts and capabilities toward adopting new and advanced means and methods to sustain efficacy and effectiveness in their industries. Additionally, to gain competitive advantages, institutions should collaborate to implement new and modern methodologies within the ecosystem. Flexibility is key to institutional success, but the degree and manner in which institutions articulate and instill flexibility vary. To explain this variance, we examine current perceived customers' uncertainty to facilitate knowledge of future perceived customers' uncertainty (Zhang et al., 2020).

2.4. Study hypotheses

Electronic payment services systems represent vital financial services profoundly influenced by information technology, serving as key indicators of economic sector development. Institutions strategically advance payment systems to enhance transparency, efficiency, and expedite transactions, thereby bolstering customer satisfaction and meeting their evolving needs (Torki et al., 2020). This amalgamation of information systems and technology not only improves transactional processes and accuracy but also boosts operational efficiency, timely reporting, and user productivity (Lim, 2013). Consequently, the acceptance behavior of technology-based AIS can be harnessed to drive effective and efficient business processes, ultimately influencing the creation of reliable and accurate financial reports.

In a comprehensive study on electronic payment services systems, Acheampong et al. (2018a, 2018b) underscore the importance of system reliability, freedom, anonymity, interoperability, portability, and ease of use. Individuals enjoy the convenience of making payments anytime and from anywhere, as highlighted by Nguyen and Huynh (2018). Despite these advantages, concerns persist regarding security breaches leading to potential financial losses (Al-Qadi, 2018). Instances of fraud involving verification codes sent to users further exemplify the imperfections in electronic payment systems (Aviyanti et al., 2021). Al-Maaithah et al. (2015) note ongoing apprehensions about the security of electronic payments, with internet security concerns presenting significant barriers to online payment reception (Al-Qadi, 2018; Wang et al., 2003).

In addition to the aforementioned issues, consumers express deep-seated concerns about the security of credit card information, potential threats from hackers, and the reliability of vendors (Al-Omoush et al., 2019). Trust is pivotal in the adoption of electronic payment service systems, with the assurance factor exerting significant influence over individuals' attitudes towards adoption (Phonthanukithaworn et al., 2015). A study by Kim et al. (2010) demonstrates a positive and significant relationship between trust and intention. Consequently, a lack of confidence in system reliability may deter individuals from utilizing electronic payment services systems.

The literature extensively explores the impact of security, reliability, and assurance on business decision-making, underscoring their significance in driving effective AIS (Zamani et al., 2017). Various theoretical frameworks, including the theory of acceptance and use of technology and the diffusion of innovations theory, elucidate the relationship between electronic systems' characteristics and information system effectiveness (Venkatesh et al. 2003; Syahadiyanti & Subriadi, 2018). These theories shed light on the complex interplay between behavior controls, technology adoption, and the desire to utilize electronic payment systems (Giantari et al., 2013; Khatimah & Halim, 2016). According to Davis (1989), when a new technology is presented to the users there are several things that impact their decision concerning when and how to employ it. Sokobe (2015) states that the technology acceptance model is a robust model that is commonly used to analyze the adoption of information communication technology (ICT) and it is viewed as an information system theory which helps to understand the adoption and use of the internet (Gibbs et al., 2007; Abu Afifa et al., 2022). However, the theory assists to understand how adopters come to accept or reject the use of ICT in their enterprise (Afifa et al., 2023a, 2023b, 2023c).

The diffusion of innovation theory, developed by Gabriel Tarde in 1890, aims to elucidate how new ideas and technology propagate through societies, the factors influencing their adoption rates, and the qualities that determine their effective application (Syahadiyanti & Subriadi, 2018). This theory identifies innovation characteristics as crucial determinants of the pace at which innovations are embraced. Factors such as communication channels, social system attributes, promotional efforts, and the roles of influencers collectively influence the diffusion process, wherein innovations are disseminated to members of a social system through specific channels over time.

Jaradat et al. (2018) delineate five key characteristics of innovations that serve as indicators in gauging perceptions: relative advantages, compatibility, complexity, trialability, and observability. These characteristics play pivotal roles in shaping individuals' perceptions and willingness to adopt innovations. Building on previous research (e.g. Hogarth et al., 2008; Sokobe, 2015), the primary model utilized in this study incorporates these theories to explore the utilization of electronic payments. The desire to adopt electronic payments is influenced by behavior controls and the adoption of new technology, underscoring the importance of understanding the factors driving adoption behaviors (Giantari et al., 2013; Khatimah & Halim, 2016).

In conclusion, the characteristics of electronic payment service systems—security, reliability, and assurance—may play pivotal roles in determining AIS effectiveness. Security ensures the confidentiality and protection of sensitive financial information from fraudulent activities (Aviyanti et al., 2021). Reliability ensures the accuracy, timeliness, and completeness of electronic payment transactions, thereby safeguarding the integrity of financial data (Lin & Nguyen, 2011). Assurance ensures compliance with industry standards, legal regulations, and audit requirements, further bolstering system credibility (Alduais & Al-Smadi, 2022). Consequently, the effectiveness of AIS may hinge on these characteristics, given their direct impact on the accuracy, completeness, and timeliness of financial data, critical for informed

decision-making and financial reporting. As a result, this study aims to investigate the following direct hypotheses:

H_{1a} : There is a relationship between the security characteristic of electronic payment services systems and the effectiveness of AIS in Jordanian governmental institutions.

H_{1b} : There is a relationship between the reliability characteristic of electronic payment services systems and the effectiveness of AIS in Jordanian governmental institutions.

H_{1c} : There is a relationship between the assurance characteristic of electronic payment services systems and the effectiveness of AIS in Jordanian governmental institutions.

Furthermore, perceived customers' uncertainty can moderate the relationship between the characteristics of electronic payment services systems and AIS effectiveness. Electronic payment systems are designed with various features such as security, reliability, and assurance, which are intended to enhance the effectiveness of AIS by ensuring accurate and efficient financial transactions (Alrabei, 2023; Al-Okaily et al., 2020a, 2020b). However, if customers—such as citizens interacting with government payment systems—experience high levels of uncertainty regarding these systems, the expected benefits may not be fully realized (Chandra et al., 2010). For instance, concerns about data breaches, complex interfaces, or unreliable service can lead to reluctance or errors in transaction processes, thereby undermining the effectiveness of the AIS (Pavlou et al., 2007). In other words, high levels of uncertainty regarding system security, reliability, and assurance may diminish trust in the electronic payment services system, thereby reducing system usage (Al-Okaily et al., 2020a, 2020b; Daoud & Ibrahim, 2017), consequently limiting AIS effectiveness (Luo et al., 2012). This is because customers' doubts and fears can lead to hesitation in using the system, potential errors in transaction entries, or decreased engagement with the system altogether. Consequently, the intended improvements in accounting accuracy, efficiency, and reliability may be diminished as a result of the uncertainty affecting user behavior and interaction with the system.

Conversely, low levels of uncertainty may foster trust in the electronic payment services system, driving increased electronic payment system usage and enhancing AIS effectiveness (Huang et al., 2017). In environments where customers have confidence in the electronic payment system, they are more likely to engage with the system fully and accurately, leveraging its features to improve transaction processing and financial reporting. This confidence can lead to a more seamless and reliable integration of the electronic payment services systems with the AIS, resulting in better outcomes in terms of data accuracy, reduced processing times, and overall improved financial management (Al-Dmour et al., 2019). Therefore, addressing and reducing perceived uncertainty is essential for maximizing the benefits of electronic payment systems in enhancing AIS effectiveness.

Thus, perceived customers' uncertainty assumes a critical role in shaping the relationship between electronic payment systems' characteristics and AIS effectiveness (Lutfi et al., 2017). Consequently, the study's moderating hypotheses are formulated accordingly, as follows:

H_{2a} : There is a moderating effect of perceived customers' uncertainty on the relationship between the security characteristic of electronic payment services systems and the effectiveness of AIS in the context of Jordanian governmental institutions.

H_{2b} : There is a moderating effect of perceived customers' uncertainty on the relationship between the reliability characteristic of electronic payment services systems and the effectiveness of AIS in the context of Jordanian governmental institutions.

H_{2c} : There is a moderating effect of perceived customers' uncertainty on the relationship between the assurance characteristic of electronic payment services systems and the effectiveness of AIS in the context of Jordanian governmental institutions.

Finally, based on our proposed hypotheses, Figure 1 illustrates the research model as follows:

3. Methodology

The study adopts a descriptive analytical approach commonly utilized in humanities and accounting studies. This approach involves identifying and describing the demographic characteristics of the study

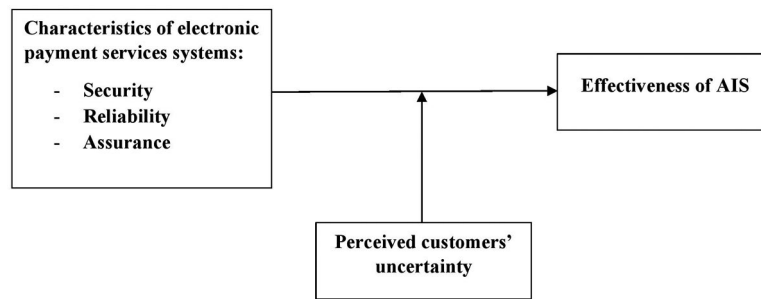


Figure 1. Research model.

sample, describing the study variables, and determining the levels of each variable descriptively. The analytical aspect of the approach is used to examine and test the study hypotheses. Specifically, it aims to identify the impact of the independent variable, which in this case is the characteristics of electronic payment services systems (security, reliability, and assurance), on the dependent variable, which is the effectiveness of AIS. Additionally, the study seeks to identify the moderating role of perceived customers' uncertainty in the relationship between these variables within Jordanian government institutions.

In summary, the descriptive analytical approach allows for a detailed exploration of the relationships between variables and the examination of how perceived customers' uncertainty may influence the relationship between the characteristics of electronic payment services systems and the effectiveness of AIS in Jordanian government institutions.

The population and sampling as well as the study instrument details are presented in the following subsection.

3.1. Population and sampling

The study population consists of Jordanian governmental institutions, specifically those affiliated with ministries and their central environments. The sample for the study comprises employees working in the accounting and financial departments of these institutions who utilize AIS.

Ethics are a critical issue in this research; therefore, this study was approved by the Research Ethics Committee, Al-Zaytoonah University of Jordan. All procedures performed in this study involving human participants were in accordance with the ethical standards of the institution, with the approval number (IRB #15/04/2023–2024). Besides, participants were informed about the study's procedures, risks, benefits, and other aspects before their participation. Only those who explicitly provided their consent were allowed to participate in the study. In fact, consent from participants and their Jordanian governmental institutions was obtained in oral form. This approach was chosen due to specific cultural and logistical considerations in Jordan. In many cases, verbal consent is preferred and considered more culturally appropriate, particularly in scenarios where participants may feel more comfortable engaging in discussions rather than signing formal documents. Additionally, obtaining written consent might have posed logistical challenges, such as limited access to documentation facilities or concerns about the perception of formality among participants. However, we ensured that all participants fully understood the purpose of the research, their rights, and the voluntary nature of their participation before proceeding.

The authors also committed to sharing research data, methods, and materials when possible in a manner consistent with ethical and legal considerations. Next, a simple random sampling method was employed to select participants from this population. After identifying relevant employees, 213 questionnaires were distributed to the sample. Subsequently, a total of 128 completed questionnaires were retrieved, resulting in a recovery rate of 60%. All retrieved questionnaires were deemed valid for statistical analysis, indicating a satisfactory response rate for the study.

3.2. Study instrument

To achieve the objectives of the study, an instrument (a questionnaire) was developed through which data about the independent, dependent, and moderator variables of the study could be collected in order to

measure the impact of the characteristics of electronic payment services systems on the effectiveness of AIS and to identify the moderating role of perceived customers' uncertainty. The questionnaire consisted of two main parts (see [Appendix 1](#)). The first part includes demographic data, including educational qualifications, scientific specialization, years of experience, and job title. The second part focuses on the subject of the study and adopts a 5-item Likert scale. This part contains the following sections:

1. This section contains the items on the characteristics of the independent variable (the characteristics of electronic payment services systems), with a total of 21 items in the final version of the questionnaire (adapted from Alhammadi and Tariq (2020)). This study uses three main characteristics of electronic payment services systems: security, reliability, and assurance. In this study, security is defined as the technological safeguards that prevent unauthorized individuals from accessing the computerized accounting system via the firm's website online (Kumaga, 2011). Reliability is described as knowledge that is completely unbiased, free of discrepancies, and accurately represents activities and operations. In other words, it is defined as the processes associated with information consistency (Mansour et al., 2017). Finally, assurance is defined as techniques for gathering high-quality information as competent services that improve the integrity of the information or its input to a level that decision-makers consider satisfactory (Hunton et al., 2000).
2. This section contains the items on the dependent variable (the effectiveness of AIS), with a total of 11 items in the final version of the questionnaire (adapted from Abu Afifa and Saleh (2021, 2022), and Mazi and Ebere (2019)). This study defines the accounting information system's effectiveness as a measure that provides an overview of the extent to which the goal can be achieved from a set of resources that are organized to collect, process, and store electronic data, then convert it into useful information and provide the necessary official reports in terms of quality, quantity, and time (Abu Afifa & Saleh, 2021, 2022).
3. This section contains the items on the moderator variable (the perceived customers' uncertainty), with a total of 6 items in the final version of the questionnaire (adopted from Al-Mawali and Lam (2016)). Customers' uncertainty is defined in this study as the inability of institutions to accurately predict customers' needs and demands (Horvath et al., 2021; Hoque, 2004).

In order to ensure the validity and reliability of the questionnaire, the current study used several methods. Firstly, to verify the possibility of using the study instrument (the questionnaire) for the purposes of scientific research and to ensure that it was suitable for measurement and appropriate for the purposes of this study, the researchers applied the face validity test. A specific number of experts were asked to review the questionnaire and then incorporate their feedback, as the researchers distributed the questionnaire to many faculty members in Jordanian universities for the purposes of judging. Secondly, factor analysis was conducted using Smart-partial least squares (PLS) 3 software to assess the questionnaire items and study model. The questionnaire items were evaluated using structural equation modeling, as this method examines and evaluates the validity of the questionnaire items through convergent validity and then examines the relationships between the study variables. To ensure convergent validity, the values of the confirmatory loading factors and average variance extracted (AVE) were calculated, where the values of the loading factors should be greater than 0.70 and the AVE values greater than 0.50, as recommended by Hair et al. (2019). [Figure 2](#) illustrates the results of the confirmatory factor analysis.

Questionnaire reliability refers to the extent of the internal consistency between questionnaire items, as the internal consistency between the items indicates the reliability of the respondents across time. This occurs when test-retest reliability and stability produce the same results when the same test is re-administered to the same respondents at two different time periods. The internal consistency between the questionnaire items was computed using Cronbach's alpha, where, according to Sekaran and Bougie (2016), a Cronbach's alpha coefficient value of more than 0.60 is considered acceptable. The results in [Table 1](#) show that the value of Cronbach's alpha coefficients is closer to 1, which is a perfectly adequate indicator of internal consistency and reliability. Additionally, the results also show that all AVE values are greater than 0.50, indicating that the scale measurements are valid for analysis. Overall, these validation

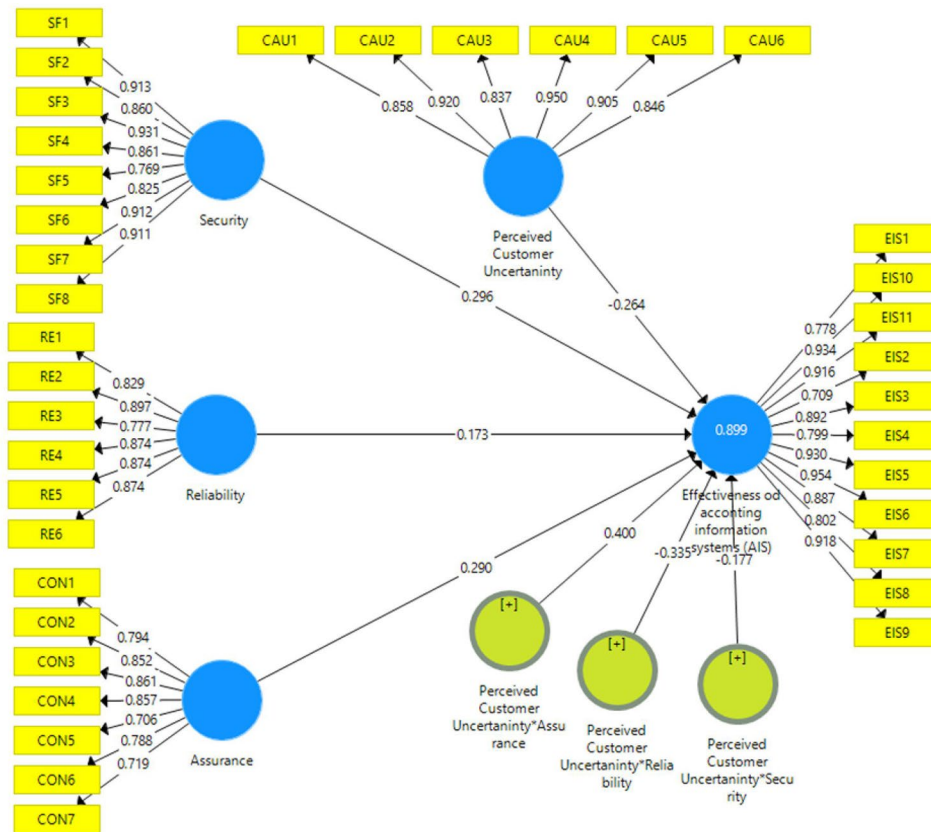


Figure 2. Confirmatory Loading Factors.

Table 1. Questionnaire reliability and validity.

Variable	Cronbach's Alpha Coefficient	AVE Value	Number of Items
Security	0.955	0.764	8
Reliability	0.926	0.731	6
Assurance	0.905	0.638	7
Effectiveness of AIS	0.966	0.755	11
Perceived Customers' Uncertainty	0.945	0.787	6
Entire Questionnaire	0.939		38

processes enhance the rigor and credibility of the study's findings by ensuring that the questionnaire effectively measures the constructs under investigation.

Finally, the hypotheses of the study were tested through the Smart-PLS 3 software, where this approach provides the option of bootstrapping, which leads to the use of generating samples from the same original sample 500 times. This provides a more flexible estimation than traditional methods (Streukens & Leroi-Werelds, 2016). In other words, PLS is more convenient and flexible than the usual ordinary least squares (OLS) method (Hair et al., 2012), as it is more flexible when there are outliers and non-normal distributions in the study data (Matthews et al., 2018). Overall, bootstrapping with Smart-PLS 3 software enhances the robustness of hypothesis testing in the study by providing more reliable estimates of model parameters, standard errors, confidence intervals, and significance levels. This approach helps ensure the validity and credibility of the study's conclusions regarding the impact of electronic payment services systems' characteristics on the effectiveness of AIS, as well as the moderating role of perceived customers' uncertainty.

4. Data analysis and results

4.1. Demographic characteristics of the sample

Table 2 illustrates the demographic data of the respondents, which includes their educational level, scientific specialization, years of experience, and job title.

Table 2. Characteristics of respondents.

	Characteristic	Frequency	Percentage (%)
Education Level	Diploma	35	27.3
	Bachelor	80	62.6
	Master	10	7.7
	PhD	2	1.6
	Other	1	0.8
Scientific Specialization	Accounting	96	75
	Business Administration	12	9.4
	Banking and Finance	3	2.3
	Economics	6	4.7
	AIS	5	3.9
Years of Experience	Other	6	4.7
	5 years or less	25	19.5
	6-10 years	24	18.8
	11-15 years	35	27.3
	More than 15 years	44	34.4
Job Title	Director	5	3.9
	Deputy Director	3	2.3
	Head of Department	32	25
	Employee	85	66.5
	Other	3	2.3

Table 3. Normal distribution test.

Variable	Skewness Coefficient	Kurtosis Coefficient
Security	−0.667	−0.524
Reliability	−0.935	0.158
Assurance	−1.312	1.126
Effectiveness of AIS	−0.686	−0.208
Perceived customers' uncertainty	1.365	1.220

As shown in Table 2, 35 respondents (27.3%) had an undergraduate diploma. Eighty respondents (62.6%) had a bachelor's degree. As for those who hold higher education degrees, 10 respondents (7.7%) held a master's degree, while 2 respondents (1.6%) had a PhD. Finally, 1 respondent (0.8%) had other certificates. Regarding the scientific specialization, 96 respondents (75%) had a degree in accounting, 12 respondents (9.4%) had a degree in business administration, 6 respondents (4.7%) had a degree in economics, 5 respondents (3.9%) had a degree in AIS, 3 respondents (2.3%) had a degree in financial and banking, and 6 respondents (4.7%) had certificates in scientific disciplines other than administrative and economic sciences.

There were 25 respondents (19.5%) who had up to 5 years of experience. Twenty-four respondents (18.8%) had experience of between 6 and 10 years; 35 respondents (27.3%) had experience of between 11 and 15 years; and, finally, 44 respondents (34.4%) had 15 or more years of experience. Regarding the job title, 85 respondents (66.5%) were working in non-managerial jobs. 32 respondents (25%) were working as heads of departments, 3 respondents (2.3%) held the position of deputy director, 5 respondents (3.9%) held a manager position, and 3 respondents (2.3%) held job titles other than the positions listed in the questionnaire.

4.2. Hypotheses testing

Adding to the previous studies on the theory of acceptance and use of technology and the diffusion of innovation theory, we expect a strong and significant relationship between the characteristics of electronic payment services systems and the AIS effectiveness. However, before testing the study hypotheses, the normal distribution of the data was assessed, as was checking that the independent variables were free from the multicollinearity problem.

The normal distribution of the data was assessed based on the Skewness and Kurtosis tests, where the absolute Skewness coefficient values should be less than 1 and the Kurtosis coefficient values should be near to 3 (Hair et al., 2014). Table 3 shows the results of testing the normal distribution of the study variables, where the absolute values of the Skewness coefficient are all less than 1, except for the variables of assurance and perceived customers' uncertainty. Besides, the Kurtosis coefficient values are all

less than 3. Therefore, it is statistically preferable to use nonparametric techniques such as the PLS technique in estimating the regression model.

The multicollinearity test is an important test that must be confirmed before using multi-linear regression or testing the study hypotheses through structural equation modeling (SEM), as the presence of this problem in the independent variables leads to problems in estimating the regression equation and creates a pseudo-regression problem. As recommended by Hair et al. (2019), the value of the variance inflation factor (VIF) must be less than 5 and the tolerance greater than 0.20 in order to judge the absence of this problem in the independent variables. Table 4 shows the results of the VIF test, where the test values ranged between 4.038 and 6.832 and the tolerance values were 0.146 and 0.248, and therefore the values were higher than the statistically permissible range for each of the variables (reliability, assurance, and perceived customers' uncertainty). Therefore, it can be concluded that the independent variables suffer from the problem of multicollinearity, and it is necessary to use a method to estimate the regression model that is more efficient than the traditional method of OLS. Therefore, the PLS method was adopted as it provides a solution to the problem of multicollinearity through the use of the bootstrapping method in the standard error estimation process (Farahani et al., 2010).

Next, Table 5 illustrates the matrix of inter-correlations between the variables, where all correlations between the variables were statistically significant at the level of 0.01. The largest value of the correlation coefficient was 0.909 between the assurance and perceived customers' uncertainty variables, while the lowest correlation coefficient was 0.792 between the assurance and security variables. It is clear from the inter-correlations between the independent variables that most of the correlations were greater than 0.80, and therefore we confirmed that there was a problem of multicollinearity, and, as a result, the PLS method was used to solve this problem (Farahani et al., 2010).

Following that, the PLS-SEM results regarding the effect of the characteristics of electronic payment service systems (security, reliability, and assurance) on the effectiveness of AIS are shown in Figure 3 and Table 6.

Table 6 indicates the results of PLS-SEM for the hypotheses H_{1a} , H_{1b} , and H_{1c} of the study, where it is clear, through the R^2 value of 0.865, that the variance in the dependent variable (the effectiveness of AIS) of 86.5% was caused by the three independent variables (the characteristics of electronic payment services systems) combined and that the rest can be attributed to other factors. The beta value for the effect of security on the effectiveness of AIS was 0.292, and this value indicates that the effect was medium and positive. To find out the significance of this effect, the value of the t-test was used, where the t-value was 3.133 and the p -value was 0.002, which means accepting the hypothesis H_{1a} that there is a relationship between the security characteristic of electronic payment services systems and the effectiveness of AIS in Jordanian governmental institutions.

The beta value for the effect of reliability on the effectiveness of AIS was 0.339, which indicates that there is a positive and medium effect. The t-value was 3.520, and the p -value was 0.000. Therefore, hypothesis H_{1b} that there is a relationship between the reliability characteristic of electronic payment services systems and the effectiveness of AIS in Jordanian governmental institutions is accepted. Finally,

Table 4. Multicollinearity test.

Variable	VIF	Tolerance
Security	4.038	0.248
Reliability	5.074	0.197
Assurance	6.832	0.146
Perceived customers' uncertainty	6.792	0.147

Table 5. Inter-correlation matrix for study variables.

Variable	Security	Reliability	Assurance	Effectiveness of AIS	Perceived Customers' Uncertainty
Security	1				
Reliability	**0.847	1			
Assurance	**0.792	**0.813	1		
Effectiveness of AIS	**0.869	**0.876	**0.864	1	
Perceived Customers' Uncertainty	**−0.752	**−0.830	**−0.909	**−0.858	1

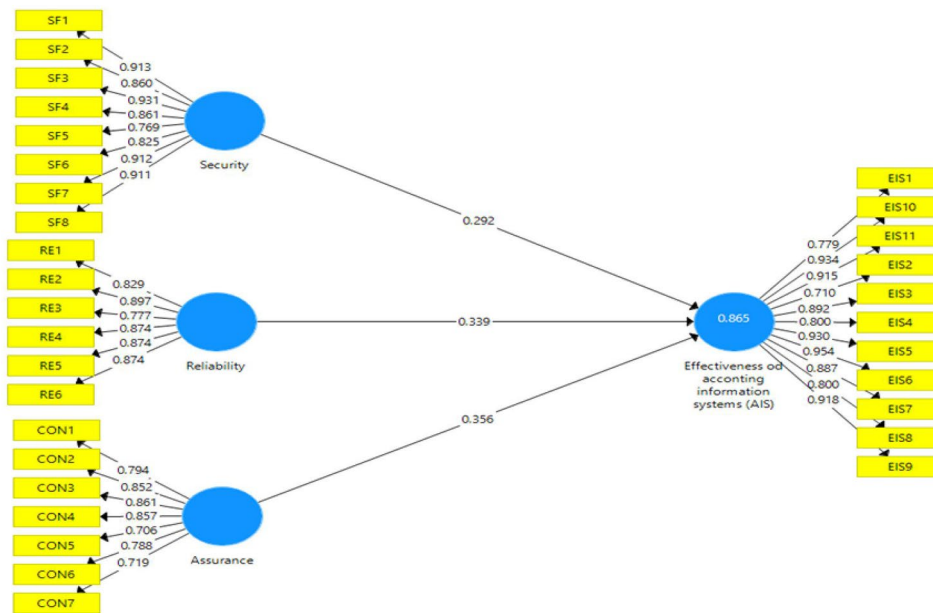


Figure 3. Testing hypotheses H_{1a} , H_{1b} , and H_{1c} .

Table 6. Results of testing hypotheses H_{1a} , H_{1b} , and H_{1c} .

IV	R ²	Beta	SE	TS _{CAL}	p-Value	Decision	Relationship
Security	0.865	0.292	0.093	3.133	0.002*	Accepted H_{1a}	Sig.
Reliability		0.339	0.096	3.520	0.000*	Accepted H_{1b}	Sig.
Assurance		0.356	0.079	4.521	0.000*	Accepted H_{1c}	Sig.

Notes:

The value of t-tabulated is (1.96) at $n=128$.

*Statistical significance at 0.01.

the beta value for the effect of assurance on the effectiveness of AIS was 0.356. This value indicates that the effect of assurance on the effectiveness of AIS was significant and medium. The t-value was 4.521, and the p -value was 0.000. As a result, hypothesis H_{1c} that there is a relationship between the assurance characteristic of electronic payment services systems and the effectiveness of AIS in Jordanian governmental institutions is then accepted.

Thus, by accepting the above hypotheses, it can be concluded that there is a statistically significant effect of the characteristics of electronic payment service systems on the effectiveness of AIS in Jordanian government institutions.

To test moderating hypotheses, Baron and Kenny (1986) analytical steps are used, and interactions between the moderating variable (perceived customers' uncertainty) and the characteristics of electronic payment services systems (security, reliability, and assurance) are created. In fact, the study examines the moderating role of perceived customers' uncertainty on the relationship between the characteristics of electronic payment service systems (security, reliability, and assurance) and the effectiveness of AIS, as shown in Figure 4.

Table 7 shows the results of testing moderating hypotheses H_{2a} , H_{2b} , and H_{2c} to identify the effect of perceived customers' uncertainty as a moderator variable on the relationship between the characteristics of electronic payment services systems (security, reliability, and assurance) and the effectiveness of AIS, as it is clear from the results that the value of the coefficient of determination (R^2) has reached 0.899, which is considered statistically very significant. In other words, the variance in the dependent variable explained by the independent variables and their interactions with the moderator variable reached 89.9%, and this value indicates a high quality of interpretation. The value of the beta regression coefficient for the effect of perceived customers' uncertainty on the effectiveness of AIS was -0.264 , and this value indicates that the effect of perceived customers' uncertainty on the effectiveness of AIS was

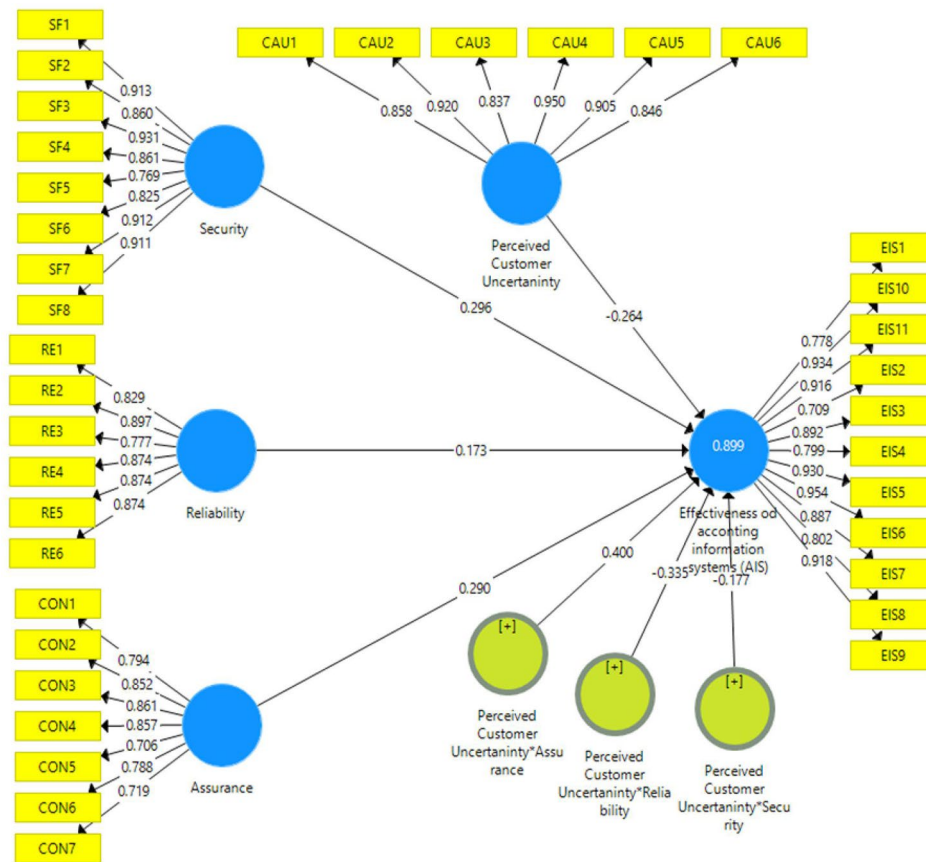


Figure 4. Testing moderation hypotheses.

Table 7. Results of testing hypotheses H_{2a} , H_{2b} , and H_{2c} .

IV	R ²	Beta	SE	TS _{CAL}	p-Value	Decision	Relation
Security	0.899	0.296	0.085	3.494	0.001*	Accepted H_{1a}	Sig.
Reliability		0.173	0.095	1.818	0.070***	Accepted H_{1b}	Sig.
Assurance		0.290	0.118	2.462	0.014**	Accepted H_{1c}	Sig.
Perceived customers' uncertainty		-0.264	0.078	-3.407	0.001*	Accepted	Sig.
Perceived customers' uncertainty*Security		-0.177	0.143	-1.238	0.216	Rejected H_{2a}	Not Sig.
Perceived customers' uncertainty*Reliability		-0.335	0.145	-2.303	0.022**	Accepted H_{2b}	Sig.
Perceived customers' uncertainty*Assurance		0.400	0.146	2.730	0.007*	Accepted H_{2c}	Sig.

Notes:

The value of t -tabulated is (1.96) at $n=128$.

*, **, and ***: Statistical significance at 0.01, 0.05, and 0.1, respectively.

negative and medium. The t -value was -3.407 , and the p -value was 0.001. Therefore, it can be inferred that there is a statistically significant effect of perceived customers' uncertainty on the effectiveness of AIS.

Furthermore, the beta value for the interaction between the perceived customers' uncertainty and security was calculated and had a value of -0.177 . This value indicates that the interaction between the two variables was negative. The t -value was -1.238 , and the p -value was 0.216. Therefore, hypothesis H_{2a} that there is a moderating effect of perceived customers' uncertainty on the relationship between the security characteristic of electronic payment services systems and the effectiveness of AIS in the context of Jordanian governmental institutions is rejected. Additionally, the beta value for the interaction between the perceived customers' uncertainty and reliability was -0.335 . This value indicates that the interaction between the two variables was negative. The t -value was -2.303 , and the p -value was 0.022. Therefore, hypothesis H_{2b} that there is a moderating effect of perceived

customers' uncertainty on the relationship between the reliability characteristic of electronic payment services systems and the effectiveness of AIS in the context of Jordanian governmental institutions is accepted.

Finally, the beta value for the interaction between perceived customers' uncertainty and assurance was 0.400, which indicates that the interaction between the two variables was positive. The t -value was 2.730, and the p -value was 0.007. Therefore, hypothesis H_{2c} that there is a moderating effect of perceived customers' uncertainty on the relationship between the assurance characteristic of electronic payment services systems and the effectiveness of AIS in the context of Jordanian governmental institutions is accepted. Collectively, these findings strongly support the theory of acceptance and use of technology and diffusion of innovation theory propositions in that a change in AIS effectiveness behavior should occur.

5. Discussion and conclusion

The current study aims to investigate the impact of security, reliability, and assurance characteristics of electronic payment service systems on the effectiveness of AIS in Jordanian governmental institutions while also examining the moderated effect of perceived customers' uncertainty in this context. This empirical research collected data using a questionnaire method, gathering perspectives from employees in accounting and financial departments who utilize AIS within Jordanian governmental institutions. Out of 213 distributed questionnaires, 128 were retrieved, resulting in a recovery rate of 60%, all of which were deemed valid for statistical analysis.

The findings confirmed a statistically significant effect of security on the effectiveness of AIS. This was attributed to the strict application of security procedures and policies, including encryption of electronic payment data and the implementation of modern programs to address viruses and backup procedures. Similarly, the study found a significant effect of reliability on AIS effectiveness, linked to policies ensuring data verification, privacy protection, and unbiased information display. These results align with previous studies by Shagari et al. (2017) and Mondal and Saha (2013).

Furthermore, the study revealed a significant effect of assurance on AIS effectiveness, suggesting that Jordanian government institutions' adoption of electronic payment services systems with robust data verification procedures and error-free policies improves AIS effectiveness. This finding is consistent with Shagari et al. (2017).

Regarding the moderation effect of perceived customers' uncertainty, the study found no moderation between security and AIS effectiveness. This was attributed to consensus in security practices within Jordanian government institutions, reflecting significant investments to address customer uncertainty. However, perceived customers' uncertainty did moderate the negative relationship between reliability and AIS effectiveness, as well as positively moderate the relationship between assurance and AIS effectiveness. These findings suggest that reducing human error risks through electronic payment systems and implementing policies ensuring data integrity enhance the relationship between assurance and AIS. These results are consistent with Fitrios (2016) and Barker and Penman (2020).

Besides the theoretical implications that support the theory of acceptance and use of technology and diffusion of innovation theory, these findings have practical implications for decision-makers and policy-makers, offering insights into enhancing the effectiveness of Jordanian governmental institutions' services through electronic payment systems adoption. Understanding the impact of electronic payment systems' characteristics on AIS effectiveness, moderated by perceived customers' uncertainty, can improve financial information accuracy and consistency, facilitating better decision-making processes. Additionally, the study provides insights on improving AIS effectiveness in the context of electronic payments, aiding in making more informed and reliable financial decisions.

However, the study has limitations, as it only examined Jordanian governmental institutions affiliated with ministries. Future research could expand the model to include other institutions, such as private and other public institutions in the Middle East and North Africa (MENA) region. Additionally, considering the impact of internal control applications on electronic payment method adoption in institutions could enrich future studies. Thus, we propose expanding the research model in future work to include the internal control applications as a control variable.

Authors' contributions

Isam Saleh: Supervision, Conceptualization, Writing – original draft, Data analysis. **Malik Abu Afifa:** Conceptualization, Data Collection and Methodology. **Abdallah Alkhawaja:** Proof, Writing – original draft and editing. **Tamim Hannon:** Writing.

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Data availability statement

Data is available upon reasonable request from the corresponding author.

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Appendix 1. Questionnaire

Section I: Personal information

Please respond to the following questions by placing a check mark (✓) in the answer box that corresponds to your response.

1. Education Level

- ☐ Diploma ☐ Bachelor's Degree ☐ Master's Degree
☐ PhD Degree ☐ Other

2. Academic Discipline

- ☐ Accounting ☐ Business Administration ☐ Banking and Finance
☐ Economics ☐ AIS ☐ Other: _____

3. Years of Experience

- ☐ 5 years or less ☐ 6–10 years
☐ 11–15 years ☐ more than 15 years

4. Job Title

- ☐ Director ☐ Deputy Director ☐ Head of Department
☐ Employee ☐ Other: _____

Section II: Study areas

Please place a check mark (✓) in the answer box that corresponds to your response.

No	Paragraph	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I. The e-payment services systems of government institutions are characterized by security.						
1	The data stored in the e-payment databases of government institutions is encrypted.					
2	There are documented procedures and policies that define the mechanism for protecting the confidentiality of data and information in e-payment services systems.					
3	There is an internal control system for preventing data tampering in the e-payment services systems.					
4	Users of the e-payment services systems are constantly educated about the latest malicious programs (viruses).					
5	Government institutions have an IT department that develops electronic systems for protection from malware.					
6	E-payment service information is backed up in an organized manner.					
7	The risks of e-payment services are continuously evaluated, addressed, and reduced by specialists.					
8	Training courses are conducted for programmers and users on e-payment services systems and the associated security issues.					
II. The e-payment services systems of government institutions are characterized by reliability						
1	There are documented policies and procedures that specify the privacy of data and information available on the e-payment systems.					
2	The information received from the e-payment system fully reflects the actual reality.					
3	The verification process for the e-payment system information is available.					
4	The information retrieved from the e-payment system is free from bias.					
5	It is easy to understand the outputs of e-payment systems.					

No	Paragraph	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
6	The validity of information from the e-payment services systems was in the substance, not the form.					
III. The e-payment services systems of government institutions are characterized by assurance						
1	There are documented policies and procedures that determine the safety and integrity of the data and information available from the e-payment services systems.					
2	Through the e-payment services systems in government institutions, the type of data entered is verified so that it does not violate the nature of the data entered in the field.					
3	Detailed reference information is specified (such as a reference number, user name, time, date, etc.) that is related to the transaction executed on the e-payment systems.					
4	Detailed data is provided from the e-payment systems to the extent that it meets the needs of decision-makers.					
5	Users of the e-payment systems are notified of the results of examining the received information by the specialists.					
6	E-payment services are checked by a third party to ensure that procedures, policies, and confidence standards are followed.					
7	E-payment services contribute to reducing the risk of human errors.					
IV. The effectiveness of accounting information systems in government institutions.						
1	Accounting information systems are linked to the organizational structure of government institutions.					
2	Accounting information shows the interrelationship between administrative activities through appropriate periodic reports that seek to achieve goals.					
3	Accounting information systems are characterized by the speed of processing data.					
4	Accounting information systems provide the ability to retrieve stored data in a timely manner.					
5	Accounting information systems provide the ability to obtain feedback.					
6	Accounting information systems perform data preparation accurately.					
7	Accounting information systems assist in reducing routine procedures.					
8	Accounting information systems reduce the effort required to perform operations (input, processing, and output).					
9	Accounting information systems provide ease of data flow between the various administrative units at government institutions.					
10	The outputs of accounting information systems influence decision-makers in government institutions.					
11	Accounting information systems have the ability to meet the needs of different administrative levels in government institutions.					

Measuring the moderating effect of perceived customers' uncertainty by determining the extent to which the government institution can predict the following:

No.	Paragraph	Completely predicted	Mostly Predicted	Moderately Predicted	Unpredictable	Completely unpredictable
1	The customer's needs for new electronic payment services.					
2	The extent to which the current payment system meets the customer's needs.					
3	Customers' preferences toward electronic payment services.					
4	Customers' tastes toward electronic payment services.					
5	Demand for or use of electronic payment services.					
6	The extent to which a new e-payment system meets the customer's needs					