



Review

The Research Trend of Security and Privacy in Digital Payment

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Abstract: The aim of this study is to synthesize the rapidly increasing literature on privacy and security risk of digital payment. By reviewing 591 studies, the literature on this topic was evaluated using a bibliographical approach to highlight the intellectual development of the field and recommend potential research directions in this still-emerging field. According to our assessment, academics have continued to focus on perceived privacy and security, while more multigroup analyses based on subdimensions of risk are needed. In addition, the vast majority of studies have not considered the inter-relationship between risk attributes. We analyse the potential causes of the lack of research diversity and provide additional suggestions to improve digital payment research in the future. This study will be valuable for academics, analysts, regulators, practitioners, and investors.

Keywords: digital payment; risk; security; privacy; mobile payment; electronic payment



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1. Introduction

The term “digital payment” refers to a paying technique in which payment data and instructions are transmitted via digital devices, such as a personal digital assistant or cellular phone. Global acceptance of digital payments has been increasing in the last year. The internet’s development in recent years has aided in the spread of this payment instrument, as new financial needs have been created by electronic commerce which were unable to be fulfilled effectively by the existing traditional payment systems. The growth can also be attributed to the economic and technological advancements of the internet, the expansion of social networking, the growth of mobile phone users, the expanded usage of electronic money, and the growing service of credit cards [1–3]. Due to the pervasiveness of smartphones today, consumers benefit from the simplicity and ease of paying for products and services via this kind of payment channel, which lowers transaction costs. Customers can also access and control their transactions remotely via the web-based user interface.

However, mobile payments are underutilised in several countries, such as China, India, Singapore, and Malaysia, where consumers choose to pay for goods and services with traditional methods [2]. According to Schierz et al. [4], only one percent of mobile phone users have used a mobile payment system. This lack of adoption could be attributed to security and privacy concerns among users. Risks of digital payment could be linked to service risk, device risk, network risk, and platform risk. For example, it has been suggested that the risk perceived among consumers of online shopping is one of the main factors that hinder its development [5]. Although digital payment services have become established

and widely used in many nations, including Japan, Singapore, and Korea, digital payments are still in their infancy on a global scale, especially in Europe [6].

Even in smart cities, the adoption of such innovative technology is still low. For example, Kumar et al. [7] reported that in the smart city Coimbatore, only 74.3% of the population uses mobile payments. The slow or low adoption of digital payment technologies could be linked to a variety of factors, including security considerations, privacy issues, usage barriers, value barriers [8], a lack of security, system complexity, and privacy concerns [9,10]. In addition, Kartika et al. [11] argued that in smart cities, it is important to improve the security and confidentiality of information in noncash financial transactions in order to promote such services. Yang et al. [12] observed that due to regulatory shortcomings in data protection, customers find it increasingly difficult to enforce their rights in e-commerce. Customers' privacy and financial worries are heightened as a result of regulatory ambiguity around mobile payments. El Haddad et al. [13] suggested that despite technology improvements, e-commerce still faces a considerable concern in terms of trust and perceived risk and their relationships with user satisfaction.

Much research has examined digital payment from a technical and user acceptance standpoint. Researchers have a diverse range of interests, including the antecedents and determinants of users' satisfaction [14,15], network operators [16], consumer acceptance [17,18], continued use behaviour [17,18], and stakeholders' expectations [19] of a variety of services, such as mobile payment, quick response code payment [20], mobile and electronic wallets [21,22], internet and mobile banking [23,24], and digital payment [25]. The study indicates that the number of authors and publications on digital payments has expanded over the past two decades. Despite the vast number of studies on digital payment variability, research on the antecedents of digital payment has produced conflicting findings [2]. It has been suggested that additional, in-depth studies on the adoption process of these tools are essential, as is active monitoring of the effects of various financial solutions on customers' perceptions and daily lives [3]. As such, it is critical to conduct a review of the existing body of knowledge.

Despite the growing number of studies on digital payments, there seems to be a scarcity of peer-reviewed research on risk perception of digital payment. A review of the existing studies on digital payment proves the presence of a variety of previously explored research themes, and the prior review studies either focus on specific aspects of digital payment, such as customer adoption behaviour [2], digital payment utilisation persistence [26], and mobile payment adoption [27]; or a specific context, such as golf counties [28], Sub-Saharan Africa [29], and Thailand [30]. Thus, this study provides an overview of the available literature and contributes to the field's enrichment and the development of future research areas. To accomplish this, a bibliometric approach is used to analyse the present state of the literature on digital payment security and privacy. This offers a thorough synthesis of the literature in this field and discusses future research directions and consequences for digital payment providers and policymakers.

Based on all of the above, the rest of the article is organised as follows. First, the research method and sample literature collection are presented. This is followed by the analysis, findings, and future research discussions. The research concludes with the limitations of our study in Section 5.

2. Materials and Methods

We thoroughly analysed digital payment literature, encompassing articles published over 22 years. The field was mapped using a systematic review that combined qualitative and quantitative methodologies [31,32]. Systematic reviews are a frequently used technique for organizing and synthesising research results. They are especially beneficial when dealing with vast and complicated research bodies, such as those in digital payment.

While narrative approaches may be beneficial, they have been criticised for their high degree of subjectivity and lack of generalizability [33,34], while systematic reviews have defined methodologies for conducting a complete literature review. The fundamental ideas

of systematic reviews are as follows: specific objectives, reproducibility, a wide and comprehensive search based on merit, hence minimising reviewer bias, and the incorporation of a synthesised technique to organise the literature [35–39].

The systematic review approach utilised in this research consisted of five steps: (1) identification of keywords and terms, (2) identification of articles, (3) quality evaluation, (4) data extraction, and (5) data synthesis. The data mining keywords were chosen based on comparable evaluations on behavioural finance [40]. Given that the purpose of this study is to perform a systematic evaluation of security and privacy issues in digital payment, phrases such as “digital payment”, “Electronic payment”, “Mobile payment”, and “Security” OR “Privacy” were used (see Figure 1). To discover all published research in the field, data mining was performed using the Scopus database. This database is often regarded as the most comprehensive, including research from a wide variety of subjects compared to other databases (i.e., Web of Science). Massaro et al. [41] suggested that Scopus is one of the largest abstract and citation databases of peer-reviewed literature. Rasel and Win [42] used Scopus database because of its broader coverage of relevant and quality publications. This database allows a search for publications with prespecified keywords, for example, in the title, abstracts, or keywords. At this point, the sample size was 2691 papers.

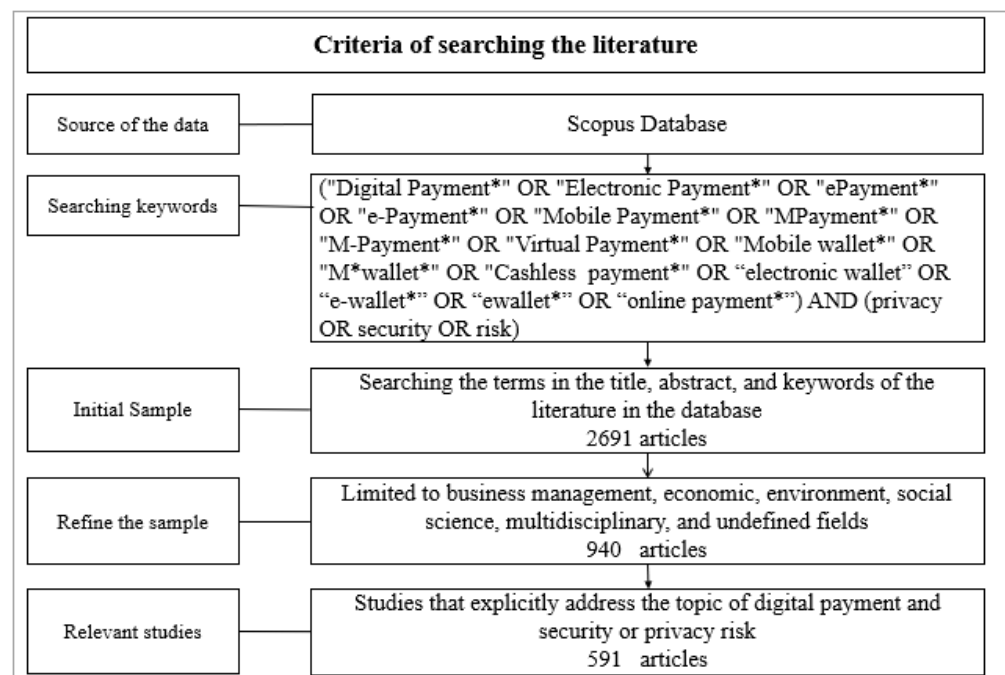


Figure 1. The flow chart of collecting the literature. Note: The asterisks such as in ‘payment*’ are used to find all derivatives of the word payment.

At this stage, any studies that were deemed irrelevant were removed from the original sample. By focusing on certain fields, namely, business management, finance, economics, environment, and social science, the number of sample studies decreased to 940 studies that fell within these fields. Titles and abstracts of these studies were screened for irrelevant research. Only studies that clearly addressed digital payment and security or privacy risk were included. Final sample included in this study is 591 documents. The sample literature was evaluated following an approach that is widely applied in similar review research [31,43,44]. The methods used in the analytical structure of this study are presented in Figure 2.

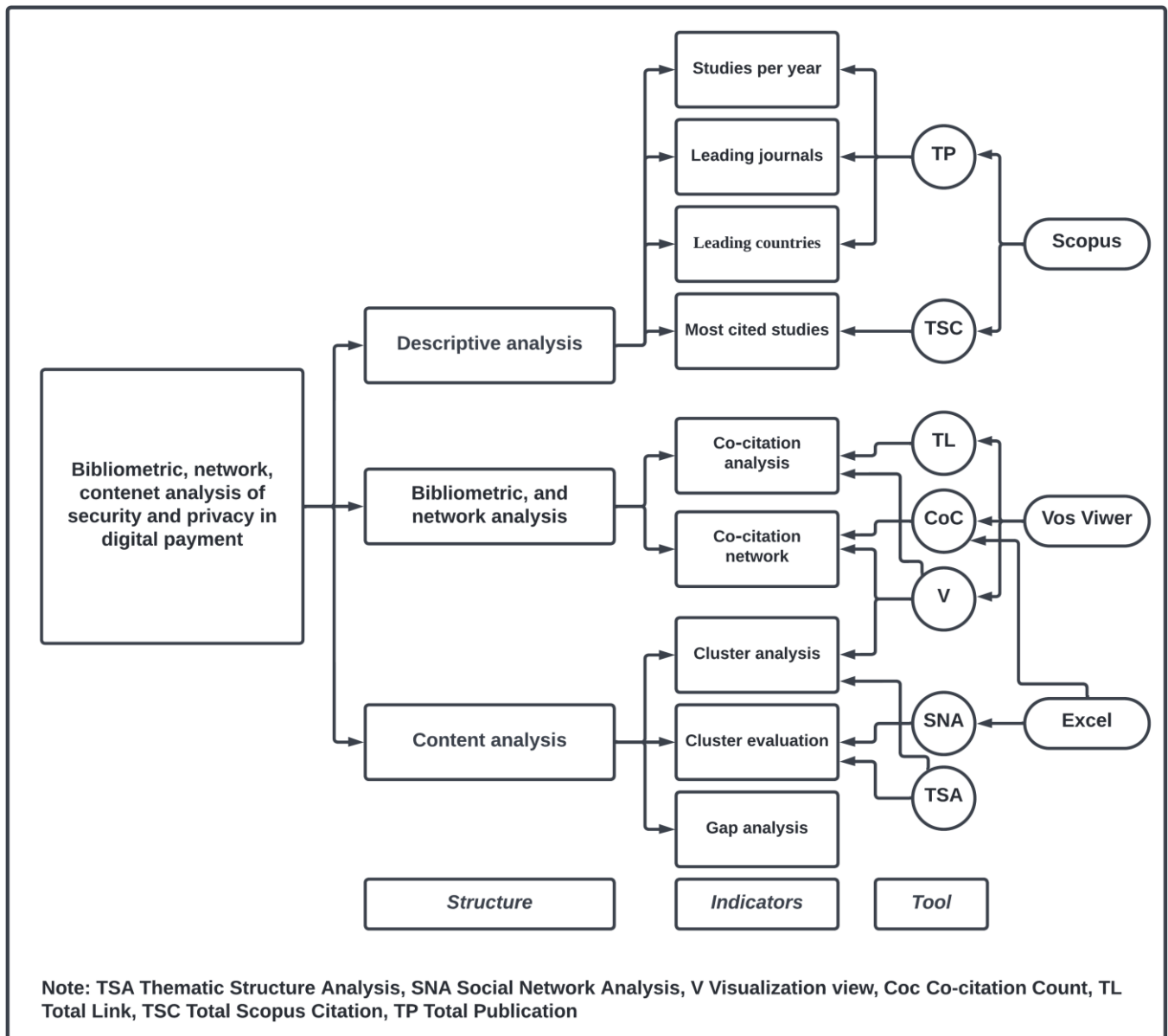


Figure 2. The analytic structure of this paper.

3. Results and Discussion

To determine the basic continuous pattern of publication on this topic, a descriptive analysis of 591 publications was conducted. The publication trend was examined in terms of total publications by journal, country, area, and year. The yearly pattern of articles shows that the interest in studying this subject has increased over the last decade as a result of technological advancements that enable more dependable, user-friendly, adaptable, and functionally rich mobile payment systems. In our sampled literature, the earliest document goes all the way back to 1989, when Bürk and Pfitzmann [45] compared the security and degrees of unobservability of different digital payment systems. Indeed, before 2016, there was limited published research, with an average of less than 10 studies each year (Figure 3). Following this, the amount of research investigating the security and privacy of digital payment steadily increased each year. The year 2021 had the most publications, with 128 articles (about 22% of publications on this topic).

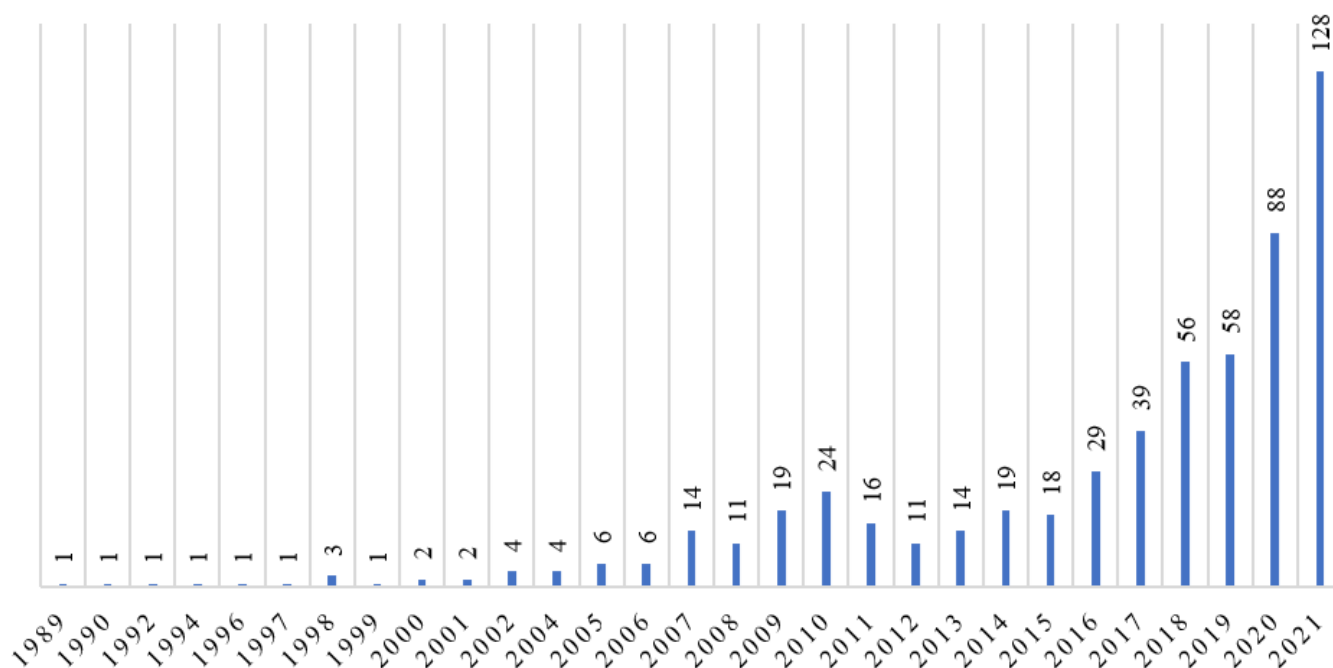


Figure 3. The number of studies per year.

3.1. Leading Countries

Table 1 summarises the contribution of existing digital payment literature by subject area (coauthored papers have been considered at multiple geographic locations). The sample studies were conducted in 80 different countries, with 48 countries contributing less than five studies and 19 countries contributing just one study. The table lists countries with more than five documents, the average year of publication, and the total citations. The results reveal that developed countries, such as China, India, and the United States, contributed the most. The average year of publication for these countries was before 2015–2018, indicating that they were the drivers of interest in investigating this topic. The growing interest in these markets was due to the continuous development of digital payment applications. For example, the development of facial recognition payment in China has led the world. However, despite the economic size of these countries and the existence of various types of digital payments, they remain mostly cash-based markets. This triggers scholars’ interest in better understanding the security and privacy concerns related to digital payment technology. It should be noted that China has contributed the most to the prevalent literature on digital payment, while African countries have contributed the least. Additionally, further work may concentrate on comparing samples from various nations based on customers’ perceptions of the adoption of various payment approaches [21].

Table 1. Countries contributed to the field of digital payment.

Country	No. Studies	Time Cited	Avg. Citations	Avg. Pub. Year	Country	No. Studies	Time Cited	Avg. Citations	Avg. Pub. Year
China	98	1262	12.88	2015.60	South Africa	11	359	32.64	2017.46
India	89	1364	15.33	2018.19	Finland	10	1231	123.10	2013.50
USA	69	2733	39.61	2015.15	France	10	623	62.30	2015.40
Indonesia	42	144	3.43	2019.48	Thailand	10	113	11.30	2017.40
Malaysia	37	432	11.68	2018.92	Pakistan	9	154	17.11	2017.11
UK	35	1082	30.91	2015.54	Saudi Arabia	9	140	15.56	2018.78
Korea	31	764	24.65	2016.94	Singapore	9	234	26.00	2017.78

Table 1. Cont.

Country	No. Studies	Time Cited	Avg. Citations	Avg. Pub. Year	Country	No. Studies	Time Cited	Avg. Citations	Avg. Pub. Year
Germany	21	953	45.38	2011.38	Viet Nam	9	72	8.00	2020.44
Spain	20	843	42.15	2017.00	Belgium	8	205	25.63	2011.63
Taiwan	20	273	13.65	2014.50	Russia	8	12	1.50	2018.00
Hong Kong	17	247	14.53	2016.29	United Arab Emirates	8	40	5.00	2019.87
Australia	13	676	52.00	2014.08	Poland	7	14	2.00	2020.43
Canada	12	124	10.33	2017.83	Iraq	6	2	0.33	2018.50
Iran	11	151	13.73	2013.91	Turkey	6	87	14.50	2015.50
Jordan	11	70	6.36	2017.91					

3.2. Leading Journals

Between 1982 and 2021, 591 articles appeared in approximately 370 journals and conference proceedings. However, 353 of them had fewer than five publications, while 276 had only one. Two aspects of each journal were analysed: first, the number of publications and citations, and the average year of publication; and second, the journals’ quality as defined by the Academic Journal Guidance (AJG) 2021. Table 2 depicts the list of the top ten active journals based on the number of publications in the area of digital payment during this period. The table also provides some material inputs, such as total citations, average citations, and average publication year. *International Journal of Bank Marketing* is the most productive journal based on total publications, i.e., 16 with a total of 471 citations and 29 average citations per article, followed by *Electronic Commerce Research and Applications* with 14 publications, 2070 citations, and 147 average citations. This indicates that citation number is based on quality rather than the number of publications. For example, with about seven publications, *International Journal of Information Management* had an average of 72 citations per document. Other quality journals in the list include *Sustainability*, *Journal of Payments Strategy and Systems*, and *International Journal of Bank Marketing*.

Table 2. Influential journals in the field of digital payment.

Journal Name	Documents	Citations	Avg. Citations	Avg. Pub. Year
<i>Int. J. Bank Mark.</i>	16	471	29.44	2016.88
<i>Electron. Commer. Res. Appl.</i>	14	2070	147.86	2011.21
<i>IFIP Adv. Inf. Commun. Technol.</i>	12	22	1.83	2015.50
<i>Sustain.</i>	11	83	7.55	2019.91
<i>J. Electron. Commer. Res.</i>	9	170	18.89	2015.89
<i>Int. J. e-Bus. Res.</i>	8	48	6.00	2017.50
<i>J. Retail. Consum. Serv.</i>	8	324	40.50	2020.00
<i>Int. J. Inf. Manage.</i>	7	507	72.43	2016.29
<i>Int. J. Sci. Technol. Res.</i>	6	2	0.33	2019.17
<i>J. Paym. Strategy Syst.</i>	6	4	0.67	2020.17
<i>J. Theor. Appl. Electron. Commer. Res.</i>	6	68	11.33	2016.67

The AJG 2021 was also used to assess the studies’ quality. It assigns a quality rating to business and management journals and ranks them as 1, 2, 3, 4, and 4*. Four with asterisk (4*) represents the highest-quality journal, while 1 represents the lowest. The AJG rating is a critical factor in researchers’ advancement in management and finance areas, and it is frequently used by researchers [31,43]. The result in Table 3 indicates that the overwhelming majority of studies on digital payment privacy and security has been published in not-ranked journals (401 studies). Surprisingly, only two studies were published in Grade 4* journals out of 591 documents. As shown in the table, scholars have been more interested in Grades 1 and 2 journal outlets.

Table 3. The rating of sample studies based on Academic Journal Guide (AJG) 2021.

Journal Grade of AJG 2021	Documents	Citations	Avg. Citations	Avg. Pub. Year
Grade 4*	2	7	3.5	2021.00
Grade 4	3	528	176	2007.00
Grade 3	29	1531	52.79	2016.51
Grade 2	67	4233	64.14	2016.05
Grade 1	89	1315	14.78	2019.38
No Grade	401	2549	6.36	2015.79

3.3. Most-Cited Studies

In this section, the citation trends of the sample literature were analysed. Citation analysis is a widely used technique for determining the significance of existing literature. Citation analysis determines the popularity of an individual publication in the body of existing literature based on the number of citations of that publication from other published studies. The initial citation analysis revealed that out of 591 documents, 134 studies had more than ten citations and 39 studies had over 50 citations. As shown in Table 4, we found that the most popular studies within sample literature had more than 150 global citations, including Schierz et al. [4] and Mallat [46], who were cited by the majority of researchers in this field. Citation analysis demonstrates the overall thematic trend in research on this topic.

Table 4. The most influential studies based on citation number.

Author/s Name	Year	Cited By	Summary of Findings	Source Title
Schierz et al. [4]	2010	594	The impacts of subjective norm, individual mobility, and compatibility are all strongly supported by the empirical findings. The impact of security is well-documented.	<i>Elect. Commer. Res. Appl.</i>
Mallat [46]	2007	494	The advantages of mobile payments differ from what adoption theories suggest and include time and location independence, availability, remote payment options, a lack of critical mass, and queue avoidance. Perceived risk, complexity, and premium pricing are among the main hurdles to adoption highlighted.	<i>J. Strategic Inform Syst.</i>
Dahlberg et al. [47]	2008	442	This study presents a framework consisting of four contingency and five competitive force variables and arranges mobile payment research around each. Contemporary studies best cover consumers’ perspectives on mobile payments as well as technical security and trust. The effects of social and cultural variables on mobile payments and comparisons between mobile and traditional payment services are all topics that have yet to be researched.	<i>Elect. Commer. Res. Appl.</i>
Slade et al. [48]	2015	320	The nonusers’ intentions to embrace remote mobile payments are highly influenced by performance expectancy, social influence, innovativeness, and perceived risk, but not by effort expectancy.	<i>Psychol. Mark.</i>
Kim, Tao, et al. [49]	2010	273	A conceptual model that identifies the factors that influence consumers’ perceptions of security and trust, as well as the impact of these factors on the adoption of e-payment systems, is proposed.	<i>Elect. Commer. Res. Appl.</i>
Thakur and Srivastava [50]	2014	265	Privacy risk and security risk are found to be significant subdimensions of perceived risk.	<i>Internet Res.</i>

Table 4. Cont.

Author/s Name	Year	Cited By	Summary of Findings	Source Title
Au and Kauffman [51]	2008	257	This study examines a new use of technology that is gaining traction globally in conjunction with the wireless revolution: mobile payments. Although this technology application is likely to have complexities and surprises, we urge the reader to keep in mind that many of the same economic dynamics will be at play as they have been in the past with other financial services and associated technology applications.	<i>Electronic Commerce Research and Applications</i>
Morosan and DeFranco [52]	2016	228	Performance expectancy was found to be the strongest predictor of intentions to use near-field communication mobile payments, followed by hedonic motives, habit, and social factors. There are a number of key consequences for academics and industrial decision-makers.	<i>Int. J. Hosp. Manag.</i>
De Kerviler et al. [53]	2016	174	Social benefits and hedonic, utilitarian, financial, and privacy threats are major drivers from the perspective of perceived value. The authors also look at the distinctions between the drivers of more common mobile buying behaviours and emphasize the importance of experience.	<i>J. Retail. Consum. Serv.</i>
Von Solms and Naccache [54]	1992	169	Blind signatures appear to be an ideal answer in light of the increased emphasis on protecting the privacy of user data and actions in electronic systems. This research, on the other hand, looks at a flaw in blind signatures, demonstrating how a perfect solution can lead to a perfect crime.	<i>Comput. Secur.</i>
Yang et al. [12]	2015	160	The main determinants of perceived risk are confirmed to be perceived service intangibility, perceived regulatory uncertainty, perceived technology uncertainty, and perceived information asymmetry, while perceived privacy risk, perceived financial risk, and perceived performance risk were found to have strong negative effects on acceptance intention and perceived value.	<i>Ind. Manag. Data Sys.</i>
Slade et al. [55]	2015	158	The extended model explains more variance in behavioural intention, but performance expectancy remains the best predictor across both models.	<i>J. Strateg. Mark.</i>

After examining these articles, we reach the conclusion that the thematic assessment that has developed in the field of digital payment research is narrow and focuses on perceived privacy and perceived security risks as determinants of consumer adoption of mobile payments [4,46]. It has been stated that privacy risk and security are significant subdimensions of the overall perceived risk toward digital payment. In this regard, a major gap is found to be the scarcity of studies on the antecedents of digital payment security and privacy risks.

3.4. Co-Citation Analysis

Bibliographic coupling is defined as the connection between two referencing documents when they refer to the same work. When two works share a large number of citations, this indicates a strong coupling. Additionally, bibliographic coupling denotes the subject matters' similarity. If the list of references contains commonly cited research, the two authors are bibliographically associated. While there are several techniques for reviewing the intellectual structure of a field, such as co-citation and citation assessment, these methods fall short of identifying emerging themes [31,43]. Bibliometric coupling overcomes this constraint by identifying contemporary topics within a domain. The pres-

ence of two publications in an article’s reference list more than once can indicate a degree of similarity in the theory, methodology, or empirical discipline of each. The link strength between two documents, supplied by VoSviewer, was used to quantify the connectivity between pair references. Van Eck and Waltman [56] suggested that this metric quantifies the strength of the connection between each pair of connected references.

The co-citation analysis revealed that there are 166 pairs of documents that have been cited together at least ten times and only 105 pairs that have been cited together more than twenty times.

As illustrated in Figure 4, the strongest co-citation relationship exists between Chen and Yang [57] and Davis et al. [58]; the link strength between these publications is 27. The former introduced the planned behaviour theory, while the latter applied it in understanding the antecedents of digital payment adoption, including perceived risk and security. As shown in the figure, the second most powerful co-citation relationship exists between Davis et al. [58] and Venkatesh et al. [59], followed by Schierz et al. [4] and Venkatesh et al. [58]. These studies mainly evaluated factors influencing the intention to utilize mobile payment [60–62] as well as a mobile wallet [63,64], based on the unified theory of acceptance and use of technology (UTAUT) [24,48], the technology acceptance model (TAM) [65,66], and the planned behaviour theory [53,67].

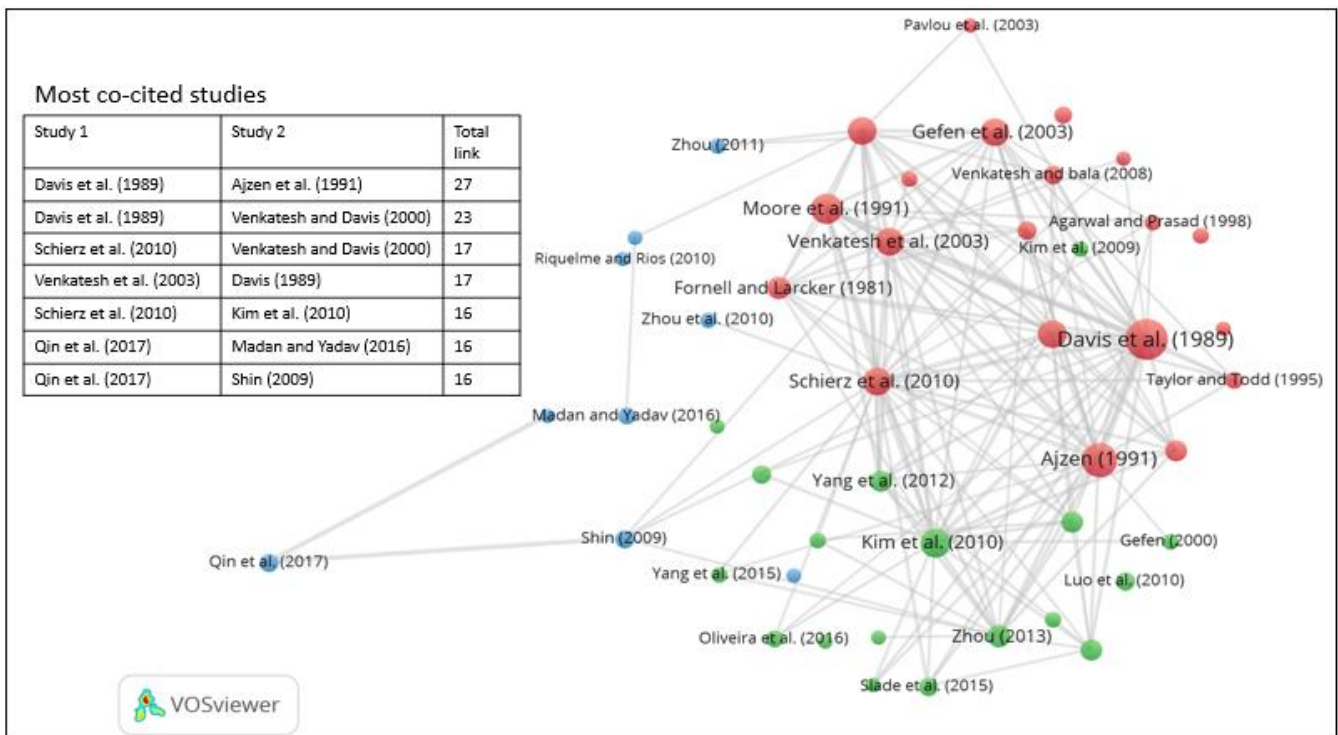


Figure 4. Document pairs with high link strengths.

4. Co-Citation Network

We analysed the evolution of clusters over time to improve our comprehension of the evolution of studies on digital payment. The evolution of clusters demonstrates the emergence and development of research subthemes in the area. Figure 5 demonstrates the number of articles published in each cluster over time. It can be deduced that earlier research was more concentrated on cluster 1 (red). We examined the references of prior research (591 studies) and discovered that the sample literature cited 23,116 unique references. The number of articles cited more than once locally was 1304, and 47 studies were cited more than ten times. The term “locally cited” refers to the number of times a reference was cited within our sample of literature. This investigation exemplifies the thematic trend in research on the security and privacy of digital payment.

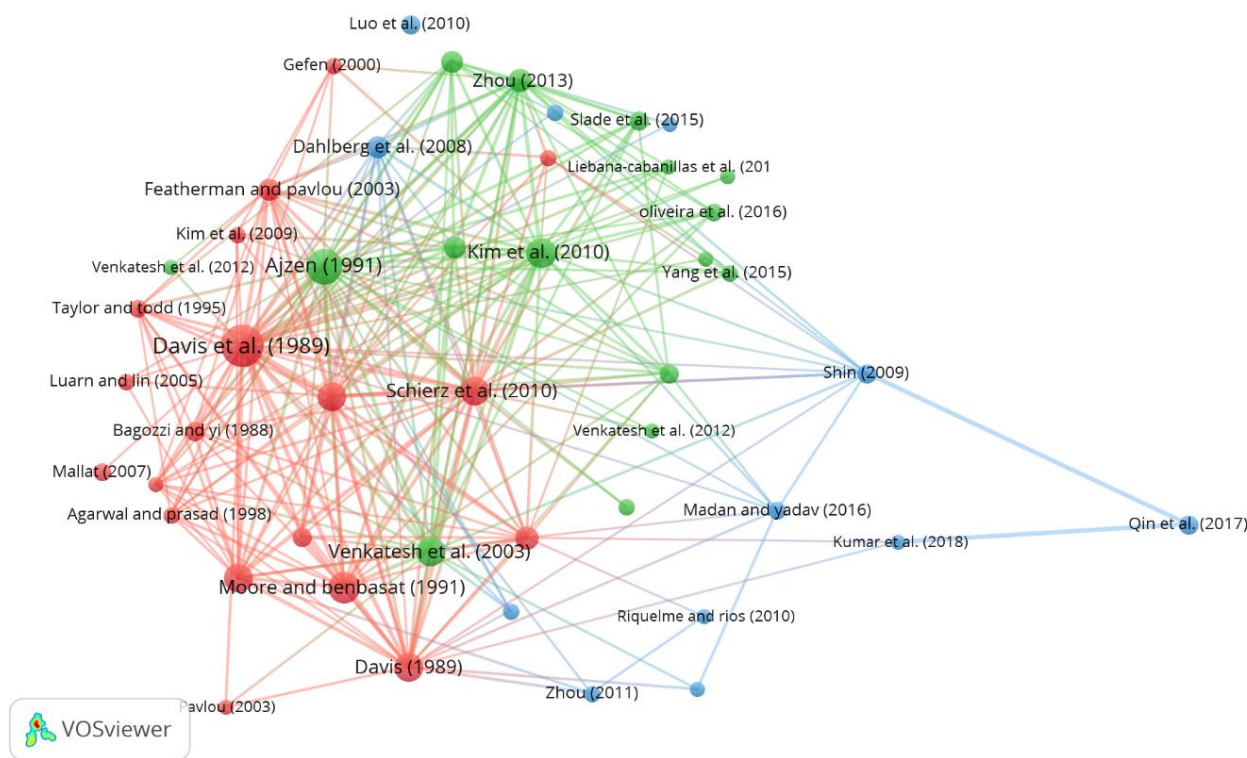


Figure 5. The co-citation network analysis.

Following an assessment of these works, we conclude that the theme series that has emerged in the area of digital payment literature is rather small, focusing on the UTAUT and the TAM developed by [58,59,68]. The research developed from the TAM was introduced by Davis et al. [58]. In this regard, it was found that there is a scarcity of theoretical lenses on the cultural aspect of digital payment users. As a result, we argue that the ontological and theoretical frameworks in the current literature do not adequately address the intricacies and complexity of digital payment. The full map was too complicated to be understood; therefore, we followed Khatib et al. [31] and limited the map to the most influential studies in each cluster based on the average number of citations. More in-depth evaluation of these clusters is presented in the following sections.

4.1. Cluster 1 (Red)

As illustrated in Table 5, this cluster is the largest within the digital payment community, with studies focusing on two primary areas: the technology acceptance model (TAM) [58,69,70] and structural equation modelling [71–73]. The TAM illustrates the relationship between perceived ease of use, attitudes, and perceived usefulness toward technological innovation and acceptance behaviour [58,69]. This model received widespread support from the literature. Pavlou [74] argued in favour of the TAM as a way to increase consumer acceptance of electronic commerce. Additionally, the TAM was enhanced by incorporating subjective norms, individual mobility, and compatibility, which were statistically significant in the model [4]. Luarn and Lin [18] provided compelling evidence that the extended TAM is effective at forecasting users' intentions to adopt mobile banking. Researchers advanced the technology acceptance model by introducing TAM2 [59] and TAM3 [70]. It has been suggested that the TAM explained only 40–60% of customer behaviour intention, leaving nearly half of the relative factors unaccounted for.

Table 5. Summary of studies in cluster one.

Author/s	# GS Citations	Focus of the Study	Summary of the Findings
[75]	4030	The antecedents of new information technologies adoption	Only compatibility implies a considerable modification in the work behaviour of a potential adopter.
[72]	45,132	Reviewing structural equation modelling in practice	It provides guidance to substantive scholars on the use of structural equation modelling for theory building and testing.
[73]	28,578	Structural equation models	The technique comprises a concerted effort to reconcile what are referred to as objective and subjective norms.
[71]	84,340	Structural equation models	This study builds and implements testing systems based on the measurement of shared variance within the structural model to determine the explanatory power of a model.
[76]	9375	TAM	Customer trust is just as critical to online commerce as the well-established TAM usage determinants of perceived utility and perceived ease of use.
[74]	6918	TAM	The suggested model incorporates both trust and perceived risk, which are necessary considerations in light of the implicit uncertainty inherent in the e-commerce context.
[51]	699	Mobile payments	This study stresses the roles of innovators and consumers of mobile payment services, sellers and network intermediaries, as well as government regulators and standards bodies, all of which are relevant to a range of issue areas.
[46]	1245	The adoption of mobile payment	Mobile payment acceptance is shown to be dynamic and dependent on contextual variables, such as a lack of other payment options or a sense of urgency. Factors such as perceived risk, lack of critical mass, complexity, and premium cost also have a significant effect.
[58]	31,696	Computer technology acceptance	Perceived utility significantly influences people's intentions. Perceived ease of use shows a small but substantial influence on intentions. Subjective norms have little effect on intentions. Only a part of the influence of these beliefs on intentions is mediated by attitudes.
[69]	63,961	User acceptance of information technology	Correlations between usefulness and behaviour are much stronger than those between ease of use and behaviour. Perceived ease of use may be a causal antecedent of perceived usefulness.
[77]	3185	E-service adoption	Adoption of e-services is hurt mostly by performance-related risk perceptions, and perceived ease of use of the e-service reduced these risk worries.
[78]	997	The initial trust in mobile banking and intention to use	The firm's overall reputation was insufficient to persuade customers to use mobile banking. The proportional benefits, trust proclivity, and structural guarantees have a significant impact on early trust in mobile banking.
[18]	2516	Factors determining users' acceptance of mobile banking	The data demonstrate that the extended TAM is highly predictive in anticipating customers' intentions to utilise mobile banking.
[79]	11,821	The adoption of information technology innovation	The study creates a tool for assessing an individual's different viewpoints for accepting a breakthrough in information technology.

Table 5. Cont.

Author/s	# GS Citations	Focus of the Study	Summary of the Findings
[4]	1379	Mobile payment acceptance	The findings corroborate previous research indicating that compatibility, individual mobility, and perceived standard all have an effect on mobile payment acceptance.
[80]	11,470	Information technology usage	By concentrating on the characteristics that are most likely to affect system usage via both design and implementation tactics, the deconstructed theory of planned behaviour gives a more comprehensive account of behavioural intention.
[70]	6805	Extending of technology acceptance model into TAM3	The initiative built a comprehensive nomological network for information technology uptake and use of TAM3.
[59]	23,706	Extending the boundaries of the technology acceptance model into TAM2	Both cognitive instrumental processes (reported ease of use, demonstrability of results, output quality, and work relevance) and social influence processes significantly affect user approval (image, voluntariness, and subjective norm).

Note: GS, Google Scholar.

However, the TAM focuses on the positive aspects of a consumer's perspective when it comes to adopting new technology, and there are several factors (i.e., emotional, external, or environmental factors) ignored by this model and its extensions. Legris et al. [81] claimed that earlier research on this model is not entirely consistent and clear, and that crucial components are not included in the model; they must be incorporated into a bigger one that includes variables relating to both individual and social transformation processes. Similarly, Chuttur [82] concluded that the model lacks sufficient and rigorous research and that, despite its widespread use, there is disagreement about its theoretical assumptions and practical usefulness. Other user qualities (emotional, cognitive, and demographic elements) have been proposed to be taken into account as well, since they may function as a moderator of the link between TAM variables and technology acceptance.

4.2. Cluster 2 (Green)

Cluster 2 addresses the theme of digital payment adoption from a planning and behaviour perspective introduced by Ajzen [57], who proposed that perceived behavioural control and attitudes toward the behaviour subjective norms can predict intentions to perform different behaviours and that these intentions, in combination with perceptions of behavioural control, account for a substantial amount of variation in actual behaviour. As presented in Table 6, studies in this cluster have primarily evaluated the trust and risk that formulated the attitude of technology users addressed in the planned behaviour theory. Based on the framework of this theory, Venkatesh et al. [83] developed the unified theory of acceptance and use of technology model; it comprises four primary drivers of intention and usage and four important relationship moderators. This trend of studies highlights the same gap in the literature: customers' attitudes toward digital payment may be significantly influenced by individual cultural differences. The UTAUT2 was introduced by extending the unified theory of acceptance and use of technology [84], while other scholars evaluated the consumer acceptance of mobile wallets [64], mobile payment [50,85], and mobile banking [23] to predict the acceptance, adoption, and use of information technologies.

Table 6. Summary of studies in cluster 2.

Author/s	# GS Citations	Focus of the Study	Summary of the Findings
[57]	97,385	The planned behaviour theory	Subjective norms, perceived behavioural control, and attitudes are all tied to suitable sets of salient behavioural control and normative beliefs about the activity, but the exact form of these beliefs is uncertain.
[86]	447	Literature review	Scholars have continued to focus on specific themes (particularly customers' acceptance and technology elements).
[83]	36,128	UTAUT	The authors develop the UTAUT as a complete model.
[87]	891	UTAUT2	Performance expectation, effort expectancy, trust, price value, and hedonic motivation all have a large and beneficial effect on behavioural intention. Additionally, this study aims to provide Jordanian banks with suitable standards for adopting and developing mobile banking successfully.
[84]	9793	Introducing UTAUT2	The extensions presented in UTAUT2 resulted in a significant increase in the variation explained by behavioural intention (from 56% to 74%) and technological usage (from 40% to 5%).
[88]	1392	The drivers of intention to use mobile payment	Compatibility with existing payment systems is not a significant factor in users' choice to accept it. Perceived simplicity of use and perceived usefulness are significant predictors of intention to utilise m-payment.
[89]	418	To assess the relative significance of several elements in the adoption of a new system of mobile payment	The user's age introduces significant changes in the proposed links between third-party effects and the payment system's ease of use, between perceived trust in the system and its ease of use, and between perceived trust and a favourable attitude toward the payment system's use.
[90]	219	The acceptance of mobile payment in virtual social networks	The suggested behavioural model was changed accordingly, demonstrating that prior experience improves the likelihood of use.
[91]	828	The determinants of customer adoption and intention to recommend mobile payment	Social influence, innovativeness, performance expectations, perceived technical security, and compatibility are all expected to have a major indirect and direct impact on mobile payment acceptance and the intention to suggest these technologies.
[55]	294	The possibility of a new customer technology adoption paradigm, as well as its extension with trust and risk frameworks	Although the extended model explains a greater proportion of the variance in behavioural intention, performance expectancy remains the greatest predictor in both models.
[50]	467	To investigate the functional link between mobile payment usage intention, perceived risk, and adoption readiness	When the proposed model was evaluated, five of the six hypotheses were found to be fully supported, while one was found to be moderately supported. The invariance test revealed significant variation between users and nonusers.
[84]	9158	UTAUT2	In comparison to UTAUT, the extensions offered in UTAUT2 resulted in a significant increase in the variation explained by behavioural intention (from 56% to 74%) as well as technological use (40 percent to 52).
[85]	703	The drivers of mobile payment adoption	While personal characteristics, social influence, and behavioural beliefs all play a role in determining mobile payment service acceptance and use, their effects on behavioural intention vary throughout stages.

Table 6. Cont.

Author/s	# GS Citations	Focus of the Study	Summary of the Findings
[12]	341	How diverse uncertainty leads to distinct perceived risk dimensions, which impede mobile payment adoption	Perceived service intangibility, perceived regulatory uncertainty, perceived information asymmetry, and perceived technological uncertainty have all been confirmed as significant predictors of perceived risks, whereas perceived privacy risk, perceived financial risk, and perceived performance risk have all been shown to have a significant negative impact on perceived value and acceptance intention.
[92]	841	Continue to use mobile payment	The primary factor determining trust is the quality of the service, but the primary factor affecting satisfaction is the quality of the system. The quality of information and services has an effect on flow. Trust, flow, and contentment all contribute to the intention of mobile payment users to continue using it.
[23]	1592	UTAUT and task technology fit model	Social influence, task technology fit, and performance expectations all have a substantial impact on user adoption. The match of task technology with performance expectations has a substantial effect.

Similar to the findings of the cluster 1 studies, researchers in this cluster concentrated on customer acceptance of digital payments, while paying less attention to merchant adoption. Nonetheless, consumer adoption (as defined by the aforementioned models) has remained a highly-researched area of study. However, the publications' findings on certain variables remain equivocal. According to Oliveira et al. [91], all factors of social impact, innovativeness, performance expectations, perceived technology security, and compatibility exert a substantial indirect and direct effect on mobile payment uptake and the desire to suggest this technology. However, in a ground-breaking study conducted by Kim et al. [88], all respondents said that compatibility was not the key factor in their decision to use mobile payment. Additionally, reputation of the platform and firm is a strong predictor of customer trust in digital payments [93], although Kim et al. [78] observed that reputation as a corporate trait did not attract individuals to mobile banking. This inconsistency may be explained by the fact that the needs and expectations of adopters differ significantly across user groups. As a result, scholars must strive to balance the varied interests of various groups of individuals. Hence, service providers can tailor their offerings to fit the task requirements of various groups, hence increasing user adoption of technology innovation [23]. Furthermore, adoption models may need to be adjusted to account for country-specific differences [94]. Kim et al. [78] reported that an individual's disposition to trust is shaped by their cultural upbringing. Countries' successes or failures in adopting mobile payments vary according to their infrastructure, urban–rural disparities, and regulatory synthesis between the banking and telecommunications sectors.

4.3. Cluster 3 (Blue)

Cluster 3 is the smallest one in the sample literature that takes the research a step further by focusing on security and privacy risks [10,95–97]. Customer privacy and security are essential factors in digital payment applications which aim to give customers confidence in the application company by maintaining privacy and security on every element of the customer. Consumers face substantial vulnerabilities in online settings, including identity theft and information exploitation. For example, businesses may utilise consumers' data for marketing reasons without their agreement or even disclosure. This is unsurprising, given that a person's online distinctive and valued identity is comprised of a combination of financial and personal data. Risk perception is a significant predictor of acceptance of novel technologies. It has commonly held in the literature that perceived security and

privacy are both expected to have a major indirect and direct effect on mobile payment acceptance and the intention to use this technology [91,95,97–99]. Khalilzadeh et al. [100] argued that risk and security have the most substantial impact on the behavioural intention of customers toward digital payments. Luo et al. [96] found that eight different risk facets, including privacy and security, are salient antecedents to innovative technology acceptance. However, short message service, rapid response code, magnetic security transmission, and near-field communication systems can be employed for digital payment. The question remains whether risk perception toward different payment systems are different. For example, Ghezzi et al. [101] suggested that mobile payment solutions must deal with more privacy and security issues than in e-commerce and electronic payment.

Regarding security and privacy, as shown in Figure 6, various research works have approached it from the behavioural aspect of customers and it has been found to have significant impact (direct/indirect) on intentions to use and recommend digital technologies [91,102]. As past studies have demonstrated, trust can thrive and is necessary via the internet while dealing with an unpredictable and unsafe environment. In retail situations, trust between the trustor (a customer) and the trustee (a seller) is a significant incentive, since it improves repurchase intention and minimises perceived risk. In general, users are comfortable sharing generic and nonspecific information such as preferences but are less comfortable supplying sensitive information, such as account or credit card details. Additionally, whether or not clients transfer personal and financial data online is contingent upon their faith in a particular online supplier.

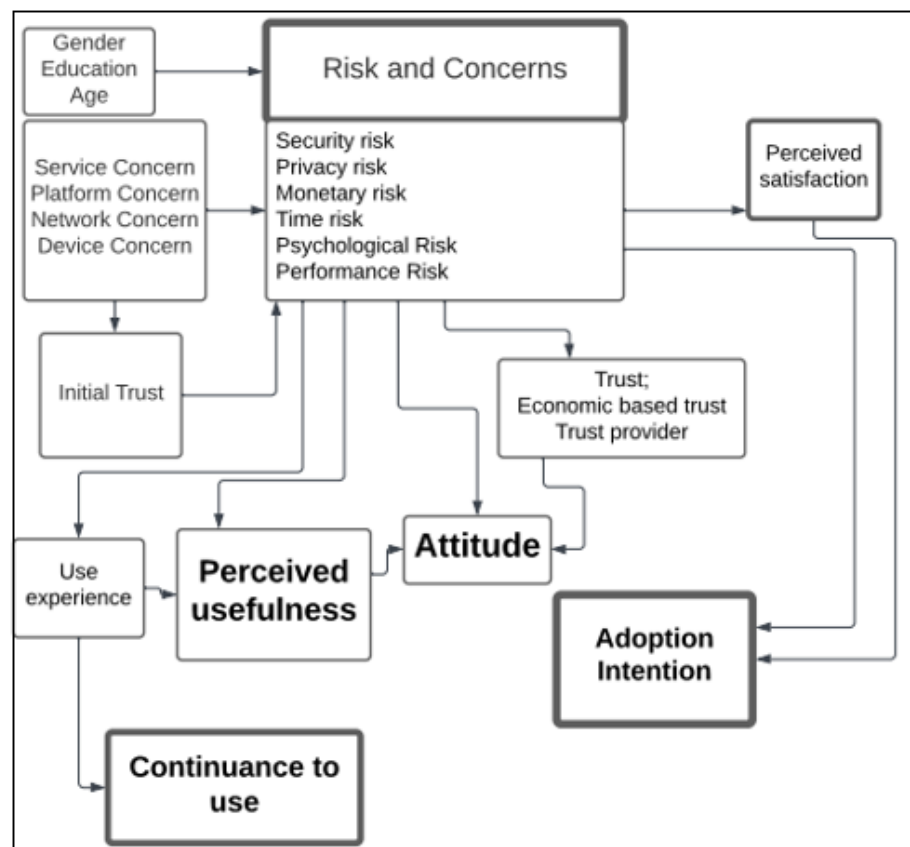


Figure 6. The determinants and consequences of risk.

As summarised in Table 7, researchers in this cluster have examined a variety of issues affecting mobile payment service markets [47,101], developing frameworks that take into account all players [51]. Academia appears to be restricted in terms of what technological benefits it can provide practitioners, except firms engage academic researchers

aggressively. According to the report, confidence in a payment vendor, service provider, institutional context, and technology component has a significant role in forming trust in services [76,103]. Diverse payment scenarios previously required physical tokens and their combinations, network traffic algorithms based on software, trust, and creation of various securities. This is perhaps the most fertile ground for collaboration and academic study. Lu et al. [103] established a model of client decision making based on trust in the setting of nonindependent third-party mobile payment services.

Table 7. Summary of studies in cluster 3.

Author/s	# GS Citations	Focus of the Study	Summary of the Findings
[47]	1060	Mobile payment	The paper provides a paradigm comprised of four unforeseen and five competing force elements.
[101]	101	The drivers of mobile payment applications	The case studies aided in the comprehension of the primary diffusion drivers: Despite the numerous benefits associated with these services, severe inhibitory factors and adoption barriers continue to limit user uptake.
[103]	698	The usage intention of mobile payment	Trust, in conjunction with positive and negative valence variables, has an effect on behavioural intention both directly and indirectly. These effects on employees and students have considerably varying magnitudes.
[104]	209	The usage intention of mobile wallets	Social influence, performance expectancy, enabling circumstances, perceived value, perceived risk, PRS, and PBS are recognized as significant predictors of behavioural intents to use mobile wallet systems, whereas effort expectancy is identified as a statistically insignificant predictor.
[91]	828	The adoption intention of mobile payment	Social influence, performance expectations, innovativeness, compatibility, and perceived technological security are all predicted to have a significant impact on mobile payments acceptance and the desire to suggest these technologies, both directly and indirectly.
[105]	297	Mobile payment compared to others	Factors have stymied technical and commercial development through the use of a decision support system based on the Electre I multicriteria decision making process.
[98]	244	The usage intention of mobile payment	Individuals' intentions to utilise m-payment services are favourably influenced by perceived security, visibility, relative benefit, and ease of use. Additionally, trialability and ubiquity have a good effect on an individual's impression of security, but concerns about privacy issues have a negative effect.
[100]	373	The usage intention of the mobile payment restaurants sector	Compared to the original model of UTAUT, the suggested model has roughly 20% predictive accuracy and higher explanatory powers. This provides compelling evidence for the impacts of trust, security, and risk on consumers' willingness to adopt NFC-based MP technology in restaurant settings.
[95]	110	The use of m-wallets	Perceived utility and perceived simplicity of use have a substantial effect on user satisfaction and desire to use m-wallets in the future. Perceived security has a considerable influence on customer happiness, while grievance resolution mitigates the influence of perceived security on the desire to continue using m-wallets.

Table 7. Cont.

Author/s	# GS Citations	Focus of the Study	Summary of the Findings
[97]	1352	The usage intention of internet banking	The findings corroborate several of UTAUT's hypotheses, including performance expectation, social influence, and effort expectancy, as well as the importance of risk as a greater predictor of intention.
[10]	53	Mobile wallets	We then provide a novel approach to secure mobile wallets and protect the privacy of mobile users by incorporating digital signature and pseudoidentity techniques.
[99]	791	The usage intention of mobile banking	The factors that have the most influence on people's willingness to use mobile banking services are social risk, social norms, and utility. When it comes to their sense of usefulness, female respondents were more impacted by ease of use than male, while male respondents were more influenced by relative advantage.
[21]	138	Satisfaction with mobile wallets	There is a strong correlation between mobile wallet users' perceptions, preferences, and satisfaction. Additionally, the data demonstrate the effect of consumers' perception, happiness, and preference on mobile wallets adoption in India.
[106]	561	The usage intention of mobile banking	Initial trust is mostly determined by structural assurance and information quality; however, perceived utility is greatly influenced by information quality and system quality. Initial trust has an effect on perceived usefulness, and both variables are associated with the desire to utilise mobile banking.
[96]	1271	Emerging IT artefacts	Risk perception, which is comprised of eight distinct dimensions, is a significant predictor of new technology uptake. Apart from previous research, the findings give empirical support for the use of personal characteristic variables in assessing the adoption of developing IT artefacts.
[64]	748	The validation of a complete consumer acceptance model of mobile payment	The model validates the conventional function of technology adoption factors. The users' attitudes and intentions are impacted by perceived security and trust. Demographics have a significant moderating influence on the correlations between the variables, as demonstrated by the extended model.

5. Discussion and Future Research

This section provides critical discussion on the topic and provides suggestions for future research. A large number of studies on digital payment have discussed it from the technical and user acceptance and adoption standpoints, with some attention to perceived security and privacy risks. In line with the common theories (i.e., the TAM and the UTAUT), it has been reported that perceived security has a positive effect on behavioural intention [102], while the effect is negative for perceived privacy [13,102]. Despite this contradiction in the direction of the relationship between subattributes of risk, some studies used risk as a general construct in their research model [102,107–109]. Hence, future work might extend the existing models through multigroup analyses based on subdimensions of risk, including service-related risk, platform-related risk, network-related risk, and device-related risk. Additionally, cultural differences could be another driver of contradictory findings of prior studies. Kim et al. [78] reported that an individual's disposition to trust is shaped by their cultural upbringing. Dahlberg et al. [47] also suggested that social and

cultural variables might have a significant effect on digital payments adoption. In this regard, customers who espouse cultural values of uncertainty avoidance would have a strong intention to use digital payments services, reducing the uncertainty of the usage of digital payment services, which would also reduce the fear of information security breaches. Moreover, consumers from low-uncertainty-avoidance cultures are likely to take more risks compared to individuals from high-uncertainty-avoidance cultures. According to several studies, culture plays an important role in the adoption of new technologies [25].

In addition, individuals in smart cities are reported to have limited adoption of digital payment for security and confidentiality concerns [11]; future research, therefore, could evaluate the security assurance and confidentiality of financial technology transactions as they are proportional to the user's convenience and the availability of the service itself. Furthermore, the complex inter-relationship between risk attributes that consequently influence individual behaviour is still unclear. For instance, Morosan and DeFranco [52] reported that perceived security influences the general privacy perception, while El Haddad et al. [13] reported this association through perceived financial fears. In addition, other studies [102,107,108] did not consider the inter-relationship between risk attributes. We therefore argue that understanding the inter-relationship between risk attributes can be another area of interest in further research.

Moreover, some prior studies evaluated the antecedents of digital payment risk, such as quality [109], ease of use [13], technology risk [110], software awareness [110], financial incentives [108], and Fintech service knowledge [111]. There are several factors that influence risk perception yet to be examined, such as reputation, as users may depend on belief indicators such as reputation to establish their initial trust in digital payment providers, and the consideration of financial transaction service providers to explore models of service improvements that comply with government rules or international standards to enhance compliance and information security culture. Furthermore, whilst the majority of studies concentrated on retail, concern and risk will differ depending on the industry. This is a critical topic for future research.

6. Conclusions

Globally, the proliferation of mobile phones has paved the way for digital mobility systems that benefit a variety of organisations. To strengthen the field of digital payments security and privacy, it was necessary to conduct a literature assessment and become aware of knowledge gaps, thereby defining an agenda for researchers and practitioners. Thus, this study updates a previous review of the literature published in Scopus-indexed journals to assess the field's intellectual development. The investigation adds to the literature by making the following significant findings: (1) China contributed the most to the prevalent literature on digital payment risk, while African countries contributed the least. (2) Because digital payment research has primarily focused on the unified theory of acceptance and use of technology and the technology acceptance model, these findings highlight a research gap in that there are few theories addressing the cultural aspects of digital payment users. Thus, we conclude that the theoretical and ontological frameworks available in the current literature do not adequately address the nuances and complexities of digital payment. (3) Numerous studies have examined digital payment from both a technical and user acceptance standpoint. Researchers have a plethora of topics to choose from when it comes to the antecedents and determinants of digital payment risk.

For practitioners, our study summarises and organises existing research findings according to a set of criteria. We also offer a comprehensive framework for digital payment risk, highlighting the factors that must be taken into consideration when developing digital payment services. According to our review, practitioners should direct technical development toward increased collaboration with consumers and merchants. Additionally, our findings indicate that in order for mobile payment services to flourish, their business models must develop away from exclusive proprietary solutions and toward cooperative and standardised solutions. Newly added technological drivers draw the attention of

merchants toward the influence of technology and its skilful usage on adoption behaviour. Newly added strategic activities of addressing security and privacy concerns makes a case for the importance of innovative-technology-related risk in customers' adoption.

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