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DETERMINANTS OF CITIZENS' USE OF SMART CITY SERVICES*

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Abstract

The concept of smart cities continues to expand and plays an increasingly important role in the development of local communities. As digital technologies become more integrated into urban governance, public service delivery, and daily life, the transition toward smarter and more sustainable urban environments depends heavily on citizens' active participation and willingness to adopt smart city solutions. This paper investigates the complex set of factors that influence citizens' use of smart city services. Drawing on survey data from citizens, the study explores the distinguishing characteristics between users and non-users of smart city services, as well as the key determinants influencing their adoption.

The findings reveal that digital literacy, awareness of smart city services, positive user experience, perceived usefulness of services and data, satisfaction with the quality of local public services, and trust in local public institutions are positively associated with citizens' use of smart city services. In contrast, lower levels of stress-coping ability and reduced self-confidence hinder the adoption of smart services. This research contributes to a deeper understanding of citizens' behavior in the context of smart city development.

Keywords: smart city, services, citizens, adoption, technology acceptance, digital literacy.

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1. Introduction

The concept of smart cities began to develop in the late 20th century and has since continued to evolve, increasingly influencing the development of local communities (Intesa Sanpaolo Innovation Center, 2025). The intensified development of smart cities can be attributed to several interrelated factors. The first is the accelerating process of urbanization; according to Eurostat (2024) data, 39.2% of the European population lived in cities, 36.3% in towns and suburbs, and 24.6% in rural areas in 2021. Among individual European countries, the highest shares of urban populations were recorded in Malta (96.3%), the Netherlands (86.6%), and Spain (82.9%) (Eurostat, 2024). The share of the urban population in Croatia has also been following an upward trend; in 2022, it reached approximately 58.6% (Statista, 2025). By 2050, approximately 70% of the global population is expected to live in cities, with European data projected to reach 83.7% (United Nations, 2018). Smart city initiatives seek to enhance urban livability by integrating technology with sustainable planning and participatory governance.

The second reason for the intensified development of smart cities is climate change, as cities are major contributors to carbon emissions and pollution. According to data from the European Commission Joint Research Centre (2025), urban areas account for 70 to 80% of the European Union's greenhouse gas emissions. While these emissions significantly impact local air quality, their effects are also evident on a global scale (Huszar *et al.*, 2021), with traffic being a substantial contributor to air pollution in cities (Böhm, Nanni and Pappalardo, 2022). Therefore, the development of smart cities is supported at the European level through targeted programs and initiatives. For example, the EU Mission on Climate-Neutral and Smart Cities aims to achieve 100 climate-neutral and smart cities in the European Union by 2030 (European Commission, 2025a). The European Commission's Scalable Cities initiative includes 134 cities (European Commission, 2024); the initiative aims to foster the development of an innovative, sustainable, and city-driven community of smart and climate-neutral cities (European Commission, 2025b).

The third contributing factor is the rapid evolution of digital technologies (Internet of Things, artificial intelligence, big data, and more), which enables the creation of smart city services. On the other hand, data on digital literacy indicate that only 55.6% of European citizens possess at least basic digital skills (European Commission, 2025b). As digital technologies increasingly integrate into urban governance, service delivery, and daily interactions, the transition toward smarter and more sustainable urban environments increasingly depends not only on technological capacity but also on citizens' engagement and digital inclusion.

This paper examines the factors that influence citizens' willingness to use smart city services, by referring to the influence of respondents' characteristics on the use of smart city services, the role of service-related determinants such as positive user experiences, and the influence of a broader set of determinants, including trust in local government, digital

literacy, and related variables. In this way, this research contributes to a better understanding of the use of smart city services.

With the development of smart cities, the body of scientific literature on this topic has also been growing. Nevertheless, despite the increasing number of research studies, most remain focused either on the technological aspects of city development or on highlighting the positive experiences associated with smart cities (Zhao *et al.*, 2021). However, there is a notable lack of research that explores citizen resistance towards smart city services; as van Twist, Ruijer and Meijer (2023) emphasize, comprehensive empirical insights into the reasons behind citizen discontent remain scarce. This study contributes to that research dimension by focusing on citizens' perspectives regarding smart cities and how they perceive and adopt smart services in local communities, particularly in terms of everyday use, digital literacy, trust in local government, overall satisfaction with available local services and other relevant factors. Differences in the use of smart services are also considered with respect to the size of local units and include cities and municipalities at different levels of development. The novelty of this research lies specifically in examining how psychological factors impact the adoption of smart services. The research extends existing smart city research beyond technological and infrastructural dimensions, contributing to the extension of behavioral models, particularly the Technology Acceptance Model. Addressing these gaps can provide more tailored strategies to enhance citizen participation in smart city initiatives.

The structure of this paper is organized as follows. Following the introduction, the second section reviews the literature. Section three explains the methodology employed and describes the characteristics of the sample population. The fourth section presents the empirical findings of the survey. The fifth section contains a discussion of results and conclusions are drawn in the last section.

2. Literature review

Research on smart cities goes in several directions. One stream of literature focuses on the impact of emerging technologies on the development of smart cities and, as noted by Dirsehan and van Zoonen (2022), highlights the role these technologies play in enabling smart urban environments. Smart cities utilize big data and the Internet of Things, which facilitates the development and management of public information services through automated data collection (Manfreda and Mijač, 2024). Zanella *et al.* (2014) investigate the role of Internet of Things in supporting smart city development in Italy, while Hashem *et al.* (2016) examine the use of big data to support smart cities. More recent literature also discusses the potential of 5G technologies for smart cities (Mahomed and Saha, 2025; Gohar and Nencioni, 2021), as well as how artificial intelligence is transforming smart city infrastructure (John *et al*., 2025; Delli, 2024; Yan *et al.*, 2023). In a systematic review of 191 smart city studies conducted between 2000 and 2019, Zhao *et al.* (2021) found that

most research focuses on the perceived benefits of smart cities, while challenges related to technology implementation and project failures receive less attention. Furthermore, while the impact of new technologies on smart city development is widely studied, Wirtz, Becker and Schmidt (2021) emphasize the importance of examining this topic from the user perspective. Manfreda and Mijač (2024) analyze the existing literature and show that there is a lack in the literature dealing with the impact of smart city technology on happiness of citizens. A systematic literature review on citizen discontent with smart city projects provided by van Twist, Ruijer and Meijer (2023) shows that some people show active discontent with the smart city, while others are passive because they lack the knowledge and skills to express the reasons behind their discontent.

The other direction of literature focuses on using smart services in the public sector. Research on the adoption and use of digital services by citizens reveals various factors that shape the use of these services. Within the field of e-government, studies have consistently identified perceived usefulness (Chatzoglou, Chatzoudes and Symeonidis, 2015), trust (Bélanger and Carter, 2008; Carter and Bélanger, 2005; Hooda *et al.*, 2022), experience with the Internet (Chatzoglou, Chatzoudes and Symeonidis, 2015), peer influence (Chatzoglou, Chatzoudes and Symeonidis, 2015), and previous experiences with use of the Internet (Alzahrani, Al-Karaghouli and Weerakkody, 2018) as significant predictors of adoption. Moreover, satisfaction with e-government platforms depends on factors such as information quality, system reliability, service trustworthiness, and cost efficiency, underscoring the need for consistently high service delivery standards (Weerakkody *et al*., 2016). The persistence of the digital divide remains a pressing concern, as age disparities are evident across age groups, with younger citizens significantly more engaged with digital services than older populations (Lee and Porumbescu, 2019). Al-Hujran *et al.* (2015) investigate factors that impact the adoption of e-government and show that the citizens' attitude towards e-government use is one of the strongest determinants of intentions to use it. The literature indicates that many people still prefer traditional service delivery over digital public services (Alzahrani, Al-Karaghouli and Weerakkody, 2018). This underscores the importance of investigating the determinants that shape the acceptance and foster the use of smart city services.

When it comes to literature addressing the acceptance of smart city services, most studies are grounded in the Technology Acceptance Model developed by Davis (1989), which includes key variables such as perceived usefulness, perceived ease of use, behavioral intention, and actual use. This model explains and predicts how and why individuals adopt and use new technologies (Wirsbinna, Grega and Juenger, 2023). Other studies rely on the extended Unified Theory of Acceptance and Use of Technology developed by Venkatesh *et al.* (2003).

According to a systematic literature review by Dirsehan and van Zoonen (2022), existing research primarily focuses on the adoption of specific technologies, such as mobile urban applications, rather than on citizens' broader acceptance of smart city services.

However, more recent studies have expanded this focus; for example, Manogaran and Teoh (2023) analyzed the determinants of smart city technology acceptance among working professionals in Malaysia during the post–COVID-19 period, whereas Trutnev and Vidiasova (2019) focused their research on factors shaping citizens' trust in smart city services in Russia. Similarly, Habib, Alsmadi and Prybutok (2019) examined citizens and public servants, identifying effort expectancy, self-efficacy, perceived privacy, perceived security, and price value as important factors influencing citizens' probability of using smart city services. The perceived levels of privacy and security are also essential for encouraging the use of smart city technologies (Habib, Alsmadi and Prybutok, 2019). However, adoption also depends on the degree of trust in technology and government (Habib, Alsmadi and Prybutok, 2019). As Trutnev and Vidiasova (2019) demonstrated in their study on factors influencing trust in St. Petersburg, the availability of strategies, benefits received by different stakeholders, IT knowledge, and the perceived quality of smart service solutions, all contribute to increasing citizens' trust in smart cities. Özçağdavul and Sayan (2025), based on 250 participants in Turkey, noticed that transparency is a driver of positive attitudes toward smart city applications, while data ownership impacts the level of trust.

Additionally, ease of use, or the level of complexity, affects the adoption of smart services in Saudi Arabia (Alzaidi, Alnfia and Ali, 2022). People of Taiwan tend to use smart services if they are of high quality and innovative, and if their privacy is secure (Yeh, 2017). Finally, Neirotti *et al*. (2014), using a dataset of 70 cities, demonstrated that economic, urban, demographic, and geographic factors significantly influence the development of smart city initiatives. Active participation and citizen engagement contribute to the success of smart city projects and initiatives (Wirsbinna, Greaga and Juenger, 2023), as involving citizens in decision-making ensures that services are better aligned with community needs, rather than being shaped without their input and without knowing their real needs.

3. Methodology

The analysis is based on the data collected by surveying the citizens in Croatia. The study was conducted on a sample of 785 respondents. A nationally representative sample was created based on age, gender, and counties, ensuring that multiple cities and municipalities within each county were included to ensure representation of areas with varying levels of development. The structure of citizens by age, gender, education, county of residence, and settlement size is presented in Table 1.

The study sample consisted of 21% of individuals aged 18 to 34, 33.6% aged 35 to 64, and 45.4% aged 65 and older. Of the total respondents, 52.6% were female and 47.4% were male. Regarding educational attainment, 38.2% of participants reported completing at least a university-level education. The research also accounted for variation in settlement size. Specifically, 38.3% of respondents resided in settlements with fewer than 2,000 inhabitants, 32.6% with between 2,001 and 10,000 inhabitants, 21.9% in settlements ranging

Table 1: Sample characteristics (N = 785, in %)

Gender	Female	52.6
	Male	47.4
Age	18–34	21.0
	35–64	33.6
	65+	45.4
Education	High school or lower	60.8
	University or higher	38.2
	Prefer not to say	1.0
County	Bjelovar-Bilogora	4.6
	Slavonski Brod-Posavina	5.0
	Dubrovnik-Neretva	4.5
	City of Zagreb	4.3
	Istria	5.2
	Karlovac	4.8
	Koprivnica-Križevci	5.4
	Krapina-Zagorje	4.7
	Lika-Senj	3.9
	Međimurje	4.8
	Osijek-Baranja	5.6
	Požega-Slavonia	3.7
	Primorje-Gorski Kotar	5.5
	Sisak-Moslavina	4.3
	Split-Dalmatia	4.3
	Šibenik-Knin	4.2
	Varaždin	5.2
	Virovitica-Podravina	5.0
	Vukovar-Srijem	4.7
	Zadar	5.2
	Zagreb	5.0
Size of settlement	Up to 2,000 residents	38.3
	2,001-10,000 residents	32.6
	10,001-100,000 residents	21.9
	More than 100,000 residents	7.1

Source: The author based on the survey

from 10,001 to 100,000 inhabitants, and 7.1% in large cities with populations exceeding 100,001 inhabitants. Participants were drawn from all counties within the Republic of Croatia, with all counties represented and only minimal variation in the percentage of respondents per county.

The focus of the research is on use of smart city services. Therefore, all respondents who indicated that they 'completely agree' or 'agree' with the statement that they use smart city services when available were categorized as users, while all other respondents were classified as non-users of smart city services.

Furthermore, to explore the factors influencing the use of smart city services, the analysis included the level of digital literacy, measured by respondents' self-assessed knowledge of information technology. Additionally, the study included respondents' awareness of smart city services, reflecting their familiarity with the smart city services offered in the municipality or city where they live.

The survey also asked citizens to assess their level of concern regarding the speed of smart city service development in their municipality or city and their privacy concerns. Privacy concern was measured by respondents' level of worry about collecting their personal information to manage or provide public services in their municipality or city.

People are expected to be more willing to use smart city services and technology if they perceive that it brings benefits. So, previous positive experiences should positively impact the use of smart city services. So, the survey investigated whether respondents had previous positive experiences with smart city services and e-government.

Ease of use of smart city services was assessed by asking respondents to what extent they believe that smart city services make their daily life easier. Respondents were also asked about their perception of smart city data utility, evaluating to what extent data collection should be enabled to obtain information about public services (e.g., parking availability, waste volume, etc.).

In addition to assessing attitudes toward services, the survey included a question about respondents' satisfaction with public services in the city or municipality where they live. Respondents answered the questions using a scale from 1 (strongly disagree) to 5 (strongly agree).

Additionally, questions assessing the level of trust in local public institutions, self-confidence, stress coping ability, and the socio-demographic characteristics of the respondents were included. All questions used in the analyses have been presented in the annex of the article.

The t-test and chi-square test were employed to analyze the survey responses and identify the determinants influencing the use of smart city services. In addition, to provide further validation and robustness of the results, a probit analysis was conducted. Given the large number of variables, factor analysis was performed to derive factor scores, which were subsequently incorporated into the probit model. All the data has been collected in 2025.

4. Research results

The data shows respondents' average scores reflecting their knowledge, use, attitudes, and concerns about smart city services. The findings suggest that citizens use smart city services when available, with a mean score of 3.3 (Table 2). Moreover, 45.7% of respondents reported using these services, while 54.3% do not. Smart city service awareness is moderate,

with an average score of 3.1. Only 38.1% of citizens are aware of the smart city services, while 28.2% are unfamiliar with them. Such results partly explain why many respondents are non-users of smart city services. This suggests that local authorities should prioritize raising public awareness about the availability of smart city services and educating citizens on how to use them effectively.

Table 2: Descriptive statistics

Variable	Mean	Std. Deviation	Minimum	Maximum
Use of smart city services	3.27	1.154	1	5
Digital literacy	3.75	1.093	1	5
Smart city service awareness	3.09	1.153	1	5
Concern with the speed of smart city services development	2.85	1.180	1	5
Privacy concerns	3.16	1.136	1	5
Positive smart city service experience	3.07	1.140	1	5
Positive e-government service experience	3.49	1.103	1	5
Perceived usefulness	3.18	1.133	1	5
Smart city data utility perception	3.82	0.946	1	5
Willingness to use smart city services in the future	3.73	1.013	1	5

Source: The author based on the survey

The analysis of additional attitudes reveals that citizens generally support the collection and use of data to improve public services (mean 3.8). Specifically, 66.9% of citizens support this data collection and use, while only 7.9% oppose it. Citizens are confident in their information technology skills required to utilize online services (mean 3.8) and favor the development of smart city technologies and services in municipalities and cities (mean 3.7). In fact, 64.2% consider their digital literacy sufficient, whereas 13.0% do not. Additionally, 61.3% of citizens stated that they would use more smart city services if they were available, while 9.8% disagreed.

Furthermore, citizens report mixed experiences about the use of smart city services (mean 3.1). While 35.7% have had positive experiences, 25.6% are dissatisfied with their past use of smart city services. The situation is better regarding the use of smart services in the public sector, with an average score of 3.5. 53.2% of citizens have positive experiences in this area, whereas 15.9% report negative experiences. The statement that smart city services make daily life easier received an average score of 3.2. A total of 39.0% of respondents agreed that these services make daily life easier, while 23.1% disagreed with the statement.

Regarding respondents' privacy concerns, the survey results indicate that citizens are moderately concerned about the collection of personal information to manage or provide public services in their municipality or city (mean 3.16). 38.5% of citizens have privacy concerns, and 25.4% do not have such concerns.

The data in the following table indicates which factors influence citizens' use of smart city services.

Table 3: Results of t-statistics

Variable	Smart service	Mean	Std. Dev.	Std. Error Mean	Equal variances	T	df	Sig. (2-tailed)
Digital literacy	Non-users	3.39	1.141	.055	assumed	-10.830	783	.000
	Users	4.18	.854	.045	not assumed	-11.094	772.604	.000
Smart city service awareness	Non-users	2.64	1.055	.051	assumed	-13.172	783	.000
	Users	3.62	1.031	.054	not assumed	-13.197	766.004	.000
Concern with the speed of smart city services development in the municipality/city	Non-users	2.85	1.102	.053	assumed	-.119	783	.905
	Users	2.86	1.269	.067	not assumed	-.118	714.412	.906
Privacy concerns	Non-users	3.16	1.025	.050	assumed	-.018	783	.985
	Users	3.16	1.257	.066	not assumed	-.018	689.174	.986
Positive smart city service experience	Non-users	2.55	.981	.048	assumed	-16.119	783	.000
	Users	3.69	.998	.053	not assumed	-16.096	756.320	.000
Positive e-government service experience	Non-users	3.04	1.099	.053	assumed	-13.820	783	.000
	Users	4.02	.842	.044	not assumed	-14.131	776.207	.000
Perceived usefulness	Non-users	2.68	1.029	.050	assumed	-15.311	783	.000
	Users	3.77	.952	.050	not assumed	-15.412	776.161	.000
Smart city data utility perception	Non-users	3.56	1.014	.049	assumed	-8.797	783	.000
	Users	4.13	.751	.040	not assumed	-9.019	770.774	.000
Level of satisfaction with public services in the city/municipality	Non-users	3.21	.950	.046	assumed	-4.410	783	.000
	Users	3.52	.980	.052	not assumed	-4.398	752.256	.000
Access to public services in the city/ municipality	Non-users	3.17	1.124	.054	assumed	-4.253	783	.000
	Users	3.52	1.157	.061	not assumed	-4.242	752.747	.000
Level of trust in local public institutions	Non-users	2.67	1.085	.053	assumed	-4.608	783	.000
	Users	3.04	1.144	.060	not assumed	-4.587	745.585	.000
Level of stress coping ability	Non-users	3.39	1.012	.049	assumed	-3.708	783	.000
	Users	3.67	1.052	.056	not assumed	-3.696	750.131	.000
Level of self-confidence	Non-users	3.39	.993	.048	assumed	-5.028	783	.000
	Users	3.74	.936	.049	not assumed	-5.054	773.348	.000

Source: The author based on the survey

The results indicate that there is a strong and statistically significant relationship between the use of smart city services and the level of citizens' digital literacy (Table 3). Users reported a mean digital literacy score of 4.18, significantly higher than non-users' mean of 3.39. This finding suggests that citizens with a higher level of digital literacy are more likely to use modern smart technologies and smart city services.

Additionally, awareness of available smart city services in their place of residence differs between groups. Users achieved an average awareness score of 3.62, compared with 2.64 among non-users. This indicates that increasing the use of public services requires familiarizing citizens with smart city services.

The existence of previous positive experiences with using smart city services and e-government services has proven significant for the use of smart city services. There are notably large differences regarding positive experiences with smart city services (mean 3.69 for users and 2.55 for non-users) and e-government services (mean 4.02 for users and 3.04 for non-users). Non-users report that they do not have positive experiences with smart city services. These results emphasize the importance of sharing positive experiences within society to increase the use of smart city services. Additionally, the perceived usefulness of smart city services is an important factor influencing their adoption: non-users generally do not see the usefulness of these services (mean 2.68), whereas users do (mean 3.77). This suggests that perceived practical value strongly influences adoption decisions.

Although both users and non-users on average see the usefulness of data collection and analysis being enabled to inform about public services, the perceived usefulness is higher among users of smart city services (mean 4.13) than among non-users (mean 3.56), and there are statistically significant differences between users and non-users of smart city services.

Statistically significant differences also appear in satisfaction with the public services provided in the city or municipality where the person lives, as well as the perception of the availability of public services in the city or municipality. Users expressed higher satisfaction (mean 3.52) than non-users (mean 3.21). The difference was confirmed by a t-test, indicating that users have a significantly higher level of satisfaction with the public services provided in the local unit. Similarly, the perception of the availability of public services shows a statistically significant difference, with users rating the availability of local public services higher than non-users (mean 3.52 for users and 3.17 for non-users). Therefore, both satisfaction and perception of the availability of public services are significantly more positive among users. This may suggest that direct experience in using local public services contributes to a better perception of those services and a higher level of satisfaction with the quality of life in the city or municipality.

While other studies did not include personality traits as factors influencing the use of smart city services, this study included the self-perceived level of stress-coping ability and level of self-confidence in the analysis, and it proved to be a statistically significant factor. Users scored higher stress coping ability (mean 3.67 for user and 3.39 for non-users) and self-confidence compared to non-users (mean 3.74 for users and 3.39 for non-users). These results suggest that personal resilience and confidence are associated with greater adoption of smart city services, extending beyond purely technological or infrastructural factors.

Privacy concerns (mean 3.16 for both groups) and concerns with the speed of smart city services development in the local unit (mean 2.86 for users and 2.85 for non-users) did not prove significant as factors contributing to the use of smart city services. There were no statistically significant differences in concerns between users and non-users of smart city services.

Furthermore, a chi-square test was used to test differences in user status with respect to gender, age, and the size of the settlement where the respondent lives.

Table 4: Results of the chi-square test

	Variable	Non-users, %	Users, %	Chi-square test
Age group	18–34	62.4	37.6	0.030
	35–64	50.9	49.1	
	65+	56.8	43.2	
Gender	Female	55,0	45,0	0.680
	Male	53.5	46.5	
Size of settlement	Up to 2,000 residents	57.8	42.2	0.101
	2,001–10,000 residents	50,0	50,0	
	10,001–100,000 residents	57.6	42.4	
	More than 100,000 residents	44.6	55.4	

Source: The author based on the survey

The analysis shows a statistically significant association between the age of respondents and the use of services, confirmed by the chi-square test result. Specifically, the proportion of non-users of services is highest in the 18–34 age group (62.4%) and among people over 65 years old (56.8%). In the 35–64 age group, nearly half are users of smart city services, while the other half are non-users. The results indicate that gender and size of the settlement do not influence differences in the use of smart city services.

As a result of the conducted principal component analysis, three factors were identified. The first factor is associated with smart service awareness and experience; it encompasses variables related to digital literacy, awareness, perceived usefulness of smart city services, and positive experiences with both smart city and e-government services, reflecting citizens' familiarity and engagement with digital public services. The second factor is associated with the level of public service satisfaction and trust; it includes variables measuring satisfaction with and access to public services, as well as trust in local public institutions. The third factor encompasses psychological characteristics, including citizens' levels of self-confidence and stress-coping ability.

Table 5: Results of the probit model

Factor	Marginal effects	Standard errors	p	95% Confidence interval
Factor 1 – Smart city services awareness and experience	0.435	0.029	0.000	0.378-0.493
Factor 2 – Public service satisfaction and trust	0.114	0.022	0.000	0.071-0.156
Factor 3 – Psychological factors	0.051	0.021	0.017	0.009-0.093

Note: Marginal effects estimated at the mean.

Source: The author based on the survey

The results of the probit analysis, presented in Table 5, confirm that all three factors contribute to the use of smart city services. The smart service awareness and experience factor has the strongest positive effect, indicating that citizens who are more familiar with and experienced in using smart city services are more likely to adopt them. The public service

satisfaction and trust factor also contributes to smart city service usage, with a smaller but still statistically significant effect. Psychological factors also contribute to the use of smart city services, exhibiting the smallest yet statistically significant effect.

5. Discussion

The findings suggest that limited awareness and moderate digital literacy partly explain the use of smart city services among citizens. Eurostat (2025) data on digital skills in the European Union reveal that in 2023, only 56% of citizens aged 16–75 possessed at least basic digital skills, with rates ranging from 27.7% in Romania to 82.7% in the Netherlands. In Croatia, 59% of citizens aged 16–75 possessed at least basic digital skills. These figures clearly indicate significant disparities in digital competence across Europe. The findings highlight that limited digital literacy remains a large barrier to the adoption of smart city services. In this regard, enhancing digital competencies among citizens is a crucial step toward a more inclusive digital transformation. Beyond improving digital skills, local authorities should also prioritize raising public awareness about the availability of smart city services and provide education among non-users. Such measures could help reduce the digital divide and ensure that technological advancements benefit a wider segment of the population. A similar conclusion has been reported in Kruhlov and Dvorák (2025), which emphasize that bridging the digital divide is important for effective smart cities governance. The gap in satisfaction and perceived availability of services between users and non-users suggests that direct engagement with smart city services may lead to improved perceptions of local governance and greater life satisfaction.

The study also confirms that positive experiences and perceived usefulness play a key role in shaping citizens' willingness to use smart city services. Sharing successful examples and positive user experiences could increase adoption rates. Differences in satisfaction and perceived availability of services between users and non-users suggest that direct experience with smart city services contributes to a more favorable perception of local governance and higher satisfaction with quality of life. This implies that once citizens recognize benefits, their motivation to engage with such services increases. Such results closely align with the Technology Acceptance Model and the Unified Theory of Acceptance and Use of Technology, both of which emphasize perceived usefulness and ease of use as critical determinants of technology adoption (Davis, 1989; Venkatesh *et al.*, 2003).

In addition to individual perception of usefulness, trust in local institutions emerged as another key determinant of adoption. In line with earlier studies (e.g. Habib, Alsmadi and Prybutok, 2019; Xin *et al.,* 2022), this research confirms that a high level of trust in local public institutions positively influences the use of smart city services. Lee-Geiller (2024) noticed that there is a positive association between citizens' evaluation of e-government effectiveness and trust in local government, with digital literacy serving as a positive moderating factor. However, the opposite also holds true. A low level of trust in local

government and local public institutions reduces citizens' sense of security and negatively affects the use of smart city services. Strengthening institutional trust is thus essential for advancing smart city development.

Privacy concerns and the perceived pace of smart city service development were not significant predictors of use, suggesting that citizens' decisions to adopt smart city services are driven more by usefulness, trust, and digital competence than by fear of data misuse.

Another important contribution of this study lies in the inclusion of psychological factors. This study uniquely included psychological factors, self-confidence and stress coping ability, which were both significantly higher among smart service users than non-users. Afshar *et al.* (2015) indicate that people who subjectively report a higher level of stress tend to experience more negative emotions and are more likely to be passive in coping with demanding everyday situations that cause them stress. Therefore, personal traits also influence engagement with smart services.

However, as this research is based on survey data collected among individuals in Croatia, there are some limitations of the research. The sample was limited to one country, which may constrain the generalizability of the findings to other cultural or governance settings. Comparative studies across countries could reveal how different governance models and policy frameworks impact the adoption of smart city services. Furthermore, these results underscore the need for future research to encompass a broader range of psychological characteristics to better understand if and how diverse psychological characteristics, such as technology anxiety, perceived control, and level of optimism, affect the adoption of smart solutions in cities. In addition, integrating objective behavioral data into the research, such as actual service usage data, could also complement self-reported measures and enhance the validity of findings.

6. Conclusions

The development of smart cities is recognized in European documents as essential for sustainable urban development, the environment, and improving citizens' quality of life. Smart cities use digital technologies and data-driven systems to enhance public services' efficiency, sustainability, and inclusiveness. The smart city concept offers various potentials ranging from more efficient public service delivery and reduced administrative costs to greater environmental sustainability. However, the literature often emphasizes the importance of ensuring active citizen participation and involvement in developing smart city services, as the success of smart cities largely depends on their acceptance of smart technologies and services. Issues of digital literacy and whether the digital divide leads to unequal access to public services among different social groups are also frequently discussed.

This study investigates the factors distinguishing users from non-users of smart city services and the factors influencing the use of smart city services. In summary, the findings provide evidence that citizens' digital literacy, awareness of smart city services, positive

experience, perceived usefulness of services and data use, level of satisfaction with public services in local units, and trust in local public institutions positively influence citizens' use of smart city services. Conversely, low stress-coping ability and low self-confidence reduce the likelihood of adopting such services. Such results indicate which competencies citizens need to systematically strengthen to increase the benefits of introducing smart city services and improve the quality of life. Beyond enhancing digital literacy, knowledge, and the dissemination of examples of effective smart city service use and positive experiences that encourage further adoption and a growing number of users, it is crucial to strengthen citizens' trust in local public institutions and local government. Strengthening this trust can foster citizen participation, greater social inclusion, and a more equitable distribution of the benefits generated by smart city services.

The analysis revealed that the smart city service awareness and experience have the strongest positive effect on the use of smart city services among citizens, indicating that citizens who are more familiar with and experienced in using smart city services are most likely to adopt them. The public service satisfaction and trust factor also contributes positively, though with a smaller yet statistically significant effect. Psychological factors, such as stress-coping ability and self-confidence, exert the weakest but still meaningful influence, suggesting that emotional and cognitive aspects play a complementary role in shaping adoption behavior.

These findings contribute to the literature on the digital transformation of public services by linking technological, institutional, and psychological factors with their impact on the acceptance of smart city services. This study examined only two psychological factors, both of which were found to significantly influence the acceptance of smart services in urban settings. These results underscore the need for future research to encompass a broader range of psychological characteristics to better understand how diverse emotional and cognitive characteristics, along with specific personality traits, affect the adoption of smart solutions in cities.

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Annex 1: List of variables

Variable	Survey statement
Digital literacy	My knowledge of information technology is sufficient for using online services.
Smart city service awareness	I am aware of the smart services offered in my municipality/city.
Use of smart city services	I use smart services in my municipality/city where they are available.
Concern with the speed of smart city services development	I am concerned about the speed at which new smart services are introduced in my municipality/city.
Privacy concerns	I am worried about collecting my personal information to manage or provide public services in my municipality/city.
Positive smart city service experience	I have positive experiences using smart services in my municipality/city.
Positive e-government service experience	I have positive experiences using smart services in the public sector (e-health, online applications for issuing personal documents, etc.).
Perceived usefulness	The smart services in my municipality/city make my daily life easier.
Smart city data utility perception	In cities, data collection and analysis should be enabled to inform public services (e.g., parking availability, public transport congestion, waste volume, etc.).
Level of satisfaction with public services in the city/municipality	I am generally satisfied with the city/municipality.
Access to public services in the city/municipality	In my municipality/city, I receive all the public services I need daily.
Willingness to use smart city services in the future	I would use them if I had greater access to smart solutions in my municipality/city.
Level of stress coping ability	I am a relaxed individual who copes well with stress.
Level of self-confidence	I have high self-confidence.
Level of trust in local public institutions	I have a high level of trust in local public institutions.
Education	Level of education
Age group	Age, in years
Gender	Female, male
Place of residence	Name of the municipality or city