

ORIGINAL RESEARCH

Smart city technologies from the perspective of technology acceptance

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Abstract

Most studies in the literature aim to discuss and examine the technologies in smart cities. Much less is known about the dynamics of their acceptance by citizens. Therefore, we conducted a systematic literature review of studies examining the acceptance of smart city technologies (SCTs), focussing particularly on Technology User Acceptance Models (TAM). Using a novel framework of SCTs based on the technology visibility and citizen interaction, we categorise them as individual-based explicit SCTs, collective-purpose explicit SCTs, digitising SCTs, and infrastructure SCTs. We assess that studies about citizen acceptance of SCTs have been mainly focussed on individual technologies. Also, the review shows that the field is nascent and fragmented, and that a wide variety of variables have been used to predict the adoption of individual-based explicit SCTs, with the classic ones of TAM (perceived use and perceived usefulness) unmistakably being relevant in the smart city context as well. As a result of the fragmentation of the field, our review was not yet able to identify generalisable knowledge about the acceptance of the smart city and its technologies by citizens. We end with some suggestions for future research approaches and designs.

KEYWORDS

citizen perspectives, smart city, systematic literature review, technology acceptance

1 | INTRODUCTION

As an urban innovation [1], the concept of smart cities has been getting more attention from academics as well as practitioners [2, 3]. However, there is no consensus in the literature about the definition of a smart city and the definitions vary according to the interpretation of ‘smart’ [4]. Even though smart cities do not only stand for technology solutions [5], smart cities mostly rely on intelligent technologies to be considered as smart [6]. Also, in practice different cities calling themselves smart, feature different technology-enhanced services based on the needs and resources of the particular business and government configurations in a city. Increasingly, citizens emerge as key stakeholders in the further development of smart cities, again in a variety of forms. As various authors have shown, citizens have become an important part of policy discourse, as expressed in terms like ‘human-centred’ [7] or ‘citizen-centric’ smart cities [3]. Simultaneously, bottom-up civic smart initiatives become ever more

wide-spread, for instance in citizen-science groups, neighbourhood platforms or arts and technology collectives [8]. Yet, there is relatively little work about citizens as users of smart city technologies. Partly, this will be because some SCTs are unobtrusive, such as water and infrastructure management and the public are unaware about their existence and cannot engage actively in their deployment [6]. Partly, other SCTs (for instance managing traffic flows or public transport) operate outside of the realm individual adaptation or rejection. Nevertheless, there is a considerable range of SCTs that require acceptance and usage by citizens to grow and contribute to smart city goals and strategies, for instance e-government services, sharing platforms, or neighbourhood apps. As the smart city concept strongly depends on the adoption of technology [9], a deeper understanding is needed whether the dynamics are different for the acceptance of different SCTs.

In other contexts, the Technology Acceptance Models (TAM, [10]) have already proven to offer solid ground for

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identifying the factors influencing the perceived usefulness and perceived ease of use of particular technologies. In the smart city literature, TAM models are gaining traction as well and there is an urgent need, both for academic and societal purposes, to acquire a systematic understanding of the context and factors influencing citizen acceptance of SCTs, and of how such acceptance may differ depending on the particular technology at stake and citizens involved. In the following sections, we will first examine the smart city technologies in more detail and discuss the TAM approach. This will result in three research questions that we will try to answer through the systematic literature review. We then discuss the methodology of our review, after which we will present the results and reflect on them.

2 | BACKGROUND

2.1 | Key enabling smart city technologies

Even though there is not a consensus about the definition of smart cities, most definitions emphasise the use of information and communication technologies (ICT) to improve citizens' quality of life [11, 12]. Ref. [13] makes an analogy between humans and smart cities. While the control centre of a smart city is the brain, the inputs to the smart city systems are like the senses, and the body of smart cities refer to both infrastructures and ICT platforms. Smart city technologies (SCTs) provide efficient services for residents like energy and water supply, urban infrastructure, and transportation [14]. In other terms, they nudge citizens towards living a smart lifestyle [15]. Mainly, smart city technologies rely on interactive and internet-based applications that produce actionable data for urban stakeholders [16]. There are different approaches to classify these technologies, but none of them has been widely adopted in academics or in practice [16–19]. Moreover, these classifications are mostly based on the perspective of engineers and suppliers, and tend to ignore the perspective of users [3]. Reichental (2020) underlines that, cities are culturally situated and defined by human experience. Therefore, cities need to be approached as 'smart' not only from the perspective of the technologies they deploy, but also from its contribution to the quality of life of people living in those cities [20]. In terms of smart city services, the importance of people-centric services has been acknowledged in the academia [21]. However, a classification of SCTs enabling the services that starts from citizens' positions and perspectives on which the acceptance depends is absent.

We propose that from a citizen perspective, we can categorise SCTs based on their explicitness and citizen interaction. Explicitness refers to whether the technologies are explicit and easily noticeable for citizens. Interaction refers to the degree of citizens' engagement that these technologies need or allow for. These dimensions produce a 2×2 framework of SCTs as illustrated in the Figure 1. This categorisation helps us to clearly see the distinction between different SCTs from the perspective of citizens. It also helps to see which technologies are subject to citizen acceptance, and which ones are not part of their possible engagement or outside their realm of decision

making. It thus directs our literature review to specific smart city technologies that citizens can accept or not, rather than to the whole assemblage.

We call explicit SCTs which require high citizen interaction, such as smart health care devices, as individual-based explicit SCTs. The growing incidences of lifestyle diseases, sedentary lifestyles, and busy work schedules push people to use these devices and they may choose among the alternatives offered in various price ranges based on the features [22]. By considering e-scooters as another example in this category, individuals may prefer to use them rather than taking a personal car or using public transportation to get to their destination [23]. Since the decision to use the SCTs in this category is up to the individuals, individual factors contribute to use intention in addition to the perceptions of the technology and demographic information [24].

We name explicit SCTs which do not require citizen participation in the decision to use these technologies as collective-purpose explicit SCTs. To clearly distinguish this category from the previous one, we can refer to the implemented technologies for the benefits of citizens. Of course, the citizens interact with them, but this interaction is limited. They don't choose among alternatives. So, in this category, individuals are not decision makers. Even though they collect public opinions, mostly, local governments decide to establish SCTs to create collective benefits. Nowadays, several hundred million cameras are installed in public and private environments and surveillance technologies are increasingly used to prevent or detect crimes and to improve security [25]. It is important to note that smart urban safety requires individual intuitions regarding personal safety as well as collective responsibilities such as keeping an eye on each other [26]. Surveillance technologies, for instance, can be considered as collective-purpose explicit SCTs that contribute to the collective responsibilities of cities for urban quality of life. Moreover, if individuals perceive benefits in the implementation of these SCTs, the surveillance acceptability is increasing [27], they become voluntary participants [28] and encourage surveillance practices [29].

In contrast to explicit SCTs, implicit ones cannot be noticed easily by the citizens, but they contribute to the quality of urban life. They can be classified further according to the citizens' interaction. When we think about water level management systems, they are Internet of Things based systems implemented to monitor the condition of the water level and provide early warnings for floods and landslide [30]. These technologies do not require active interaction of citizens and they contribute to the urban quality of life even if they are installed implicitly by the local governments. Thus, we call these technologies as infrastructure SCTs.

The last category of SCTs is implicit ones with high citizen interaction. Augmented reality applications can be considered as an example for this category. These applications create virtual environment complementary to the real life and require additional devices to interact with it. They can be used to improve the user knowledge of nearby locations, an essential aspect in Smart City contexts [31]. When we consider the use of additional devices that make these technologies implicit and

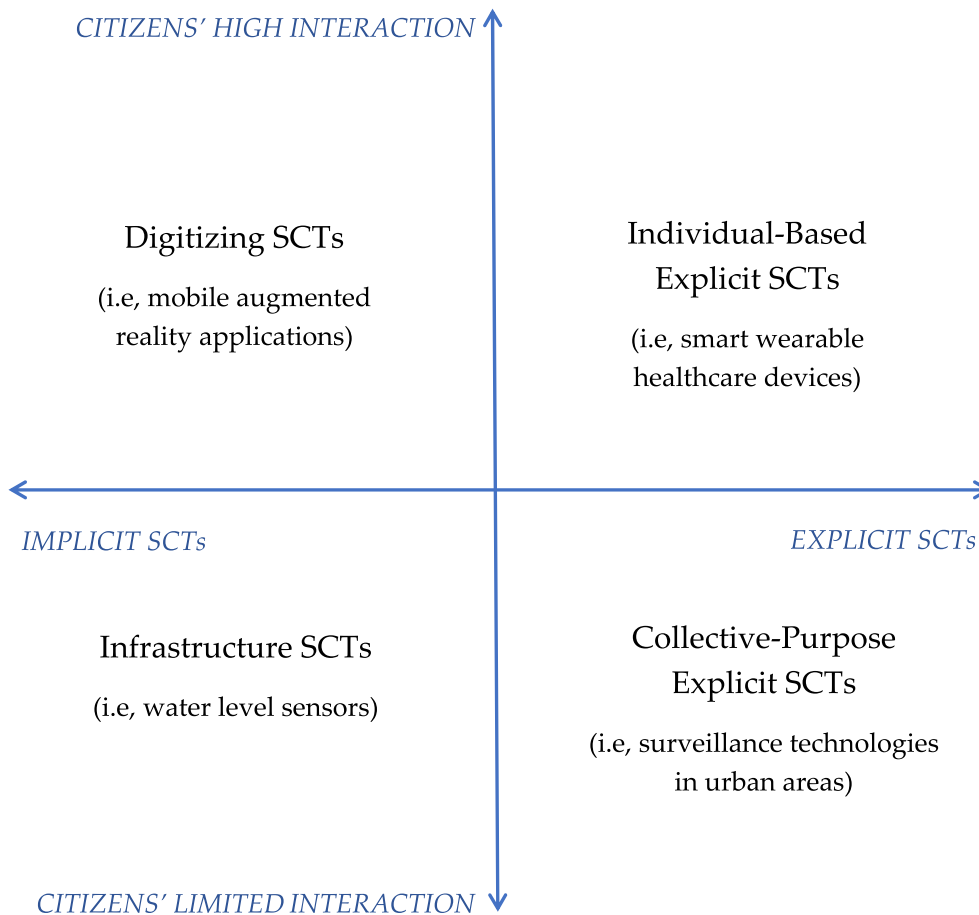


FIGURE 1 Framework for Smart City Technologies. *Source:* Developed by the authors based on the extant literature review

high interaction of users, we refer them as digitising SCTs, since they digitise the real world. The importance of this category is expected to be higher in the future of smart cities because of the rapid development of the metaverse that refer to the virtual worlds including the digital equivalents to the physical world [32].

2.2 | Technology acceptance models

Smart city infrastructures and technologies will be useless if the citizens that are supposed to benefit from them do not use them [9]. The individuals' adoption of new technologies has been a major research concern and various theories have been adapted from sociology, and psychology [33]. To better understand how people perceive and accept new technology, scholars particularly use the Technology Acceptance Model (TAM) developed by Ref. [10]. His article entitled 'Perceived Usefulness, Perceived ease of Use, and User Acceptance of Information Technology' can be considered the starting point of the technology acceptance models developed afterwards, and so far, it has received more than 20,000 citations in computer science, business and education according to Scopus, and more than 55,000 citations according to Google Scholar data.

TAM is based on the theory of reasoned action developed by Fishbein and Ajzen [34]. They propose that the transformation of the personal attitudes of individuals into behaviour is affected by attitude, subjective norm, and behavioural intention. Based on this model, Davis defined two variables in 1989 that influenced attitudes regarding the use of technology and designed the technology acceptance model (TAM), namely perceived usefulness and perceived ease of use [10]. Perceived usefulness is defined as the belief that a particular system or technology will improve the performance of work done by the user, while the perceived ease of use refers to the system or technology used without any effort [10]. In other words, the usefulness and easiness of a newly developed technology makes it to be adopted by humans.

The TAM has been discussed in different studies in parallel with the developing technology and has continuously received elaboration and refinement with new variables: social impact processes (social norm and image) and cognitive tool processes (job relevance, output quality, and result demonstrability) are currently seen as influencing the perceived usefulness in the behaviour of users accepting technology. In addition to these variables, experience and voluntariness variables moderating the effect of subjective norm on intended use were added to the model and the TAM2 model was introduced [35]. TAM3, which was developed to predict the individual use and adaptation of

new information technologies, details the perceived ease of use component in TAM2. The variables explaining the perceived ease of use in TAM 3 are as follows: computer self-efficacy, perceptions of external control, computer anxiety, computer playfulness, perceived enjoyment and objective usability [36]. From this work, a unified model (UTAUT) that explains the acceptance of technology for new information systems was developed. Performance expectancy, effort expectancy, social influence and facilitating conditions that play a role in the formation of behavioural intention are seen to be moderated by the variables of voluntariness of use, gender, age, and experience. [37]. Continuing to work on technology acceptance models, Ref. [33] proposed the UTAUT 2 model by adding hedonic motivation, price value and habit to the model to expand the UTAUT model. More recently, Ref. [38] have proposed the Cognitive-Emotional-Normative (CAN) model for the evaluation of the adoption of new technological products. Cognitive elements in the technology acceptance model are considered as perceived usefulness and perceived ease of use; emotional elements are positive feelings, negative feelings, and anxiety; and normative elements are the subjective norms.

All these additions and modifications of the TAM have resulted in a model that explains the adoption of new technologies by performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price/value, and habits. Moreover, age, gender, and experience have moderating roles in these relations. On the other hand, variables from different theories are used to explain better the adoption of technology, such as task-technology fit from Task-Technology Fit Model [39], relative advantage, compatibility, and ease of use from Innovation-Diffusion Theory [40], self-efficacy from Social Cognitive Theory [41].

2.3 | Research goal and questions

Our distinction between smart city technologies based on their explicitness and the possibility of citizen interaction with them, enables us to be specific in the question about citizen acceptance of smart city technologies. In combination with the TAM approach, our research problem is to assess the landscape of SCT acceptance and the research questions for the systematic literature review are:

- Which factors influence the acceptance of SCTs by citizens?
- Are these factors contingent on the type of technology that is involved?
- Are these factors contingent on the socio-demographical features of citizens?

3 | RESEARCH METHODOLOGY

A systematic literature review (SLR) was designed to achieve the research purpose. SLR refers to a systematic, transparent, and reproducible process for identifying academic literature

about a clearly defined topic [42]. Its aim is to identify all empirical evidence to answer a particular research question or hypothesis [43]. To conduct SLR, a systematic reviewing protocol is needed to overcome bias [44]. So, we manually reviewed all the papers and employed a qualitative analytical protocol to reveal the acceptance of SCTs by citizens. We respected the systematic literature review process suggested by Ref. [45] and Ref. [46]. We prepared a flowchart of each step to ensure an organised, transparent, and replicable procedure of the steps in the SLR as highlighted by Ref. [45]. The design consists of eight steps as illustrated in the Figure 2.

3.1 | Data collection

In the first phase of SLR approach which took place in December 2021, we decided to use SCOPUS as a research source as it covers a comprehensive database to reach high-quality and peer-reviewed publications for emerging fields of study [47]. The following query was performed within article title, abstract, keywords of the relevant papers: ('smart cit*') AND ('technology acceptance' OR 'acceptance of technolog*' OR 'technology adoption' OR 'adoption of technolog*').

Secondly, the search was limited to articles and conference papers as document type, and the language was set in English.

As this SLR attempts to reveal out the smart city technologies from the perspective of technology acceptance, in the third step, the documents were employed cited reference search for "[48]" or "[10]" or "[49]". And it returned 40 documents at the end of the phase 3.

For the triangulation of data as done by Ref. [50] and Ref. [44], we performed a similar research on Web of Science (WoS) which is considered as an ideal database for bibliometric analysis [51–53]. The articles in this database are said to have the highest impact in the field of social sciences [54]. So, for the phase 4, we used the following query within 'Title OR Abstract OR Author Keywords': ('smart cit*') AND ('technology acceptance' OR 'acceptance of technolog*' OR 'technology adoption' OR 'adoption of technology*'). We set the document type as article and proceedings paper, and the language as English.

As the fifth step, we employed cited reference search for '[48]' or '[10]' or '[49]'. And this filtering returned 17 documents.

Phase 6 consists of merging 40 documents from SCOPUS and 17 documents from WoS. 16 documents were common between both databases resulting in 41 unique documents to be analysed further. All the documents were fully downloaded at the phase 7 and all of them were manually evaluated by the authors to ensure that they are relevant to the adoption of smart city technologies. This allowed us to exclude an article by Ref. [55] that include the terms 'smart city' and 'technology acceptance' in the abstract and citing Ref. [10], but it is unrelated to the domain under study. Moreover, 5 studies considered the technology acceptance of business managers and governmental users. Since they were not mentioned as citizens in these studies, we decided to exclude them too. The remaining 35 documents were then investigated with a

qualitative protocol based on SCT categorisation as the last step (phase 8).

3.2 | Analysis method

When a research field is small with less than 50 papers, its content can be manually reviewed [56]. Our method was both inductive and deductive, that is, both identifying themes emerging from the literature but also framing them in our typology.

We found that of the four types of SCT we identified, TAM studies mostly focus on individual-based explicit SCTs (in 24 articles), while collective-purpose explicit SCTs and Digitising SCTs were addressed in two articles each. We did not find studies that focus on infrastructural SCTs. Seven studies could be qualified as examining the smart city in general, with no specific focus on a type of technology. The results are illustrated in the Figure 3.

4 | RESULTS

4.1 | Describing the landscape

The data collection protocol has provided a total of 35 documents about smart city technologies from the perspective of technology acceptance including 20 articles and 15 conference proceedings. Figure 4 depicts the annual trends and fluctuations in the number of documents (articles and conference proceedings). Identification of and broader interest in smart city technologies from the perspective of technology acceptance rose especially since 2017 and the peak is in 2019.

The 35 articles were published in 26 different journals and proceeding books. *Technological Forecasting and Social Change* had the most documents, 6 followed by *Information Technology and People*, *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *Multi Conference on Computer Science and Information Systems (MCCSIS 2019)*, and *PervasiveHealth: Pervasive Computing Technologies for Healthcare*, each with 2 documents. The remaining 26 journals and proceedings books included only a single document about the topic. So, the publications are fragmented in different journals and conferences expressing the multidisciplinary nature of the topic (related to different fields such as computer science, psychology, and sociology, etc.).

These 35 studies attempt to understand the dynamics of how and why urban residents accept SCTs in various locations such as India [22, 57–59], in China [60], Brazil [61], in Nigeria [62], in Mauritius [63], in South Korea [64], Iran [65], in Luxembourg [66], The Netherlands [26], in Slovenia [67] and Indonesia [68–73]. Moreover, citizens from cross locations were also the point of interest in some publications. For instance, Ref. [74] applied meta-analytic structural equation modelling by considering seven primary studies representing data about 4003 individuals from countries across Europe, Asia, and North America.

Finally, as we can see in Table 1, while most studies examined a general urban population, seven studies focussed on younger generations or experienced smart phone users.

Having thus described the overall landscape of TAMs of smart cities we now turn to the more analytic questions to answer our research questions.

4.2 | Acceptance of individual-based explicit SCTs

Most of the studies (24 out of 35 studies that correspond to 68.57%) focussed on specific technologies and technology-enhanced services in the context of smart city for the individual use. The investigated individual technologies include blockchain technology [89], Cloud IoT [90], IoT-based smart wearable healthcare devices [22, 59, 79], smart home technologies [76], smart energy technology [74], e-government [62, 72, 73, 91], mobile applications [63, 70, 77, 80, 83], mobile payment [68, 78], smart mobility [75], autonomous vehicles [60, 82, 84], contact tracing apps [61] and IT for public safety [92].

4.2.1 | Factors predicting the use of individual-based explicit SCTs

Our findings indicate that the most studied individual-based explicit SCTs are mobile applications (by four papers), followed by autonomous vehicles (by three papers) and e-government (by three papers).¹

These studies provide both a stable and a very mixed answer to our first research question regarding the factors influencing the acceptance by citizens of smart city technologies. The stable pattern derives from the majority of studies in this category identifying perceived usefulness (58.33%) and perceived ease of use (54.16%) as important predictors for acceptance. Ref. [77], for instance, studied the adoption of a gamified mobile application for university students in a smart campus as a part of smart city movement, and found that the majority of the users (85.28%) perceived the system to be useful and 85.43% of them perceived it to be easy to use. There is also relative stability in the construction of the dependent variables as most of the documents (75%) focuses on intention to use particular technologies, rather than examine their actual usage.

The instability in the outcomes derives from the fact that different authors have entered different variables into the mix of independent and mediating explanatory variables of individual smart city technologies, such as user experience, quality of Internet, and user satisfaction [63]; attitude, compatibility and playfulness [73]; performance expectancy, effort expectancy, costs and socio-demographic variables [80]; service

¹It is important to note that, even though there is a wide body of literature about autonomous vehicles, micromobility and other shared services, this study considered only the ones which were positioned in the smart city context as a key futuristic technology and integral to smart cities [60, 82, 84].

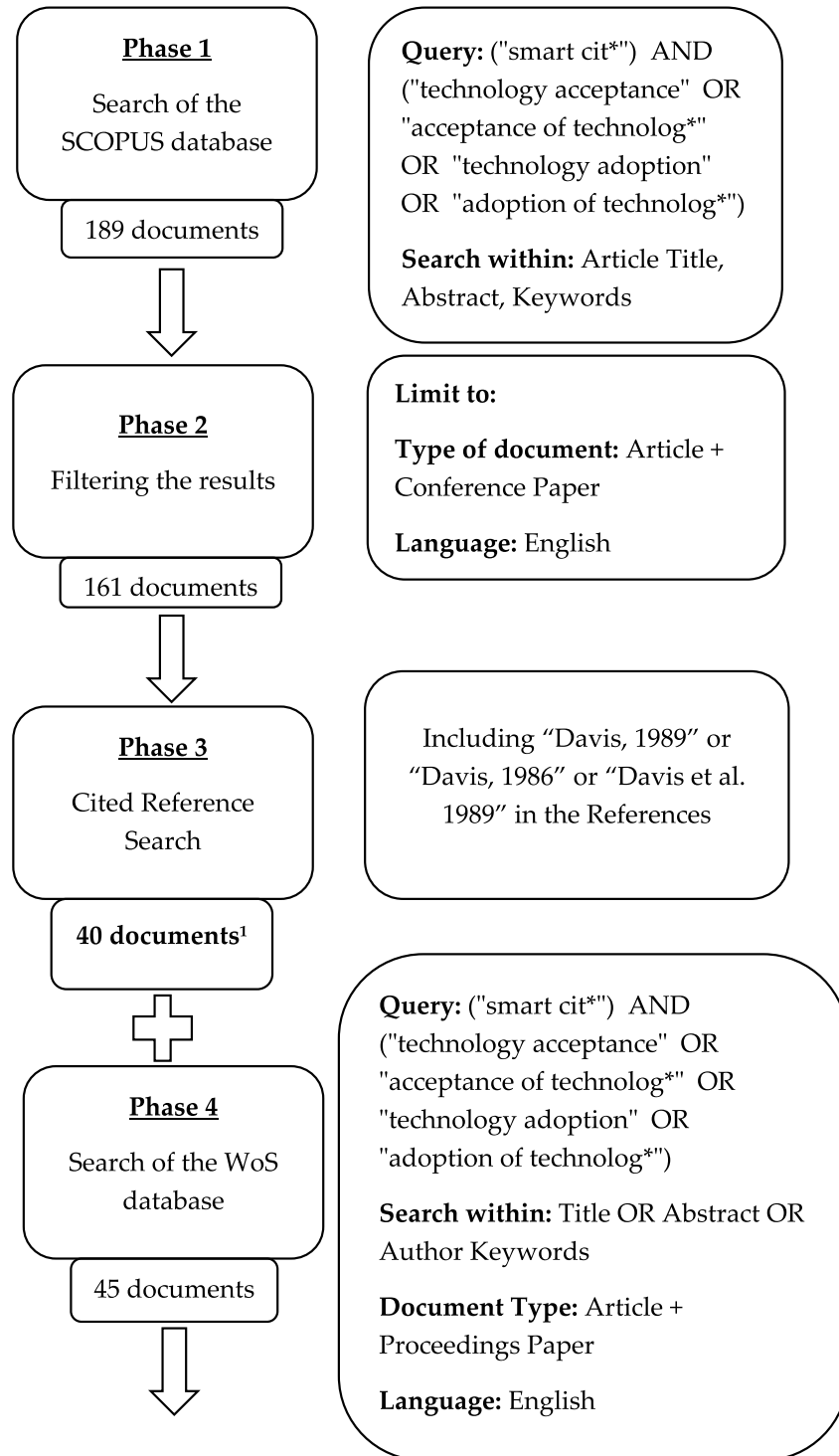


FIGURE 2 Structural design of the systematic literature review approach. *Source:* Prepared by the authors

quality [75], awareness [57], trust, concerns about security and trust, safety [78], social value [81], anthropomorphism [58], personal innovativeness, technological and legal concerns [82], user experience, user satisfaction [63], culture [83], cloud computing [90], organisation support, and compatibility [93].

We summarised the wide range of independent, mediating and dependent variables in Table 2, which also includes

whether the variables exert significant effects on each other. From this we assess that perceived use and (to a slightly lesser extent) perceived ease of use are predictors that have significant effects on technology acceptance in all studies. Hence, SCTs are subject to the same logic established in other TAM studies. However, beyond that there are few other conclusions to draw; first, because of the variety of explanatory variables,

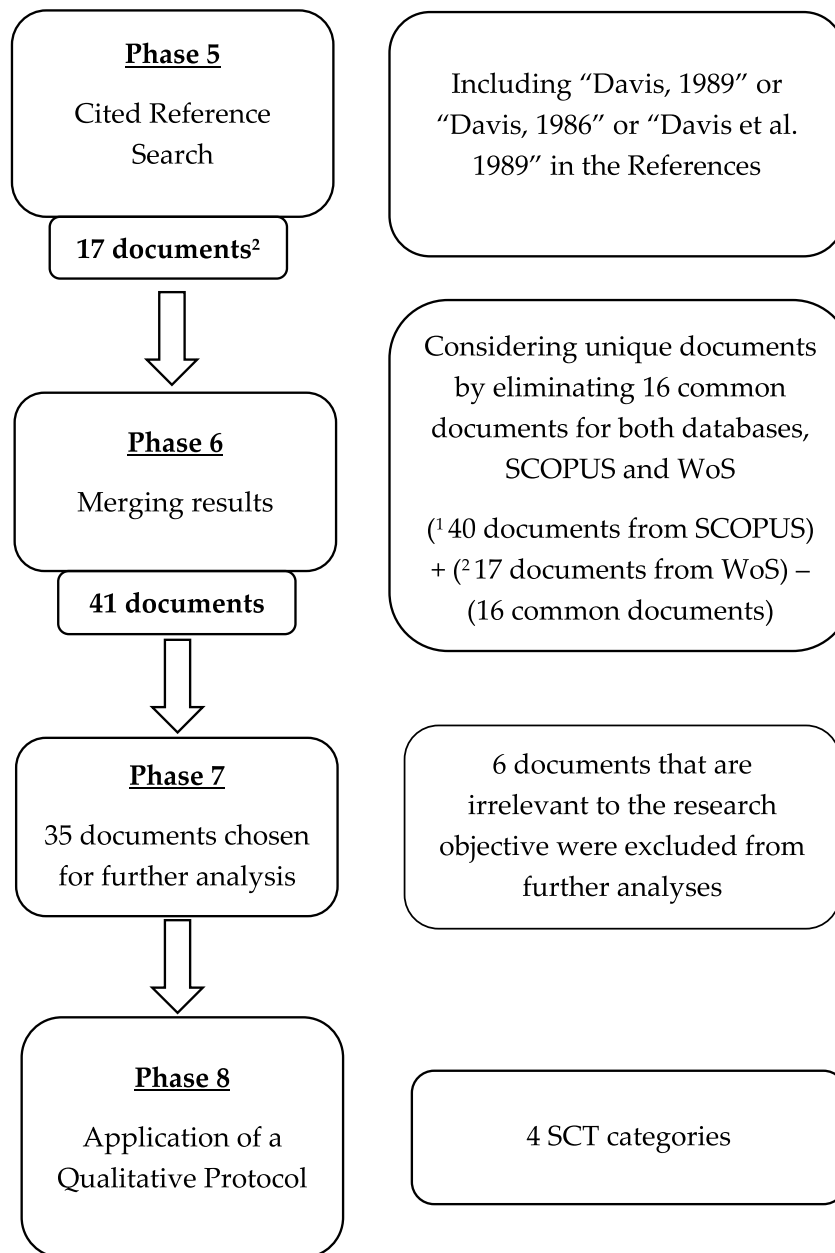


FIGURE 2 (Continued)

making each study stand on its own rather than contributing to a wider trend or tendency; second, because the studies that have used similar or comparable variables do not produce similar outcomes.

4.2.2 | Socio-demographic moderators in the acceptance of SCTs

In addition to the predicting variables of TAM, four papers in our SLR investigated socio-demographic variables as moderators between the relationship between antecedents and the acceptance as suggested by the models UTAUT and

UTAUT2. In their empirical research of autonomous vehicle adoption, Ref. [84] examined the moderating roles of gender, age, family size, income, education level, and marital status and showed their effect on the relationship between perceived usefulness and social influence on intention to use autonomous vehicles except income and gender. According to their results, individuals with lower education than the bachelors' degree are more strongly affected by social influence in the adoption of autonomous vehicles, since they were assumed having lower knowledge about these vehicles and they gather information from their social groups. Moreover, increased number of family members mean different opinions in the social group, so they may create more social influence.

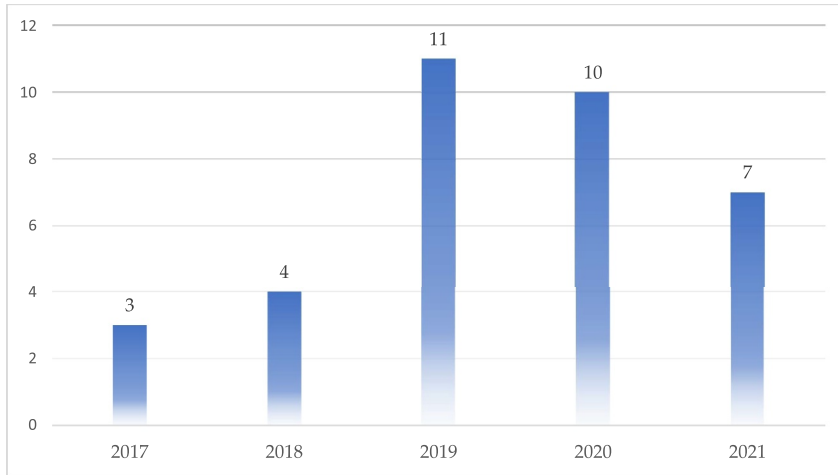


FIGURE 3 Clusters of Smart City Technologies from the perspective of Technology Acceptance. *Source:* Prepared by the authors based on the research findings

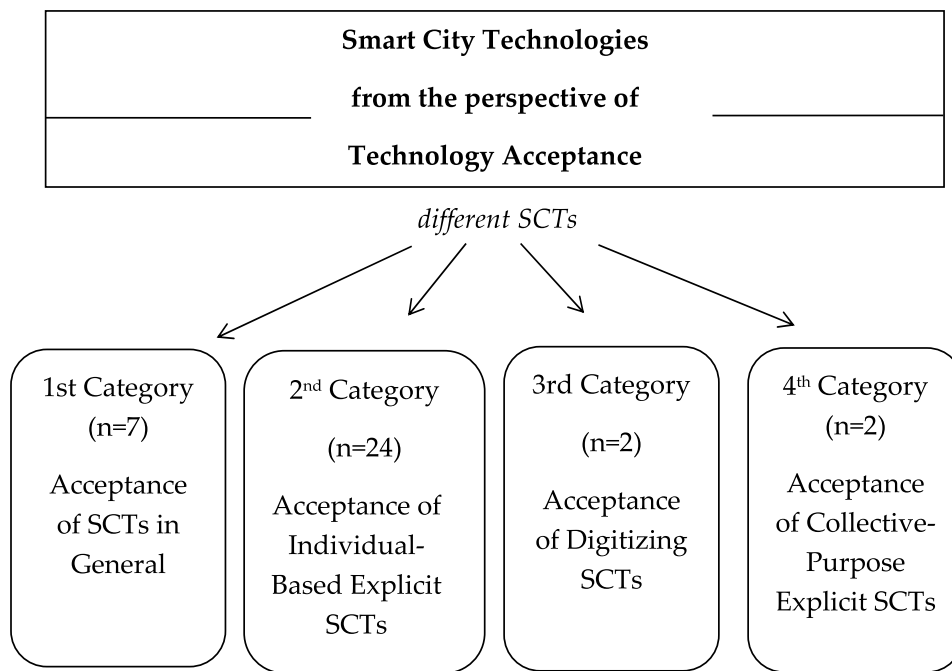


FIGURE 4 The number of scientific papers per year included in this review. *Source:* Prepared by the authors based on authors' own computations

Finally, the effect of perceived usefulness on intention to use was significantly stronger for married people compared to those of singles. The explanation was done as married people who already had a stable life asks for safety and stability to protect their families and perceived usefulness provides this benefit to people. This is also the reason of the stronger effect of older people compared to younger ones. Age was also considered for TAMs in different studies. Ref. [70] compared generations X and Y in their use of an airport rail services application by using TAM and TRA modifications. They showed that while subjective norm had no effect on the intention to use for generation X, it was found influential for generation Y. They based this finding on the individualism possessed by Generation X. Moreover, the effects of trust on perceived usefulness and the one of familiarity on trust were significant for Gen Y but not for Gen X.

On the other hand, the researchers who work on the acceptance of smart city services and IoT technologies use demographics as control variables [79]. Ref. [80] used demographics (age, gender, education, and income) as control variables and noticed that age was associated with mobile app use intentions in the way that older participants have weaker intention to use it.

4.3 | Acceptance of other SCTs

The 11 studies in our corpus that analysed the acceptance of other types of smart city technologies than the individual ones present a similar picture of confirmation and variability. Seven of them analysed the antecedents for the acceptance of SCTs without specifying a particular technology, 2 of them analysed

TABLE 1 Qualitative analytical protocol of the documents in investigation

Author(s)	Smart city technology (SCT) users	Smart city technologies (SCTs)
Mital et al. [59]	Indian consumer	IoT based smart devices ^a
Papa et al. [22]	Respondents in India	Smart wearable healthcare devices ^a
Ahmed et al. [75]	Drivers	Smart mobility service adoption ^a
Baudier et al. [76]	Highly-educated students, drawn from 'digital native' population	Smart home concept ^a
Chatterjee et al. [57]	Citizens of India	Preventive technologies for prevention of cybercrimes ^a
Chukwu et al. [62]	Citizens in Nigeria	E-government services ^a
Cruz et al. [61]	Users in Brazil	A contact tracing app which is a hybrid crowdsensing application ^a
Janssen and Prasetyowati [77]	Students from the department of informatics in UMN	New mobile application to the existing smart campus platform in Universitas Multimedia Nusantara, Indonesia ^a
Shihab and Hidayanto [72]	Citizens in Jakarta, Indonesia	eParticipation ^a
Susanto et al. [73]	Citizens in 7 districts of Surabaya city (Indonesia) who have downloaded the City113 app	City113 mobile application, an e-government system ^a
Singh et al. [78]	Smart phone users	Mobile payment service ^a
Bestepe and Yildirim [79]	Users	IoT-based smart services ^a
Butot et al. [26]	Citizens of Rotterdam	'Smart urban safety', which advocates advanced uses of digital technologies and data for urban safety management ^a
Yuen et al. [60]	Passengers in Beijing	Autonomous vehicles ^a
Atmajaya et al. [68]	YAP users in Indonesia	YAP mobile payment services ^a
Gimpel et al. [74]	Individuals from countries across Europe	Smart energy technology – that is, technology that increases energy efficiency or increases the integration of renewable energy sources ^a
Hou et al. [80]	Adult residents of a mid-sized city in the Southeastern United States	Mobile application ^a
Julsrud and Krogstad [81]	Citizens in the two smart cities, Oslo and Tallinn	Mobile phone data ^a
Kuberkar and Singhal [58]	Pune smart city citizens (in India.)	Artificial intelligence (AI) powered chatbot ^a
Manfreda et al. [82]	Millennials in Slovenia aged from 20 to 30	Autonomous vehicles ^a
Mohamudally and Armoogum [63]	Citizens of Mauritius	Mobile applications ^a
Naufaldi and Suzianti [70]	X and Y generations in Jakarta (Indonesia)	Railink applications (provider of airport rail services issued online ticketing service based on smartphones) ^a
Negara and Setyohadi [83]	Consumers in Yogyakarta, Indonesia	Smart city mobile applications ^a
Park et al. [84]	Customers in South Korea	Autonomous vehicles ^a
Setijadi et al. [71]	Citizens in Sampang district and Pamekasan (Indonesia)	Smart city concept ^b
Sepasgozar et al. [65]	Urban service technology users in Iran	Urban service technologies ^b
Shin et al. [64]	General public in South Korea	5G smart city innovations ^b
Salim, El Barachi, Onyia, and Mathew [85]	City/urban residents	Smart city services ^b
Troisi, Fenza, Grimaldi, and Loia [86]	Citizens in five cities (Berlin, Dublin, London, Milan, and Madrid)	Smart technologies ^b
Chaiyasoonthorn et al. [87]	Community living in smart cities	New technology of smart cities ^b
Darmawan et al. [69]	Respondents in Sampang and Pamekasan Regencies (Indonesia)	Smart city concept ^b
Jones et al. [66]	Users in Luxembourg	Location-based cultural heritage game ^c

(Continues)

TABLE 1 (Continued)

Author(s)	Smart city technology (SCT) users	Smart city technologies (SCTs)
Rebelo et al. [88]	Citizens	a mobile augmented reality service ^c
Offermann-van Heek et al. [25]	Residents in urban environments	Surveillance technologies ^d
van Heek et al. [25]	User	Surveillance technologies in urban environments ^d

^aindividual-based explicit SCTs.

^bSCTs in general.

^cdigitising SCTs.

^dcollective-purpose explicit SCTs.

Source: Prepared by the authors based on document evaluations.

collective SCTs and 2 of them investigated the acceptance of digitising SCTs. Almost half of these studies in our SLR (54.5%) do find the standard and extended TAM/UTAUT variables to be relevant for the acceptance of other smart city technologies, there is a wide range of alternative independent variables, that are variously constructed from for instance ‘smart city readiness’ [71], ‘urban services technology acceptance’ [65]; or intention to use [88]. And the independent and mediating explanatory variables also consist of different extension to the core TAM variables of perceived usefulness and perceived ease of use, for instance perceived prosperity, perceived trust, perceived security, perceived compatibility, and perceived sustainability [87]; perceived enjoyment, intention to share experience, intention to get knowledge, perceived value, perceived similarity and perceived reciprocal benefits [88]; location of use [25, 94]; and attitude to technology [66].

In sum, the prominent antecedents of the SCTs’ adoption were summarised in the Figure 5. Accordingly, perceived usefulness and perceived ease of use were the most common antecedents used in the adoption of SCTs in general, without specifying a technology. On the other hand, perceived usefulness/performance expectancy, perceived ease of use/effort expectancy, social norms/social influence, and additional constructs were prominent antecedents of individual-based explicit SCTs. Since there were only two works examining the antecedents of digitising and collective SCTs and no one for the infrastructure, no antecedents were identified for them.

5 | CONCLUSION AND IMPLICATIONS

Our analysis has shown that technology acceptance studies about SCTs have been mainly conducted in the past five years, and have mainly focussed on individual smart city technologies, such as mobile urban applications or automated vehicles in urban contexts. These studies have been published in different journals and conferences and are related to different disciplines such as computer science, psychology, sociology or urban studies. This nascent and fragmented state of the field is furthermore apparent in the wide diversity of technologies that have been studied, in the range of different constructions of the dependent, moderator and independent variables, and in the lack of consistent results. With the exception of the

perceived usefulness and the perceived ease of use of the technology at stake, the current body of work does not give a clear indication which other variables are of relevance to understand the acceptance of SCTs.

This means that our systematic literature review has produced limited answers to our research questions. With respect to the factors influencing the acceptance of smart city technologies by citizens, we found confirmation of the general insights of TAMs, especially where the use of individual-based explicit SCT is concerned. Since we aimed at drawing a frame in citizens’ acceptance of SCTs, we have attempted to show that there is a research gap in the literature, and we have tried to reveal potential contributions in this field. Limited confirmation of the acceptance of other SCTs is not surprising, since the individuals can decide to use only SCTs requiring high citizen interaction, namely, individual-based explicit SCTs and digitising SCTs. On the other hand, since Digitising SCTs refer to relatively new and emerging technologies, most of the previous studies were devoted to understanding the dynamics of the acceptance of individual-based explicit SCTs. On the other hand, even though the filter we used at 3rd stage may seem as a source of bias, we know that important reference papers in the field of human-computer interaction have cited Davis (1989) [10] to develop their theoretical background of technology acceptance (The paper has been cited by almost 70,000 times on Google Scholar). Therefore, we believe that our approach is innovative to respond our research questions. Our second research question whether explanatory factors are contingent on particular technologies is hard to answer due to the idiosyncratic nature of the studies we found. Our question regarding socio-demographic differences can also not easily be answered, although there is some indication in the studies that smart city technologies are more easily accepted by young and well educated people than by older generations. Yet, this may also be an artefact that these groups have been specifically sampled in some of the studies we reviewed.

These outcomes imply some clear suggestions for further academic research about citizens’ acceptance of smart city technologies that revolve around replication and comparison. This field would benefit tremendously if the various research projects resembled each other a bit more in terms of the variables used. Since TAM is built on perceived use and perceived usefulness as explanatory variables, we found these variables in most studies and were thus able to reach a conclusion about

T A B L E 2 List of findings about the adoption of individual-based explicit SCTs

Individual-based explicit SCTs	Number of studies	TPB		TAM		TAM 2		TAM 3		UTAUT		UTAUT 2			Technology adoption																
		PBC	PU	PEOU	SN	ENJ	ANX	PE	EE	SI	FC	DEM (m)	HM	P/V	HAB	Additional constructs	ATT	INT	BEH												
Artificial intelligence (AI) powered chatbot	1											+	+	+	+				i												
Autonomous vehicles	3		+	+/x															+	x	i	i									
Contact tracing app	1																			x		i									
e-Government	2	-	+	+	x															p/-		i	i								
e-Participation	1		+	+/x	x								x							+		i	i								
IoT based smart devices	1	x	+	+	x																		i								
IoT based smart services	1	e	e	e						e										e			i								
Mobile application	4		+	+									+	+	+					-/+x			i	i							
Mobile payment	2	+	+	+/x																	-/x			i	i						
Mobile phone data	1																				+				i						
Preventive technologies	1	+	+	+																	+				i						
Railink applications	1	+	+		+/x																					i					
Safety	1																				e										
Smart energy technology	1								x				+	x	x									x			i	i			
Smart home	1																							x	+			i			
Smart mobility service	1	+	+	+																									i	i	
Smart wearable healthcare devices	1	+	+	+																										i	i

Abbreviations: ANX, Anxiety; ATI, Attitude; BEH, Use Behaviour; CIN, Continuous Intention to Use; DEM(m), Demographics as moderator; EE, Effort Expectation; ENJ, received Enjoyment; FC, Facilitating Conditions; HAB, Habits; HEM, Hedonic Motivation; INT, Intention to Use; P/V, Price / Value; PBC, Perceived Behavioural Control; PE, Performance Expectation; PEOU, Perceived Ease of Use; PU, Perceived Usefulness; SI, Social Influence; SN, social Norm; TAM, Technology Acceptance Model; TPB, Theory of Planned Behavior; UTAUT, Unified Theory of Acceptance and Use of Technology; +, Construct(s) with Significant Positive Effect; -, Construct(s) with Significant Negative Effect; x, Construct(s) with Insignificant Effect; p, Proposed relationship; e, Explored relationship; i, Included.

Source: Prepared by the authors based on document evaluations.

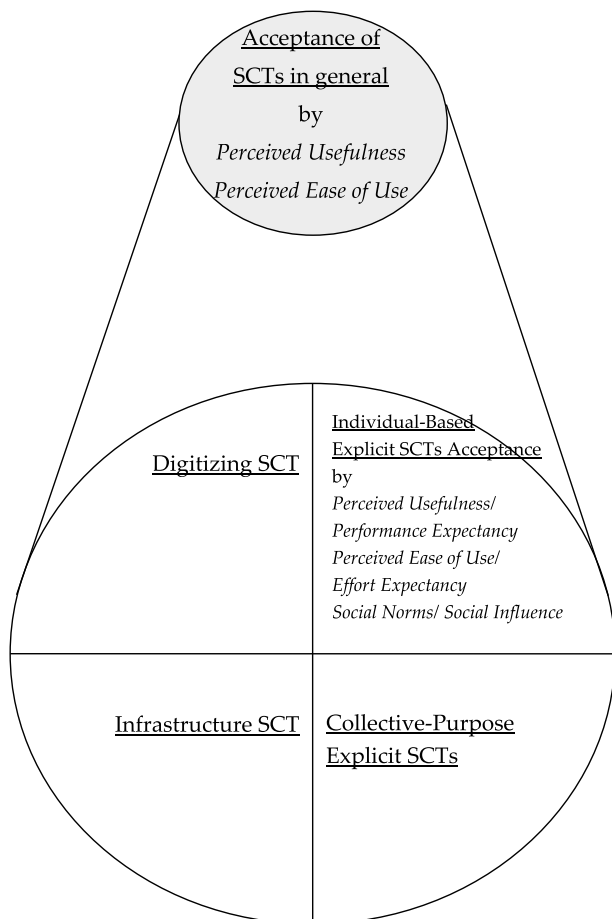


FIGURE 5 Prominent Antecedents of Reviewed SCTs' Adoption.
 Source: Prepared by the authors based on authors' own computations

them, namely that they also matter for smart city technologies. The selection and construction of other variables is currently too diverse to allow for necessary generalisations. Hence, we plea for future studies to follow a replication logic and emulate a base line of variables that have been used in (preferably more than one) other study. Furthermore, a comparative logic in the design of separate studies, analysing more than one technology in the same project, rather than focussing on one particular technology will also contribute to the production of more generalisable outcomes than we have currently found. A different kind of comparative design, equally helpful for this purpose, would be to focus on one technology that is present or on the horizon in different smart cities, thus also identifying situated acceptance of smart city technologies. With individual and separate smart city technologies quickly expanding in many different cities (a range of new urban apps, sharing mobile technologies, robots, drones, and so on), such comparative designs built on replication logics become ever more important to better understand if and how citizens accept them.

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CONFLICT OF INTEREST

We have no conflict of interest to disclose.

DATA AVAILABILITY STATEMENT

The authors confirm that the data supporting the findings of this study are available within the article.

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REFERENCES

- Nam, T., Pardo, T.A.: Smart city as urban innovation: focusing on management, policy, and context. In: Paper Presented at the Proceedings of the 5th International Conference on Theory and Practice of Electronic Governance (2011)
- Israilidis, J., Odusanya, K., Mazhar, M.U.: Exploring knowledge management perspectives in smart city research: a review and future research agenda. *Int. J. Inf. Manag.* 56, 101989 (2021). <https://doi.org/10.1016/j.ijinfomgt.2019.07.015>
- Lee, J., Lee, H.: Developing and validating a citizen-centric typology for smart city services. *Govern. Inf. Q.* 31, S93–S105 (2014). <https://doi.org/10.1016/j.giq.2014.01.010>
- Cocchia, A.: Smart and digital city: a systematic literature review. *Smart city*, 13–43 (2014). https://doi.org/10.1007/978-3-319-06160-3_2
- Moik, B., Bobek, V., Horvat, T.: India's national smart city mission: analysis of project dimensions including sources of funding. *Mednarodno inovativno poslovanje = J. Innov. Bus. & Manage.* 13(1), 50–59 (2021). <https://doi.org/10.32015/jibm/2021.13.1.50-59>
- Bendor, R.: Value replacement therapy: imagining urban technologies otherwise. In: Zoonen, E.R. L.v. (ed.) *Speculative Design Methods: For Citizen Engagement in Smart Cities Research*, pp. 63–73. Leiden-Delft-Erasmus Centre for BOLD Cities, Rotterdam (2021)
- Lara, A.P., et al.: Smartness that matters: towards a comprehensive and human-centred characterisation of smart cities. *J. Open Innov.: Technology, Market, and Complexity* 2(2), 8 (2016). <https://doi.org/10.1186/s40852-016-0034-z>
- Niederer, S., Priester, R.: Smart citizens: exploring the tools of the urban bottom-up movement. *Comput. Support. Coop. Work* 25(2), 137–152 (2016). <https://doi.org/10.1007/s10606-016-9249-6>
- Capdevila, I., Zarlenga, M.I.: Smart city or smart citizens? The Barcelona case. *J. Strategy & Manage.* 8(3), 266–282 (2015). <https://doi.org/10.1108/jsma-03-2015-0030>
- Davis, F.D.: Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Q.* 13(3), 319–340 (1989). <https://doi.org/10.2307/249008>
- Chang, V., Wang, Y., Wills, G.: Research investigations on the use or non-use of hearing aids in the smart cities. *Technol. Forecast. Soc. Change* 153, 119231 (2020). <https://doi.org/10.1016/j.techfore.2018.03.002>
- Habib, A., Alsmadi, D., Prybutok, V.R.: Factors that determine residents' acceptance of smart city technologies. *Behav. Inf. Technol.* 39(6), 610–623 (2020). <https://doi.org/10.1080/0144929x.2019.1693629>
- Toh, C.K.: Security for smart cities. *IET Smart Cities* 2(2), 95–104 (2020). <https://doi.org/10.1049/iet-smc.2020.0001>
- Shcherbina, E., Gorbenkova, E.: Smart city technologies for sustainable rural development. In: Paper Presented at the IOP Conference Series: Materials Science and Engineering (2018)
- Voordijk, H., Dorrestijn, S.: Smart city technologies and figures of technical mediation. *Urban Res & Prac* 14(1), 1–26 (2021). <https://doi.org/10.1080/17535069.2019.1634141>
- Kuk, G., Janssen, M.: The business models and information architectures of smart cities. *J. Urban Technol.* 18(2), 39–52 (2011). <https://doi.org/10.1080/10630732.2011.601109>
- Batty, M., et al.: Smart cities of the future. *Eur. Phys. J. Spec. Top.* 214(1), 481–518 (2012). <https://doi.org/10.1140/epjst/e2012-01703-3>

18. Caragliu, A., Del Bo, C., Nijkamp, P.: Smart cities in Europe. *J. Urban Technol.* 18(2), 65–82 (2011). <https://doi.org/10.1080/10630732.2011.601117>
19. Michel, H.: e-Administration, e-Government, e-Governance and the Learning City: a typology of Citizenship management using ICTs. *Electron. J. eGovernment* 3(4), 213–218 (2005)
20. Reichental, J.: Smart cities for dummies. John Wiley & Sons, Inc (2020)
21. Ji, T., et al.: Towards people-centric smart city development: investigating the citizens' preferences and perceptions about smart-city services in Taiwan. *Sustain. Cities Soc.* 67, 102691 (2021). <https://doi.org/10.1016/j.scs.2020.102691>
22. Papa, A., et al.: E-health and wellbeing monitoring using smart healthcare devices: an empirical investigation. *Technol. Forecast. Soc. Change* 153, 119226 (2020). <https://doi.org/10.1016/j.techfore.2018.02.018>
23. Glenn, J., et al.: Considering the potential health impacts of electric scooters: an analysis of user reported behaviors in Provo, Utah. *Int. J. Environ. Res. Publ. Health* 17(17), 6344 (2020). <https://doi.org/10.3390/ijerph17176344>
24. Ratan, R., et al.: The (digital) medium of mobility is the message: examining the influence of e-scooter mobile app perceptions on e-scooter use intent. *Computers in Human Behav. Reports* 3, 100076 (2021). <https://doi.org/10.1016/j.chbr.2021.100076>
25. van Heek, J., Arning, K., Ziefle, M.: Where, wherefore, and how? In: Paper Presented at the Proceedings of the 6th International Conference on Smart Cities and Green ICT Systems (2017)
26. Butot, V., et al.: Citizen repertoires of smart urban safety: perspectives from Rotterdam, The Netherlands. *Technol. Forecast. Soc. Change* 158, 120164 (2020). <https://doi.org/10.1016/j.techfore.2020.120164>
27. Nam, T.: Untangling the relationship between surveillance concerns and acceptability. *Int. J. Inf. Manag.* 38(1), 262–269 (2018). <https://doi.org/10.1016/j.ijinfomgt.2017.10.007>
28. Lyon, D.: Surveillance Society. McGraw-Hill Education, (2001)
29. Dinev, T., Hart, P., Mullen, M.R.: Internet privacy concerns and beliefs about government surveillance—An empirical investigation. *J. Strat. Inf. Syst.* 17(3), 214–233 (2008). <https://doi.org/10.1016/j.jsis.2007.09.002>
30. Soegoto, E., Fauzi, F., Luckyardi, S.: Internet of things for flood and landslide early warning. In: Paper Presented at the Journal of Physics: Conference Series (2021)
31. Yagol, P., et al.: New trends in using augmented reality apps for smart city contexts. *ISPRS Int. J. Geo-Inf.* 7(12), 478 (2018). <https://doi.org/10.3390/ijgi7120478>
32. Warf, B., Sui, D.: From GIS to neogeography: ontological implications and theories of truth. *Spatial Sci.* 16(4), 197–209 (2010). <https://doi.org/10.1080/19475683.2010.539985>
33. Venkatesh, V., Thong, J.Y., Xu, X.: Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS Q.* 36(1), 157–178 (2012). <https://doi.org/10.2307/41410412>
34. Fishbein, M., Ajzen, I.: *Intention and Behavior: An Introduction to Theory and Research*. Addison-Wesley, Reading (1975)
35. Venkatesh, V., Davis, F.D.: A theoretical extension of the technology acceptance model: four longitudinal field studies. *Manag. Sci.* 46(2), 186–204 (2000). <https://doi.org/10.1287/mnsc.46.2.186.11926>
36. Venkatesh, V., Bala, H.: Technology acceptance model 3 and a research agenda on interventions. *Decis. Sci. J.* 39(2), 273–315 (2008). <https://doi.org/10.1111/j.1540-5915.2008.00192.x>
37. Venkatesh, V., et al.: User acceptance of information technology: toward a unified view. *MIS Q.* 27(3), 425–478 (2003). <https://doi.org/10.2307/30036540>
38. Pelegrin-Borondo, J., Reinares-Lara, E., Olarte-Pascual, C.: Assessing the acceptance of technological implants (the cyborg): evidences and challenges. *Comput. Hum. Behav.* 70, 104–112 (2017). <https://doi.org/10.1016/j.chb.2016.12.063>
39. Dishaw, M.T., Strong, D.M.: Extending the technology acceptance model with task–technology fit constructs. *Inf. Manag.* 36(1), 9–21 (1999). [https://doi.org/10.1016/s0378-7206\(98\)00101-3](https://doi.org/10.1016/s0378-7206(98)00101-3)
40. Oh, J., Yoon, S.-J.: Validation of haptic enabling technology acceptance model (HE-TAM): integration of IDT and TAM. *Telematics Inf.* 31(4), 585–596 (2014). <https://doi.org/10.1016/j.tele.2014.01.002>
41. Tsai, C.-H.: Integrating social capital theory, social cognitive theory, and the technology acceptance model to explore a behavioral model of telehealth systems. *Int. J. Environ. Res. Publ. Health* 11(5), 4905–4925 (2014). <https://doi.org/10.3390/ijerph110504905>
42. Fisch, C., & Block, J.: Six Tips for Your (Systematic) Literature Review in Business and Management Research. 68, 103–106 (2018): Springer
43. Snyder, H.: Literature review as a research methodology: an overview and guidelines. *J. Bus. Res.* 104, 333–339 (2019). <https://doi.org/10.1016/j.jbusres.2019.07.039>
44. van Oorschot, J.A., Hofman, E., Halman, J.I.: A bibliometric review of the innovation adoption literature. *Technol. Forecast. Soc. Change* 134, 1–21 (2018). <https://doi.org/10.1016/j.techfore.2018.04.032>
45. Littell, J.H., Corcoran, J., Pillai, V.: *Systematic Reviews and Meta-Analysis*. Oxford University Press (2008)
46. Palmatier, R.W., Houston, M.B., & Hulland, J. *Review Articles: Purpose, Process, and Structure*. 46, 1–5 (2018): Springer
47. Falagas, M.E., et al.: Comparison of PubMed, Scopus, web of science, and Google scholar: strengths and weaknesses. *Faseb. J.* 22(2), 338–342 (2008). <https://doi.org/10.1096/fj.07-9492lsf>
48. Davis, F.D.: *A Technology Acceptance Model for Empirically Testing New End-User Information Systems*, Cambridge (1986)
49. Davis, F.D., Bagozzi, R.P., Warshaw, P.R.: User acceptance of computer technology: a comparison of two theoretical models. *Manag. Sci.* 35(8), 982–1003 (1989). <https://doi.org/10.1287/mnsc.35.8.982>
50. Tamilmani, K., et al.: The battle of Brain vs. Heart: a literature review and meta-analysis of “hedonic motivation” use in UTAUT2. *Int. J. Inf. Manag.* 46, 222–235 (2019). <https://doi.org/10.1016/j.ijinfomgt.2019.01.008>
51. Kim, H., So, K.K.F.: Two decades of customer experience research in hospitality and tourism: a bibliometric analysis and thematic content analysis. *Int. J. Hospit. Manag.* 100, 103082 (2022). <https://doi.org/10.1016/j.ijhm.2021.103082>
52. Murgado-Armenteros, E.M., et al.: Analysing the conceptual evolution of qualitative marketing research through science mapping analysis. *Scientometrics* 102(1), 519–557 (2015). <https://doi.org/10.1007/s11192-014-1443-z>
53. Zupic, I., Čater, T.: Bibliometric methods in management and organization. *Organ. Res. Methods* 18(3), 429–472 (2015). <https://doi.org/10.1177/1094428114562629>
54. Podsakoff, P.M., et al.: The influence of management journals in the 1980s and 1990s. *Strat. Manag. J.* 26(5), 473–488 (2005). <https://doi.org/10.1002/smj.454>
55. Chew, K.-W., Shingi, P., Ahmad, M.I.: TAM derived construct of perceived customer value and online purchase behavior: an empirical exploration. In: *Project E-Society: Building Bricks*, pp. 215–227. Springer (2006)
56. Donthu, N., et al.: How to conduct a bibliometric analysis: an overview and guidelines. *J. Bus. Res.* 133, 285–296 (2021). <https://doi.org/10.1016/j.jbusres.2021.04.070>
57. Chatterjee, S., et al.: Prevention of cybercrimes in smart cities of India: from a citizen's perspective. *Inf. Technol. People* 32(5), 1153–1183 (2019). <https://doi.org/10.1108/itp-05-2018-0251>
58. Kuberkar, S., Singhal, T.K.: Factors influencing adoption intention of AI powered chatbot for public transport services within a smart city. *Int. J. Emerging Technol. Learn.* 11(3), 948–958 (2020)
59. Mital, M., et al.: Adoption of Internet of Things in India: a test of competing models using a structured equation modeling approach. *Technol. Forecast. Soc. Change* 136, 339–346 (2018). <https://doi.org/10.1016/j.techfore.2017.03.001>
60. Yuen, K.F., et al.: Factors influencing autonomous vehicle adoption: an application of the technology acceptance model and innovation diffusion theory. *Technol. Anal. Strat. Manag.* 33(5), 505–519 (2021). <https://doi.org/10.1080/09537325.2020.1826423>

61. Cruz, M.M., et al.: Assessing the level of acceptance of a crowdsourcing solution to monitor infectious diseases propagation. In: Paper Presented at the 2020 IEEE International Smart Cities Conference (ISC2) (2020)
62. Chukwu, J., Conrad, M., Crosbie, T.: Empirical Investigation of Factors that Impact E-Government Adoption in Nigeria (2019)
63. Mohamudally, N., Armoogum, S.: Citizen empowerment in newly born smart cities in Mauritius. In: Paper Presented at the Proceedings of the 4th International Conference on Smart City Applications (2019)
64. Shin, S.-Y., Kim, D., Chun, S.: Digital divide in advanced smart city innovations. *Sustainability* 13(7), 4076 (2021). <https://doi.org/10.3390/su13074076>
65. Sepasgozar, S.M., et al.: Implementing citizen centric technology in developing smart cities: a model for predicting the acceptance of urban technologies. *Technol. Forecast. Soc. Change* 142, 105–116 (2019). <https://doi.org/10.1016/j.techfore.2018.09.012>
66. Jones, C.E., Theodosis, S., Lykourantzou, I.: The enthusiast, the interested, the sceptic, and the cynic: understanding user experience and perceived value in location-based cultural heritage games through qualitative and sentiment analysis. *J. Computing & Cultural Heritage (JOCCH)* 12(1), 1–26 (2019). <https://doi.org/10.1145/3297716>
67. Manfreda, A., Ljubi, K., Groznik, A.: Autonomous vehicles in the smart city era: an empirical study of adoption factors important for millennials. *Int. J. Inf. Manag.* 58, 102050 (2019). <https://doi.org/10.1016/j.ijinfomgt.2019.102050>
68. Atmajaya, I.G.A.S., et al.: *The Analysis of User's Intention in Using Mobile Payment: A Case of Yap!*. In: Paper Presented at the 12th International Conference on ICT, Society and Human Beings, ICT 2019, 5th International Conference on Connected Smart Cities, CSC 2019 and the 16th International Conference on Web Based Communities and Social Media. WBC 2019 (2019)
69. Darmawan, A.K., et al.: Identifying success factors in smart city readiness using a structure equation modelling approach. In: Paper Presented at the 2019 International Conference on Computer Science, Information Technology, and Electrical Engineering (ICOMITEE) (2019)
70. Naufaldi, R.A., Suzianti, A.: Adoption model analysis of digital service system application for multi generation community in Indonesia. In: Paper Presented at the Proceedings of the 4th International Conference on Communication and Information Processing (2018)
71. Setijadi, E., et al.: A model for evaluation smart city readiness using structural equation modelling: a citizen's perspective. In: Paper Presented at the 2019 Fourth International Conference on Informatics and Computing (ICIC) (2019)
72. Shihab, M.R., Hidayanto, A.N.: Citizen adoption of e-participation: a study of Jakarta smart city e-participation initiatives. *J. Manag. Inform. & Decision Sci.* 24(4), 1–12 (2021)
73. Susanto, T.D., Diani, M.M., Hafidz, I.: User acceptance of e-government citizen report system (a case study of city113 app). *Procedia Comput. Sci.* 124, 560–568 (2017). <https://doi.org/10.1016/j.procs.2017.12.190>
74. Gimpel, H., Graf, V., Graf-Drasch, V.: A comprehensive model for individuals' acceptance of smart energy technology—A meta-analysis. *Energy Pol.* 138, 111196 (2020). <https://doi.org/10.1016/j.enpol.2019.111196>
75. Ahmed, W., et al.: Predicting IoT Service Adoption towards Smart Mobility in Malaysia: SEM-Neural Hybrid Pilot Study (2020). arXiv preprint arXiv:2002.00152
76. Baudier, P., Ammi, C., Deboeuf-Rouchon, M.: Smart home: highly-educated students' acceptance. *Technol. Forecast. Soc. Change* 153, 119355 (2020). <https://doi.org/10.1016/j.techfore.2018.06.043>
77. Janssen, A., Prasetyowati, M.: Gamifying student routines to improve campus experience through mobile application in Indonesia. *Int. J. Eng. Technol.* 7(4.40), 85–89 (2018)
78. Singh, B.P., Grover, P., Kar, A.K.: Quality in mobile payment service in India. In: Paper Presented at the Conference on E-Business, E-Services and E-Society (2017)
79. Bestepe, F., Yildirim, S.O.: A systematic review on smart city services and IoT-based technologies. In: Paper Presented at the Proceedings of the 12th IADIS International Conference Information Systems 2019, IS 2019 (2019)
80. Hou, J.J., et al.: The road toward smart cities: a study of citizens' acceptance of mobile applications for city services. *Energies* 13(10), 2496 (2020). <https://doi.org/10.3390/en13102496>
81. Julsrud, T.E., Krogstad, J.R.: Is there enough trust for the smart city? exploring acceptance for use of mobile phone data in oslo and tallinn. *Technol. Forecast. Soc. Change* 161, 120314 (2020). <https://doi.org/10.1016/j.techfore.2020.120314>
82. Manfreda, A., Ljubi, K., Groznik, A.: Autonomous vehicles in the smart city era: an empirical study of adoption factors important for millennials. *Int. J. Inf. Manag.* 58, 102050 (2021). <https://doi.org/10.1016/j.ijinfomgt.2019.102050>
83. Negara, J.G.P., Setyohadi, D.B.: Uncertainty avoidance and individualism collectivism on acceptance of smart city mobile applications. In: Paper Presented at the 2020 4th International Conference on Informatics and Computational Sciences (ICICoS) (2020)
84. Park, J., Hong, E., Le, H.T.: Adopting autonomous vehicles: the moderating effects of demographic variables. *J. Retailing Consum. Serv.* 63, 102687 (2021). <https://doi.org/10.1016/j.jretconser.2021.102687>
85. Salim, T.A., et al.: Effects of smart city service channel-and user-characteristics on user satisfaction and continuance intention. *Inf. Technol. People* 34(1), 147–177 (2020). <https://doi.org/10.1108/itp-06-2019-0300>
86. Troisi, O., et al.: Covid-19 sentiments in smart cities: the role of technology anxiety before and during the pandemic. *Comput. Hum. Behav.* 126, 106986 (2022). <https://doi.org/10.1016/j.chb.2021.106986>
87. Chaiyasoonthorn, W., Khalid, B., Chaveesuk, S.: Success of smart cities development with community's acceptance of new technologies: Thailand perspective. In: Paper Presented at the Proceedings of the 9th International Conference on Information Communication and Management (2019)
88. Rebelo, F., et al.: Expected user acceptance of an augmented reality service for a smart city. In: Paper Presented at the International Conference of Design, User Experience, and Usability (2018)
89. Lou, A.T., Li, E.Y.: Integrating innovation diffusion theory and the technology acceptance model: the adoption of blockchain technology from business managers' perspective. In: Paper Presented at the International Conference on Electronic Business (2017)
90. Narwane, V.S., et al.: To identify the determinants of the CloudIoT technologies adoption in the Indian MSMEs: structural equation modelling approach. *Int. J. Bus. Inf. Syst.* 31(3), 322–353 (2019). <https://doi.org/10.1504/ijbis.2019.101110>
91. Nugroho, R.A., et al.: Traditional market sellers acceptance of electronic government system: case study of electronic-retribution application in Surakarta, Indonesia. In: Paper Presented at the 2017 International Conference on Information Management and Technology (ICIMTech) (2017)
92. Oliveira, V., Santos, G.: Information technology acceptance in public safety in smart sustainable cities: a qualitative analysis. *Procedia Manuf.* 39, 1929–1936 (2019). <https://doi.org/10.1016/j.promfg.2020.01.239>
93. Maqsoom, A., et al.: Exploring managerial perspectives of using building management system through TAM: an empirical study of commercial sector of Pakistan. *Period. Polytech. Civ. Eng.* 64(3), 690–701 (2020). <https://doi.org/10.3311/ppci.15323>
94. Offermann-van Heek, J., Arning, K., Ziefle, M.: All eyes on you! impact of location, camera type, and privacy-security-trade-off on the acceptance of surveillance technologies. In: *Smart Cities, Green Technologies, and Intelligent Transport Systems*, pp. 131–149. Springer (2017)

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