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Smart cities and quality of life in Budapest: An Urban Consumer Perception-Based Approach

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AIMS OF THE PAPER

The aim of this study is to examine the association between smart city development and residents' quality of life in Budapest. This includes evaluating urban consumers' perceptions and attitudes towards existing smart solutions in the city across various aspects of their life.

METHODOLOGY

The research employed a trilingual questionnaire (English, Hungarian and Mandarin Chinese) to accommodate Budapest's diverse population of resident consumers. The data collection yielded 453 valid responses. Distribution occurred through both electronic platforms (web-based interfaces, QR codes, District Forums, expatriate networks) and paper-based instruments, which were completed by interviewers in various districts of the city.

MOST IMPORTANT RESULTS

Respondents generally have a positive image of Budapest, and they find the city relatively safe. Budapest's urban environment is rated quite positively, especially the city's atmosphere. Consumers find public transport efficient, easy to use and easy to navigate. Smart transportation-related services (mobile apps, ticketing, electronic information boards) were rated highly. However, respondents are not so happy with the parking situation and overall traffic management. They are least happy with the quality and cost of housing, followed by healthcare and low salaries compared to the cost of living. Also, they do not see Budapest as a very clean or sustainable city.

RECOMMENDATIONS

It is important to build on the city's strengths (e.g., efficient transport system, cultural attractions, good atmosphere) and to address apparent weaknesses (e.g., cleanliness, lack of parking). The city should be made safer for certain groups of residents (e.g., women) and the number of local green spaces should be increased for older residents who might find it harder to access central locations. Sustainability needs to be communicated more prominently, and residents, especially those less confident (e.g., older residents), should be encouraged to use smart tools.

Keywords: smart cities, quality of life, residents, urban consumers, city management, Budapest

INTRODUCTION

This study examines the importance of quality of life (QoL) within smart city (SC) frameworks, aiming to develop a comprehensive indicator system that positions residents or urban consumers at the centre of SC development, while formulating recommendations to enhance their QoL. The theoretical foundation was established through a comprehensive literature review spanning scholarly contributions (2020–2024) in the domains of "smart cities" and "quality of life". Empirical research was then conducted in Budapest, Hungary, utilizing a carefully constructed resident questionnaire as the primary data collection instrument. The survey aimed to capture the multidimensional quality of life indicators of urban consumers across six fundamental smart city domains: smart economy, smart environment, smart mobility, smart living, smart people and smart governance. The selection of Budapest as the research setting offers a valuable case study of SC development in a Central European context, while the questionnaire design ensures the capture of both objective indicators and subjective perceptions of QoL within the SC framework.

This investigation aims to provide municipalities and urban planners with a robust analytical framework for evaluating and optimizing residents' or consumers' QoL, which supplements more "top-down" strategies using a "bottom-up" approach. Furthermore, this study is timely because of Budapest's low performance in European QOL indices and the noticeable paucity of empirical data revealing residents' perceptions and needs.

LITERATURE REVIEW

Smart city and its domains

It has been suggested that the focus of SCs is switching from infrastructure supply-oriented approaches to improving citizens' quality of life and sustainability (Myeong et al. 2022). Transformation of a city system into a smart system aims to enhance the quality of life for its residents and their way of living, as well as its environment, economy, transportation, and governance (Muvuna et al. 2020). The six foundational Smart City dimensions identified by Giffinger & Gudrun (2010) – smart economy, mobility, environment, people, governance, and living – have been widely adopted in subsequent research (Bielinska-Dusza et al. 2021; Braga et al. 2021; Ozkaya & Erdin 2020). Various scholars have expanded this framework: Cantuarias-Villessuzanne et al. (2021) added "smart architecture and technologies"; Valencia-Arias et al. (2021) replaced "environment" with "sustainability" and incorporated "quality of life"; Ji et al. (2021) included additional dimensions: "smart safety", "smart health", "smart energy", and "smart transport". Chen & Chan (2023) consolidated these elements into five components:

- Smart environment (incorporating sustainability);
- Smart people (including social welfare and individual growth);
- Smart livelihood (encompassing lifestyle and community aspects i.e. sense of belonging);
- Smart economy and economic policy (including policy and governmental interventions);
- Smart mobility (covering transportation, facilities, and security).

Quality of life (QoL) is a fundamental part of smart city development and vision. Braga et al. (2021) and Valencia-Arias et al. (2021) connect smart ways of life with locals' lifestyle choices and QoL, measurable through social indicators. Individual QoL determinants include physical health, psychological state, level of independence, and social relationships (Chen & Chan 2023). Oh (2020) evaluates QoL through subjective satisfaction with housing, facilities, urban environment, physical and mental health, and area safety.

QoL enhancement relies on smart-city services (Lytras et al. 2021) and advanced integrated technologies (Dai et al. 2024), encompassing economic, environmental, transport, and governance factors (Muvuna et al. 2020), as well as municipal service efficiency (Edge et al. 2020). Additional considerations include disaster risk reduction (Kodag & Kodag 2023), social cohesion, resource management, and environmental preservation (Shami et al. 2022).

Chang and Smith's (2023) review identifies five key themes: smart urban governance, citizens' experiences, participation, sustainability, and QoL measurement. Despite the importance of smart governance in urban development (Ozkaya & Erdin 2020; Braga et al. 2021), gaps exist between policies and practice (Nunes et al. 2021; Chen & Chan 2023). Critics highlight issues related to power relations (Vanolo 2014), weak stakeholder engagement (Kitchin 2015), and social inequalities (Krivý 2018), leading to proposals for integrated e-governance models (Cheniki et al. 2020). While QoL should be central to smart city development (Keshavarzi et al. 2021), it is cautioned that urban development policies should not follow a universal model (Kitchin 2015; Vanolo 2014). This means that each context is unique and requires distinct measurement and management approaches.

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The literature suggests that the SC domain of smart living is most closely connected to quality of life (e.g., Cantuarias-Villessuzanne et al. 2021; Csukás & Szabó 2021; Ji et al. 2021; Shami et al. 2022). The research in this article is therefore primarily focused on smart living, but it also incorporates some of the most important aspects of smart cities including economic issues such as employment, salaries, and the cost of living, as well as transport efficiency and affordability. The questionnaire also asked respondents how strongly they agreed that the city should be smart and use smart tools and services. The outline of the questionnaire is shown in Appendix Table A1.

It could be argued that communities and the quality of life in a city are integral to a city's socio-economic image and brand (Piskóti & Nagy 2019). People constitute one of the six aspects used to measure the effectiveness of "Hexagon" city branding by Anholt (2006), which can be assessed based on the friendliness of the people and a sense of safety. These issues have important implications for competitiveness, investment, tourism and the attraction of new residents and consumers. It has also been argued that the image of a city can have an impact on residents' subjective well-being (Zhang & Li 2022). Many of the aspects of quality of life examined in this study can help to shape residents' positive image of a place.

Previous studies of urban consumers have suggested that they tend to be more highly educated, have better incomes, and are more driven by technology than rural consumers (Madan 2017). The adoption of e-commerce during and after COVID was considerable in cities (Choi et al. 2024), and younger consumers (Gen Z) are likely to be seeking digitally driven sustainable consumption (Theocharis & Tsekouropoulos 2025).

CONTEXT

Short Case Study Background (Budapest)

Smart developments have been ongoing in Budapest for more than a decade (Csukás & Szabó 2021). However, it was thought that Budapest was lagging behind other cities in the region (Csécsei 2020), especially in terms of quality of life and satisfaction related to healthcare, housing, air pollution and a lack of trust in others (European Commission 2023). More recent studies suggest that gentrification, clashes of interest over land use, and overtourism have contributed to "disrupted wellbeing" (Namaz & Tvergyák 2023). Budapest, like many cities in Central and Eastern Europe, has tended to follow the Western pattern of prioritising economic growth over environmental protection and social cohesion (Vesalon & Creţan 2019). Interestingly, since the study was undertaken, the Economist Intelligence Unit (EIU 2024) described Budapest as "the most liveable city in Eastern Europe" as it had advanced to 32nd place in the latest ranking of the "world's most liveable cities". It was also voted the 4th "Most Liveable Student City" in 2024 (The Campus Advisor 2024).

Budapest developed a Smart Tourism Vision in 2017, which incorporated seven strategic pillars: economic development and employment generation; sustainable energy initiatives; transport infrastructure enhancement; green space optimization; historical urban preservation and renewal; social regeneration; and tourism development. There have been several smart projects in Budapest, but most of these have focused on environmental and transportation issues. The concern in this research (e.g. in contrast to Fekete 2023) is with social and quality of life issues. It also examines attitudes to and propensity to use smart technology and tools. In the study of Budapest by Fekete (2023) only around 40% of residents were familiar with the term "smart city" and even fewer could name some smart solutions. Nevertheless, the Census (2022) suggests that 83% of citizens engage in digital activities. Previous studies also highlighted the need to gather opinions of the wider population in smart city research (Csukás & Szabó 2022).

Budapest is administratively divided into 23 districts, each characterized by different economic, social, and cultural features. These districts operate relatively autonomously, making holistic city management challenging. This can lead to conflicts over development priorities and regulations, as well as funding and resource allocation. This is especially problematic if developments span multiple district.

The image and branding of Budapest have changed frequently over the years, resulting in a lack of consistency. In recent years (especially since COVID), there has been an attempt to rebrand the city to discourage those forms of (over)tourism that diminish residents' quality of life. This includes strategies that encourage tourists to respect the local people and environment (Pinke-Sziva et al. 2025).

METHODOLOGY

Design and aims of the empirical research

The aims of the research were:

(1) To examine and evaluate resident consumers' subjective perceptions and experiences

regarding SCQoL dimensions in the context of a smart city (Budapest).

(2) To understand attitudes to smart city technology and the tools that residents are most likely to use.

(3) To generate evidence-based recommendations for citizen-centric approaches to urban planning and management by identifying the gap between consumers and service providers.

The research methodology was systematically structured into four distinct phases, which are presented in Table 1.

Table 1. Summary of the methodology

Phase I. Systematic review of smart city and quality of life literature
The initial phase commenced with a comprehensive literature review conducted through the Web of Science database, focusing on the key words "smart cities" and "quality of life". 38 of the most relevant and recent were analysed in depth.
Phase II. Development of SCQOL domains and indicators
The measurement instrument employed closed-ended items with standardized Likert scaling, consistent with established smart city and quality of life assessment protocols (e.g., Bielinska-Dusza et al. 2021; Chen & Chan 2023; Ji et al. 2021; Oh 2020; Shami et al. 2022; Vidiasova & Cronemberger 2020). Smart tools for each domain were identified through previous research and AI-generated suggestions.
Phase III. Pilot test
30 interviewees were selected from the target demographic, and the draft questionnaire was sent to them. Native-speaking experts in social research reviewed the draft questionnaire for language accuracy and design effectiveness. The feedback obtained during this phase was instrumental in refining the research instrument for optimal effectiveness. Based on pilot feedback, several questions were refined, particularly those related to housing affordability and educational levels.
Phase IV. Questionnaire distribution
The questionnaire was initially distributed through online platforms such as district resident forums, expatriate networks and by snowball sampling. Then the sample was balanced as far as possible according to the Census (2022) using face-to-face questionnaires distributed in central locations, targeting-represented groups (e.g., men, older residents, those from suburban districts). The data collection consequently resulted in a representative sample of 453 respondents from Budapest's population of approximately 1,685,342 inhabitants.

Source: author's own

The domains and indicators used in the questionnaire have been summarized in Appendix 1. Table A1. The questionnaire was developed in English, Hungarian, and Mandarin Chinese to accommodate Budapest's diverse population, including its largest ethnic minority (1.8% Chinese) and foreign residents (5.8%). The final questionnaire sample included 453 validated responses. Hungarian 2022 Census data (HCSO 2022) were meticulously examined and aligned as far as possible using a representative quota sampling method. A chi-square test of independence was performed comparing the sample with Budapest's overall population. The results show that the sample proportions align with the population proportions for gender (P-value =>0.05) and nationality (P-value > 0.05). Minor discrepancies appeared in the distribution of age, educational attainment, profession, civil status, property ownership, accommodation status, and residential district. Specifically, the sample contained a disproportionate number of young adults, singles, highly educated individuals and central district residents (especially Districts I., V., VIII.). This can be partly explained by some of these demographics' greater access to online questionnaires or the distribution of face-to-face questionnaires in mainly central locations in the city. Despite these limitations, the sample achieved a reasonable representation.

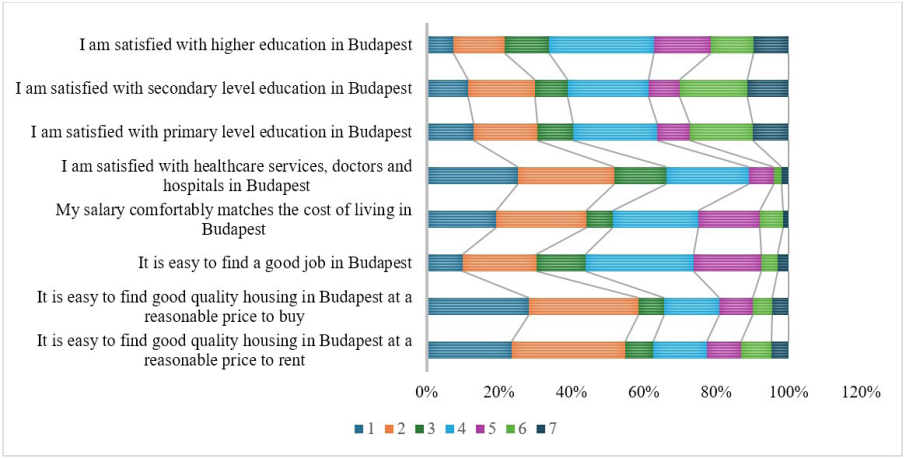
The analysis employed a multi-tool approach, utilizing Power BI for primary analysis and interactive visualizations, while data preprocessing and analysis were conducted through Microsoft Excel and Rstuido.

FINDINGS

The following section presents the main findings from the questionnaire. The 5-point Likert Scale was encoded as 1, 2, 3, 4 and 5 respectively, while

"I don't know" was coded as 6 and "Not relevant to me" as 7. Figure 1. illustrates the data for several key elements of quality of life including health, housing, employment, and education.

Figure 1. Reponses relating to economy, housing and education

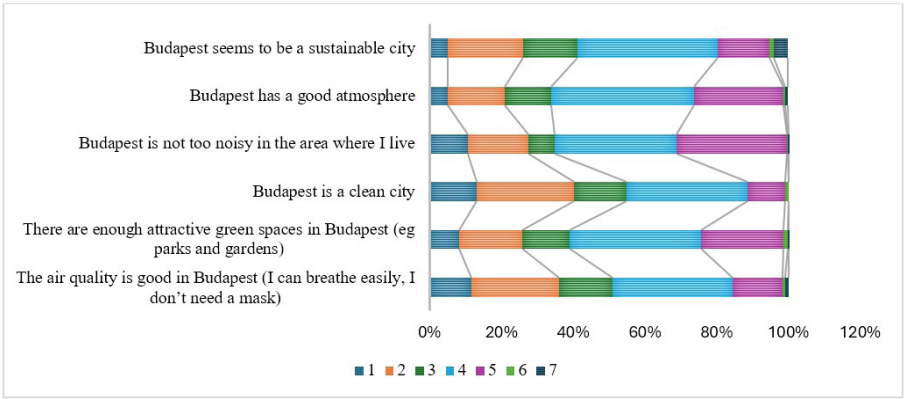


Source: author's own

Attitudes vary in terms of satisfaction level, with respondents being least satisfied with the cost of housing, the healthcare system, and the salary level compared to the cost of living. Housing affordability (buying and renting) had the lowest average scores at 2.41 and 2.49, respectively, and over 50% of the whole sample ranked this aspect below the median score of 3. This was especially true for the working population. With respect to job opportunities, secondary school graduates encounter the most significant barriers to securing appropriate employment, but so too do holders of advanced degrees (Master's and PhD degrees), followed by Bachelor's diploma holders.

Figure 2. shows data for issues related to the environmental domain of quality of life, including cleanliness, greenness, sustainability, atmosphere and noise.

Figure 2. Responses relating to environment



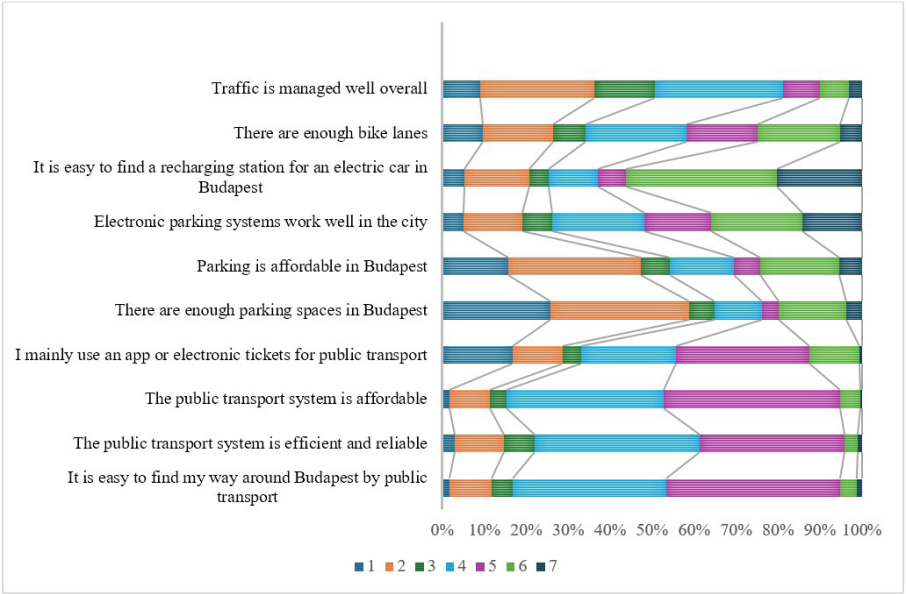
Source: author's own

Notable is the somewhat positive evaluation of environmental quality indicators, specifically sustainability measures, urban atmosphere, and noise levels in residential areas. More than 60% of respondents do not find the area they live in too noisy and 65% of respondents agree that the city has a good atmosphere. There is some variance in the results according to age and gender in terms of cleanliness, with older residents and women being less satisfied. Younger residents aged 18–24 are less

concerned about this issue. More than 60% ranked the statement about enough attractive green spaces (e.g., parks and gardens) with a 4 or 5, but men and older residents (50+) are less positive about the number of attractive green spaces. Some respondents said that Budapest's status as a sustainable city was "Not relevant to me", which indicates a potential gap in residents' involvement and a lack of sufficient communication of sustainability concepts.

Figure 3. shows the domains of quality of life that relate to so-called "smart mobility", many of which are closely connected to transportation.

Figure 3. Responses relating to transport

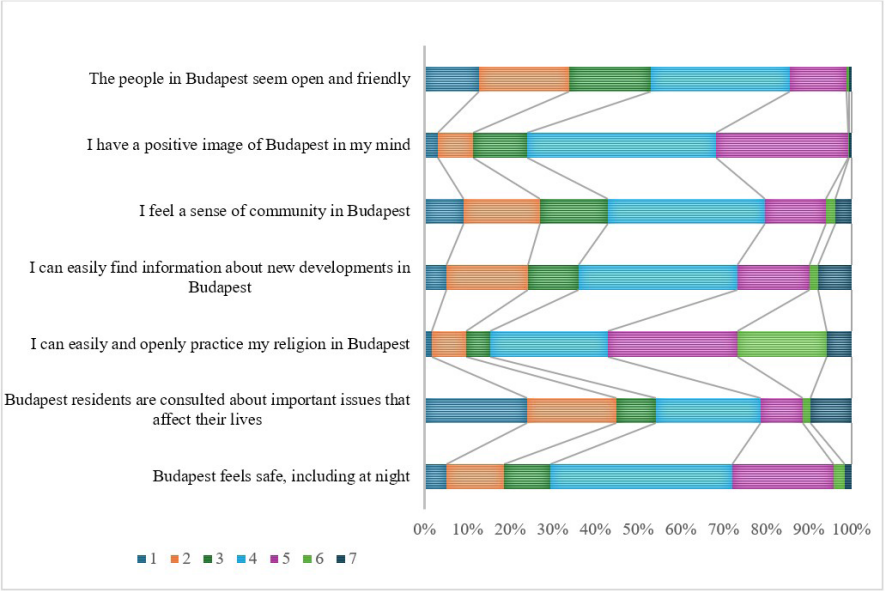


Source: author's own

Figure 3. shows a positive evaluation of Budapest's public transportation system, with consumers expressing satisfaction in multiple criteria, including system efficiency, reliability, ease of navigation, and affordability. The introduction of digital solutions through mobile applications has further enhanced the public transport experience. However, a significant digital divide emerges across age groups in the utilization of transportation applications. Older consumers report the lowest satisfaction scores and show a lesser tendency to use mobile applications followed by the 50–64 age group. More than half of the sample express dissatisfaction with the inadequate parking spaces and affordability. This finding cuts across demographic categories, indicating a systemic challenge in the city's parking infrastructure. The contrasting satisfaction levels between public transport and parking facilities suggest an uneven development in Budapest's transportation infrastructure.

Figure 4. illustrates data related to the social dimensions of quality of life, including friendliness, sense of community, consultation and perceived safety.

Figure 4. Responses relating to social issues

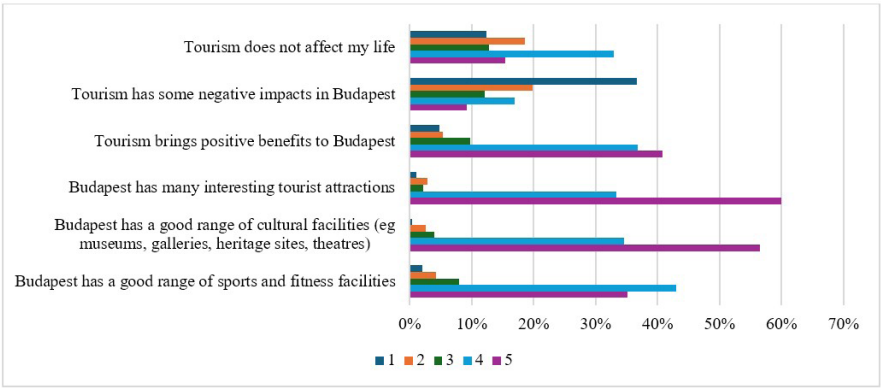


Source: author's own

The overall attitude towards social issues is mostly positive in Figure 4. More than 75% of respondents have a positive image of Budapest (rated 4 or 5), regardless of age, and 66% of residents find the city relatively safe (rated 4 or 5), including the oldest residents (aged 65 and above). However, females feel less safe than males (3.51 versus 3.91). The findings whether Budapest appears open and friendly were somewhat mixed. There were no significant age variations, however, male respondents found the city friendlier than females (3.3 versus 2.98). A couple of concerns have emerged from the analysis regarding the deficiency in public consultation processes and the relative difficulty in staying informed out about new developments in the city.

Respondents were also asked about their attitudes to tourism, culture and leisure. (Figure 5.) There were interesting variations according to whether consumers lived in central districts (e.g., those frequently visited by tourists) or in suburbs. This has important implications for overtourism management.

Figure 5. Responses relating to tourism, culture, and leisure



Source: author's own

Most respondents are positive about cultural and sports facilities, as well as tourist attractions. Reactions to tourism are varied, but they tend to be more neutral or positive than negative. There are not many significant variations according to gender, but women feel slightly more positive about the facilities and attractions, and slightly more negative about the impacts of tourism. The responses of residents living in districts that are heavily visited by tourists e.g., Districts VI. and VII. (the "party quarter"), show higher negative impacts. Although these areas present a paradox: highest ratings for cultural facilities and attractions (scores above 4.5), they also show the strongest negative tourism impact perceptions, exemplifying a tourism-quality of life conflict.

Consumers express positive attitudes towards most smart tools, particularly those related to mobility, parking, and ticketing for cultural attractions, although they show less interest in digital experiences within cultural facilities. In terms of attitudes towards using smart tools, the findings reveal that the oldest residents (65+) were surprisingly the most positive about smart city tools, possibly due to the topic's novelty compared to younger respondents (18–24 year olds). Additionally, women consistently ranked every statement about smart city services higher than men.

We further examined differences in responses based on educational attainment with respect to mean SC attitudes. Appendix 1. Table A2. summarizes the results of Tukey's post hoc analysis for four different educational attainment groups. The smart economy domain (comprising statements about the cost of living and job opportunities) exhibits the greatest disparity according to educational attainment, with university-level individuals (holding Bachelor's, Master's and PhD degrees) responding with more favourable attitudes. This reinforces previous observations that university-level respondents tend to encounter more opportunities to access suitable employment.

In terms of attitudes toward smart solutions and tools, the contrast between university-level qualifications (Bachelor's, Master's, or PhD) and primary school education (basic general level) or lower is most substantial. This finding indicates that consumers with advanced education demonstrate increased confidence when interacting with smart city facilities.

Nationality plays a significant role in shaping residents' perceptions of aspects of quality of life in a smart city. It is worth noting that Hungary reported the lowest level of self-reported happiness among 30 countries worldwide in a recent IPSOS (2025) study. A t-test revealed that the largest gap between Hungarian and foreign residents is found in the domain of smart governance as shown in Table 2. This domain related to information about new developments and consultation about important issues. This is surprising considering that many foreigners struggle to learn Hungarian (the main language of government communication and consultation). This gap is subsequently followed by differences in smart mobility (related to transportation and parking), smart solutions, smart people (related to education, image, atmosphere, openness, and sense of community) and environment (air quality, green spaces, cleanliness, noise levels, and sustainability). No significant difference is observed in terms of job opportunities and housing affordability. Interestingly, irrespective of nationality, they maintain positive attitudes toward smart city projects and express a desire to utilize more smart city services and tools.

Table 2. Comparative analysis of main SC domains by nationality

Domain	Difference between foreigners and Hungarians	p-value
Smart Environment (SEn)	0.472	0.000***
Smart Mobility (SM)	0.524	0 .000***
Smart People (SP)	0.368	0.001**
Smart Governance (SG)	0.539	0.000***
Smart Solutions (SS)	0.487	0.000***

*Note: Only significant differences of means are represented in this table. *p < 0.05, **p < 0.01, ***p < 0.001.*
Source: author's own

A cluster analysis using Ward's linkage revealed three distinct clusters of smart tools:

- Urban mobility and transportation infrastructure, encompassing e-information boards, e-parking systems, e-ticketing services, bike-sharing programs, electric vehicle charging stations, and car-pooling facilities.
- Household-level quality of life services, including educational institutions' online learning platforms, home-office support systems, smart waste collection services, and online platforms for healthcare access and complaint management, directly impacting residents' daily domestic experiences and personal wellbeing.
- Community-level amenities, incorporating public WiFi coverage, smart lighting systems, surveillance cameras, and touchscreen information kiosks, play a crucial role in enhancing the everyday quality of life for local residents by improving public space functionality and accessibility.

Cross-cluster analysis revealed patterns in consumers' smart city service preferences with transportation-related services, particularly mobile apps and electronic information boards, showing strong ratings. In contrast, citizen engagement services such as touchscreen kiosks and online platforms received lower ratings, indicating the need for creating more accessible systems or better local engagement.

CONCLUSIONS AND RECOMMENDATIONS

This study assesses the relatively under-researched connection between smart living and quality of life. It contributes to the development of SCQoL measures and indicators, which could apply to other post-socialist CEE cities that have followed similar trajectories to Budapest. They could also be used to measure the quality of life in smart cities more globally. Indeed, although every context and community varies, the domains and indicators apply to almost any city that hopes to enhance the quality of life by prioritising smart living. The positive and negative evaluations of different domains of quality of life can help city planners and managers to improve various aspects of the city, such as addressing the lack of affordable housing or inadequate parking provision.

It is essential to capitalize on the city's proven assets by further enhancing its already efficient public transportation infrastructure, strategically promoting existing cultural attractions, and preserving the city's positive atmosphere. Immediate attention should be directed toward implementing comprehensive cleanliness improvement programs and developing innovative solutions for parking infrastructure deficiencies. Priority should be given to establishing targeted safety measures, particularly for female residents, alongside creating green spaces in residential areas to benefit older citizens with limited mobility. Residents in District VII. face significant concerns about negative impacts of tourism, regardless of the high cultural facility ratings. This has implications for the management of overtourism in central districts.

Gender, educational attainment, and nationality significantly affect residents' perceptions of different facets of smart cities. Educational entertainment significantly influences their perceptions of job opportunities, attitudes towards the environment and sustainability, and the use of smart tools. The greatest divide is observed between holders of Master's or PhD degrees and those with primary school education. Regardless of nationality, however, residents generally hold positive perceptions of smart city projects and indicate interest in accessing expanded smart city services and tools.

Cluster analysis of smart city service preferences suggests that while mobility and transportation services have achieved widespread adoption and satisfaction, significant variations remain in the implementation and consumer preference patterns for educational, administrative, and security services. This finding highlights potential areas for targeted development in Budapest's smart city initiatives. In terms of digital integration, it would be beneficial to introduce user-friendly smart technology training programs, especially for older residents, accompanied by clear and accessible communication campaigns. These initiatives should be supported by comprehensive urban planning to address housing quality and availability, innovative space management solutions for inner-city parking constraints, smart traffic management systems for congestion relief, and balanced visitor management strategies to mitigate overtourism impacts. A phased implementation approach should be considered, beginning with immediate safety and cleanliness improvements, followed by short-term digital literacy and engagement programs, medium-term infrastructure and housing developments, and long-term sustainable tourism management solutions.

LIMITATIONS

This study faced sampling limitations, specifically in demographic representation. Despite attempts to achieve comprehensive coverage across age groups

according to the Census, older residents remained underrepresented in the sample. This demographic imbalance potentially affects the generalizability of the findings across all age segments of the population. To address these limitations, the research could be complemented by qualitative methodological approaches, such focus groups with older residents. It would also be interesting to discuss the findings with other groups of residents during focus groups, as well as conducting some stakeholder interviews or a Delphi Study to gain further insights and make future recommendations for planning and management.

One major challenge is that Budapest's decentralized system grants districts autonomy in many aspects of city management resulting in diverse approaches to smart city projects including tourism management. While enabling local control, this autonomous management challenges a coordinated city-wide strategy.

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APPENDIX 1.

Table A1. A summary of domains and related indicators of smart cities used in the questionnaire

Domain of smart cities	Indicators
Smart economy (Ivaldi et al. 2020; Ortega-Fernández et al. 2020; Ozkaya and Erdin 2020; Braga et al. 2021; Kim et al. 2021; Pira 2021; Valencia-Arias et al. 2021; Vidiesova and Cronemberger 2021; Zhu et al. 2022; Chen and Chan 2023; Kim et al. 2021)	Cost of living Jobs
Smart governance (Ozkaya and Erdin 2020; Braga et al. 2021; Mills et al. 2022; Zhu et al. 2022; Chen and Chan 2023; Leung and Lee 2023)	Information provision Consultation Complaints
Smart mobility (Oh 2020; Ortega-Fernandez et al. 2020; Ozkaya and Erdin 2020; Kim et al. 2021; Keshavarzi et al. 2021; Nunes et al. 2021; Valencia-Arias et al. 2021; Chen and Chan 2023)	Public transport Parking Cycling Traffic
Smart environment (Liu et al. 2020; Oh 2020; Shami et al. 2022; Zhu et al. 2022)	Air quality Green spaces Cleanliness Noise levels Sustainability
Smart people (Cornejo Ortega and Malcolm 2020; Ozkaya and Erdin 2020; Bielińska-Dusza et al. 2021; Del-Real et al. 2023; Csukás and Szabó 2021; Cantuarias-Villessuzanne et al. 2021; Ligarsky and Wolny 2021; Pira 2021; Shami et al. 2022; Chen and Chan 2023)	Education Social issues Image Atmosphere
Smart living (Oh 2020; Ortega and Malcolm 2020; Ozkaya and Erdin 2020; Bielińska-Dusza et al. 2021; Cantuarias-Villessuzanne et al. 2021; Csukás and Szabó 2021; Ji et al 2021; Ligarsky and Wolny 2021; Pira 2021; Shami et al. 2022)	Housing Healthcare Safety Leisure Culture Tourism

Table A2. Tukey's post hoc analysis for different educational attainment groups

Comparison group	Difference	P-value (adj)
Smart Economy		
2-1	0.945	0.000***
3-1	1.080	0.000***
4-1	0.869	0.001***
Smart Environment		
2-1	0.476	0.013*
Smart Living		
2-1	0.368	0.003**
3-1	0.382	0.004**
4-1	0.346	0.008**
Smart Mobility		
3 - 1	0.428	0.011*
4 - 1	0.391	0.019*
Smart Solutions		
3 - 1	0.490	0.001***
4 - 1	0.843	0.000***
3 - 2	0.264	0.011*
4 - 2	0.617	0.000***
4 - 3	0.353	0.001***

*Note: Only significant differences of means are represented in this table. *p < 0.05, **p < 0.01, ***p < 0.001. Educational attainment was coded as follows: Primary school (basic general level) or less = "1", Secondary school (High school) = "2", University level (Bachelor level) = "3", University level (Master or PhD) = "4".*