

CORVINUS UNIVERSITY OF BUDAPEST  
DOCTORAL SCHOOL OF BUSINESS AND MANAGEMENT

# **RESIDENTS' QUALITY OF LIFE IN THE CONTEXT OF SMART CITIES**

**Institute of Sustainability**

**Songling Chang**

**Supervisor: Dr. Melanie Kay Smith, Habil. Associate Professor**

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Songling Chang

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## **List of Abbreviations**

SC Smart City

QoL Quality of Life

SCQOL Smart City Quality of Life

OECD Organization for Economic Cooperation and Development

ICT Information Communication Technologies

AI Artificial Intelligence

EIU Economist Intelligence Unit

IMD International Institute for Management Development

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# 1. INTRODUCTION

## 1.1. Relevance of the Topic

This research examines the role of quality of life within smart city frameworks from a citizens' perspective. The primary objective of this Dissertation is to develop a comprehensive Smart City Quality of Life (SCQOL) indicator system that positions citizens at the centre of Smart City (SC) development, while formulating evidence-based recommendations for enhancing residents' quality of life (QoL). This includes providing municipalities and urban planners with a robust analytical framework for evaluating and optimizing inhabitants' QoL through systematic implementation strategies using a community-orientated “bottom-up” approach.

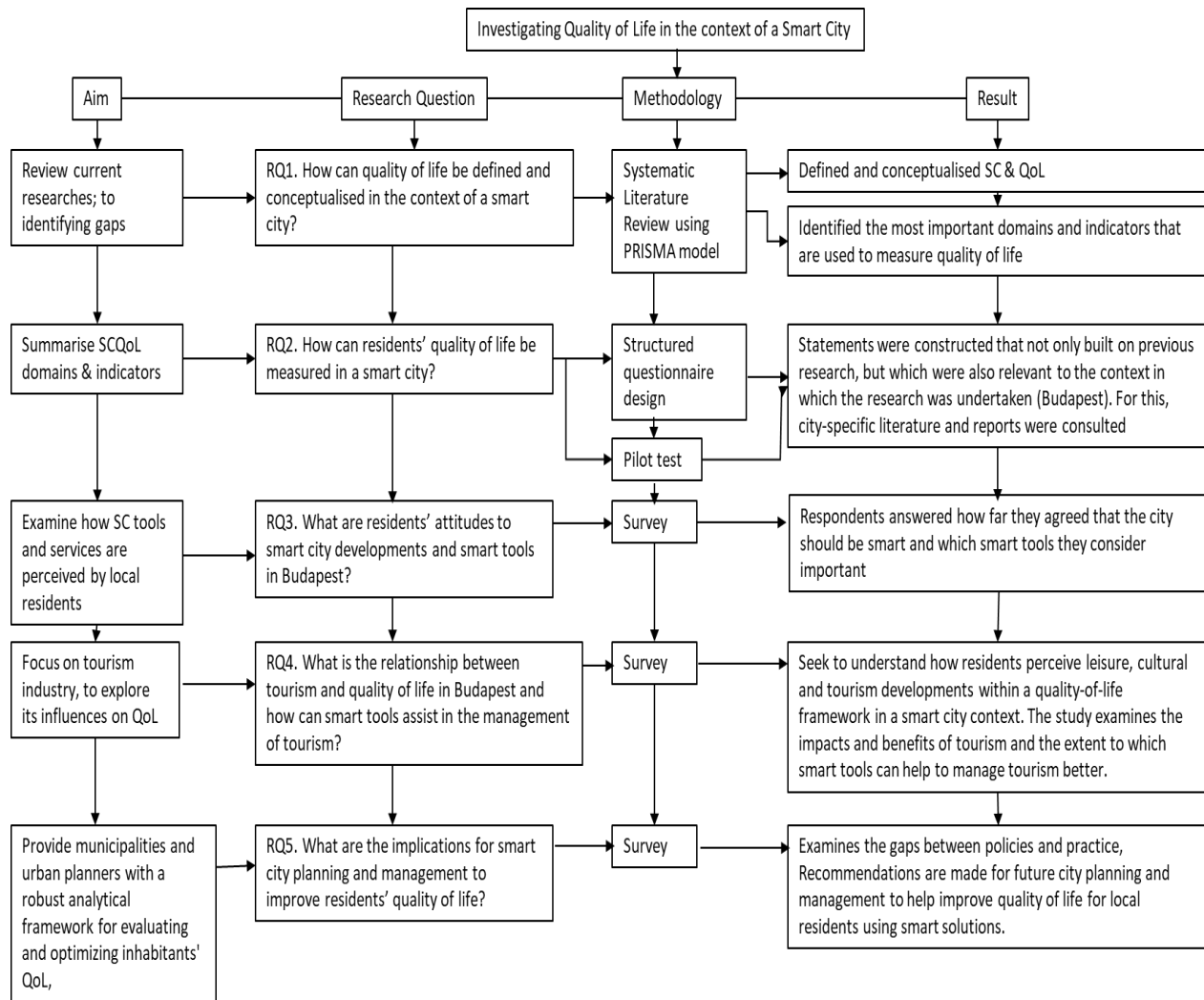
In terms of structure and process, this research comprises a systematic literature review that analyses definitions and concepts of smart city and quality of life, as well as the domains and indicators used to measure QoL. The study includes the design of a resident-based questionnaire that refines and expands on these SCQOL indicators. The investigation is based on an in-depth examination of Budapest as a contextual case study, offering practical insights for future smart city development initiatives that improve resident quality of life. Compared to previous studies, this study's timeliness and relevance for Budapest and Hungary are evidenced through multiple aspects. The research addresses Budapest's relatively low rankings in European Quality of Life indices and responds to a notable lack of empirical data regarding residents' needs and demands. By providing empirical research focused on residents' perspectives, this study helps bridge a significant knowledge gap in Budapest's smart city development trajectory.

Numerous definitions highlight the paramount importance of quality of life (QoL) in smart cities (SC), suggesting it should be considered the principal aim of smart city developments (Csukás and Szabó, 2021; Ji et al., 2021; Mills et al., 2022; Vidasova and Cronemberger, 2020). However, gaps exist between policies and practice (Nunes et al. 2021; Chen and Chan 2023; Hartley, 2023; Spicer et al., 2023). QoL and citizen-centric concerns have seldom been emphasized in previous studies. This neglect has practical implications and Dameri and Rosenthal-Sabroux (2014) noted that smart cities have sometimes failed to meet their objectives when citizens' needs were insufficiently considered. The extent of this research gap becomes apparent through Myeong et al.'s (2022)

systematic review, which found that human-focused research comprised just 8.1% of smart city studies. Smart cities must be responsive to communities and promote and improve people's quality of life (Del-Real et al., 2023; Wang and Zhou, 2023). Alfaro-Navarro et al. (2024) examine the digital capabilities of urban citizens and their potential to improve quality of life with mixed results. Some other recent studies have begun to address these issues in more depth. Pazos-García (2025) suggest that there is a positive relationship between quality of life and the competitiveness of cities, but that this can depend on good governance. For example, Spicer et al. (2023) highlight the gap between smart city services that municipal administrators put in place and the types of services residents actually want to see. Hartley (2023) emphasises the need for better communication and information from governments, and Wijayasinghe and Sachitra (2024) call for better smart education of citizens in smart city developments.

The main research aim is therefore: ***To define and measure the most important elements of quality of life for residents in a smart city.*** The thesis logic flow is depicted in Figure 1, and it will be discussed further in the following chapters.

**Figure 1. Roadmap of thesis**



*Source: own compilation*

## 1.2. Theoretical Background

Recent researchers indicate a significant paradigm shift from infrastructure-centric approaches toward citizen-oriented quality of life and sustainability frameworks (Myeong et al., 2022). The centrality of quality of life in smart city research is emphasized by Csukas and Szabó (2022) who state that "improving the quality of life of citizens is a central concept, and we assume it to be an ultimate goal of SC developments" (p. 3). Szarek-Iwaniuk and Senetra (2020) describe smart cities as being "characterized by sustainable economic development and a high quality of life, which are

driven by investments in human and social capital, traditional (transport) and modern (ICT) infrastructure, responsible resource management, and social participation" (p. 4). This perspective is reinforced by Vidiyasa and Cronemberger (2020) who note that "enhancing citizens' quality of life and experience with city services is often regarded as the ultimate goal for smart city initiatives" (p. 3).

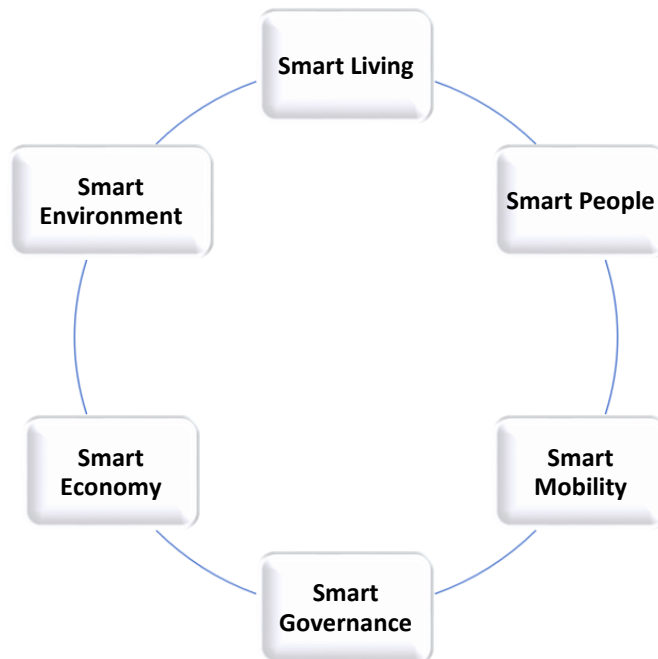
This transformation encompasses comprehensive improvements across multiple urban dimensions, including societal well-being, environmental sustainability, economic vitality, transportation efficiency, and governance (Muvuna et al., 2020). Notably, Del-Real et al. (2023) emphasize that meaningful innovation must be intrinsically linked to community responsiveness rather than pursuing technological advancement in isolation. A smart city comprises policies and programs aimed at enhancing municipal service efficiency and effectiveness, promoting urban (re)development, enabling private investment, and improving quality of life through information and communication technologies investment (Edge et al., 2020). ICT can be utilized to achieve improved quality of life in liveable and secure environments (Cantuarias-Villessuzanne et al., 2021).

Research indicates that smart cities should fundamentally combine human capital, social capital, and information and communications technology infrastructure to generate economic development and improve well-being and quality of life (Cantuarias-Villessuzanne et al., 2021; Csukás and Szabó, 2021; Szarek-Iwaniuk and Senetra, 2020). A contemporary smart city necessitates an integrated urban ecosystem characterized by secure ICT infrastructure, efficient physical systems, dynamic economic frameworks, inclusive social structures, environmental resilience, and transparent governance mechanisms (Zhu et al., 2022). As yet, only a few articles have been devoted to the topic of AI or artificial intelligence for improving the quality of life in smart cities. It is documented that AI is most used in the areas of transportation, environmental management, healthcare, cyber-security and communication (Ullah, Quddusi & Haider, 2024). AI can be useful especially in mobility planning, energy management and healthcare data handling (Szpilko et al., 2023). Although there is consensus in the literature that AI can improve quality of life in urban areas, it also brings new challenges, especially relating to data security, privacy, and regulatory compliance (Szpilko et al., 2023).

The evolution of smart city conceptualization is reflected in emerging terminologies: "quality-life oriented smart cities" (Cantuarias-Villessuzanne et al., 2021), "human smart cities" (Keshavarzi et al., 2021), "citizen-centric smart cities" (Shami et al., 2022), "people-centric smart cities" (Ji et al., 2021), "happiness driven smart cities" (Zhu et al., 2022), and "smart age-friendly cities" (Barletta et al., 2020; Li and Woolrych, 2021). Contemporary discourse increasingly positions quality of life enhancement as the paramount objective of smart city development ( Helbing et al., 2021; Ji et al., 2021; Pira, 2021; Treude, 2021; Chen and Chan, 2023). For this reason, the research focuses on quality of life in smart cities from a resident perspective. Although the topic has been theorised more extensively in recent years, it has been under-researched empirically.

As presented in Figure 2, Giffinger and Gudrun (2010) identified six dimensions of SC in previous literature: smart economy, smart mobility, smart environment, smart people, smart governance, and smart living. These domains have been adopted in multiple subsequent studies by researchers, often with some modifications or expansions (Ortega-Fernández et al., 2020; Ozkaya and Erdin, 2020; Bielińska-Dusza et al., 2021; Braga et al., 2021).

**Figure 2. Main domains of a smart city (Giffinger, 2010)**



*See Article A3, Table 4 for a summary of smart city domains and indicators.*

Smart living has been identified as the most crucial domains of a smart and sustainable city (Ozkaya and Erdin, 2020) and is frequently equated with quality of life (Giffinger et al., 2010; Braga et al., 2021; Valencia-Arias et al., 2021; Shami et al., 2022). Both concepts contribute to the development of liveable, safe urban environments (Cantuarias-Villessuzanne et al., 2021) and the enhancement of citizens' lives while addressing social challenges (Chen and Chan, 2023). Ozkaya and Erdin (2020) suggest that smart living includes healthcare conditions, education facilities, individual safety, housing quality and affordability, cultural interaction opportunities (e.g. events, heritage sites, museums, shopping), tourist attractivity, and social cohesion (e.g. homelessness, volunteering). Within this framework, technology is positioned as a means to improve citizens' lives rather than representing a goal in itself (Edge et al., 2020; Cantuarias-Villessuzanne et al., 2021; Shami et al., 2022).

Ji et al. (2021) situate tourism-related elements within the smart living domain, including online city-tourism information services. These authors suggest that tourism belongs to the 'soft domain' of smart cities alongside education, culture, innovation/entrepreneurship, human capital management, e-government, and welfare/social inclusion. These services, they argue, play a vital role in enabling citizens to fulfil their higher needs related to self-development. Although touristic attraction is not always considered to be the most important element in SCQOL studies (e.g. Ozkaya and Erdin, 2020), it nevertheless plays an increasingly important role in cities, especially those suffering from overtourism. For example, Wang et al. (2021) emphasize the disconnect between tourism development and liveability, noting that highly developed tourist cities do not necessarily rank high in liveability evaluations. They specifically highlight that "Tourist cities are supposed to be pleasant places for tourists, but for local residents, how they feel gets little attention" (ibid.p.2) and conclude that "a good tourist city is not necessarily a very liveable one" (ibid.p.11). Part of our study therefore investigates the impact of tourism on local residents' wellbeing and quality of life.

However, clear domain differentiation remains difficult due to the multifaceted nature of influences on smart living. Smart city domains demonstrate significant interconnectivity: governance systems and economic frameworks share regulatory boundaries; mobility networks and environmental outcomes are intrinsically linked; and human capital development directly affects quality of life

measures. Such interdependencies demand integrated, holistic management strategies rather than compartmentalized approaches to urban innovation. For this reason, although the research emphasised smart living because of its close connection to quality of life, it was considered important to include other dimensions of smart cities such as economic factors (e.g. cost of living, job opportunities) and infrastructure (e.g. transport and environment).

Capturing smart governance proved particularly challenging due to its predominantly “top-down” implementation (our research takes a more “bottom-up” approach), its close connections to other domains, e.g. public transport, traffic, infrastructure and safety (Chen and Chan, 2023), and its frequent invisibility from the citizen perspective. A major gap can exist between planning and the measurable impact of digital interventions, especially in the domain of data-driven monitoring and governance (Hsu, Schletz & Yu, 2023). It should also be noted that Budapest's urban governance currently confronts various barriers and restrictions stemming from political cooperation deficiencies, economic constraints, and funding limitations. However, this Dissertation does not aim to investigate the processes behind or barriers to smart city initiative implementation; rather, it focuses on examining how residents perceive existing and ongoing developments.

### **1.3. Research Questions, Methods and Process**

This section examines the main research questions, related publications, the research methods that were used to gather secondary and primary data, and the process of the study design.

#### **1.3.1 Research Questions and Related Publications**

The research aims and questions were identified based on previous studies that had indicated the gaps in the research on smart cities. The main research aim was as follows:

***To define and measure the most important elements of quality of life for residents in a smart city***

The main aim took into consideration previous studies and filled the following gaps:

- **To supplement the lack of citizen-focused research in smart cities (Myeong et al., 2022)**
- **To address the need to be responsive to communities and improve people's quality of life (Del-Real et al., 2023; Wang and Zhou, 2023).**
- **To assess the role of tourism in smart cities and especially smart living (Ji et al. (2021)**
- **To measure how far technology can be used as a means to improve citizens' lives in smart cities (Cantuarias-Villessuzanne et al., 2021; Shami et al., 2022).**

- **To collect data documenting citizens' quality of life in smart cities that was missing in previous research in Budapest (Csukás and Szabó, 2018; Csukás and Szabó, 2022)**
- **To provide evidence for governmental policies and practice (Nunes et al. 2021; Chen and Chan 2023), and to make recommendations for urban planners, managers and municipality.**

The research questions were then designed based on these gaps:

*RQ1. How can quality of life be defined and conceptualised in the context of a smart city?*

*RQ2. How can residents' quality of life be measured in a smart city?*

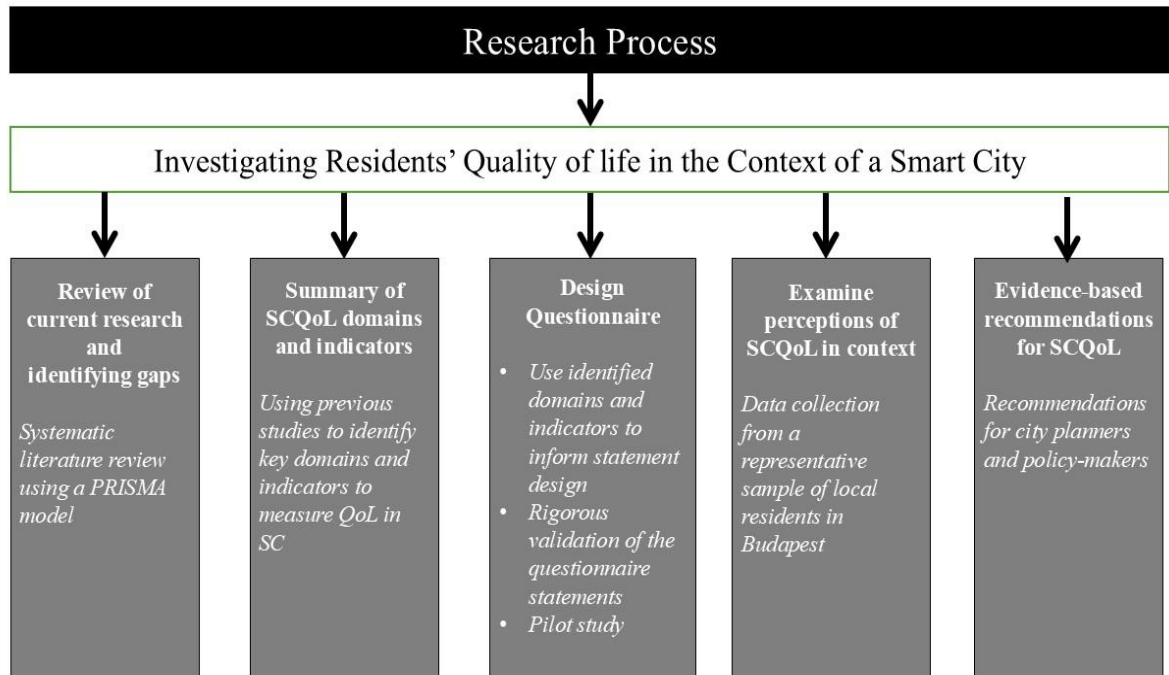
*RQ3. What are residents' attitudes to smart city developments and smart tools in Budapest?*

*RQ4. What is the relationship between tourism and quality of life in Budapest and how can smart tools assist in the management of tourism?*

*RQ5. What are the implications for smart city planning and management to improve residents' quality of life?*

These research questions were addressed through a systematic literature review, the design of a questionnaire for local residents in context (Budapest), data analysis, and recommendations for smart city management. Figure 2 illustrates the comprehensive process of research and statistical analysis.

**Figure 2. The overview of the research procedure and methodology**



Source: own compilation

Subsequent publications that answered these research questions are shown in Table 1.

**Table 1. Research questions and related publications**

| Research Question                                                                                 | Related Publication(s)                                                                                                                                                                                                                                                                                                                                            | Reference                                                                                                                                                                                                                                     |
|---------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>RQ1. How can quality of life be defined and conceptualised in the context of a smart city?</i> | This aim was answered using a systematic review of 38 relevant articles from 2020-2022 using the keywords 'smart city' and 'quality of life', as well as subsequent literature from 2023 and 2024. This review helped to define and conceptualise smart cities and to identify the most important domains and indicators that are used to measure quality of life | Chang, S., and Smith, M. K. (2023). Residents' Quality of Life in Smart Cities: A Systematic Literature Review. <i>Land</i> , 12(4), 876. <a href="https://doi.org/10.3390/land12040876">https://doi.org/10.3390/land12040876</a> (published) |
| <i>RQ2. How can residents' quality of</i>                                                         | This aim was answered using the process of the questionnaire design which built on the domains, indicators                                                                                                                                                                                                                                                        | Smith, M. K., Chang, S. and Michalkó, G. (2024). Smart Living and Quality of Life:                                                                                                                                                            |

|                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>life be measured in a smart city?</i>                                                                                                          | and measurements identified in previous research on smart cities and quality of life. Statements were constructed that not only built on previous research, but which were also relevant to the context in which the research was undertaken (Budapest). For this, city-specific literature and reports were consulted (e.g. research by Csukás and Szabó, 2018, 2021, 2023, Fekete, 2023, and the Smart City Vision of Budapest, 2017). | Domains and Indicators. <i>Journal of Urban and Regional Analysis</i> . 16. 10.37043/JURA.2024.16.2.1<br><b>(published)</b>                                                                                                                                                                                                 |
| <i>RQ3. What are residents' attitudes to smart city developments and smart tools in Budapest?</i>                                                 | The questionnaire asked respondents how far they agreed that the city should be smart and which smart tools they consider important, including electronic health options, online learning platforms, e-information and e-ticketing systems, smart lighting and security cameras, online complaint platforms, and digital experiences in attractions.                                                                                     | Smith, M. K. and Chang, S. (2025). Quality of Life and Overtourism in Budapest: Resident Experiences and Smart Solutions, <i>Worldwide Hospitality and Tourism Themes</i> , 17 (4), 452–464.<br><a href="https://doi.org/10.1108/WHAT-T-03-2025-0086">https://doi.org/10.1108/WHAT-T-03-2025-0086</a><br><b>(published)</b> |
| <i>RQ4. What is the relationship between tourism and quality of life in Budapest and how can smart tools assist in the management of tourism?</i> | This research question seeks to understand how residents perceive leisure, cultural and tourism developments within a quality-of-life framework in a smart city context. The study examines the impacts and benefits of tourism and the extent to which smart tools can help to manage tourism better.                                                                                                                                   | Smith, M. K., Chang, S. and Michalkó, G. (2025). Tourism and Quality of Life in Smart Cities, <i>Turizmus Bulletin</i> ,<br><b>(accepted)</b>                                                                                                                                                                               |
| <i>RQ5. What are the implications for smart city planning and management to improve residents' quality of life?</i>                               | This research question focus on evaluating residents' perceptions and attitudes towards existing smart solutions in the city across various smart city life aspects.                                                                                                                                                                                                                                                                     | Chang, S. (2025) Smart Cities and Quality of Life in Budapest: An Urban Consumer Perception-Based Approach. <i>The Hungarian Journal of Marketing and Management</i> <b>(accepted)</b>                                                                                                                                      |

Source: own compilation

### **1.3.2 Research Methods**

One of the most important reasons for undertaking a systematic review was to understand better the domains and indicators that are used to measure and research QoL in smart cities. QoL is clearly a composite and complex field of study and requires the incorporation of multiple domains including both objective and subjective indicators. Some authors recommend a holistic approach to measuring quality of life including objective indicators (measurable using the available statistical data) with subjective indicators related to feelings and perceptions (Ligarski and Wolny, 2021). It is difficult to summarize which of these domains and indicators are the most important, but a close reading of the 38 articles in the systematic review helped to better understand the relative significance of each domain and related indicators. The findings from SC and QoL research can help city administrators or policy makers to prioritize which services are needed most by citizens and are therefore worth allocating resources to or investing in (Valencia-Arias et al., 2021). Each smart city domain typically correlates with numerous indicators used to measure their significance in data collection. For this reason, a number of indicators were collected that were related to each domain from previous studies. One of the challenges is that smart city researchers usually do not include their questionnaire in articles, therefore their indicators could only be used as a guideline for the questionnaire design rather than including specific statements which have been tested in other research studies. Thus, the work is mainly ‘adapted from’ these studies.

Previous studies in the systematic review of the literature used a range of research methods, including qualitative content analysis or text analysis of official documents, in-depth interviews or focus groups. However, resident questionnaires emerged as the predominant methodology in smart city quality of life research (e.g. De Guimarães et al., 2019; Oh, 2020; Vídiasova and Cronemberger, 2020; Bielińska-Dusza et al., 2021; Ji et al., 2021; Simonofski et al., 2021; Shami et al., 2022; Chen and Chan, 2023). The sample size in these previous studies ranged from 235 to 829 resident respondents and used a combination of snowball sampling, online using social media or citizen platforms, and face-to-face questionnaires undertaken in public places. The use of Likert scale 1-5 was common.

Two questions were included that aimed to capture respondents’ attitudes to smart city development that were adapted from Chen and Chan (2023):

- **The development of Budapest as a smart city is important to me**
- **I would like to use more smart services in Budapest**

Fekete's (2023) smart city research in Budapest indicated that residents were mainly unable to name smart solutions, therefore prompts were given to respondents in the final questionnaire. A further question was included that gathered information about the smart services that residents are most likely to use. In addition to the literature review, the researcher gave instructions to artificial intelligence to “list specific or tangible smart city initiatives that citizens can use”. Table. 2 shows the final domains, indicators and statements that were chosen for the questionnaire.

**Table 2. Domains, indicators and statements chosen to measure SCQoL based on previous studies**

| <b>Domain of smart cities</b>                                                                                                                                                                                                                                    | <b>Indicators</b>     | <b>Statement referring to quality of life element</b>                  | <b>Associated smart service (if applicable)</b>      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------------------------------------------------------|------------------------------------------------------|
| <b>Smart economy</b><br><br>(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) | Cost of living        | My salary comfortably matches the cost of living                       | Opportunities to work online from home               |
|                                                                                                                                                                                                                                                                  | Jobs                  | It is easy to find a good job                                          |                                                      |
| <b>Smart governance</b><br><br>(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 | I can easily find information about new developments                   | WiFi available everywhere in the city                |
|                                                                                                                                                                                                                                                                  | Consultation          | Residents are consulted about important issues that affect their lives |                                                      |
|                                                                                                                                                                                                                                                                  | Complaints            |                                                                        | Online complaint platforms where people can say what |

|                                                                                                                                                                                                                 |                  |                                                                                                                                                                    |                                                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
|                                                                                                                                                                                                                 |                  |                                                                                                                                                                    | they find good or bad about the city to the Mayor or government                 |
| <b>Smart mobility</b><br><br>(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 | It is easy to find my way around by public transport<br><br>The public transport system is efficient and reliable<br><br>The public transport system is affordable | Electronic information boards to show when the next bus/train is coming         |
|                                                                                                                                                                                                                 | Parking          | I mainly use an app or electronic tickets for public transport<br><br>There are enough parking spaces<br><br>Parking is affordable                                 | A transport system with e-ticket options (e.g. via apps or online booking)      |
|                                                                                                                                                                                                                 | Cycling          | Electronic parking systems work well in the city<br><br>It is easy to find a recharging station for an electric car                                                | Electronic parking options<br><br>Electricity charging stations for cars        |
|                                                                                                                                                                                                                 | Traffic          | There are enough bike lanes<br><br>Traffic is well managed overall                                                                                                 | Bike-sharing schemes<br><br>Car-pooling or sharing apps                         |
|                                                                                                                                                                                                                 | Air quality      | The air quality is good                                                                                                                                            | Rubbish collection based on smart technology which indicates when bins are full |
|                                                                                                                                                                                                                 | Green spaces     | There are enough attractive green spaces                                                                                                                           |                                                                                 |
|                                                                                                                                                                                                                 |                  |                                                                                                                                                                    |                                                                                 |

|                                                                                                                                                                                                                                                                                         |                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                |                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                         | Cleanliness<br><br>Noise levels<br><br><br>Sustainability                                                                                 | It is a clean city<br><br>It is not too noisy in the area where I live<br><br>It seems to be a sustainable city                                                                                                                                                                                                                                                                |                                                            |
| <b>Smart people</b><br><br>(Cornejo Ortega and Malcolm, 2020; Ozkaya and Erdin, 2020; Bielińska-Dusza et al., 2021; Del-Real et al., 2023; Csukás and Szabó, 2021; Cantuarias-Villesuzanne et al., 2021; Ligarsky and Wolny, 2021; Pira, 2021; Shami et al., 2022; Chen and Chan, 2023) | Education<br><br><br><br><br><br><br><br><br>Social issues<br><br><br><br><br><br><br><br><br>Image<br><br><br><br><br><br><br>Atmosphere | I am satisfied with primary level education<br><br>I am satisfied with secondary level education<br><br>I am satisfied with higher level education<br><br>The people seem open and friendly<br><br>I can easily and openly practice my religion<br><br>I feel a sense of community<br><br>I have a positive image of the city in my mind<br><br>The city has a good atmosphere | Online learning options offered by educational institution |
| <b>Smart living</b><br><br>(Oh, 2020; Ortega and Malcolm, 2020; Ozkaya and Erdin, 2020; Bielińska-Dusza et al., 2021; Cantuarias-                                                                                                                                                       | Housing                                                                                                                                   | It is easy to find good quality housing at a reasonable price to rent<br><br>It is easy to find good quality housing at a                                                                                                                                                                                                                                                      |                                                            |

|                                                                                                                                     |            |                                                                                                                                                                                                          |                                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| <p>Villesuzanne et al., 2021; Csukás and Szabó, 2021; Ji et al, 2021; Ligarsky and Wolny, 2021; Pira, 2021; Shami et al., 2022)</p> | Healthcare | <p>reasonable price to buy</p> <p>I am satisfied with healthcare services, doctors and hospitals</p>                                                                                                     | <p>Electronic health options where people can access doctors online</p>                                             |
|                                                                                                                                     | Safety     | <p>Budapest feels safe, including at night</p>                                                                                                                                                           | <p>Smart lighting systems</p> <p>Cameras linked to security services in public spaces</p>                           |
|                                                                                                                                     | Leisure    | <p>The city has a good range of sports and fitness facilities</p>                                                                                                                                        | <p>Touchscreen kiosks in public areas providing information about local services, events and points of interest</p> |
|                                                                                                                                     | Culture    | <p>The city has a good range of cultural facilities (e.g. museums galleries, heritage sites)</p>                                                                                                         | <p>Electronic ticket options for theatres, museums and other cultural facilities</p>                                |
|                                                                                                                                     | Tourism    | <p>The city has many interesting tourist attractions</p> <p>Tourism brings positive benefits to the city</p> <p>Tourism has some negative impacts on the city</p> <p>Tourism does not affect my life</p> | <p>Digital experiences in cultural facilities like museums, heritage sites and galleries</p>                        |

*Source: own compilation*

### **1.3.3 Research Process**

The doctoral Dissertation process was carried out in several stages as shown in Figure 2, which are summarized as follows.

#### **Research phrase I**

The first phase of the study involved a systematic literature review using the keywords 'smart cities' and 'quality of life', which was conducted between 2020 and 2022 using the Web of Science database (i.e. the most recent and up-to-date articles focusing on SCs and QoL at the time when the review began). The process was based on the PRISMA model. From this comprehensive review, 38 of the most relevant and recent papers were selected for in-depth analysis (see Article A1 Chang and Smith, 2023).

#### **Research phrase II**

Phase II involved the development of the research framework by extracting key domains and indicators from the literature review. These findings were instrumental in designing the questionnaire, with statements carefully aligned to commonly identified domains and indicators (see Table 2). The research instrument employed a 5-point Likert scale for statement assessment and was produced in three languages—Hungarian, English and Mandarin Chinese—to accommodate Budapest's diverse demographic composition, including its foreign resident population (5.8%) and predominant minority group (Chinese at 1.8%) (HCSO, 2023). The draft questionnaire was then subjected to rigorous validation processes through discussions with expert researchers, including at various conferences and workshops.

#### **Research phrase III**

A structured questionnaire was designed based on previous research. When designing the questionnaire on quality of life in smart cities, all smart city domains (as defined by Giffinger et al., 2010) were considered. Phase III consisted of a pilot test involving 30 participants from the target demographic across all three language versions, following Perneger et al. (2015). Demographic representation was maximized through quota sampling techniques aligned with the latest Census population parameters (HCSO, 2022). This testing phase served multiple crucial purposes: assessing linguistic clarity and comprehensibility, evaluating question wording and ease

of understanding, identifying potential ambiguities requiring refinement, and validating the questionnaire's practical applicability. The feedback obtained during this phase proved instrumental in refining the questionnaire, particularly in statements concerning housing affordability and education levels (see Article A2 Smith, Chang and Michalkó, 2024).

#### Research phrase IV

Phase IV entailed the distribution of the questionnaire, which was achieved through a dual approach. Initially, the questionnaire was distributed via online platforms, including district resident forums, expatriate networks, and snowball sampling. Following the collection of approximately half of the responses online, the sample was strategically balanced according to the Census (2022) through the distribution of face-to-face questionnaires in central city locations including the city park and Deák Ferenc square. This approach enabled the researchers to specifically target demographic groups that were under-represented, such as male residents, older populations (65+), and individuals from suburban districts, ensuring a more comprehensive and representative sample. The timing coincided with the European Football Championships, creating favourable conditions for questioning men in public spaces around matches. The data collection resulted in a representative sample of 453 respondents from Budapest's population of approximately 1,685,342 inhabitants. Despite efforts to implement representative quota sampling aligned with the latest Census data (HCSO, 2022), the resulting sample shows adequate gender balance but inadequate representation of older residents (65+). All 23 districts appear in the sample, although representation varies considerably (1% in District XXIII to 9% in District VIII), with a notable skew toward central rather than suburban or peripheral districts (see Table 3).

**Table 3. Chi-square test of independence between the questionnaire sample compared to the whole Census (N=453)**

| Attributes | Classification (Coding) | Sample proportion (%) | Population proportion (%) | Chi-square | P-value  |
|------------|-------------------------|-----------------------|---------------------------|------------|----------|
| Gender     | Female                  | 51.69                 | 53                        | 0.051      | 0.821    |
|            | Male                    | 46.74                 | 47                        |            |          |
| Age        | 18-24                   | 23.37                 | 9                         | 157.126    | 0.000*** |
|            | 25-49                   | 53.74                 | 49                        |            |          |
|            | 50-64                   | 17.23                 | 22                        |            |          |

|                      |                                    |       |    |          |          |
|----------------------|------------------------------------|-------|----|----------|----------|
|                      | 65-79                              | 5.66  | 20 |          |          |
| Civil status         | Married                            | 32.38 | 39 | 78.729   | 0.000*** |
|                      | Single                             | 58.98 | 40 |          |          |
|                      | Divorced                           | 5.4   | 13 |          |          |
|                      | Widowed                            | 3.25  | 8  |          |          |
| Education            | Primary school or less             | 9.05  | 14 | 31.287   | 0.000*** |
|                      | Secondary school                   | 39.51 | 47 |          |          |
|                      | University level                   | 51.44 | 39 |          |          |
| Profession           | Employee in foreign company        | 12.58 | 48 | 1116.856 | 0.000*** |
|                      | Unemployed                         | 2.21  | 2  |          |          |
|                      | Retired/pensioner                  | 7.73  | 23 |          |          |
|                      | On maternity leave                 | 1.1   | 3  |          |          |
|                      | Student                            | 14.35 | 12 |          |          |
|                      | Other                              | 62.03 | 12 |          |          |
| Nationality          | Hungarian                          | 84.55 | 83 | 0.769    | 0.381    |
|                      | Foreign                            | 15.45 | 17 |          |          |
| House or flat owner  | Yes                                | 50.55 | 81 | 272.886  | 0.000*** |
|                      | No                                 | 49.45 | 19 |          |          |
| Accommodation status | I live alone                       | 23.4  | 21 | 211.116  | 0.000*** |
|                      | I live with a partner              | 34    | 15 |          |          |
|                      | I live with my parents             | 10.15 | 7  |          |          |
|                      | I live with my child or children   | 3.75  | 15 |          |          |
|                      | I live with partner and child(ren) | 18.1  | 36 |          |          |
|                      | I live with a friend or friends    | 10.6  | 6  |          |          |

**Note:** Sample number = 435; Census number = 906,147, which is the number of residents aged 20 or above. The population proportions for age, gender, education were obtained from the 2022

**Population Census (<https://nepszamlalas2022.ksh.hu/en/>). Significance levels: \* $<0.05$ , \*\* $<0.01$ , \*\*\* $<0.001$ .**

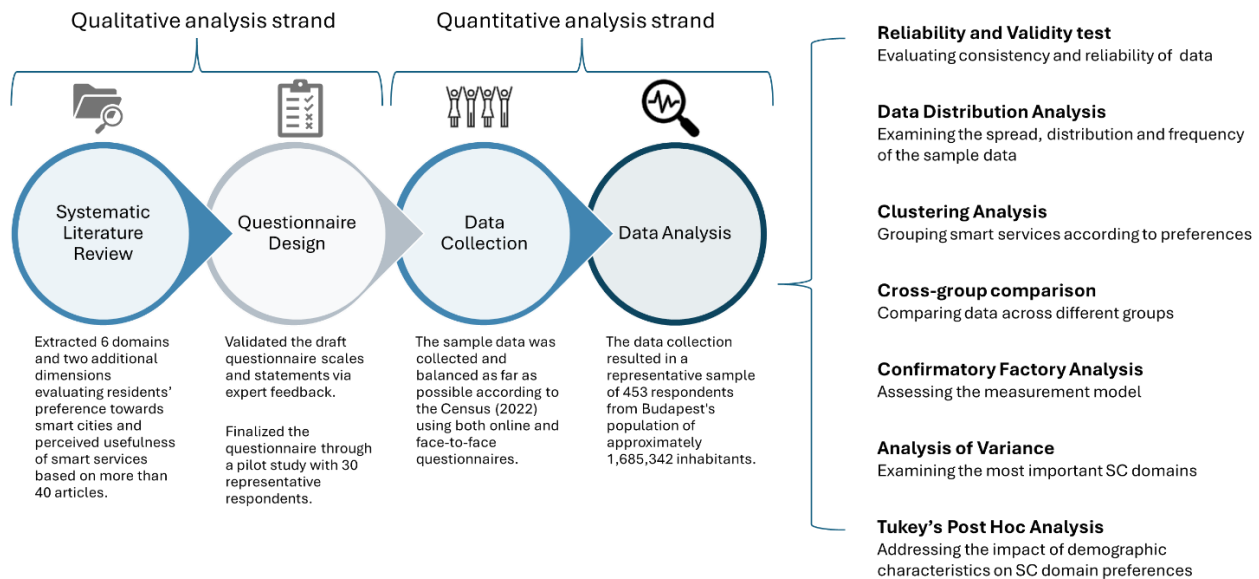
### **Research phrase V**

This phase involved data analysis of the questionnaire findings using appropriate statistical methods in order to identify significant patterns and trends, and to assess demographic variations in response. The dataset was prepared in Power BI and Microsoft Excel, the statistical analysis and visualisation were conducted using programming languages Python and R. A set of statistical and mathematical analyses were conducted. First of all, the researchers evaluated the reliability and validity of collected data and key indicators which were calculated including Kaiser–Meyer–Olkin (KMO), Average Variance Extract (AVE), Composite Reliability (CR). This was followed by examining the spread, distribution and frequency of the data. Cluster analysis further provided a deeper understanding by grouping smart services according to priority. Based on previous theoretical foundations, the measurement model was examined via confirmatory factory analysis. Analysis of variance identified the most important dimensions in SC. Tukey’s post hoc analysis addressed the influence brought by different socio-demographic characteristics.

### **Phrase VI Discussion and Conclusion**

The findings were disseminated through International and National conferences, reviewed by experts from the relevant areas. They were then well-structured and published in reputable international journals. The primary publications have been enumerated in Chapter 1.4 of this Thesis.

**Figure 3. Diagram summarising the flow of the research process containing statistical analysis**



*Source: own compilation*

### 1.3.4 Context for Dissertation: Budapest

The absence of data documenting citizens' needs in smart cities was highlighted in previous quality of life research (Csukás and Szabó, 2018; Csukás and Szabó, 2022). This gap prompted the researchers to conduct a resident-centred study of quality of life in Budapest as an emerging smart city. Smart developments in Budapest have been progressing for over a decade (Csukás and Szabó, 2021). However, initial assessments indicated that Budapest was falling behind regional competitors (Csécsei, 2020), particularly regarding quality-of-life indicators such as healthcare, housing, air pollution, and interpersonal trust (European Commission, 2023). Previous research identified that issues like gentrification, land use conflicts, and excessive tourism have led to what is termed "disrupted wellbeing" (Namaz and Tvergyák, 2023:1). In the past, like other Central and Eastern European cities, Budapest prioritized economic development over environmental and social considerations (Vesalon and Crețan, 2019). The recent situation showed improvement, with the Economist Intelligence Unit (EIU, 2024) ranking Budapest as "the most liveable city in Eastern Europe" and 32nd globally among "world's most liveable cities". According to 2023 data, the perceived level of citizen participation in municipal decision-making rose from 32.3 points in 2019

to 34 points in 2023 (BVK, 2025). Additionally, Budapest achieved recognition as the 4th "Most Liveable Student City" in 2024 (The Campus Advisor, 2024). However, a 2025 analysis also found that satisfaction with key indicators such as healthcare services, green space availability and public transport was ranked considerably below other European capitals (Növekedés.hu, 2025).

In 2017, Budapest established its Smart Budapest Vision, structured around seven strategic pillars encompassing economic development and employment generation, sustainable energy initiatives, transport infrastructure enhancement, green space optimization, historical urban preservation and renewal, social regeneration, and tourism development. Since adopting its smart-city strategy, the city has launched sensor-networks, mobility plans, and digital service initiatives aimed at enhancing walkability, connectivity and liveability. The national smart-city market in Hungary is growing, with the smart-cities segment projected to reach about US\$116.5 million in 2025, with nearly 10 % annual growth to 2029—indicating increased investment that could support Budapest's agenda (Statista, 2025). However, on the global ranking front, Budapest dropped to 89th in the International Institute for Management Development (IMD) Smart Cities Index in 2024, attributed to weaknesses in affordable housing, health services and security (Pénzcentrum.hu, 2024).

The research in this Thesis diverges from previous studies (e.g. Fekete, 2023) by concentrating on social aspects and quality of life issues, including attitudes toward smart technology adoption. Fekete's (2023) research revealed that only 40% of residents understood the concept of 'smart city', with even fewer able to identify specific smart solutions. However, the Census (2022) indicates high digital engagement, with 83% of citizens participating in digital activities.

The city's administrative structure consists of 23 districts, each with distinct economic, social, and cultural characteristics. The autonomous nature of these districts presents challenges for unified city management, often resulting in conflicts over development priorities, regulations, and resource allocation. For example, this can have implications for tourism management where several attractions span more than one district. This is especially true of central areas such as the so-called 'party quarter' mainly located in districts VI and VII, which have the highest concentration of tourists and Airbnb units (Pérez Garrido et al., 2022). This has led to complaints from local residents about overtourism or touristification and related impacts and behaviour (Smith et al., 2019).

It is difficult to differentiate between the concepts of gentrification, touristification and overtourism, especially in a city like Budapest where most of the impacts of tourism are concentrated in a limited number of central districts. In the past, many tourists were attracted by the cultural and heritage sites around Andrásy Avenue and the World Heritage Site, including the castle district. In recent years, the ‘party quarter’ spanning the former Jewish ghetto districts VI and VII gained popularity. More recent developments try to encourage tourists (including cruise passengers) to visit the City Park and its new cultural attractions (Smith & Chang, 2025). In accordance with the definitions of Santos-Izquierdo et al. (2025), it could be said that touristification (defined as the transformation of urban spaces into ‘tourist places’) has occurred in the city’s former Jewish ghetto area, now a night-life hub and ‘party quarter’. Overtourism is common in this area because of overcrowding and the pressure on infrastructure. Subsequent gentrification and displacement of locals have taken place because of rising house prices and cost of services, coupled with the negative impacts of tourism.

Regulations vary across districts in Budapest, for instance regarding closing hours of bars. This study also includes tourism as an element of smart living, as it has been suggested that smart tools could help to manage tourism better, as well as other quality of life-related services like transport, traffic, parking, attraction capacity, even housing (Pérez Garrido et al., 2022).

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## 1.4. Statement of Conjoint Work

The Dissertation presents the following journal articles:

**Article 1 (A1): Residents' Quality of Life in Smart Cities: A Systematic Literature Review**

**Article 2 (A2): Smart Living and Quality of Life: Domains and Indicators**

**Article 3 (A3): Quality of Life and Overtourism in Budapest: Resident Experiences and Smart Solutions**

**Article 4 (A4): Tourism and Quality of Life in Smart Cities**

**Article 5 (A5): Smart Cities and Quality of Life in Budapest: An urban consumer perception-based approach**

These five journal articles are displayed in Table 4.

**Table 4. Summary of Research Articles**

| Article | Title                                                                      | Author/s                                          | Status                                                     | Journal Ranking | Citation                                                                                                                                                                                                                        |
|---------|----------------------------------------------------------------------------|---------------------------------------------------|------------------------------------------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A1      | Residents' Quality of Life in Smart Cities: A Systematic Literature Review | Songling Chang, Melanie Kay Smith                 | Published by <i>Land</i>                                   | Q1 in SCIMAGO   | Chang, S., & Smith, M. K. (2023). Residents' Quality of Life in Smart Cities: A Systematic Literature Review. <i>Land</i> , 12(4), 876. <a href="https://doi.org/10.3390/land12040876">https://doi.org/10.3390/land12040876</a> |
| A2      | Smart Living and Quality of Life: Domains and Indicators                   | Melanie Kay Smith, Songling Chang, Gábor Michalkó | Published by <i>Journal of Urban and Regional Analysis</i> | Q2 in SCIMAGO   | Smith, M. K., Chang, S. & Michalkó, G. (2024). Smart Living and Quality of Life: Domains and Indicators. <i>Journal of Urban and Regional Analysis</i> . 16. 10.37043/JURA.2024.16.2.1.                                         |
| A3      | Quality of Life and Overtourism in Budapest:                               | Melanie Kay Smith,                                | Published in the journal <i>Worldwide Hospitality</i>      | Q2 in SCIMAGO   | Smith M. K. & Chang, S. (2025). Quality of life and overtourism in Budapest: resident                                                                                                                                           |

|    |                                                                                           |                                                   |                                                                      |                                             |                                                                                                                                                                                                               |
|----|-------------------------------------------------------------------------------------------|---------------------------------------------------|----------------------------------------------------------------------|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | Resident Experiences and Smart Solutions                                                  | Songling Chang                                    | <i>and Tourism Themes</i>                                            |                                             | experiences and smart solutions, <i>Worldwide Hospitality and Tourism Themes</i> , 17(4), pp. 452–464,<br><a href="https://doi.org/10.1108/WHATT-03-2025-0086">https://doi.org/10.1108/WHATT-03-2025-0086</a> |
| A4 | Tourism and Quality of Life in Smart Cities                                               | Melanie Kay Smith, Songling Chang, Gábor Michalkó | Accepted by <i>Turizmus Bulletin</i>                                 | Category B by Hungarian Academy of Sciences |                                                                                                                                                                                                               |
| A5 | Smart Cities and quality of life in Budapest: An urban consumer perception-based approach | Songling Chang                                    | Accepted by <i>The Hungarian Journal of Marketing and Management</i> | Category B in Hungarian Academy of Sciences |                                                                                                                                                                                                               |

As multiple researchers contributed to these publications, individual contributions require transparent documentation. This documentation follows the structured attribution framework established by Brand et al. (2015), recognized internationally as a standardized methodology for detailing author contributions in scholarly journal publications, as presented in Table 5.

**Table 5. Statement of conjoint work**

| General data | A1   | A2                                     | A3                        | A4                | A5                                  | Working paper (Draft)          |
|--------------|------|----------------------------------------|---------------------------|-------------------|-------------------------------------|--------------------------------|
| Journal      | Land | Journal of Urban and Regional Analysis | Worldwide Hospitality and | Turizmus Bulletin | Journal of Marketing and Management | Sustainable Cities and Society |

|                                   |                                                                                                              |                                                                                                           |                                                                                                |                                                                                              |                                                                                                                                                               |                                                                                                  |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
|                                   |                                                                                                              |                                                                                                           | Tourism Themes                                                                                 |                                                                                              |                                                                                                                                                               |                                                                                                  |
| <b>Status</b>                     | Published                                                                                                    | Published                                                                                                 | Published                                                                                      | Accepted                                                                                     | Accepted                                                                                                                                                      | Soon to be submitted to the Journal of Sustainable Cities and Society                            |
| <b>Language</b>                   | English                                                                                                      | English                                                                                                   | English                                                                                        | English                                                                                      | English                                                                                                                                                       | English                                                                                          |
| <b>WOS, Scopus MTA-list</b>       | Q1                                                                                                           | Q2                                                                                                        | Q2                                                                                             | B                                                                                            | B                                                                                                                                                             | Q1                                                                                               |
| <b>Scimago Journal Rank</b>       | 0.77                                                                                                         | 0.3                                                                                                       | 0.44                                                                                           | -                                                                                            | -                                                                                                                                                             | 2.869                                                                                            |
| <b>First author contribution</b>  | Conceptualisation<br>Methodology<br>Investigation<br>Software<br>Writing – original draft<br>Formal analysis | Conceptualisation<br>Writing – original draft<br>Methodology<br>Formal analysis<br>Project administration | Conceptualisation<br>Investigation<br>Writing – original draft<br>Writing – review and editing | Conceptualisation<br>Methodology<br>Writing – original draft<br>Writing – review and editing | Conceptualisation<br>Writing – original draft<br>Methodology<br>Software<br>Investigation<br>Formal analysis<br>Data curation<br>Writing – review and editing | Conceptualisation<br>Writing – original draft<br>Formal analysis<br>Writing – review and editing |
| <b>Second author contribution</b> | Conceptualisation<br>Methodology<br>Investigation<br>Writing – review and editing                            | Methodology<br>Writing – review and editing<br>Formal analysis                                            | Investigation<br>Software<br>Formal analysis<br>Data curation                                  | Data curation<br>Formal analysis<br>Visualisation<br>Writing – review and editing            |                                                                                                                                                               | Methodology<br>Investigation<br>Software<br>Data curation<br>Formal analysis<br>Visualisation    |

|                                          |                                                 |                                                                                 |                                                         |                                                                                                           |  |                                                                  |
|------------------------------------------|-------------------------------------------------|---------------------------------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|--|------------------------------------------------------------------|
|                                          | Formal<br>analysis<br>Project<br>administration |                                                                                 | Visualisati<br>on<br>Writing –<br>review and<br>editing |                                                                                                           |  |                                                                  |
| <b>Third<br/>author<br/>contribution</b> |                                                 | Resources<br>Supervision<br>Visualisation<br>Writing -<br>review and<br>editing |                                                         | Resources<br>Funding<br>acquisition<br>Supervision<br>Visualisation<br>Writing -<br>review and<br>editing |  | Software<br>Formal<br>analysis<br>Data curation<br>Visualisation |

Note: Article A4 is a single-authored work that was nonetheless supported by my supervisor Professor Dr. Melanie Kay Smith.

## 2. RESIDENTS' QUALITY OF LIFE IN SMART CITIES: A SYSTEMATIC LITERATURE REVIEW (ARTICLE A1)

**Reference:** Chang, S., & Smith, M. K. (2023). Residents' Quality of Life in Smart Cities: A Systematic Literature Review. *Land*, 12(4), 876. <https://doi.org/10.3390/land12040876>

**Songling Chang**<sup>1,\*</sup> and **Melanie Kay Smith**<sup>2,3,4</sup>

<sup>1.</sup> Department of Tourism, Institute of Sustainable Development, Corvinus University of Budapest, 1093 Budapest, Hungary

<sup>2.</sup> Department of Tourism, Leisure and Hospitality, Budapest Metropolitan University, 1148 Budapest, Hungary; [msmith@metropolitan.hu](mailto:msmith@metropolitan.hu)

<sup>3.</sup> Pärnu College, University of Tartu, 80012 Pärnu, Estonia

<sup>4.</sup> Department of Historical and Heritage Studies, Faculty of Humanities, University of Pretoria, 0028 Pretoria, Pretoria, South Africa

\* Correspondence: [songling.chang@stud.uni-corvinus.hu](mailto:songling.chang@stud.uni-corvinus.hu)

**Abstract:** Despite its popularity in urban studies, the smart city (SC) concept has not focused sufficient attention on citizens' quality of life (QoL) until relatively recently. The aim of this study is, therefore, to examine the concept of QoL in SCs using a systematic review of 38 recent articles from 2020–2022. This includes definitions and concepts, indicators and domains that are used to measure QoL, and the typical research methods that are used to collect data. The review analyses some of the main themes that emerge from the field of SCQoL which include smart urban governance, sustainability, smart living, participation, and social inclusion. The findings from this SC and QoL research can help city planners to prioritize which domains are the most important or meaningful for citizens and which services to invest in. It has been suggested that smart living is the most important domain of a SC. However, various studies have found that citizens experience SC initiatives holistically and that QoL is quite dependent on context in terms of priorities. Therefore, citizen participation strategies should be tailored and adapted to each respective context. SC governance also needs to be more long-term and strategic with real evidence that citizens are involved in decision making and problem solving and are not just passive recipients.

**Keywords:** smart cities; quality of life; indicators; citizens; governance; smart living

### 2.1. Introduction

The smart city (SC) concept emerged as a new trend to answer challenging issues related to urban development. It has been suggested that the focus of SCs is switching from infrastructure supply-oriented approaches to improving citizens' quality of life and sustainability [1]. Transformation of a city system into a smart system is meant to improve the quality of life for its people and their way of living, its environment, economy, transportation, and governance [2]. It has been argued that innovation for the sake of innovation is not smart, but rather that a SC is intertwined with and responsive to its community [3]. A SC should be an urban area with accessible and secure ICT infrastructures, reliable and efficient physical infrastructures, productive and innovative economy, equal and inclusive society, sustainable and resilient environment, and participatory and transparent governance [4]. Research confirms that the basis of smart cities is the combination of human capital, social capital, information, and communications technology infrastructure in order to generate economic development and improve the wellbeing and quality

of life [5,6]. Thus, reference is increasingly made to “quality-life oriented smart cities” [7], “human smart cities” [8], “citizen-centric smart cities” [9], “people-centric smart cities” [10], “happiness driven smart cities” [4], and “smart age-friendly cities” [11,12]. It has frequently been argued that the enhancement of quality of life, liveability, and wellbeing should be the primary goal of SCs [10,13–16].

However, previous studies have often not focused specifically on quality of life and citizen-centric issues. It has been stated that smart cities did not always reach their objectives because they did not take into consideration the needs of citizens [17]. One systematic review of SCs showed that research on humans was the least important (8.1%) [1]. Our study, therefore, focuses on SCs and quality of life specifically. A systematic review was conducted to identify the main themes and topics that are discussed in recent SC and QoL articles, as well as identifying which tools and indicators are used to research the relationship between smart cities and residents’ quality of life.

The structure of the paper begins by discussing the screening process for the collection of relevant articles based on inclusion and exclusion criteria. This is followed by a quantitative and qualitative analysis of the articles based firstly on keywords and abstracts and followed by a closer reading of the selected relevant texts. The main findings of the articles are summarized thematically, and recommendations are made for future research, especially those studies that aim to measure citizens’ quality of life in SCs.

## 2.2. Materials and Methods

Firstly, a bibliometric review was conducted using the Bibliometrix package and the Web of Science Core Collection. Several keywords were used in addition to ‘smart city’, including ‘urban ICT’, ‘urban computing’, ‘urban planning’, ‘urban design’, ‘sustainable cities’, ‘urban sustainability’, ‘sustainable urban development’, and ‘smart sustainable cities.’ Keywords from 1357 articles were analysed resulting in the identification of the most frequently occurring words dating back to 2005. It could be seen that a large number of articles focused on environmental issues and ecology, but relatively few mentioned quality of life until around 2014, and social sustainability was not a major focus until 2017. This suggests a gap in the research for an analysis of issues that are important to local residents. It was also observed that the term ‘quality of life’ (QoL) is used much more frequently than ‘wellbeing’ in SC articles. Recent articles start to emphasize the importance of quality of life from 2018 and 2019 [1]. The systematic review in this article, therefore, aimed to build on but not to duplicate the most recent studies of SCs and QoL. Studies undertaken since 2019 concluded that quality of life had become a central priority in SC studies [18–20]; however, there was still no clear definition of what QoL means in the context of SCs [20].

Following on from the latter studies, the articles selected for systematic review in this paper were published between 2020 and 2022 (i.e., the most recent and up-to-date articles focusing on SCs and QoL at the time when the close analysis began). The screening procedure was conducted with the pre-defined keywords ‘smart city’ and ‘quality of life’, and the process was based on the PRISMA model (Figure 1). The titles and abstracts of the collected articles were screened, duplicate items were removed, and irrelevant articles were excluded. The criteria for inclusion and exclusion are discussed below. The review resulted in 38 articles.

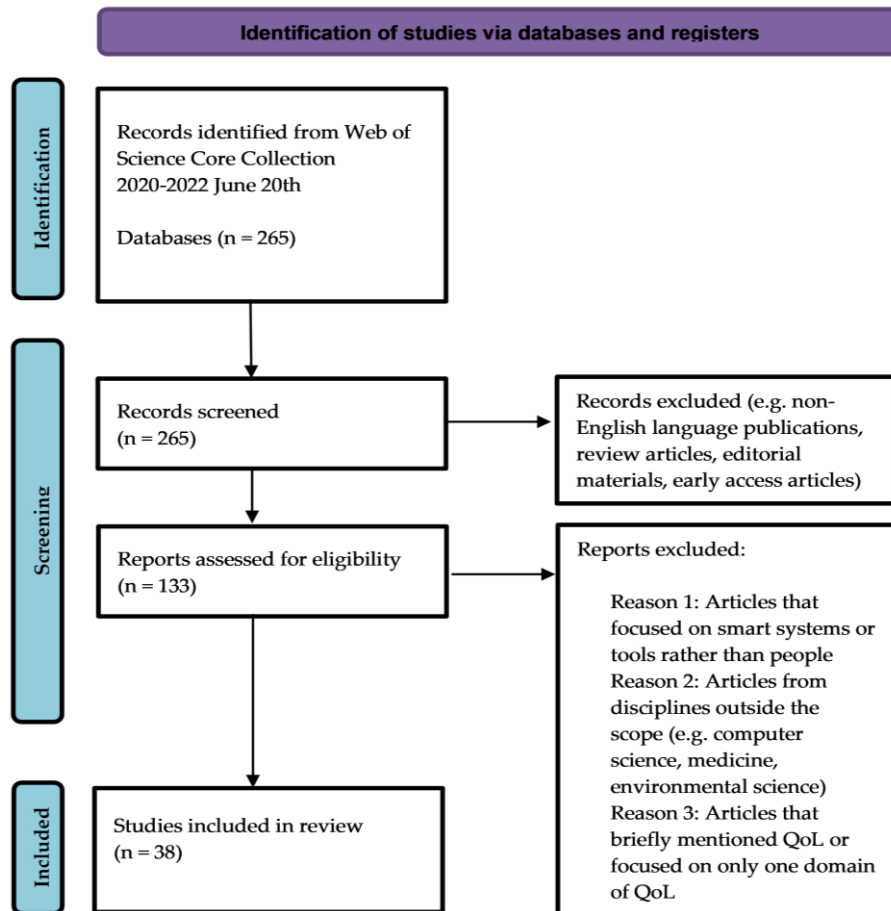


**Figure 1.** PRISMA model. Source: Authors' own (2023).

The aims of the systematic review were the following:

- **To define quality of life in the context of smart cities;**
- **To observe the main tools and methods used to research quality of life in smart cities;**
- **To analyse the most important domains and indicators that are used to measure quality of life in smart cities;**
- **To discuss the main themes that emerge from studies about the relationship between smart cities and quality of life;**
- **To identify gaps and avenues for future research using the optimum combination of research methods, tools, and indicators.**

This research takes a predominantly social science perspective; therefore, articles were excluded if they were very technical (e.g., from Computer Science journals), or based on environmental or medical science. The articles needed to be focused specifically on citizens or residents and their quality of life and not (only) on smart tools or systems (e.g., those based on cloud computing, sensing gadgets, grids, or the development of mobile applications). Several themes were of particular interest to the researchers:

Studies of cities that measure and compare factors that affect residents' quality of life in smart cities (SCs):

- Articles about the relative importance of factors and domains of SCs for citizens, including economics, mobility, environment, and governance;
- Articles that include and define 'smart living' (defined as creating liveable and safe cities [7] that enhance lives and tackle social challenges [13]);
- Articles exploring residents' perceptions of usefulness of smart city systems, services, and applications;
- Articles focusing on citizen engagement and participation in smart city developments;
- Articles about social inclusion and under-represented groups in SCs (e.g., aging residents and migrants);
- Articles that analyse the role of citizens in policy making and decision making within smart-city governance;
- Articles that discuss the relationship between SCs, residents' wellbeing and sustainability or resilience.

## **2.3. Results**

The following section analyses the selected 38 articles in terms of the journal of publication and the geographical location(s) in which the studies were undertaken. It should be noted that some articles are not place-specific, and others compare several cities globally, regionally, or nationally. It is also common to compare more than one case study in different countries. Some authors refer to good practices in specific cities but do not undertake primary data collection there. The geographical analysis is followed by a discussion of definitions of smart cities and how they relate to quality of life. This is important because many of the definitions include domains and indicators that are used to measure quality of life (QoL) in SCs. The analysis also considers the main research methods and tools that are used to undertake research on QoL in SCs. This is especially useful for future research directions and finding the optimum methods or combination of methods for data collection. Following the research methods, a section is dedicated to domains and indicators that are used to measure QoL. This is important for the design of questionnaires which are statement-based or for comparative analyses and evaluations. The second part of the review analyses the articles thematically based on topics that emerged from a quantitative analysis of Keywords and Abstracts. A closer reading of all 38 articles also confirmed the choice of main themes.

### **2.3.1 Place of Publication**

Figure 2 shows the journals in which the articles were published. It can be seen that Sustainability is by far the most popular. This may be because of the ease and speed of publication, but it also indicates the close connection between SCs and sustainability. This is also clear from the second most popular journal, which is Sustainable Cities and Society.

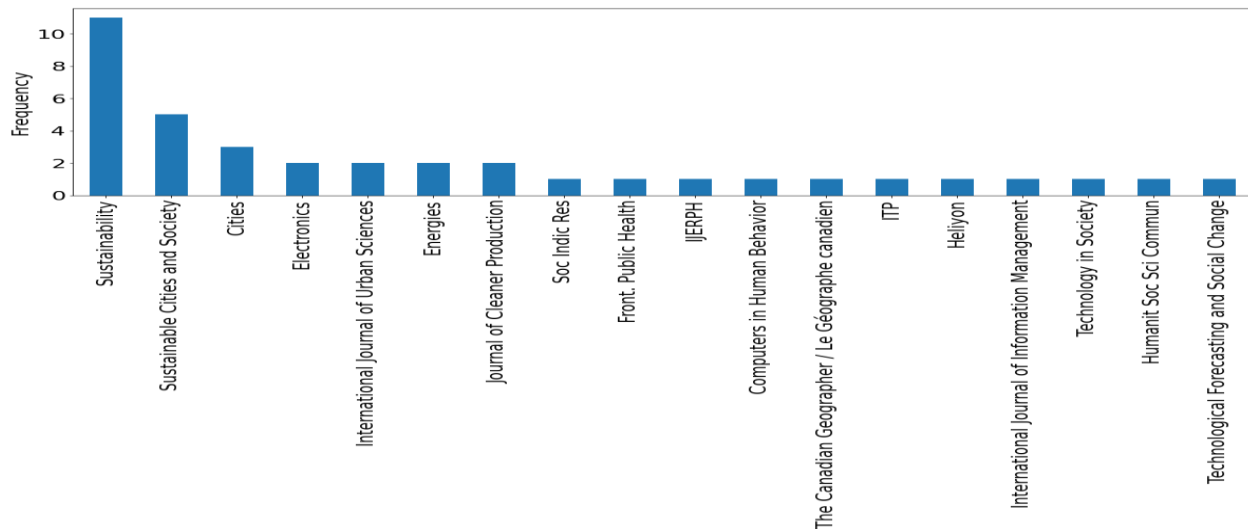


**Figure 2.** Journals in which the articles were published. Source: Authors' own (2023)

### 2.3.2 Location of Studies

The geographical spread of the articles can be summarized according to regions, countries, and specific cities. Worldwide research was carried out in large cities, e.g., a comparison of nine smart cities [21]. Only a few authors undertook research on a global scale and compared cities worldwide [22,23]. Others provided more general literature reviews or analyses that did not specify location [8,24]. The majority of the research was undertaken in European cities (32) as shown in Table 1. Some of the studies compared a number of European cities; for example, one study analyses forty European cities [7]. Other researchers compared several cities in one country, for example, 78 cities in the United States [25] and 76 Polish cities [26]. The other studies focus on specific cities or compared two cities. Table 1 summarises the exact locations in which the studies took place.

**Table 1.** Locations of the studies. Source: Authors' own (2023).

| Region          | Country                     | City or Cities                                |
|-----------------|-----------------------------|-----------------------------------------------|
| Asia            | China                       | Chongqing                                     |
| Asia            | China                       | Hong Kong                                     |
| Asia            | China                       | Macao                                         |
| Asia            | China                       | Shanghai                                      |
| Asia            | Iran                        | Tehran                                        |
| Asia            | Korea                       | Cheonan, Jochiwon, Pohang                     |
| Asia            | South Korea                 | Seoul                                         |
| Asia            | Qatar                       | Not specified                                 |
| Asia            | Taiwan                      | Not specified                                 |
| Asia, Europe    | Taiwan, Holland             | Taiwan and Utrecht are cited as good examples |
| Central America | Colombia                    | Medellin                                      |
| Europe          | Belgium                     | Leuven                                        |
| Europe          | Belgium and Sweden          | Namur (Belgium) and Linkoping (Sweden)        |
| Europe          | Greece, Portugal, Spain, UK | Athens, Lisbon, Barcelona, London             |
| Europe          | Italy                       | 116 cities                                    |
| Europe          | Poland                      | Cracow                                        |

|                       |                                                                |                                                                                       |
|-----------------------|----------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Europe                | Poland                                                         | Olsztyn                                                                               |
| Europe                | Poland                                                         | 76 cities                                                                             |
| Europe                | Portugal                                                       | Evora and Cascais                                                                     |
| Europe                | Portugal                                                       | Evora                                                                                 |
| Europe                | Spain                                                          | Barcelona, Granada, Madrid, Malaga, and Santander, Valencia                           |
| Europe                | Romania                                                        | 30 cities                                                                             |
| Europe                | Russia                                                         | St. Petersburg                                                                        |
| Europe                | UK                                                             | Manchester                                                                            |
| Europe                | 14 countries                                                   | 40 cities                                                                             |
| Europe, North America | 15 European countries, USA, Canada                             | 21 cities in Europe; 19 cities in the U.S.; 5 cities in Canada                        |
| Europe, North America | USA and 8 European countries                                   | Amsterdam, Barcelona, Berlin, Budapest, Helsinki, London, Moscow, Vienna and New York |
| Global                | Countries from Asia, Australia, Europe, North America, Oceania | 44 cities from the Global Power City Index (GPCI) Yearbook                            |
| Global                | Countries from Asia, Australia, Europe North America           | London and Vienna are highlighted as good examples                                    |
| Global                | OECD countries                                                 | Not specified (overview of indicators)                                                |
| Global                | Not specified                                                  | Not specified (literature review)                                                     |
| Global                | Not specified                                                  | Not specified (literature review)                                                     |
| North America         | Canada                                                         | Guelph                                                                                |
| North America         | Canada                                                         | Kitchener                                                                             |
| North America         | Mexico                                                         | Puerta Vallarta                                                                       |
| North America         | USA                                                            | Chattanooga                                                                           |
| North America         | United States                                                  | 78 cities                                                                             |
| South America         | Brazil                                                         | Natal                                                                                 |

### 2.3.3 Definitions of Quality of Life (QoL) in the Context of Smart Cities (SC)

QoL of an individual may be determined by their physical health, psychological state, level of independence, and social relationships [13]. QoL is defined as smart-city services that enhance standards of living [27] using advanced integrated services based on information and communication technologies and the intelligent use of urban infrastructures for improving the QoL of its citizens [28,29]. This can include a number of factors including economic, environmental, transportation, and governance [2], aiming to increase the efficiency and effectiveness of municipal services and facilitating private investment [30]. Other authors added social cohesion and participation, consumption of resources and preservation of the environment, as well as spatial development and building [9]. It is recommended that efficient public governance can help to reach a higher level of QoL by providing a transparent, collaborative, participatory, communicable, and accountable government [13]. Overall, QoL should be a significant goal of smart living, which is influenced by security, education, healthcare, and tourism [23]. Definitions of SCs that refer to QoL are summarized in Table 2.

**Table 2.** Quality of life-related definitions of smart cities. Source: Authors' own (2023).

| Author(s)                          | Year of Publication | Quality of Life-Related Definitions of Smart City                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Edge et al. [30]                   | 2020                | "In general, the smart city places innovation at the center of regenerative thinking to optimize urban infrastructure, improve sustainability, and enhance quality of life through the growth and uptake of information and communication technologies (ICTs)" (p. 1).                                                                                                                                                  |
| Ortega-Fernandez et al. [31]       | 2020                | "a successful Smart City must contribute optimally to the improvement of economic competitiveness, quality of life, mobility, and sustainability by its government or public administration" (p. 7).                                                                                                                                                                                                                    |
| Szarek-Iwaniuk and Senetra [32]    | 2020                | "A smart city is characterized by sustainable economic development and a high quality of life, which are driven by investments in human and social capital, traditional (transport) and modern (ICT) infrastructure, responsible resource management, and social participation" (p. 4).                                                                                                                                 |
| Cantuarias-Villesuzanne et al. [2] | 2021                | "Smart living examines the use of ICT for achieving quality of life in a liveable and safe environment [...]. This smart city dimension is mainly divided into four characteristics: Security, education, healthcare, and tourism" (p. 4).                                                                                                                                                                              |
| Chen and Chan [13]                 | 2021                | "SCD [Smart City Development] seeks to implement smart solutions to improve the public infrastructure and services delivered to citizens, thereby enhancing their lives and tackling social challenges" (p. 264).                                                                                                                                                                                                       |
| Csukás and Szabó [21]              | 2021                | "Improving the quality of life of citizens is a central concept, and we assume it to be an ultimate goal of SC developments" (p. 3).                                                                                                                                                                                                                                                                                    |
| Bielinska-Dusza [33]               | 2021                | "The basic emphasis in the smart city concept is on enhancing the quality of life of a city's inhabitants, improving the city's functioning and on the more effective use of available resources in shaping urban space" (p. 5)                                                                                                                                                                                         |
| Helbing et al. [16]                | 2021                | "It must also be considered that a merely data-driven approach may eliminate desirable qualities, which may affect anything from human dignity to culture to quality of life" (p. 4)                                                                                                                                                                                                                                    |
| Ji et al. [10]                     | 2021                | "Although global cities have different endowments on SC [Smart City] development and SC services provision, one common theme of SC development has been widely acknowledged: SC development should be people-centric, serving the needs of local citizens with the wider aim of improving their well-being and quality of life" (p. 2).                                                                                 |
| Ligarski and Wolny [26]            | 2021                | "The quality of life in the city is the whole of the living conditions of individuals and communities, shaped in the social, economic, environmental and awareness dimensions in a specific space of a territorial unit, which in an objective and subjective (quantitative and qualitative) perspective determine the sense of satisfying the needs and fulfilling life aspirations in a given place and time" (p. 4). |
| Vidiesova and Cronemberger [3]     | 2020                | "Enhancing citizens' quality of life and experience with city services is often regarded as the ultimate goal for smart city initiatives" (p. 3).                                                                                                                                                                                                                                                                       |
| Shami et al. [9]                   | 2020                | "Urban smartization will ultimately improve quality of citizens' lives (smart living)" (p. 2).                                                                                                                                                                                                                                                                                                                          |
| Zhu et al. [4]                     | 2022                | "Happiness Driven Smart City (HDSC) can be interpreted as a city guided by the overarching goal of improving human happiness in the prevailing digital transformation brought by technology" (p. 4).                                                                                                                                                                                                                    |

In summary, it can be seen that some definitions emphasize the central significance of QoL in SCs, arguing that it should be the main aim of SC development [9,10,21,34]. Frequently, QoL is positioned alongside other important domains as a major goal of SC development such as sustainability, resource management, economic competitiveness, mobility, or social participation. It is sometimes described as being synonymous with so-called ‘smart living’ [9], which helps to create liveable and safe cities [7] and to enhance lives and tackle social challenges [13]. Technology is viewed as a tool to improve citizens’ lives rather than an end in itself [7,9,30]; indeed, a data-driven approach is seen as being potentially detrimental [16]. Overall, a consensus is emerging that the human factor is more important than the technological factor in SCs [26].

### 2.3.4 The Most Common Research Methods used in Quality of Life Research in Smart Cities

An overview of research approaches to SC and QoL studies is provided in Figure 3. Table 3 indicates in more detail some of the most common research methods used. Case studies are often employed because most SC studies focus on a particular context, namely, a smart city or a comparison of smart cities. However, within the case studies, several research methods are used, and it is common to employ mixed methods.

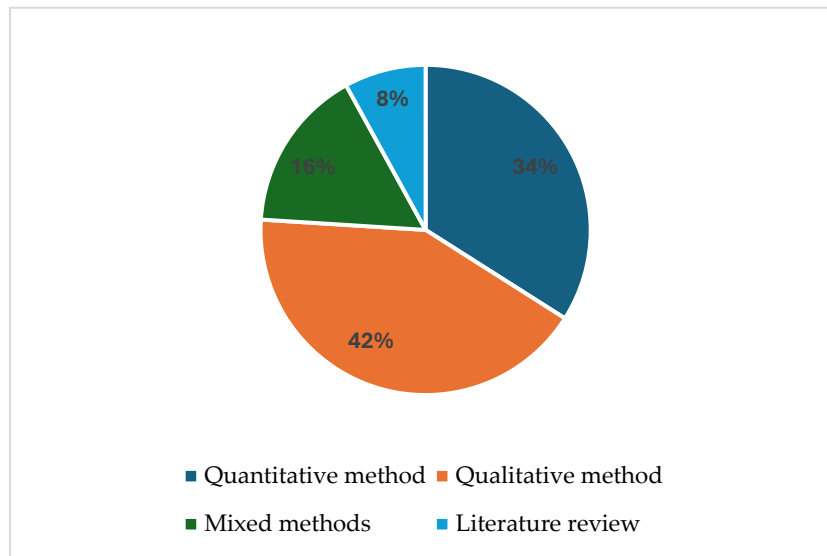


**Figure 3.** Overview of research approaches. Source: Authors’ own (2023).

**Table 3.** Summary of research methods used. Source: Authors' own (2023).

| Methods Used                                                                                                                                                         | Number of Papers | Notes                                                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Literature review or systematic review                                                                                                                               | 3                | Covering definitions and dimensions of smart cities, as well as policy and values.                                                                                                                                                                                                    |
| Application of theory, a concept, or a model                                                                                                                         | 2                | One paper used Maslow's hierarchy of needs; the other developed a Happiness Driven Smart City (HDSC) model.                                                                                                                                                                           |
| Content or text analysis                                                                                                                                             | 8                | Usually involves official document analysis (e.g., policy, strategy, etc.).                                                                                                                                                                                                           |
| Netnography (e.g., social media analysis of comments)                                                                                                                | 2                | Examples include citizens' big data in Seoul and Chinese micro-blog Weibo.                                                                                                                                                                                                            |
| Analyses of indicators, evaluation criteria or rankings (applied to cities)                                                                                          | 5                | In some cases, the literature is used to create new indicators.                                                                                                                                                                                                                       |
| In-depth interviews                                                                                                                                                  | 4                | Interviews are usually with expert stakeholders or officials involved in city development.                                                                                                                                                                                            |
| Questionnaires with citizens                                                                                                                                         | 7                | Sample size ranges from approximately 400–800 citizens.                                                                                                                                                                                                                               |
| Questionnaires with expert stakeholders                                                                                                                              | 2                | Examples include municipal offices and civil servants.                                                                                                                                                                                                                                |
| Focus group with citizens                                                                                                                                            | 2                | For example, with elderly residents and 18+ citizens.                                                                                                                                                                                                                                 |
| Focus group with expert stakeholders                                                                                                                                 | 3                | Sometimes includes academics as well as policy makers or businesses.                                                                                                                                                                                                                  |
| Delphi study (with experts)                                                                                                                                          | 1                | Undertaken with 17 tourism specialists.                                                                                                                                                                                                                                               |
| Other methods, e.g., cognitive maps; the DEMATEL technique; Design Science Research (DSR); the Analytic Network Process (ANP); risk assessment; innovation biography | 6                | Many of these approaches used mixed methods within the actual research. For example, innovative biography includes document analysis, case studies, network analysis, and interviews with key actors. DSR includes citizen questionnaires, interviews, and thematic content analyses. |

The most common research methods involve either questionnaires with local residents or a form of content or text analysis. It is unsurprising that QoL research often employs questionnaires that focus on subjective wellbeing and citizens' perceptions of domains of SCs. In addition, focus groups and netnography can be used to collect opinions from local citizens. However, it is also important to take into consideration more objective measures and indicators which may be of a quantitative nature. For example, some authors collect and analyse indicators and sub-indicators relating to smart buildings, resource management, energy consumption, transportation systems, healthcare, and smart infrastructure, amongst others [15,35]. Others analyse policy and strategy documents and reports which connect their research to smart governance, urban planning, management and resilience [14,21,34,36]. Sometimes the document analysis was quite specific, e.g., documents referring to inclusive smart cities [28]. In addition to in-depth interviews, focus groups, workshops, and Delphi studies, other ways of eliciting data from professionals included cognitive mapping research, which involved panel discussions with groups of experts [37,38,39].

Table 4 provides a summary of some of the main domains and indicators that are included in this research.

**Table 4.** Summary of smart city domains and indicators. Source: Authors' own (2023).

| Domain of Smart Cities | Examples of Indicators                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Smart economy          | Investment, competitiveness, and entrepreneurship [35]<br>Housing, jobs, and entrepreneurship [15]<br>High levels of innovation [39]<br>Productive and innovative economy [4]                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Smart governance       | Public services, taxation, and transparency of data [35]<br>Transportation, data monitoring, internet, and WiFi [15]<br>Access to interaction with the government's relevant authorities [40]<br>Supply of goods and services by government agencies and transparency in public administration [39]<br>Participatory and transparent governance [4]                                                                                                                                                                                                                                                                                           |
| Smart mobility         | Public transportation, infrastructure, and safety [13]<br>Sustainable transportation, traffic control, and ICT infrastructure [36]<br>The adoption of sustainable and eco-friendly transportation systems [36]                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Smart environment      | Pollution, energy efficiency, and green buildings [35]<br>Including green spaces, pollution, and energy use [15]<br>The adequate management of natural resources [39]<br>Sustainable and resilient environment [4]                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Smart people           | Social welfare and personal development [13]<br>Human and social networks (healthcare, education, and safety) [18]<br>Creativity, social cohesion, and qualifications [35]<br>Social cohesion and participation [9]<br>Community training and the development of key skills for innovative ecosystems [39]<br>Equal and inclusive society [4]                                                                                                                                                                                                                                                                                                 |
| Smart living           | Locals' lifestyle choices and quality of life [7]<br>An individual's way of life and community feelings, image, and pride [4]<br>Culture, healthcare, housing, and social cohesion [8]<br>Housing quality, tourism, cultural facilities, citizen security, and social cohesion [5]<br>Healthcare, education, culture, and safety [9]<br>Improvement of healthcare, education, and social services as well as the enhancement of citizens' participation [10]<br>Social indicators that reflect the quality of life of citizens [6]<br>Accessible and secured ICT infrastructures [11]<br>Reliable and efficient physical infrastructures [11] |

## 2.4. Discussion

The authors undertook a close reading of the 38 articles to identify recurrent themes that are especially relevant to quality of life. These were the following:

- **Indicators and measurement of QoL in smart cities**
- **Smart urban governance**
- **Smart living**
- **Citizen participation and social inclusion**
- **Sustainability**

The sections below discuss the chosen themes in more depth.

### **2.4.1 Indicators and Measurement of QoL in Smart Cities**

One of the most important reasons for undertaking a systematic review was to understand better the domains and indicators that are used to measure and research QoL in smart cities. QoL is clearly a composite and complex field of study and requires the incorporation of multiple domains including both objective and subjective indicators. Some authors recommend a holistic approach to measuring the quality of life including objective indicators (measurable with the available statistical data) with subjective indicators related to feelings and assessments in surveys [26]. It is difficult to summarize which of these domains and indicators are the most important, but a close reading of the 38 articles in the systematic review helped to better understand the relative significance of each domain and related indicators. It can be seen that many of the authors based their research on previously identified domains of smart cities. The consensus seems to be that the main domains are as follows:

- **Smart economy**
- **Smart governance**
- **Smart mobility**
- **Smart environment**
- **Smart people**
- **Smart living**

The research design on QoL and SCs needs to take into consideration all of these domains, but it is also necessary to decide on their relative importance when designing questionnaire statements or evaluation criteria.

The findings from SC and QoL research can help city administrators or policy makers to prioritize which services are needed most by citizens and are, therefore, worth allocating resources to or investing in [39]. It has been suggested that smart living is the most important domain of a smart and sustainable city followed by a smart economy [20]. The latter authors conclude that cities which have good scores in the smart economy and smart living domains also receive good scores in the general ranking of QoL. Smart governance is ranked the least important. Cities that score highly in smart living tend to be perceived as safe with good healthcare and education systems. Some authors also include religion and tourism in smart living [7]. Other authors focus specifically on risk [40]. Some studies have revealed discrepancies in the perceptions towards quality of life and economy spheres [34]. A study showed that citizens in Macau perceive that smart city development has little effect on enhancing the local economy and economic policies [13]. They were more concerned about improving the physical environment, such as crowding and traffic, waste management, water management, urban planning, air quality, and energy saving.

Research in Seoul, South Korea concluded that the three most important topics were traffic, the environment, and culture [41]. The results in three Korean cities indicate that citizens perceive smart cities as a means of improving their safety, convenience, and their local environments [42]. In a comparison of Taiwanese cities, researchers showed that citizens expressed the most concern

for smart safety, smart transportation, a smart environment, and smart healthcare [10]. One study concluded that the most important four pillars related to people's involvement in constructing an intelligent, informed, educated society, followed by preserving the environment and managing energy sustainably, as well as mobility, transportation, and sustainable economic development [37]. In Poland, the top four areas that have the greatest impact on QoL were identified as being living conditions in the city, public safety, education, and housing [26]. In Iran, it is thought that using smart equipment, as well as modern and innovative methods in developing society's health and hygiene will have the greatest impact on improving quality of smart living [9]. In the category of safety, it was noted that cybersecurity can be one of the most important perceived risks in cities [42].

At this point, it is important to mention the themes of surveillance and privacy, as they emerge from several of the studies as being important issues that affect residents' security [7,31,34,37]. Some authors emphasize risks associated with data privacy and protection [40]. In the domain of healthcare, it is considered especially essential to ensure information security and strict privacy protection [4]. Positive aspects of surveillance refer to greater efficiency, decreasing crime, or easing government services [21], and to help improve the safety and stability of the social environment [10]. It has been stated (especially in North American studies) that protecting privacy is a requirement of governance [3,25, and that official citywide privacy policies should be developed to protect confidential citizen data [15]. It is rare that privacy is not considered important by citizens [43], but some articles did not specifically refer to surveillance or privacy [44,45]. However, even in some studies that did not include privacy issues, there was an acknowledgement that future research should consider personal privacy and security [13]. Nevertheless, it is clear that there is more concern about surveillance in Asia, especially in China [46], and among older residents there [12].

It seems from the various studies that QoL is quite dependent on context in terms of priorities [42]. Smart cities cannot reach their objectives if they push technological solutions without taking into consideration the specificities of the territory and the people living in it [17]. It was stated that each city has its own unique characteristics; therefore, citizen participation strategies should be tailored and adapted to each respective context [46]. It is necessary to perceive each city individually and to recognise the interdependence between variables such as elements, standards, systems, and models that affect social behaviour and cultural change [25]. Some authors found that citizens' needs and priorities may even differ significantly from one municipality to the other [28]. Priorities can also vary depending on the questionnaire sample. For example, it was found that the ideal age-friendly city should focus on social participation, communication, and information, followed by employment, housing, and transportation [11].

On the other hand, it has been argued that citizens experience smart city initiatives holistically, meaning that their experiences are integrated or inter-connected and are not specific to a single city service or function (e.g., transport) [33]. One interesting model to consider for the future could be Happiness-Driven Smart Cities (HDSC) which have been described as having the following characteristics [4]:

- **A city with an efficient and green physical infrastructure;**
- **A city with a labour-friendly and innovative economy;**
- **A city with an inclusive and attractive society;**
- **A city with a sustainable and eco-friendly natural environment.**

According to the priorities identified above, it would be important to include safety, transportation, healthcare, and education within these categories.

#### **2.4.2 Smart Urban Governance**

Smart governance could be defined as the pursuit of the enhancement of citizens' quality of life, involving a high level of citizen participation, public and non-public collaboration, improving accountability, decreasing costs, and providing excellent service [11,22]. It has been suggested that quality of life in SCs is directly related to government actions, including the interaction between public and private sectors with the goal of promoting sustainable development [44]. It is believed that a better quality of urban living can be achieved by unifying public resources, human and social capital, and information and communication technology. For example, the top ranked cities in a study of 116 Italian cities had recently implemented coherent government policies related to sustainability and quality of life [45].

Smart governance values social engagement and innovative technologies along with the consideration of people's needs. Smarter governance should encourage citizen participation through digital platforms and other channels to ensure that their voices are heard and that their visions are implemented [46]. Some studies showed that the local community's perception of governance is directly affected by transparency, collaboration, partnership, communication, and accountability. Transparent smart governance is the unification of efficient communication [22] and communication channels involving citizens in decision making [5] that results in more democratic participation and partnership. Smart governance includes citizen engagement in addition to e-government. It was found that citizens' engagement is dependent on their maturity and participatory habits, as well as effective communication [3].

Effective SC management should enhance technology infrastructure, engage stakeholders, adhere to strategic, tactical, and operational levels via efficient criticism and feedback, and implement a bottom-up strategy [6,24]. An open citizen service operating system that utilizes automatic classification boosts citizens' participation. For example, in Seoul's digital platform (OTMI), relevant authorities directly answer civilians' comments and complaints about different issues such as traffic issues, environmental issues, safety, and cultural topics. Smart solutions are beneficial in forecasting bus routes, renewable energy, tackling garbage-related problems, and green spaces (i.e., parks) [23]. Similar positive outcomes of electronic portals were found in Saint Petersburg [9].

Overall, it has been suggested that smarter city governance hears inhabitants' voices and creates participatory channels [15]. Although some studies found that technology and governance are less important than other QoL factors, their influence on cities' management and performance can be significant and should be monitored [37]. A successful SC requires the government or public administration to contribute to the improvement of economic competitiveness, mobility, sustainability, and overall QoL [31]. On the other hand, it has been recommended that governance needs to be more long-term and strategic with real evidence that citizens are involved in decision making and problem solving and are not just passive recipients of information [24]. It has been suggested that in order to improve online responsive governance, the urban government should be data-driven with the assistance of machine learning or Artificial Intelligence [41]. It has been noted that there can be mismatches between citizens' expectations and the smart city policies initiated by

the government. It was argued that in some cases, government policies can even become ‘too smart’ and surpass the needs of citizens [46].

### 2.4.3 Smart Living

Smart living is sometimes described as being equivalent to quality of life [23]. Many aspects of citizens’ lives including their well-being, security, and economy are influenced by smart developments [30]. For example, a study in Tehran, Iran [9], referred to several factors of smart-living quality, including housing and building, culture, the environment, and natural resources. Some authors have referred to ‘smart livelihood’, which includes a way of life, opportunities to use smart technology, personal life quality, a feeling of belonging in the city, community pride, and citizens’ participation in government decision making [13]. Citizen-centric smart city development (SCD) can incorporate elements of QoL with an emphasis on the demands of residents, whereby municipalities offer and design services and infrastructures that are influenced by their attitudes and preferences. Some of these developments can be practical, for example, the installation of road sensors to assess traffic volume and instantly modify stop-and-go times for cars and pedestrians to reduce congestion. Others relate to more intangible and elusive aspects, such as belonging, community pride, or urban image. It has been proven that age and educational background significantly impact people’s support for SCD compared to the other demographic characteristics [13]. Research undertaken in different countries can also yield somewhat different results. For example, surveyed participants’ QoL in Poland focused mostly on leisure opportunities, safety, living conditions, transportation, communication, sports, and recreation [26]. One example of leisure spaces that are important to residents are urban parks, especially small neighbourhood parks [47].

A study of Happiness-Driven Smart Cities (HDSC) [4] argues that liveability of the environment and life-ability of residents constitute what they term ‘happy urban living’:

(1) Liveability of the environment:

Ecology (air quality, public green space, etc.)  
Society (equity, safety, supportive relationships, etc.)  
Economy (financial status, housing, employment, etc.)  
Culture (culture and leisure, etc.)

(2) Life-ability of the person:

Health (physical health, mental health, etc.)  
Education (schooling, skills, etc.)  
Art of living (varied lifestyle, etc.)

Life-ability basically means providing access to enough resources for an urban inhabitant to acquire new knowledge and skills for enjoying life as well as for self-development. Overall, Happiness-Driven Smart Cities (HDSC) are defined as urban territories that ideally have efficient, green physical infrastructures, innovation, social inclusion, leisure, attractions, and a sustainable environment. Other connected features include an efficient transportation system, real-time

monitored reliable energy management, an integrated public utility system, labour-friendly employment, entrepreneurship, education system, healthcare, security, air pollution, and water treatment [4].

#### **2.4.4 Citizen Participation and Social Inclusion**

Past studies have found that different cities can have different priorities. For example, one paper identified four clusters of smart urban forms [5]:

- **The Green City, targeting environmental issues;**
- **The App city, concentrating on technology innovation and providing related mobile applications precisely for inhabitants;**
- **The Socially Sensitive City, spotlighting equality and incorporating disadvantaged groups' needs;**
- **The Participatory City, underlying citizen participation.**

It is important to note the emphasis on citizen participation and social inclusion here. Several authors refer to the significance of social justice and connect it to ethics, inclusion, and social equality [16,21] as well as equitable spatial distribution and socio-economic disparities [47]. It has been argued that technology use should not only be about data collection, which can adversely affect human dignity, culture, and quality of life, but it should help to create a participatory system that promotes democracy, fairness, and social innovation [16]. A citizen-centric SC emphasizes a participation orientation and fulfils the expectations of the local community in the design of SC services and systems [10,32,43]. However, there are still some gaps and discrepancies between perceived SCD from the viewpoint of citizens, public servants [33], and the government [34,46]. Some citizens can be sceptical about governments and not trust them, which is why it can be important to also involve citizens in the design of smart systems [33]. SCD is, to some extent, context-dependent [43], and studies have found that the degree of participation can be affected by national digitalization goals, top-down or bottom-up approaches, the government's agenda, the degree of democracy, legal requirements, the social environment, competitiveness, and the maturity of the population in terms of demographic characteristics, educational levels, and employment rates [10,13]. Other studies have also highlighted differences between age groups as well as geographical locations. For example, in Taiwanese smart cities, respondents aged between 41 and 50 showed many positive attitudes towards SC services compared to younger groups. They marginally favour services and applications connected to "hard" domains, such as smart transportation, energy, and safety, including more specifically welfare, social inclusion, car accidents, epidemic prevention, surveillance services, sustainable freshwater supply, distant medical services, and car-parking. For "softer" areas relating to smart living, smart people, and personal growth, they rather favour non-digital approaches. In South Korean cities, it is especially true of those in poor housing circumstances with less economic stability that they respond best to QoL-related smart projects that respect daily issues and economic growth [42].

Social inclusion is characterized by equality, a balanced city development, and shrinking gaps between various groups with respect to economic conditions, education level, and so forth. The aim is to increase wider social justness. Taking an inclusive approach to SC development puts the

welfare, needs, and priorities of citizens first, helping to cultivate social and ethical plurality as well as fostering flexibility, creativity, and open-mindedness [25]. It can involve delivering assistance to vulnerable people including the elderly or disabled, as well as effective settlement policies for immigrants [9]. It is important to identify whose voices are missing, whether they are youth, refugees, or the homeless. For example, there could also be lower usage rates of digital participation platforms among migrants because of language barriers or cultural differences [48]. The following question should be asked: “What does ‘inclusion’ mean for locals?” For example, is the library or food bank offering good services for disadvantaged populations? [30]. Some authors refer to quality of life through universal accessibility; for example, they propose hiring more disabled personnel in order to achieve greater social integration with the help of teleassistance and monitoring systems [35]. Another measure that they propose is the installation of more traffic lights with acoustic signals for the blind. Other examples can include the following:

- **Quality e-health services and projects (i.e., rehabilitation therapy);**
- **Digital inclusion, particularly in less urbanized areas or for less affluent people using, for instance, expanded coverage of Wi-Fi network and broadband;**
- **Information accessible via, i.e., open data, public data, and many other websites or platforms;**
- **Offering convenience through real-time public transportation, car parking etc. [18].**

Public engagement and participation approaches vary from a strategy of consultations with ordinary community members to networks with key actors in local communities or discussions with selected private and non-private interest parties [49]. Prevailing participation approaches in Poland span direct and indirect public consultations and meetings that can be via online surveys, voting, or referenda. In some cases, the Public Participatory Geographic Information System (PPGIS) and geo-questionnaires have been used, but this method is less familiar and can be inaccessible and unreadable to locals (i.e., they do not know how to use map-based tools) [32]. It has not yet been proven that online platforms significantly engage citizens, although enhanced public awareness and participation culture can accelerate participation rates. According to users, services provided by digital participation platforms should require no fees, a user-friendly interface, accessibility, and cybersecurity [48].

## **2.4.5 Sustainability**

It was noted that in research on SCs from 1997 to 2020, the definitions of a SC are very close to those of a sustainable city [14]. Another study proposes that sustainability and equity should be the main strategic component of SC development [35]. Sustainable social services and transportation can be especially influential [45]. For example, user-friendly smart solutions are noteworthy for implementing sustainable public transportation [33]. The combined environment of sustainability and smartness can also serve as a stimulus for a knowledge-based economy [39]. Sustainable smart cities or SSC can become a path to innovation [14], especially in so-called knowledge-based cities where attraction and retention of knowledgeable workers and businesses is desirable. It seems that sustainability is one of the crucial elements of creating a ‘people climate’ in smart cities and enhancing quality of life. It was shown that smart sustainable cities are mainly connected to socio-cultural contexts and smart living considerations, putting people first, with

technology being used as a tool to serve citizens [15]. However, it was argued that smart cities are not yet sustainable or liveable enough [16], and other authors note the need to place community and social needs at the heart of the strategic resilience process in urban sustainability management. One study refers to the UN New Urban Agenda 2030, which prioritizes proper planning and management in cities to ensure a high quality of life, healthcare, safety, and economic development. This includes sustainable urban mobility and social participation [33].

## 2.5. Conclusions

This study has shown that quality of life issues ideally need to be central to smart city development. Regardless of the discipline, definitions, or dimensions, the quality of life of people should be inherent in the concept of a SC. Citizens tend to have a more positive attitude and a higher level of support for smart city development if they perceive that it will enhance their way of life, develop their local economy, improve infrastructure, transport management and safety, as well as contributing to community image and pride. City planners and other stakeholders need to be sensitive to human values that reflect the interests of a community. This means creating sustainable and equitable cities built on clear ethical principles, citizenship, and social inclusion. Research on the important domains and indicators of SCQoL, such as this study, can help city developers to prioritize and invest in those services that citizens need the most.

However, it is important to analyse gaps between policies and practice, as there is still a mismatch between citizens' needs and service design. Although smart governance is not always visible to citizens and is, therefore, not ranked as highly in SC and QoL studies as other domains, it underpins urban development, planning, and management and is often responsible for decisions about the design and implementation of smart systems. It is recommended that city authorities should be more visible and transparent in their actions, providing public information that is available both online and offline. There also is a need to engage citizens in the co-design of smart processes and solutions and to plan more long-term and strategically, rather than focusing on real-time and short-term problem solving. It is necessary to create an effective system of urban management, which creates a productive dialogue between government and society, taking into account the opinions of citizens. However, there can still be barriers because the concept of SCs remains vague or diffuses among citizens, or they may be unfamiliar with tools or systems, especially if they are from socially excluded or disadvantaged groups. Technology may be the most suitable means of communication for younger citizens, but less appropriate for older ones or those from more deprived backgrounds without access to relevant devices. Indeed, it is important overall for city planners and developers to decide how far solutions should be technology-related because residents might prefer non-digital approaches in some areas of smart living.

Research can help city authorities, planners, and developers to create efficient SCQoL systems, processes, and models which provide a means of measuring the importance of different domains of QoL, and identifying appropriate indicators and tools for collecting data and prioritizing the allocation of budgets to services. Mixed research methods appear to be the most informative in order to collect objective indicators, subjective perceptions of both professionals and residents, as well as content-analysing policy documents. Research across several cities and comparative work is invaluable, but it is important to note that one model might not work for all cities and that an adaptation to context is essential. Nevertheless, applying global principles of sustainability or good practice in citizen participation can work well in many different contexts.

## Limitations and Future Research

The systematic review undertaken in this paper is relatively limited in terms of the number of papers and the time period in which it was undertaken. The database used by the researchers was the Web of Science and other databases such as Google Scholar and Scopus were not used. The keywords used for searching were somewhat limited and synonyms were not been applied (e.g., wellbeing instead of QoL).

Future research should focus on the extent to which global models of SCs and good practice principles (e.g., sustainability, social inclusion, etc.) can be applied to different contexts. There is scope for more comparative studies across different cities, especially those based on subjective and ‘soft’ domains of QoL [13,42]. More research should also be undertaken with disadvantaged or excluded groups in society.

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### 3. SMART LIVING AND QUALITY OF LIFE: DOMAINS AND INDICATORS (ARTICLE A2)

**Reference:** Smith, M. K., Chang, S. & Michalkó, G. (2024). Smart Living and Quality of Life: Domains and Indicators. *Journal of Urban and Regional Analysis*. 16. 10.37043/JURA.2024.16.2.1

#### **Abstract**

It has been suggested that smart living is the most important domain of a smart city and many studies propose that it is synonymous with resident quality of life. The main aims of this research were to understand better residents' perceptions of quality of life issues and priorities in smart cities. The study (re)defines smart living using domains and indicators that were carefully selected from a systematic literature review, close analysis of previous studies and their methodologies, and a pilot test of a questionnaire in Budapest, Hungary. The research is considered timely because of Budapest's relatively low performance in quality of life rankings in Europe and the lack of data on the needs of citizens. The main domains of smart living and their relevant indicators include housing, health, safety, education, environment, social cohesion, leisure, culture and tourism. Overall, the research aims to assist urban researchers and city agencies in the development of indicators of smart living when measuring resident quality of life. The results could be applicable to other post-socialist cities which have followed similar trajectories to Budapest, but the results are useful for almost any city that hopes to enhance quality of life by prioritising smart living.

**Keywords:** Smart cities; smart living; quality of life; residents, Budapest

*Until today, creating liveable cities is an art. Cities are not just giant optimization problems, nor are they giant entertainment parks, where pre-manufactured experiences are consumed. Cities are places, where people meet, communicate, make friends, and fall in love. In other words, cities are first and foremost about people.*

(Helbing et al., 2021: 4)

### 3.1. Introduction

Transformation of a city system into a smart system is meant to improve the quality of life (QoL) for its people and their way of living, its environment, economy, transport and governance (Muvuna et al. 2020). However, previous studies have not always focused specifically on QoL and citizen-centric issues. One systematic review of smart cities (SC) showed that research on humans was the least important (8.1%), but it has been suggested that the focus of SC is switching from infrastructure supply-oriented approaches to improving citizens' QoL and sustainability (Myeong et al. 2022). As argued by Trencher (2019) smart cities should put people first and use technology as a tool predominantly in service of citizens. Some studies have even noted the negative impact of technology anxiety on peoples' quality of life in smart cities (Dash, 2022). Earlier studies had also implied that smart city visions can be a way of imposing discipline on cities that reduces political resistance and insurgence (Vanolo, 2014). Szarek-Iwaniuk and Senetra (2020) refer to three generations of SC, where in Smart City 3.0, citizens play a key role in urban development. It has been argued that innovation for the sake of innovation is not smart, but rather that an SC should be intertwined with and responsive to its community (Del-Real et al. 2023). Cities can only achieve an effective transformation to an SC and promote the improvement of people's QoL if they invest in ICT and human capital simultaneously (Wang and Zhou 2023). This includes addressing urban inequalities and focusing on excluded communities (Dragan, Crețan and Bulzan (2024). Rachmawati et al (2024) suggest that 'liveability' should be one of the main purposes of the urban future and that the use of ICT in sustainable smart cities can be used to enhance wellbeing.

This paper explores the meaning of smart living, including the domains that can be used to define it and the indicators that can be developed to measure it. In addition to a detailed review of recent literature using the terms 'smart cities' and 'quality of life' (2020-2023), a questionnaire was designed for local residents that incorporates the most important domains and indicators of smart living. The questionnaire was tested on a representative sample of residents in the Hungarian capital city Budapest, and care was taken to adapt the study to the specific context of a post-socialist city in CEE.

The main aims of this research were to understand better residents' perceptions of QoL issues in SC, to supplement 'top-down' approaches to smart city development with a 'bottom-up' understanding of resident priorities, and to complement research that has focused on the development of objective or 'hard' indicators with more subjective or 'soft' ones. The ultimate aim is to inform SC strategies to encourage a more citizen-centric approach, as well as to assist researchers (both academics and practitioners) in developing reliable indicators to measure QoL in SC or so-called 'smart living'. The study also reflects on urban policy and planning in CEE

cities like Budapest in their post-socialist transition and the implications for QoL and smart developments.

### **3.2. Methods**

The methods for this research included a detailed review of 40 articles (published between 2020-2023) using the keywords ‘smart city’ and ‘quality of life’. The PRISMA model was used, which meant an initial screening of 265 articles for eligibility (articles were excluded if they were not full papers and not written in English). Out of the remaining 133 articles, exclusion criteria included studies that focused on smart processes or tools rather than people; articles from outside the disciplinary scope (social science); and articles where quality of life was not a central focus. The aim was to identify definitions, domains, indicators and research methods used in the smart city domain of ‘smart living’, which is often considered to be synonymous with quality of life (Giffinger et al. 2010; Braga et al. 2021; Valencia-Arias et al. 2021; Shami et al., 2022). It has been suggested that smart living is the most important domain of a smart and sustainable city and that QoL should be a significant goal of smart living (Ozkaya and Erdin, 2020).

The second part of the research involved using the identified indicators to create a questionnaire for local residents based on the smart living domain of smart cities. This questionnaire was designed with the residents of the Hungarian capital city Budapest in mind, and it was piloted with a representative sample.

The limitations include the relatively limited time frame for the systematic review, which could have excluded seminal works from previous years (some of these are therefore cited in this article to provide background information and critical comment). The identification of indicators requires decisions to be made about inclusion and exclusion of certain domains and elements, which could result in bias and value judgment. Thirdly, it will be challenging to design a sampling strategy that is representative of the population of the whole city, including those who are more marginal, less wealthy and educated or elderly.

### **3.3. Results: Systematic Review**

In previous literature, six dimensions of SC were identified as smart economy, smart mobility, a smart environment, smart people, smart governance and smart living (Giffinger et al. 2010). Several authors have used these same domains in subsequent studies (e.g. Ortega-Fernandez et al. 2020; Ozkaya and Erdin 2020; Bielinska-Dusza et al. 2021; Braga, 2021), sometimes with additions or variations. For example, Cantuarias-Villessuzanne et al. (2021) added ‘smart architecture and technologies’ and Valencia-Arias et al (2021) use ‘sustainability’ instead of ‘environment’ and add the term ‘quality of life’. Alongside smart environment, people and living, Ji et al. (2021) include ‘smart safety’, ‘smart health’, ‘smart energy’ and ‘smart transport’. Chen and Chan (2023) focus on only five domains, but many of the elements above are incorporated under a different heading:

- Smart environment (including sustainability issues)
- Smart people (including social welfare and personal development)
- Smart livelihood (including an individual’s way of life and community feelings, image and pride)

- Smart economy and economic policy (including government support)
- Smart mobility (including public transportation, infrastructure and safety)

Smart living (and its variations) has been defined as synonymous with or closely connected to QoL (Shami et al., 2022). Several definitions of SC directly mention QoL:

- “Improving the quality of life of citizens is a central concept, and we assume it to be an ultimate goal of SC developments” (Csukás and Szabó 2021: 3).
- “SC development should be people-centric, serving the needs of local citizens with the wider aim of improving their well-being and quality of life” (Ji et al. 2021).
- “Urban smartization will ultimately improve quality of citizens’ lives (smart living)” (Shami et al. 2022).
- “Smart living examines the use of ICT for achieving quality of life in a liveable and safe environment” (Cantuarias-Villessuzanne et al. 2021: 4).

Braga et al. (2021) refer to smart ways of life associated with locals’ lifestyle choices and quality of life, and Valencia-Arias et al (2021) describe the domain of smart life as a dimension that can be measured using social indicators that reflect the QoL of citizens. QoL of an individual may be determined by their physical health, psychological state, level of independence and social relationships (Chen and Chan 2023). Oh (2020) evaluates QoL according to subjective satisfaction with housing, facilities, overall urban environment, physical and mental health, and safety of the surrounding area. It has been argued that regardless of definitions and dimensions of SC, they should promote the quality of life of people (Keshavarzi et al. 2021). On the other hand, it would be a mistake to imply that urban development policies should be based on a model that is applicable everywhere (Vanolo, 2014; Kitchin, 2015).

QoL is defined as smart-city services that enhance standards of living (Lytras et al. 2021) using advanced integrated services based on information and communication technologies and intelligent use of urban infrastructures for improving the QoL of its citizens (Barletta et al. 2020; D’Aniello et al. 2020). This can include a number of factors including economic, environmental, transport and governance (Muvuna et al., 2020) aiming to increase the efficiency and effectiveness of municipal services and facilitating private investment (Edge et al., 2020). In the context of safety, it should be noted that smart solutions can be used to reduce the risk of disasters like earthquakes (Kodag and Kodag 2023). Other authors added social cohesion and participation, consumption of resources and preservation of the environment as well as spatial development and building (Shami et al. 2022). Helbing et al. (2021) advocate a “value-sensitive smart city”, which is inclusive, collaborative, ethical, citizen-centric and society-driven. In addition to previously mentioned values like health, security, sustainability, wellbeing (or QoL), the study refers to peace, justice, equity, dignity, solidarity and privacy (among others). Zhu et al. (2022) differentiate between ‘livability’ and ‘life-ability’, with ‘livability of environment’ referring to good living conditions, including the natural environment, built environment and social environment, and ‘life-ability of person’ referring to the opportunities for managing and improving life, including self-development, acquiring new knowledge and skills and enjoying life.

One systematic review of smart cities and quality of life identified the following topics as being the most frequently occurring in past studies (Chang and Smith 2023):

- Smart urban governance
- Citizens' lived experience
- Citizen participation and social inclusion
- Sustainability
- Indicators and measurement of QoL in smart cities

It is important to analyse gaps between policies and practice (Nunes et al. 2021), as there is still a mismatch between citizens' needs and service design (Chen and Chan 2023). Although smart governance is not always visible to citizens and therefore not always ranked as highly in SC and QoL studies as other domains (Ozkaya and Erdin 2020; Braga et al., 2021), it underpins urban development, planning and management and is often responsible for decisions about design and implementation of smart systems. It is suggested that efficient public governance can help to reach a higher level of QoL by providing a transparent, collaborative, participatory, communicable and accountable government (Chen and Chan 2023). Some studies focus specifically on governance and decision-making (e.g. de Guimarães et al. 2019; Mills et al. 2022). The tools and mechanisms used by governments or municipalities for information provision, data collection and feedback can help to increase participation and social inclusion. On the other hand, many of the critiques of smart city developments highlight the inherent power relations (Vanolo, 2014), weak collaborative engagement with stakeholders (Kitchin, 2015), and hegemonic approaches to urban governance and planning, which reproduce social inequalities (Krivý, 2018). For this reason, Cheniki, Baziz and Bougdah (2020) suggest a so-called 'smart synthetic model' for e-governance that helps to integrate citizens into the political system, and to create equity between stakeholder decision-making and priorities.

Discussions about sustainability should be aligned with SDG11 goals to make cities sustainable, safe and resilient (United Nations 2015). Some SC studies focus specifically on resilience (e.g. Bruzzone et al. 2021). Several definitions of SC that focus on QoL include sustainability as an important objective (e.g. Edge et al. 2020; Ligarski and Wolny 2021; Ortega-Fernandez et al., 2020; Szarek-Iwaniuk and Senetra 2020). Cantuarias-Villessuzanne et al. (2021) categorise European cities into three clusters, arguing that the quality of life-orientated cluster should include sustainable goals. Indeed, Kubina et al. (2021) advocate the use of the 'superior' term "smart sustainable city". Rachmawati et al (2024) suggest that the use of ICT in sustainable smart cities can be used to enhance wellbeing, as well as ensure collaboration among stakeholders and to battle climate change.

Numerous indicators have been used in past studies to define the domains of smart cities, including smart living (Appendix 1 offers a summary of selected recent literature on this topic). It is important to consider here that indicators can become a "subtle disciplining technique" if they are used to set specific political or financial agendas (Vanolo, 2014: 890). It should also be noted that it is difficult to differentiate clearly between domains, as several areas of life impact on smart living. For example, Zhu et al. (2022) define a 'Happiness-driven SC' according to the following elements, which combine the economic, environmental and social domains:

- A city with efficient and green physical infrastructure
- A city with labor-friendly and innovative economy
- A city with inclusive and attractive society
- A city with sustainable and eco-friendly natural environment

SCs are inevitably affected by the economic situation and governance (e.g. in the domains of health, education and housing). Environmental issues are a global concern (e.g. climate change), but local measures can help to mitigate pollution levels and increase the number of green spaces, for example. Mobility issues may affect residents' quality of life in terms of their commute to work or access to leisure and cultural experiences. Smart people and smart living are inextricably connected in terms of social cohesion, community development and inclusion.

### **Smart Living**

It has been suggested that smart living is the most important domain of a smart and sustainable city followed by a smart economy (Ozkaya and Erdin 2020; Toli and Murtagh 2020). Smart living includes the creation of liveable and safe cities (Cantuarias-Villessuzanne et al. 2021), which enhance lives and tackle social challenges (Chen and Chan 2023). Cities that score highly in smart living tend to be perceived as safe with good healthcare and education systems (Toli and Murtagh 2020). Ozkaya and Erdin (2020) emphasise healthcare conditions, education facilities, individual safety, housing quality and affordability, cultural interaction opportunities in cultural facilities (e.g. events, heritage sites, museums, shopping), tourist attractiveness, and social cohesion (e.g., homelessness, volunteering). Other authors include religion and tourism in smart living, as well as culture (art, cinema, theatre), sport, entertainment for children, religious and spiritual edifices, and restaurants. They also highlight the cost of living (Cantuarias-Villessuzanne et al. 2021).

Some authors have referred to 'smart livelihood', which includes a way of life, opportunities to use smart technology, personal life quality, a feeling of belonging in the city, community pride, and citizens' participation in government decision making (Chen and Chan 2023). The themes of surveillance and privacy emerge from several studies as being important issues that affect residents' security (Ortega-Fernández et al. 2020; Vidiassova and Cronemberger 2020; Braga et al. 2021; Cantuarias-Villessuzanne et al. 2021). This includes risks associated with data privacy and protection (Sharif et al., 2022). In the domain of healthcare, it is considered especially essential to ensure information security and strict privacy protection (Zhu et al. 2022). Ji et al. (2021) found that the top-rated SC service belongs to the soft domain: the smart-living dimension. This was the welfare and social inclusion service, indicating that the respondents showed much concern about the delivery of SC services for serving the needs of minority groups. Social inclusion is characterized by equality, a balanced city development, and shrinking gaps between various groups with respect to economic conditions, education level, and so forth. Taking an inclusive approach to SC development puts the welfare, needs, and priorities of citizens first, helping to cultivate social and ethical plurality as well as fostering flexibility, creativity, and open-mindedness (Wang et al. 2021). It can involve delivering assistance to vulnerable people including the elderly or disabled, as well as effective settlement policies for immigrants (Shami et al. 2022). It is important to identify whose voices are missing, whether they are youth, refugees, or the homeless.

Several studies have attempted to capture the relative importance of different domains of smart living, for example, the results in three Korean cities indicate that citizens perceive smart cities as a means of improving their safety, convenience, and their local environments (Oh et al. 2020). In a comparison of Taiwanese cities, researchers showed that citizens expressed the most concern for smart safety, smart transportation, a smart environment, and smart healthcare (Ji et al. 2021). Municipalities in Poland listed the following as the most important quality of life factors: living conditions in the city, public safety, education, housing, future perspectives, leisure opportunities, transport and communication and working conditions in the city (Ligarsky and Wolny 2021). A study in Tehran, Iran (Shami et al. 2022) referred to several factors of smart-living quality, including housing and building, culture, the environment and natural resources. It was also thought that using modern and innovative methods in developing society's health and hygiene will have the greatest impact on improving the quality of smart living. These studies indicate that the relative importance of the domains largely depends on context and geographical scale (Keshavarzi et al. 2021), but wider research can lead to more definitive conclusions, for example, in their study of 44 cities, Ozkaya and Erdin (2020) found that individual safety, access to health services and the educational infrastructure are more important than other factors, whereas touristic attraction is the least important.

Several authors have suggested the most important domains of smart living. These are summarised in Table 1 and in the word cloud in Figure 1.

**Table 1 Suggested Domains of Smart Living**

| <b>Authors</b>                               | <b>Suggested Domains of Smart Living</b>                                                                                                                                                                                                                                    |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bielinska-Dusza et al. (2021)                | <ul style="list-style-type: none"> <li>• Housing quality</li> <li>• Health condition</li> <li>• Individual security</li> <li>• Education facilities</li> <li>• Economic welfare/social cohesion</li> <li>• Cultural facilities</li> <li>• Tourism attractiveness</li> </ul> |
| Oh (2020) (for “subjective quality of life”) | <ul style="list-style-type: none"> <li>• Housing (including facilities and environment)</li> <li>• Health and wellbeing (including physical and mental health)</li> <li>• Safety and convenience</li> <li>• Urban environment</li> </ul>                                    |
| Ortega and Malcolm (2020)                    | <ul style="list-style-type: none"> <li>• Housing quality</li> <li>• Citizen security</li> <li>• Social cohesion</li> <li>• Cultural facilities</li> <li>• Tourism</li> </ul>                                                                                                |
| Ozkaya and Erdin (2020)                      | <ul style="list-style-type: none"> <li>• Housing quality</li> </ul>                                                                                                                                                                                                         |

|                                                          |                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                          | <ul style="list-style-type: none"> <li>• Health conditions</li> <li>• Individual safety</li> <li>• Education facilities</li> <li>• Social cohesion</li> <li>• Cultural facilities</li> <li>• Touristic attractivity</li> </ul>                                                                                                                             |
| Cantuarias-Villessuzanne et al. (2021)                   | <ul style="list-style-type: none"> <li>• Healthcare</li> <li>• Security</li> <li>• Education</li> <li>• Tourism</li> </ul>                                                                                                                                                                                                                                 |
| Csukás and Szabó (2021)                                  | <ul style="list-style-type: none"> <li>• Housing</li> <li>• Health</li> <li>• Social cohesion</li> <li>• Culture</li> </ul>                                                                                                                                                                                                                                |
| Ji et al. (2021)                                         | <ul style="list-style-type: none"> <li>• Welfare and social inclusion service, e.g. to reduce barriers for minority groups in social learning and participation</li> <li>• Public spaces management service, e.g. maintenance</li> <li>• E-democracy service, e.g. electronic voting service</li> <li>• Online city-tourism information service</li> </ul> |
| Pira (2021)                                              | <ul style="list-style-type: none"> <li>• Health (including life expectancy)</li> <li>• Safety (e.g. crime levels)</li> <li>• Education</li> <li>• Culture and wellbeing (living conditions, inequality, quality of life ranking)</li> </ul>                                                                                                                |
| Shami et al. (2022)                                      | <ul style="list-style-type: none"> <li>• Housing and building</li> <li>• Health and hygiene</li> <li>• Security</li> <li>• Public education</li> <li>• Social cohesion and participation</li> <li>• The environment and natural resources</li> <li>• Culture</li> </ul>                                                                                    |
| Zhu et al. (2022)                                        | <ul style="list-style-type: none"> <li>• Reliable and efficient physical infrastructures</li> <li>• Accessible and secured ICT infrastructures</li> </ul>                                                                                                                                                                                                  |
| Chen and Chan (2023) (for “smart livelihood SCQOL-LIVE”) | <ul style="list-style-type: none"> <li>• Way of life</li> <li>• Personal life quality</li> <li>• A feeling of belonging in my city</li> <li>• The image of my city to others</li> <li>• Community pride</li> <li>• Opportunities to use smart technologies</li> <li>• Citizens’ participation in government decision-making process</li> </ul>             |

**Figure 1: Word Cloud of Smart Living Priorities**

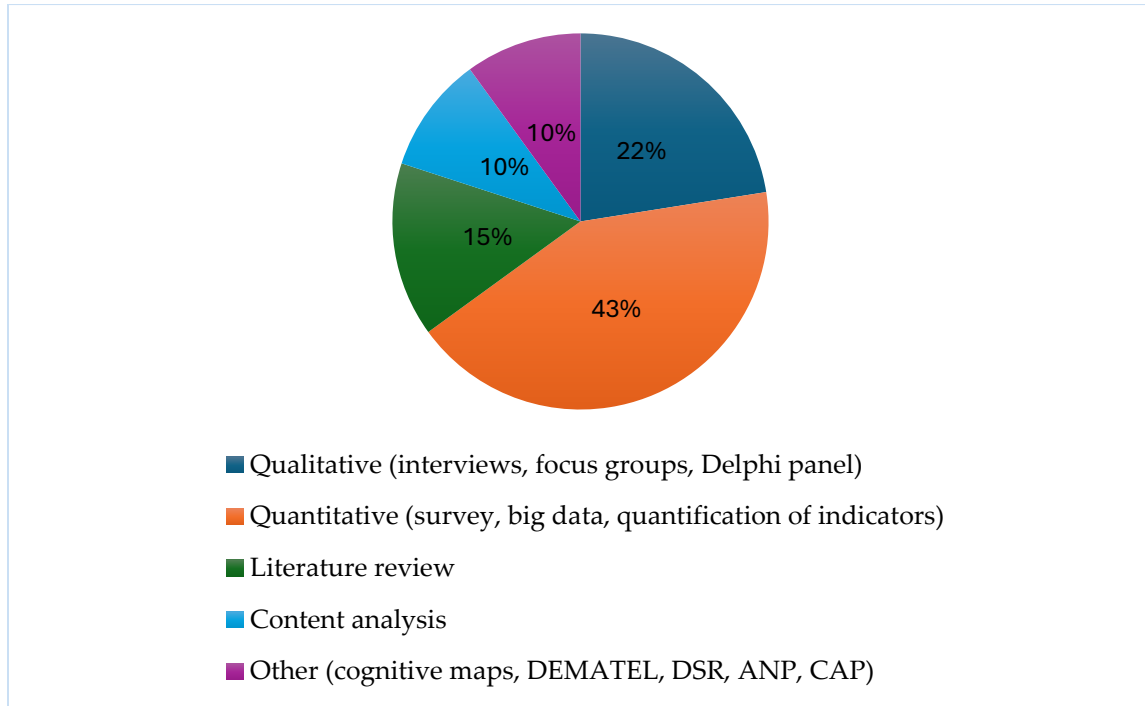


WordItOut

### **Research Methods for Smart City and Quality of Life Research**

According to the detailed literature review (2020-2023) of 40 academic articles focusing on SC and QoL, the most common research methods are quantitative (see Figure 2), especially questionnaires with local residents. QoL research often employs questionnaires that focus on subjective wellbeing and citizens' perceptions of domains of SC (e.g. de Guimarães et al. 2019; Oh 2020; Bielinska-Dusza et al. 2021; Ji et al. 2021; Simonofski et al. 2021; Vidiesova and Cronemberger 2021; Shami et al. 2022; Chen and Chan 2023). Some authors collect and analyse indicators and sub-indicators relating to smart buildings, resources management, energy consumption, transport systems, healthcare and smart infrastructure (Ivaldi et al. 2020; Ortega and Malcolm 2020; Ozkaya and Erdin 2020; Pira 2021). Others analyse policy and strategy documents and reports which connects their research to smart governance, urban planning and management (Vidiasova and Cronemberger 2020; Csukás and Szabó 2021; Treude 2021). These methods can also help to provide a framework for a case study context (e.g. political, economic and environmental issues). Sometimes the document analysis is quite specific, e.g. documents referring to resilient cities (Bruzzone et al. 2021) or inclusive smart cities (Wang et al. 2021). In addition to in-depth interviews, focus groups, workshops and Delphi studies, other ways of eliciting data from professionals include cognitive mapping research, which involve panel discussions with groups of experts (Braga et al. 2021; Nunes et al. 2021).

**Figure 2: Summary of Research Methods Used in Past Studies of QoL in SC**



Several studies use mixed research methods (e.g. those listed under the ‘Other’ category in Figure 2). These appear to be the most informative for collecting objective indicators, subjective perceptions of both professionals and residents, as well as content-analysing policy documents. Several authors include comprehensive lists of indicators and sub-indicators across the domains of SC discussed earlier (e.g. Ortega-Fernandez et al. 2020; Pira 2021), some with a specific focus on QoL (e.g. Ligarski and Wolny 2021; Chen and Chan 2023). Research across several cities and comparative work is invaluable, but it is important to note that one model may not work for all cities and that adaptation to context is essential. Nevertheless, applying global principles of sustainability or good practice in citizen participation can work well in many different contexts.

### 3.4. Context for Research

This section will demonstrate how the information above could be used in the context of a specific city. The identification of domains and indicators can be applied to various research methods but lend themselves especially well to questionnaire design which can reach a wider range of citizens than other methods (e.g. interviews or focus groups). The chosen context for the potential application of smart living research is the city of Budapest, the capital of Hungary. It is firstly necessary to consider the background to Budapest’s urban development as a post-socialist city in transition. The economic and social processes affecting urban transformation in all post-socialist cities include political change, transition to capitalism, gentrification, urban sprawl, and segregation (Vesalon and Creţan, 2019). Urban policy and planning have been somewhat *laissez-*

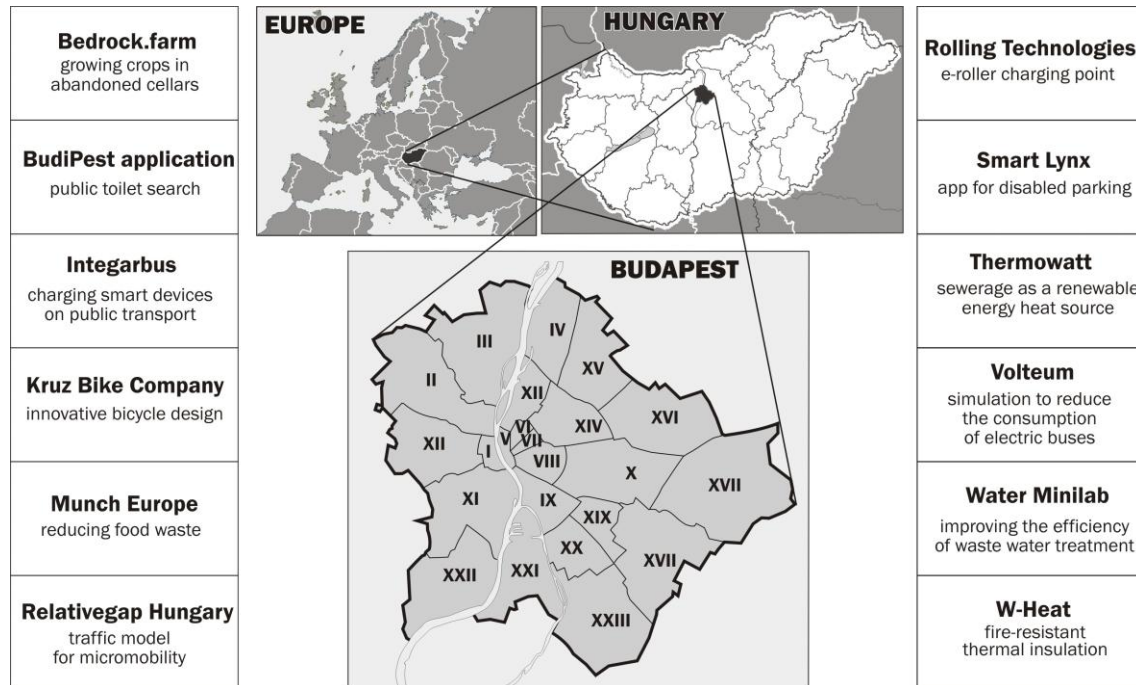
*faire* with inadequate or inconsistent regulatory and legal frameworks, and inherent corruption (Tsenkova, 2014). This has led to greater social inequalities and often a decrease in local resident quality of life (Smith and Klicek, 2020). This was partly due to increasing economic polarization, income inequalities and spatial differentiation of society (Marciniczak, Gentile and Stępiak, 2013). In Romania, it was noted that the unequal exploitation of opportunities arising after the fall of the communist regime has greatly influenced urban development (Stoian and Rusu, 2024). It is also important to mention disappointments with post-socialist living, which offered relatively little security and state support in the absence of paternalistic authority (Shlapentoh and Shiraev, 2002). Impoverishment, population decrease and outmigration are common issues (Sýkora, 2009; Marciniczak, Gentile and Stępiak, 2013; Popescu, 2014), which have not been ameliorated in many post-socialist cities like Budapest, even in recent years. It has been noted that marginal communities living in peripheral areas like the Roma people might be especially vulnerable to exclusion in this region because of uneven spatial development and displacement (Dragan, Crețan and Bulzan, 2024). It is also important to consider ethnic minorities living in border regions (Berceneau, Popa and Crețan, 2023).

Hungary experienced a more ‘benign’ form of state socialism than some countries in the Eastern Bloc (Bockman, 2011) and the return to ‘capitalism’ was therefore swifter (Marciniczak et al., 2015). Nevertheless, Budapest, like many post-socialist cities, is now suffering from issues that are also common to many Western European cities, such as gentrification, inflation, a housing crisis and associated challenges have emerged alongside increasing touristification of urban areas, all of which impact on local resident quality of life. It has been suggested that, like in other CEE cities, this is partly a result of following the Western pattern of prioritising economic growth over social cohesion and environmental protection (Vesalon and Crețan, 2019).

In their comparison of nine cities, Csukás and Szabó (2021) state that smart developments have been ongoing in Budapest for the last decade (see e.g. Figure 3), however, it has been suggested that the city ranks lower than its region’s average (Csécsei 2020). Although it seems on the surface that Budapest shows some similarities with Vienna (Austria) based on the distribution of value proposition components (e.g. citizen inclusion, engagement and equality), alongside Moscow, Budapest is the lowest performing city in terms of QoL (Csukás and Szabó 2021). However, Vanolo’s (2014) critique of smart city rankings should be mentioned here, where he argues that such standardising ‘performance technology’ may not take into consideration the diversity of factors that affect urban development in different cities, including power relations. QoL in Budapest was defined based on numerous past studies as “Activities, directly providing better conditions for the citizens to pursue happiness in their daily life, considering their needs and experience in mind, resulting in well-being” (Csukás and Szabó 2021: 7). The European Commission (2023) QoL report shows that satisfaction with living in Budapest remained relatively low between 2019 and 2023, including healthcare, housing, air pollution and lack of trust in other people. It has been suggested that the issue of “disrupted wellbeing” in Budapest should be addressed, including gentrification, clash of interests over land use and overtourism (Namaz and Tvergyák 2023:7).

Csukás and Szabó (2018) previously cited lack of correct understanding of smart city concepts as one of the barriers to development in Budapest and other Hungarian cities and they emphasised the importance of understanding the specific local needs of a city, namely the needs of citizens.

**Figure 3: Winners of smart city projects organised by City Hall in Budapest, 2021**



Source: Lívía Kaiser, cartographer (HUN-REN CSFK Geographical Institute), 2024

Csukás and Szabó (2022) provide a focused analysis of Budapest's smart strategy, suggesting that the process is not entirely transparent, including legislation and regulations, roles and responsibilities of stakeholders are not clearly articulated, and activities related to gathering the opinions of the wider population are missing. Taking into consideration these authors' identified barriers to smart city development in Hungary, this work will make recommendations for improving the current 'smartness' of Budapest by researching the needs of citizens. Research will identify the most important QoL issues for Budapest by collecting focused data from a sample of residents, which can help to assess the importance of several domains of smart living and to make recommendations for enhancing QoL based on the results. The sample will take into consideration the concerns expressed by Dragan, Crețan and Bulzan (2024) that less educated, older and poorer citizens are not as likely to have easy access to the digital world.

### 3.5. Discussion: Research Design

The research will build on and complement one previous study that focused on Budapest as a smart city from an environmental perspective. In addition to pollution and heat island effect, lack of green spaces, affordable housing and problems with the maintenance of the infrastructure were identified as key challenges by more than half of the respondents. Public cleanliness and safety were also identified as important (Fekete 2023).

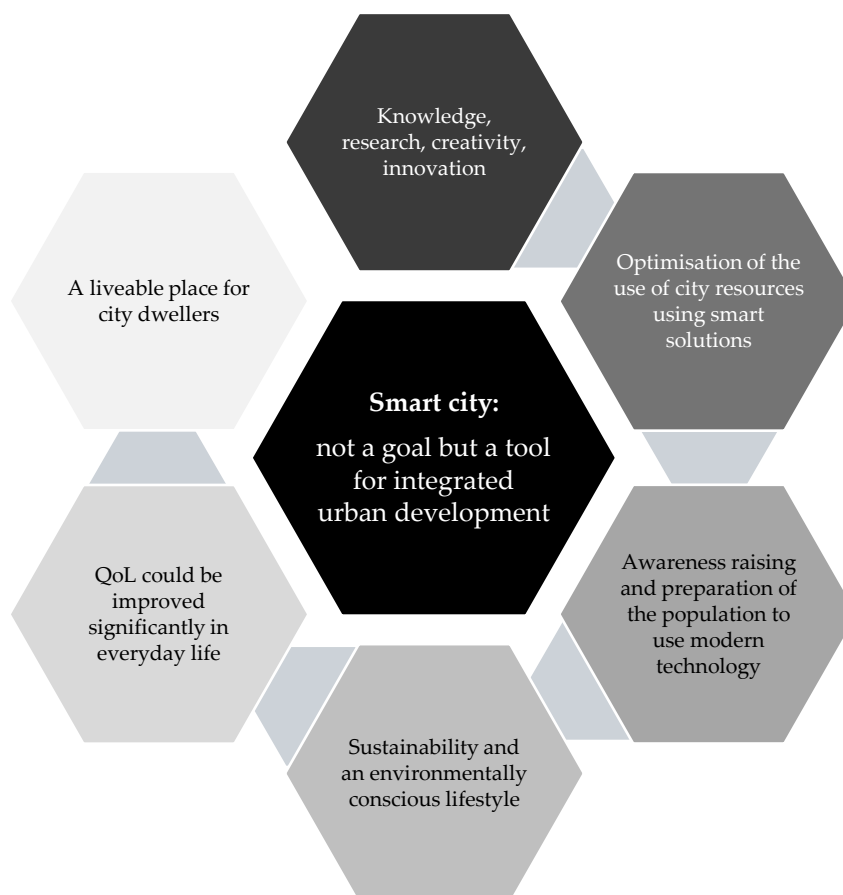
In the design of the research, it was firstly important to examine the dimensions of smart city development that were included in the Smart City Vision of Budapest (Municipality of Budapest, 2017). In summary:

- An integrated and holistic approach to development for the whole city
- The extent to which digital tools and technology can improve quality of life
- A strong connection to sustainability
- The need to enhance social responsibility
- To create a dynamic, creative and liveable city

The proposed smart living questionnaire would focus in particular on the improvement of QoL and liveability, including the role of digital tools and technology in this process. The Smart City

Vision of Budapest strategy includes the economy (incorporating creativity, knowledge and innovation); mobility and the environment (accessible, sustainable transport and energy); leisure (including green spaces, heritage and tourism); as well as social regeneration (reference is made to equal opportunities, active society, inclusion of disadvantaged groups and preserving diverse residential communities). Figure 4 summarises some of the most important intentions of the Smart City Vision for Budapest. The emphasis on improving liveability and quality of life through sustainability and technology is notable.

**Figure 4: Smart City Vision for Budapest**



Of course, health and education are also fundamental aspects of QoL, but health and education systems are affected by national government policies and are often beyond the remit of city governance. It must be mentioned that urban governance in Budapest currently faces some barriers and restrictions due to lack of political cooperation, economic and funding issues. However, the aim of this research will not be to explore the process of and barriers to implementation of smart city initiatives, instead it will examine resident perceptions of existing and ongoing developments.

Using the domains that occur most frequently in previous research on smart living, the questionnaire design will focus on the following: housing, health, education, safety, environment (public and green spaces), social cohesion, leisure, culture and tourism. The following indicators from past studies of smart living were used as inspiration for the design of the statements.

- **Housing:** technology facilitates purchase, sale and rent; efficiency in water and energy (Shami et al. 2022)
- **Health:** adequate healthcare options within their budget; e-options (Ji et al. 2021); caring for and monitoring patients' health status (Shami et al. 2022)
- **Safety:** feeling safe within the city, including at night; monitoring and controlling public space (Shami et al. 2022)
- **Education:** digital education using modern and interactive ICT tools (Ji et al. 2021); innovation in educational methods (Shami et al. 2022)
- **Public spaces:** attractive and well-maintained public spaces (Ji et al. 2021)
- **Green spaces:** citizens have access to green spaces close to their homes (Liu et al. 2020)
- **Social cohesion:** a sense of belonging in the city (Chen and Chan 2023)
- **Social inclusion:** help and support for all citizens, including disadvantaged groups (Ji et al. 2021)
- **Leisure:** enough leisure and sports activities close to home (Oh 2020); e-library service; e-fitness service (Ji et al. 2021)
- **Culture:** interesting and affordable museums and galleries; enough information about cultural events (Shami et al. 2022)
- **Tourism:** new experiences of cultural heritage for residents and tourists using ICT, e.g. augmented reality (Ji et al. 2021); becoming familiar with tourist sites (Shami et al. 2022)

### 3.6. Pilot Study

The questionnaire was designed in English (because of the much wider availability of SC and QoL literature in English), but it was translated into Hungarian with the assistance of two native speakers. The questionnaire was also translated into Mandarin by a native speaker and checked by two further native Mandarin speakers, as there is a sizeable Chinese minority in Budapest. However, it should be noted that foreigners (who would undertake the questionnaire in English) represent only 5.8% of the population of Budapest and it is estimated that there are 30,000 Chinese people in Budapest (approximately 1.8%) (HCSO 2023). The questionnaire will therefore be mainly distributed to Hungarian residents.

In addition to consulting recent literature and previous studies, the proposed questionnaire statements (which are listed in Table 2) were piloted on a representative sample of respondents in accordance with the planned distribution and using recent Census data. The ideal number of

respondents for our study would be 385 citizens, with a confidence level of 95% and a margin of error of 5% (Qualtrics 2024). This was calculated based on the total population of Budapest being 1,685,342 with an estimated 1,400,000 citizens aged 18+ (HCSO 2023). A minimum of 300 questionnaires was deemed acceptable. Previous SC and QoL studies include samples ranging from 235 citizens up to 848 (de Guimarães et al. 2019; Oh 2020; Bielinska-Dusza et al. 2021; Ji et al. 2021; Simonofski et al. 2021; Vidiesova and Cronemberger 2021; Shami et al. 2022; Chen and Chan 2023). One of the aims of conducting a pilot study is to check the correctness of the developed questionnaire (Kaur et al. 2017; Menon et al. 2021), to include only relevant information (Morris and Rosenbloom 2017), and to modify questions that do not elicit appropriate responses (Malmqvist et al. 2019). Some researchers recommend a pilot sample of around 10% of the total sample (Connelly 2008; Menon et al. 2021) and Perneger et al. (2015) suggest that thirty participants is a reasonable starting point for a pre-test of a questionnaire. As the minimum sample size would be 300 residents, the pilot sample was 30 respondents. In addition to fine-tuning language and translation, identifying repetition, omissions or redundant questions, some of the changes to statements suggested by respondents can be seen in the Notes column in Table 2.

### 3.7. Questionnaire Distribution

Taking inspiration and methodological good practice from previous studies of SC and QoL (e.g. de Guimarães et al. 2019; Oh 2020; Bielinska-Dusza et al. 2021; Ji et al. 2021; Simonofski et al. 2021; Vidiesova and Cronemberger 2021; Shami et al. 2022; Chen and Chan 2023), the questionnaire will have the following characteristics:

- It will be designed using closed questions and a Likert scale
- It will be designed in both online (weblink and QR code) and paper format in order to capture all age groups as representatively as possible
- It will be posted on social media (e.g. online District Forums, Ex-Pat networks) but also distributed in public places (e.g. the City Park in the centre of Budapest)

**Table 2 : Questionnaire Statements for Smart Living Questionnaire**

| Domain                                                                                                                                             | Suggested Statements                                                                                                                                                                                                              | Notes                                                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| <b>Housing</b><br>(Oh 2020; Ortega and Malcolm 2020; Ozkaya and Erdin 2020; Bielinska-Dusza et al. 2021; Csukás and Szabó 2021; Shami et al. 2022) | <ul style="list-style-type: none"> <li>• It is easy to find good quality housing in Budapest at a reasonable price to rent</li> <li>• It is easy to find good quality housing in Budapest at a reasonable price to buy</li> </ul> | In the pilot study, respondents emphasized the need to differentiate between buying and renting accommodation. |
| <b>Health</b><br>(Oh 2020; Ozkaya and Erdin 2020; Bielinska-Dusza et al. 2021; Cantuarias-Villesuzanne et al. 2021; Csukás and Szabó               | <ul style="list-style-type: none"> <li>• I am satisfied with healthcare services, doctors and hospitals in Budapest</li> </ul>                                                                                                    | Inspired by “the healthcare system is adequate for my needs” (Ji et al. 2021).                                 |

|                                                                                                                                                                                            |                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2021; Pira 2021; Shami et al. 2022)                                                                                                                                                        |                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                  |
| <b>Safety</b><br>(Oh 2020; Ortega and Malcolm 2020; Ozkaya and Erdin 2020; Bielinska-Dusza et al. 2021; Cantuarias-Villessuzanne et al. 2021; Pira 2021; Shami et al. 2022)                | <ul style="list-style-type: none"> <li>• Budapest feels safe including at night</li> </ul>                                                                                                                                                 | Inspired by “The city feels safe and secure, including at night” (Shami et al. 2022).                                                                                                                                                            |
| <b>Education</b><br>(Ozkaya and Erdin 2020; Bielinska-Dusza et al. 2021; Cantuarias-Villessuzanne et al. 2021; Pira 2021; Shami et al. 2022)                                               | <ul style="list-style-type: none"> <li>• I am satisfied with the education provision in Budapest <ul style="list-style-type: none"> <li>○ At primary level</li> <li>○ At secondary level</li> <li>○ At higher level</li> </ul> </li> </ul> | In the pilot study, respondents suggested specifying which level of education (e.g. primary, secondary, higher).                                                                                                                                 |
| <b>Environment (public and green spaces)</b><br>(Oh 2020; Liu et al. 2020; Ji et al. 2021; Shami et al. 2022)                                                                              | <ul style="list-style-type: none"> <li>• There are enough attractive green spaces in Budapest (e.g. parks and gardens)</li> <li>• Budapest is a clean city</li> <li>• Budapest seems to be a sustainable city</li> </ul>                   | Inspired by maintenance of public spaces (e.g. Ji et al. 2021); the importance of green spaces (e.g. Liu et al. 2020).                                                                                                                           |
| <b>Social cohesion</b><br>(Ortega and Malcolm 2020; Ozkaya and Erdin 2020; Bielinska-Dusza et al. 2021; Csukás and Szabó 2021; Ji et al. 2021; Shami et al. 2022; Chen and Chan 2023)      | <ul style="list-style-type: none"> <li>• The people in Budapest seem open and friendly</li> <li>• I feel a sense of community in Budapest</li> </ul>                                                                                       | Inspired by but simplified from: “I feel a sense of belonging in the city” (Chen and Chan 2023).                                                                                                                                                 |
| <b>Leisure</b><br>(Oh 2020; Ji et al. 2021; Ligarski and Wolny 2021)                                                                                                                       | <ul style="list-style-type: none"> <li>• Budapest has a good range of sports and fitness facilities</li> </ul>                                                                                                                             | <p>Inspired by “There are enough sports and fitness facilities close to where I live” (Oh 2020).</p> <p>Budapest has excellent new sports facilities in the centrally located city park, so we did not want to limit answers to local areas.</p> |
| <b>Culture</b><br>(Ortega and Malcolm 2020; Ozkaya and Erdin 2020; Bielinska-Dusza et al. 2021; Cantuarias-Villessuzanne et al. 2021; Csukás and Szabó 2021; Pira 2021; Shami et al. 2022) | <ul style="list-style-type: none"> <li>• Budapest has a good range of affordable cultural facilities (e.g. museums, galleries, heritage sites, theatres)</li> </ul>                                                                        | Inspired by “interesting and affordable museums and galleries” (Shami et al. 2022)                                                                                                                                                               |

|                                                                                                                                                                          |                                                                                                                                                                                                                         |                                                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Tourism</b><br>(Bielinska-Dusza et al. 2021; Ortega and Malcolm 2020; Ozkaya and Erdin 2020; Cantuarias-Villessuzanne et al. 2021; Ji et al. 2021; Shami et al. 2022) | <ul style="list-style-type: none"> <li>• Budapest has many interesting tourist attractions</li> <li>• Tourism has many positive impacts on Budapest</li> <li>• Tourism has many negative impacts on Budapest</li> </ul> | Budapest suffered from ‘overtourism’ in the pre-COVID era and residents were unhappy about overcrowding and night noise. However, we wanted to balance the negative impact question with a positive one. |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

One question will be included, which captures respondents’ attitudes to SC development with the questions inspired by, but adapted from Chen and Chan (2023):

- The development of Budapest as a smart city is important to me
- I would like to use more smart services in Budapest

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. Of these, the best known related to transport, including tickets and vehicle-sharing schemes, as well as smart benches, parking apps and a few references to lighting and energy sources. For this reason, it was deemed important to include ‘prompts’ for respondents in subsequent research. A separate question will therefore be included that gathers information about the smart services that residents are familiar with or most likely to use. In addition to the literature review, artificial intelligence (ChatGPT) made suggestions when tasked with finding “list specific or tangible smart city initiatives that citizens can use”. Some of the suggestions have been adapted to form the following list:

- A transport system with e-ticket options (e.g. via apps or online booking)
- Electronic information boards to show when the next bus/train is coming
- E-parking options
- Electricity charging stations for cars
- Car-pooling or sharing apps
- Bike-sharing schemes
- Rubbish collection based on smart technology which indicates when bins are full
- E-health options where people can access doctors online
- Online learning options offered by educational institutions
- WiFi available everywhere in the city
- E-ticket options for theatres, museums and other cultural facilities
- Digital experiences in cultural facilities like museums, heritage sites and galleries (e.g. virtual reality, augmented reality, interactive technology)
- Smart lighting systems
- Cameras linked to security services in public spaces
- Touchscreen kiosks in public areas providing information about local services, events and points of interest
- Online complaint platforms where people can say what they find good or bad about the city

Many of these are related to Smart Mobility, especially public transport and car travel, as well as Smart Environment. Figure 3 also shows that most of the current smart city initiatives in Budapest relate to mobility or environmental sustainability. However, several points are also relevant to Smart Living and these will form part of a smart solutions question for residents in the Budapest study:

- **Housing:** rubbish collection based on smart technology
- **Health:** E-health options where people can access Budapest doctors online
- **Safety:** cameras linked to security services in public spaces
- **Education:** online learning options offered by Budapest educational institutions
- **Public spaces:** WiFi available everywhere in the city; touchscreen kiosks in public areas providing information about local services, events and points of interest
- **Social inclusion:** online complaint platforms where people can say what they find good or bad about the city
- **Leisure:** bike-sharing schemes
- **Culture:** E-ticket options for theatres, museums and other cultural facilities; digital experiences in cultural facilities like museums, heritage sites and galleries (e.g. virtual reality, augmented reality, interactive technology)
- **Tourism:** touchscreen kiosks in public areas providing information about local services, events and points of interest

### 3.8. Conclusions

This paper has centralised residents' QoL in the context of smart cities using the domain of smart living. It has been suggested that this domain is actually the most important of the six commonly cited domains of SC, yet it is relatively under-researched. One of the main aims was to identify appropriate indicators for measuring smart living, including connections to smart solutions. Unlike wider measures of QoL, which also include economic and environmental dimensions, smart living focuses more on social indicators. These can include physical living conditions (e.g. housing, public space, safety), social services (e.g. health and education), but also those factors that contribute to psychological wellbeing, such as leisure, culture and social inclusion. Smart living should be underpinned by good governance and sustainability, but these processes are often unseen by residents. A wide range of research methods have been used in SC and QoL studies, with the most common being quantitative. Although mixed methods are arguably the most effective, questionnaires allows researchers to reach a representative sample of residents. This study therefore paves the way for quantitative research to be undertaken in a real city context (Budapest in Hungary) making recommendations for refining the domain of smart living, as well as identifying indicators for measuring residents' QoL within this domain. Future research will include distributing the questionnaire to a representative sample of the population of Budapest and using the results to identify the most important domains of quality of life for different segments of residents. This can help to inform policy and planning, as well as determining the allocation of resources to future smart developments. The research is considered timely because of Budapest's relatively low performance in QoL indicators in Europe, the lack of data on the needs of citizens, and to complement previous studies that focused more on economic

or environmental rather than social indicators. Overall, this article contributes to the development of theoretical and methodological approaches to SC and QoL studies, as well as assisting potential city governments in the development of measures and indicators. The results could be applicable to other post-socialist CEE cities which have followed similar trajectories to Budapest. Indeed, although every context and community is different, the domains and indicators are applicable to almost any city that hopes to enhance quality of life by prioritising smart living.

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**Competing Interests:** The authors declare no competing interests.

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## Appendix 1

### Smart Cities and Quality of Life Domains and Indicators

*\*references to smart living and quality of life are highlighted and presented in italic font*

| Authors                        | Indicators                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Notes                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ivan et al. (2020)             | <b>There are eight domains of an age-friendly city, namely:</b> <ul style="list-style-type: none"> <li>• Social participation</li> <li>• Communication and information</li> <li>• Civic participation and employment</li> <li>• Housing</li> <li>• Transportation</li> <li>• Community support and health services</li> <li>• Outdoor spaces and buildings</li> <li>• Respect and social inclusion</li> </ul>                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                             |
| Oh (2020)                      | <b>Several studies on citizen-centric urban planning suggested that “Subjective Quality of Life” can be classified into four categories:</b> <ul style="list-style-type: none"> <li>• <i>Subjective health issues</i></li> <li>• <i>Subjective safety evaluation</i></li> <li>• <i>Urban environment</i></li> <li>• <i>Residential environment (e.g. housing)</i></li> </ul>                                                                                                                                                                                                                                           | <b>Quality of life variables were:</b> <ul style="list-style-type: none"> <li>• <i>Housing (including facilities and environment)</i></li> <li>• <i>Urban environment</i></li> <li>• <i>Health and wellbeing (including physical and mental health)</i></li> <li>• <i>Safety and convenience</i></li> </ul>                                                                                 |
| Ortega-Fernandez et al. (2020) | <b>Dimensions of a smart city:</b> <ul style="list-style-type: none"> <li>• Governance (including public services, taxation, transparency of data)</li> <li>• People (including creativity, social cohesion, qualifications)</li> <li>• Economy (including investment, competitiveness, entrepreneurship)</li> <li>• <i>Living (including housing quality, tourism, cultural facilities, citizen security, social cohesion)</i></li> <li>• Environment (including pollution, energy efficiency, green buildings)</li> <li>• Mobility (including sustainable transport, traffic control, ICT infrastructure)</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                             |
| Ozkaya and Erdin (2020)        | <p>The smart and sustainable city concept consists of six characteristics. <i>While 'Smart Living' is the most important characteristic</i>, 'Smart Governance' is the last. 'Smart Economy is ranked second).</p>                                                                                                                                                                                                                                                                                                                                                                                                     | <p><i>In their Keyword ranking, ‘quality of life’ is the first.</i></p> <p><i>Cities which have good scores in the smart economy and smart living also get good scores in the general ranking.</i></p> <p><i>The concept of "Smart living (quality of life)" was assessed by seven factors. While individual safety is the most important factor, touristic attraction is the last.</i></p> |

|                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Szarek-Iwaniuk and Senetra (2020)     | <p><b>A smart city is characterized by:</b></p> <ul style="list-style-type: none"> <li>• sustainable economic development</li> <li>• <i>a high quality of life</i></li> </ul> <p><b>which are driven by:</b></p> <ul style="list-style-type: none"> <li>• investments in human and social capital</li> <li>• traditional (transport)</li> <li>• modern (ICT) infrastructure</li> <li>• responsible resource management</li> <li>• social participation</li> </ul>                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                               |
| Braga et al. (2021)                   | <p><b>Smart city development depends on six critical pillars:</b></p> <ul style="list-style-type: none"> <li>• Smart economy</li> <li>• Smart governance</li> <li>• Smart mobility (including transport)</li> <li>• Smart environment</li> <li>• Smart people</li> <li>• <i>Smart ways of life (associated with locals' lifestyle choices and quality of life)</i></li> </ul>                                                                                                                                                                                                  | <p><b>The most important four pillars are:</b></p> <ul style="list-style-type: none"> <li>• People's involvement in constructing an intelligent, informed, educated society</li> <li>• Preserving the environment, managing energy, sustainability</li> <li>• Mobility and transport</li> <li>• Sustainable economic development</li> </ul>                                   |
| Cantuarias-Villesuzanne et al. (2021) | <p><b>Seven dimensions of the smart city (described by the academic literature):</b></p> <ul style="list-style-type: none"> <li>• Smart architecture and technologies</li> <li>• Smart citizens</li> <li>• Smart economy</li> <li>• Smart environment</li> <li>• Smart government</li> <li>• Smart living</li> <li>• Smart mobility</li> </ul>                                                                                                                                                                                                                                 | <p><i>Smart living examines the use of ICT for achieving quality of life in a liveable and safe environment. This smart city dimension is mainly divided into four characteristics:</i></p> <ul style="list-style-type: none"> <li>• <i>Security</i></li> <li>• <i>Education</i></li> <li>• <i>Healthcare</i></li> <li>• <i>Tourism</i></li> <li>• <i>Religion</i></li> </ul> |
| Ji et al. (2021)                      | <p><b>Respondents' preferences about seven dimensions of SC services, including:</b></p> <ul style="list-style-type: none"> <li>• smart energy (four questions)</li> <li>• smart environment (six questions)</li> <li>• smart people (six questions)</li> <li>• <i>smart living (seven questions)</i></li> <li>• smart transport (four questions)</li> <li>• smart safety (four questions)</li> <li>• smart health (four questions)</li> </ul> <p><i>Among these dimensions, smart people and smart living represent the soft domain, and the others, the hard domain.</i></p> | <p>Although smart living was ranked highly, Taiwanese citizens expressed relatively higher preferences for SC services from the hard domain over those from the soft domain. Eight of the 10 most-preferred specific SC services were drawn from four hard-domain dimensions, i.e., smart safety, smart transport, smart environment, and smart health.</p>                   |
| Kim et al (2021)                      | <p><b>Main topics of citizens' complaints in Seoul:</b></p> <ul style="list-style-type: none"> <li>• Health: Public health, hygiene, etc.</li> <li>• Economy Industry: payments for charges, prices, etc.</li> <li>• Traffic: Public transportation, pedestrians, etc.</li> <li>• Culture: Sightseeing, cultural experiences, cyber subculture, etc.</li> </ul>                                                                                                                                                                                                                | <p>From 2006 to 2017, the three most important topics were traffic, the environment, and culture.</p>                                                                                                                                                                                                                                                                         |

|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | <ul style="list-style-type: none"> <li>• Welfare: Positive discrimination, labor welfare</li> <li>• Taxes: Default, tax collection, etc.</li> <li>• Safety: Firefighting, disaster prevention, declaration of emergency, etc.</li> <li>• Female: Infant care, multi-children families, etc.</li> <li>• Housing: Rentals, housing development, real estate policy, etc.</li> </ul>                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                     |
| Ligarski and Wolny (2021)   | <p><b>The identification of eight areas which, according to the respondents (in 76 cities), have the greatest impact on the quality of life:</b></p> <ol style="list-style-type: none"> <li>1. <i>Living conditions in the city</i></li> <li>2. Public safety</li> <li>3. Education</li> <li>4. Housing</li> <li>5. Future perspectives</li> <li>6. Leisure opportunities</li> <li>7. Transport and communication</li> <li>8. Working conditions in the city</li> </ol>                                                                                                  |                                                                                                                                                                                                                                                                                                                                     |
| Pira (2021)                 | <p><b>Indicators for smart sustainable cities:</b></p> <ul style="list-style-type: none"> <li>• Socio-cultural (including health, education, culture, safety)</li> <li>• Economic (including housing, jobs, entrepreneurship)</li> <li>• Environmental (including green spaces, pollution, energy use)</li> <li>• Governance (including transport, data monitoring, internet and WiFi)</li> </ul>                                                                                                                                                                        | <p><i>The smart city 'Living' indicators are useful (adapted from Cohen, 2014):</i></p> <ul style="list-style-type: none"> <li>• <i>Culture and wellbeing (living conditions, inequality, quality of life ranking)</i></li> <li>• <i>Health (including life expectancy)</i></li> <li>• <i>Safety (e.g. crime levels)</i></li> </ul> |
| Sharif and Pokharel (2021)  | <p><b>The primary goals considered for a smart city project were:</b></p> <ul style="list-style-type: none"> <li>• <i>the enhancements in quality of life</i></li> <li>• economy</li> <li>• transport and traffic</li> <li>• clean and sustainable environment</li> <li>• access to interaction with the government's relevant authorities</li> </ul>                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                     |
| Valencia-Arias et al (2021) | <p><b>Smart cities integrate six concepts:</b></p> <p>(1) smart economy, with high levels of innovation;</p> <p>(2) smart mobility, based on the adoption of sustainable and eco-friendly transportation systems;</p> <p>(3) smart environment, measured as the adequate management of natural resources;</p> <p>(4) smart communities, based on community training and the development of key skills for innovative ecosystems;</p> <p><i>(5) smart life, a dimension that can be measured using social indicators that reflect the quality of life of citizens</i></p> | <p><b>The evaluation (for transformation of cities into smart cities) is focused on six dimensions:</b></p> <p>(1) government</p> <p>(2) mobility</p> <p>(3) sustainability</p> <p>(4) people</p> <p>(5) economy</p> <p><i>(6) quality of life</i></p>                                                                              |

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      | (6) smart governance, from the standpoint of the supply of goods and services by government agencies and transparency in public administration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Shami et al. (2022)  | <p><b><i>Dimensions and indicators to measure the quality of smart living:</i></b></p> <ul style="list-style-type: none"> <li>• <b><i>Health and hygiene</i></b></li> <li>• <b><i>Security</i></b></li> <li>• <b><i>Public education</i></b></li> <li>• <b><i>Social cohesion and participation</i></b></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                             | <p><b><i>Smart living shall encompass innovations concerned with improvement of healthcare, education, and social services as well as enhancement of citizens' participations (electronic-government projects) which is to have positive effect on the environment, reduce vulnerability, and improve safety. (Appio et al., 2019).</i></b></p>                                                                                          |
| Zhu et al. (2022)    | <p><b>Main features of a Smart City blueprint:</b></p> <ul style="list-style-type: none"> <li>• A city with accessible and secured ICT infrastructures</li> <li>• A city with reliable and efficient physical infrastructures</li> <li>• A city with productive and innovative economy</li> <li>• A city with equal and inclusive society</li> <li>• A city with sustainable and resilient environment</li> <li>• A city with participatory and transparent governance</li> </ul>                                                                                                                                                                                                                                                                              | <p><b>Happiness Driven Smart City (HDSC) is supposed to have the following characteristics:</b></p> <ul style="list-style-type: none"> <li>• A city with <i>efficient and green physical infrastructure</i></li> <li>• A city with <i>labor-friendly and innovative economy</i></li> <li>• A city with <i>inclusive and attractive society</i></li> <li>• A city with <i>sustainable and eco-friendly natural environment</i></li> </ul> |
| Chen and Chan (2023) | <p><b>The five domains identified were the following:</b></p> <p>(1) smart environment (SCQOL-ENV), which includes seven items related to environmental and sustainability issues;</p> <p>(2) smart people (SCQOL-PPL), which includes six items related to social welfare and personal development;</p> <p><b>(3) smart livelihood (SCQOL-LIVE), which includes seven items measuring an individual's way of life and community feelings, image and pride;</b></p> <p>(4) smart economy and economic policy (SCQOL-ECON), which includes five items related to the economic impact and government support of SCD;</p> <p>(5) smart mobility (SCQOL-MOB), which includes four items measuring the city's public transportation, infrastructure and safety.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## 4. QUALITY OF LIFE AND OVERTOURISM IN BUDAPEST: RESIDENT EXPERIENCES AND SMART SOLUTIONS (ARTICLE A3)

**Reference:** Smith, M. K. & Chang, S. (2025). Quality of Life and Overtourism in Budapest: Resident Experiences and Smart Solutions, *Worldwide Hospitality and Tourism Themes*

### Abstract

**Purpose** – The aim of this study is to explore the relationship between smart cities and quality of life, identifying the indicators that can be used to measure these domains. It analyses how residents experience various aspects of urban life, particularly in terms of leisure, culture and tourism. Their attitudes to smart city developments and tools are also measured, considering the implications for managing overtourism and developing special interest tourism.

**Design/methodology/approach** – The research is based on questionnaire data collected from a representative sample of 453 residents in Budapest in 2024. It was distributed online via city district resident forums as well as being distributed face-to-face in various locations throughout the city.

**Findings** – The findings reveal that respondents have a positive image of Budapest and find the city relatively safe. Statements about public transport were ranked highly, including efficiency, reliability and affordability. Respondents had mixed feelings about friendliness and cleanliness. Respondents are very positive about cultural and tourist attractions, sports provision, as well as availability of green spaces. Respondents seem to be mainly positive about the impacts of tourism, but further analysis shows that this depends on the district that people are living in. Respondents want Budapest to become a smarter city and seem curious about using smart tools, particularly for transport, parking and ticketing. Recommendations are subsequently made for developing smarter systems for managing overtourism, developing special interest tourism, and improving resident quality of life.

**Originality/value** – The data provides new insights into under-researched domains of smart cities and their relevance for quality of life, namely leisure, culture and tourism. It captures the perceptions and opinions of residents, whose voices were often not heard in previous top-down studies of smart cities. It focuses on social and quality of life dimensions rather than an economic or technological perspective, filling another gap in smart city research.

**Keywords** - smart cities, quality of life, residents, leisure, culture, tourism, Budapest

**Paper type** - Research paper

## 4.1. Introduction

This research investigates the relationship between smart cities, resident quality of life (QoL) and tourism. The study combines a comprehensive literature review of 'smart cities' and 'quality of life' (2020-2023) with empirical research based on resident questionnaires designed to capture key indicators of QoL, especially those relating to leisure, culture and tourism. The investigation was conducted in Budapest, Hungary, a city that was traditionally associated with cultural and heritage tourism, but which more recently has been suffering from overtourism connected to nightlife. While much attention has been paid to technological and economic aspects of smart cities, less attention has been given to residents' lived experiences and perceptions. This study rather emphasises the social perspective of smart cities. Many studies have focused on some of the key domains of smart cities like health, security, housing and social cohesion, but relatively few have dealt specifically with leisure, culture and tourism dimensions.

This study therefore has three primary objectives. Firstly, it explores the relationship between smart cities and quality of life, identifying the indicators that have been used to measure these domains in previous studies. This forms the basis of the resident questionnaire design. Secondly, it explores how residents experience various aspects of urban life, particularly in terms of leisure, culture and tourism. Finally, it seeks to provide recommendations for urban planners and managers for future tourism developments that encourage a return to smaller scale cultural and special interest tourism.

## 4.2. Literature Review

A close reading of more than 40 academic articles relating to smart cities and quality of life between 2020 and 2023 revealed that a number of domains are commonly used to measure quality of life in smart cities (Chang & Smith, 2023). These are:

- Smart economy (e.g. jobs, investment, entrepreneurship, innovation, competitiveness)
- Smart governance (e.g. public services, administration, information provision)
- Smart mobility (e.g. transport, traffic control, infrastructure)
- Smart environment (e.g. energy efficiency, pollution, green spaces)
- Smart people (e.g. social networks, community, education)
- Smart living (e.g. housing, healthcare, safety, leisure, culture, tourism)

There are clearly overlaps between several of the domains, e.g. smart governance and smart economy; smart mobility and smart environment; smart people and smart living. This means that smart cities need to be managed somewhat holistically. However, the smart city domain of smart living and quality of life have been described as largely synonymous (Shami et al., 2022; Cantuarias-Villessuzanne et al., 2021). Smart living (originally defined by Giffinger et al., 2010) has been used by numerous subsequent researchers to include the following areas of urban life: health(care), housing quality, education, social cohesion and inclusion, safety and security, tourism, leisure and cultural facilities (Ozkaya and Erdin, 2020; Oh, 2020; Ortega & Malcolm, 2020; Bielinska-Dusza et al., 2021; Cantuarias-Villessuzanne et al., 2021; Csukás & Szabó, 2021; Ji et al., 2021; Pira, 2021; Shami et al., 2022). While acknowledging the importance of all of the domains of smart living, this study will focus mainly on leisure, culture, tourism and transport.

Although transport is not usually included in smart living indicators, smart mobility is a major domain of smart cities (Giffinger et al., 2010) and it is an essential facilitator of leisure, cultural and tourism activities.

### **4.3. Research Context: Budapest**

This research focuses on the city of Budapest in Hungary. It has been noted that despite more than a decade of smart city developments (Csukás and Szabó, 2021), according to the Smart City Index in 2020, Budapest is still lagging behind the region's average (Csécsei 2020). This also includes the quality-of-life rankings in Europe (European Commission, 2023), and there is a lack of data documenting the needs of citizens (Csukás and Szabó, 2018; Csukás and Szabó, 2022). It has been suggested that wellbeing has been disrupted by factors such as conflict of interest over land use, gentrification and overtourism (Namaz and Tvergyák 2023). Fekete's (2023) research in Budapest revealed that only around 40% of resident respondents were familiar with the concept of 'smart city' and even fewer were able to name some smart solutions.

For over two decades, Budapest was primarily promoted as a heritage and cultural tourism destination (Smith & Puczkó, 2012). However, in recent years, the city has gained popularity among tourists due to its vibrant 'ruin pub' scene in Districts VI and VII. This area is also the site of the former Jewish ghetto from the second World War. The increasing number of visitors has led to the area being transformed into a 'party quarter' with the highest concentration of Airbnb accommodations in the city (Pérez Garrido et al., 2022). One study on overtourism (Pinke-Sziva et al., 2019) identified the primary motivations for visiting Budapest with 43% of respondents citing cultural and heritage attractions, 31% mentioning ruin pubs and 29% highlighting thermal baths and spas. Another study showed that ruin pub tourism constitutes "a unique local feature which made the experience even more authentic, representing a special local lifestyle" (Remenyik et al., 2021:189). It could therefore be said to constitute a form of special interest tourism. However, it has also been suggested that the number one catalyst of the negative impacts of foreign visitors' behaviour is ruin pub tourism (Pérez Garrido et al., 2022).

The number of tourists in certain areas of the city has become overwhelming and it was estimated in the peak of 2019 that the number of tourists per day was double the optimum level (Pérez Garrido et al., 2022). The concerns of local residents became more pronounced, particularly in relation to the rapid escalation of property prices, resulting in displacement, as well as the disruptive noise levels and inappropriate behaviour exhibited by tourists (Pinke-Sziva et al., 2019). It was noted that 18% of local residents were considering relocating from the 'party quarter' at that time (Smith, Pinke-Sziva & Olt, 2019). Residents living close to the airport also complained about increased noise and disturbance from the expansion and proliferation of airline routes (Remenyik et al., 2021).

Budapest is administratively divided into 23 districts, each characterized by distinct economic, social, and cultural features. Governance responsibilities are shared between these districts and the Municipality of Budapest, an arrangement that often leads to conflicts over resource allocation and jurisdictional authority. As a result, there are different regulations for different districts, for example, some catering and entertainment establishments have to close at midnight, whereas others are exempt (Remenyik et al., 2021).

More recent findings (Smith, Pinke-Smith & Berezvai, 2023) suggest that while cultural motivations remain the primary reason for visiting Budapest, there has been a shift in tourists' interests compared to a decade ago. Visitors are now more attracted to the city's atmosphere and gastronomy rather than its built heritage sites or museums. Nonetheless, heritage buildings and historic spas continue to rank higher than most other activities, although nightlife has become a more significant factor than traditional cultural institutions such as museums and galleries. Although the spas are only one motivating factor for visiting Budapest, they also offer a unique form of special interest tourism. Younger tourists like performing arts and events more, whereas older tourists prefer heritage sites and museums. Although tourists demonstrated less interest in interactive and creative activities, they expressed a strong interest in cultural interactions and local lifestyles. The significance of cultural contact has been highlighted in several cultural tourism studies (Chen & Rahman, 2018), encompassing learning about local ways of life, interacting with residents, moving from staged towards more authentic experiences, and actively participating in cultural activities (Matoga & Pawłowska, 2018). Many visitors sought novel and distinctive experiences, with 60% rating this aspect above or equal to 5 on a 1–7 scale, particularly among first-time visitors. In contrast, repeat visitors were more likely to report having had an immersive experience of local culture. Additionally, educational experiences have declined in importance across most age groups, with escapism and entertainment emerging as more prominent motivations (Smith, Pinke-Sziva, Berezvai and [Buczowska-Gołabek](#), 2021). It has also been suggested that urban green spaces like city parks can enhance residents' wellbeing while forming the foundation for sustainable tourism development (Smith, Pinke-Sziva and Puczkó, 2023). Since 2015, Budapest's City Park (Liget) has been part of a major development plan that aimed to regenerate the green spaces and provide new leisure and cultural opportunities for residents and tourists alike.

Overall, solutions need to be found for the overtourism concentration in central districts of the city, as well as diversifying away from 'party tourism'. It is proposed that smart initiatives could be used to re-direct tourists towards cultural and special interest tourism. For example, Pérez Garrido et al. (2022) suggest that a centralized system could be used to calculate optimal numbers of visitors, capture data on types of tourists and length of stay, working out capacity in car parks, cultural and entertainment venues, monitoring the places visited and managing visitor flows. Data-driven management could also be used to manage traffic, transport and the housing sector.

## 4.4. Research Methods

According to the detailed literature review (2020-2023) of smart cities and QoL, the most common research methods are quantitative, including questionnaires with local residents. This research extends a previous Budapest-focused smart city study (Fekete, 2023), which revealed several critical challenges identified by the majority of respondents, including insufficient green spaces, lack of affordable housing, infrastructure maintenance issues, alongside concerns about public cleanliness and safety. The research design in this study was partly informed by the Smart City Vision of Budapest (Municipality of Budapest 2017), which incorporates several key areas: economic development (emphasizing creativity, knowledge, and innovation); environmental and mobility considerations (focusing on sustainable transport and energy); leisure activities (including green spaces, heritage, and tourism); and social regeneration (addressing equal opportunities, community engagement, inclusion of marginalized groups, and maintaining

diverse residential communities). Our research focuses predominantly on leisure activities. Notably, the Vision prioritizes technology and sustainability as means to enhance liveability and quality of life.

Table 1 shows the domains, indicators and statements that were used in the questionnaire, as well as the questions about the smart tools that residents think are most important in a smart city. It was noted that 83% of citizens in Hungary engage in digital activities (Census, 2022). One question was inspired by, but adapted from Chen and Chan (2023):

- The development of Budapest as a smart city is important to me
- I would like to use more smart services in Budapest

Some questions were also asked about the environment, as this forms the basis of the infrastructure for both everyday life and tourism, as well as perceptions of safety, which can affect both residents and tourists. The subsequent findings focus on a selection of these domains, indicators and statements.

**Table 6. Smart Living Domains, Indicators and Statements used in the Questionnaire**

| <b>Domains</b>                                                                   | <b>Indicators</b>                                                                                                                                                                                                                 | <b>Statements<br/>(1-5 Likert scale)</b>                                                                                                                                                                                                                                                                                                                                                                                        | <b>Smart tools</b> ( <i>respondents were asked how far they agreed that a smart city should have the following smart tools</i> )                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Environment</b><br>(Oh 2020; Ji et al. 2021; Shami et al. 2022)               | <ul style="list-style-type: none"> <li>• Air quality</li> <li>• Green spaces</li> <li>• Cleanliness</li> <li>• Peace and quiet</li> <li>• Sustainability</li> </ul>                                                               | <ul style="list-style-type: none"> <li>• The air quality is good</li> <li>• There are enough attractive green spaces</li> <li>• It is a clean city</li> <li>• It is not too noisy in the area where I live</li> <li>• It seems to be a sustainable city</li> </ul>                                                                                                                                                              | N/A                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Transport</b><br>(Bielinska-Dusza et al. 2021; Pira 2021; Chen and Chan 2023; | <ul style="list-style-type: none"> <li>• Affordability</li> <li>• Reliability</li> <li>• Efficiency</li> <li>• Traffic management</li> <li>• Parking</li> <li>• Smart systems</li> <li>• Recharging</li> <li>• Cycling</li> </ul> | <ul style="list-style-type: none"> <li>• It is easy to find my way around by public transport</li> <li>• The public transport system is efficient and reliable</li> <li>• The public transport system is affordable</li> <li>• I mainly use an app or electronic tickets for public transport</li> <li>• Traffic is well managed overall</li> <li>• There are enough parking spaces</li> <li>• Parking is affordable</li> </ul> | <ul style="list-style-type: none"> <li>• A transport system with e-ticket options (e.g. via apps or online booking)</li> <li>• Electronic information boards to show when the next bus/train is coming</li> <li>• Electronic parking options</li> <li>• Electricity charging stations for cars</li> <li>• Car-pooling or sharing apps</li> <li>• Bike-sharing schemes</li> </ul> |

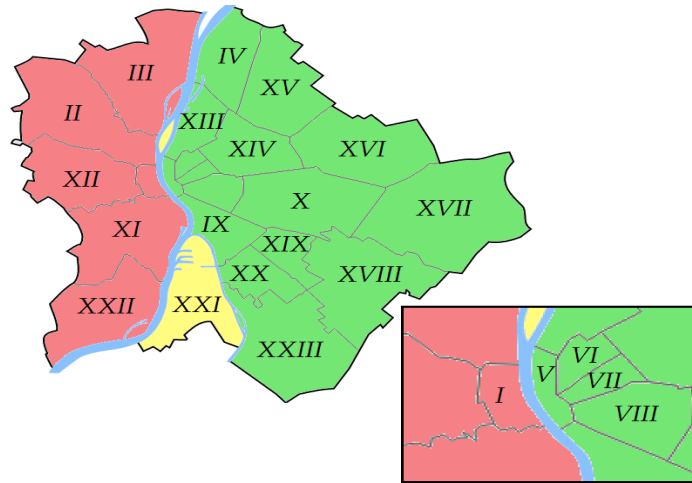
|                                                                                                                                                                                                           |                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                           |                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>• Electronic parking systems work well in the city</li> <li>• It is easy to find a recharging station for an electric car</li> <li>• There are enough bike lanes</li> </ul>                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                            |
| <b>Safety</b><br>(Oh 2020; Ortega & Malcolm 2020; Ozkaya & Erdin 2020; Bielinska-Dusza et al. 2021; Cantuarias-Villessuzanne et al. 2021; Pira 2021; Shami et al. 2022)                                   | <ul style="list-style-type: none"> <li>• Perceived security</li> </ul>                                                                                                                                                          | <ul style="list-style-type: none"> <li>• Budapest feels safe, including at night</li> </ul>                                                                                                                                                                                                                                                                                                       | <ul style="list-style-type: none"> <li>• Smart lighting systems</li> <li>• Cameras linked to security services in public spaces</li> </ul>                                                                                                                                                                                                                 |
| <b>Social</b><br>(Ortega & Malcolm 2020; Ozkaya & Erdin 2020; Bielinska-Dusza et al. 2021; Csukás & Szabó 2021; Ji et al. 2021; Chen and Chan 2023; Shami et al. 2022;)                                   | <ul style="list-style-type: none"> <li>• Friendliness of the city</li> <li>• Sense of community</li> <li>• Image</li> <li>• Atmosphere</li> <li>• Religious tolerance</li> <li>• Information</li> <li>• Consultation</li> </ul> | <ul style="list-style-type: none"> <li>• The people seem open and friendly</li> <li>• I feel a sense of community</li> <li>• I have a positive image of the city in my mind</li> <li>• The city has a good atmosphere</li> <li>• I can easily find information about new developments</li> <li>• Residents are consulted about important issues that affect their lives</li> </ul>                | <ul style="list-style-type: none"> <li>• WiFi available everywhere in the city</li> <li>• Online complaint platforms where people can say what they find good or bad about the city to the Mayor or government</li> </ul>                                                                                                                                  |
| <b>Leisure, culture and tourism</b><br>(Bielinska-Dusza et al. 2021; Cantuarias-Villessuzanne et al. 2021; Csukás & Szabó 2021; Ji et al. 2021; Oh 2020; Ortega & Malcolm 2020; Ozkaya & Erdin 2020; Pira | <ul style="list-style-type: none"> <li>• Sports</li> <li>• Cultural facilities</li> <li>• Tourist attractions</li> <li>• Attitudes to tourism</li> </ul>                                                                        | <ul style="list-style-type: none"> <li>• The city has a good range of sports and fitness facilities</li> <li>• The city has a good range of cultural facilities (e.g. museums galleries, heritage sites)</li> <li>• The city has many interesting tourist attractions</li> <li>• Tourism brings positive benefits to the city</li> <li>• Tourism has some negative impacts on the city</li> </ul> | <ul style="list-style-type: none"> <li>• Touchscreen kiosks in public areas providing information about local services, events and points of interest</li> <li>• Electronic ticket options for theatres, museums and other cultural facilities</li> <li>• Digital experiences in cultural facilities like museums, heritage sites and galleries</li> </ul> |

|                          |  |                                                                                     |  |
|--------------------------|--|-------------------------------------------------------------------------------------|--|
| 2021; Shami et al. 2022) |  | <ul style="list-style-type: none"> <li>• Tourism does not affect my life</li> </ul> |  |
|--------------------------|--|-------------------------------------------------------------------------------------|--|

**Source:** Table by authors

The questionnaire was developed in English, Hungarian, and Mandarin Chinese to accommodate Budapest's diverse population, including its largest ethnic minority (Chinese) and foreign residents. A pilot study with thirty respondents (ten from each language group) was conducted to ensure relevance and clarity. Previous researchers realized that it was challenging to capture reliable data using online methods only, so they also collected data in public places (e.g. Ji et al., 2021). This questionnaire was posted on as many Budapest district forums as possible (where access was allowed), as well as being snowballed on social media platforms. After more than half of the desired number of completed responses were collected online, the researchers viewed the responses and attempted to redress the imbalances in the sample using a face-to-face paper-based version of the questionnaire. The remaining questionnaires were distributed in public places in different districts of the city with the help of a professional survey-distributing company. They were requested to target more male respondents, especially younger men and more elderly residents (65+) in some of the outlying districts of the city. The European Football Championships were taking place in the city at that time, which represented an opportunity to question more men in outside spaces before and after matches. The researchers attempted as far as possible to employ representative quota sampling in line with the most recent Census data (HCSO, 2022) for demographic characteristics. It should be noted that the sample is quite well balanced in terms of gender, but older people (65+) are under-represented. Every district is represented (23 districts), but not evenly (ranging from 1% in District XXIII to 9% in District VIII). Overall, the central districts are represented better than the suburban or outlying ones. The sample is also relatively over-educated compared to the national average. Figure 1 shows the location of the districts of Budapest.

**Figure 1.** Map of the Districts in Budapest (highlighting central districts)



**Source:** Heizler, 2015, [https://commons.wikimedia.org/wiki/File:Budapest\\_colors\\_numbers2.png](https://commons.wikimedia.org/wiki/File:Budapest_colors_numbers2.png)

The data collection resulted in a final sample size of 453 from Budapest's population of approximately 1,685,342 (Census, 2022). Table 2 shows the most important characteristics of the sample.

**Table 2.** Profile of the Questionnaire Sample

| <b>Gender</b>                                   | <b>(%)</b> |
|-------------------------------------------------|------------|
| Female                                          | 54%        |
| Male                                            | 45%        |
| Other or prefer not to say                      | 1%         |
| <b>Age</b>                                      | <b>(%)</b> |
| 18-24                                           | 22%        |
| 25-49                                           | 48%        |
| 50-64                                           | 21%        |
| 65-79                                           | 9%         |
| <b>Education</b>                                | <b>(%)</b> |
| Primary school (basic general level) or less    | 9%         |
| Secondary school (High school)                  | 40%        |
| University level (Bachelor level)               | 23%        |
| University level (Master level or PhD)          | 28%        |
| <b>Profession</b>                               | <b>%</b>   |
| Employed                                        | 72%        |
| Student                                         | 14%        |
| Unemployed                                      | 2%         |
| Retired/pensioner                               | 8%         |
| Other (e.g. on maternity leave, unable to work) | 4%         |

| Nationality | (%) |
|-------------|-----|
| Hungarian   | 85% |
| Foreign     | 15% |

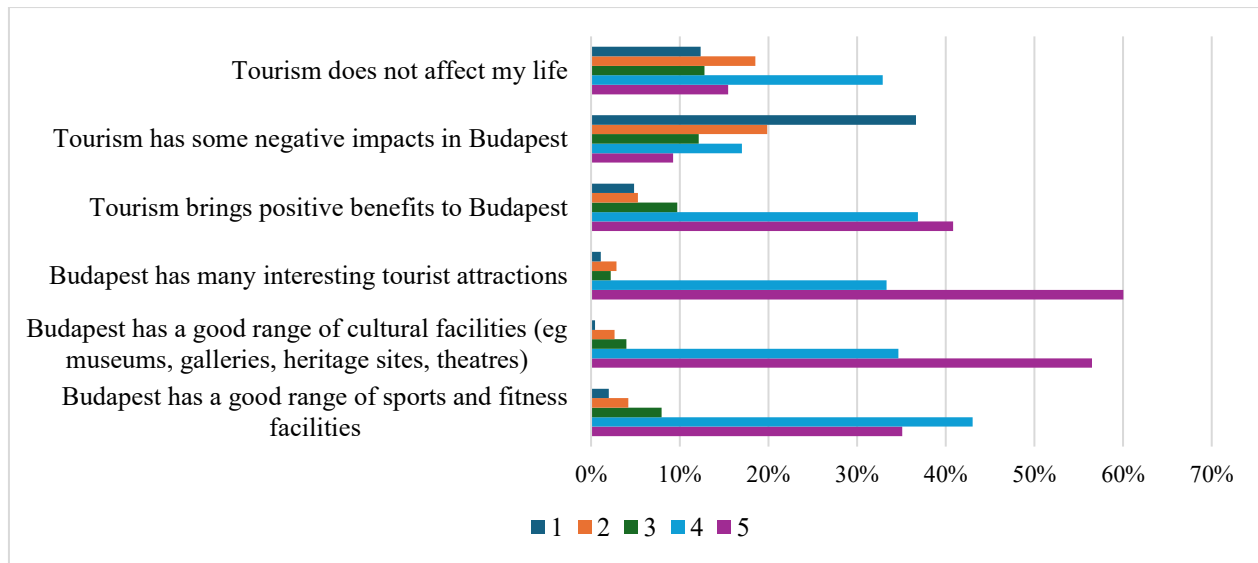
Source: Table by authors

## 4.5. Findings

The data shows that more than 75% of respondents have a positive image of Budapest (ranked 4 or 5) with no significant age variations. 65% of respondents agreed that the city has a good atmosphere and 66% find the city relatively safe (ranked 4 or 5), including the oldest residents (aged 65+), however, females felt less safe than males (3.51 versus 3.91). On the other hand, the findings about whether Budapest seemed open and friendly were rather mixed with equal numbers (around 13%) ranking this statement 5 or 1 and only a third of respondents ranking it 4. There were no strong age variations, but male respondents found it friendlier than females (3.3 versus 2.98). Statements about public transport were ranked quite highly with the majority of respondents finding the system efficient and reliable (74% ranked this statement 4 or 5) and affordable (79% ranked this statement 4 or 5). More than half use electronic tickets. On the other hand, they are not so happy with the parking situation (provision, cost, electronic system) and overall traffic management (two thirds ranked these statements 3 or below). Less than half consider Budapest to be a clean city. Older residents (50+) and males were less positive about the number of attractive green spaces, and both older residents and females were less satisfied about cleanliness.

Respondents are very positive about cultural and tourist attractions, as well as sports provision (see Figure 2). Older residents were more positive about cultural and tourist attractions, especially those aged 65+. More than 60% ranked the statement about enough attractive green spaces (e.g. parks and gardens) with a 4 or 5. Respondents seem to be mainly positive about the impacts of tourism (see Figure 2), but as further analysis shows later in the article, this depends on the district that people are living in. More than 60% do not find the area they are living in too noisy, but this might also depend on location.

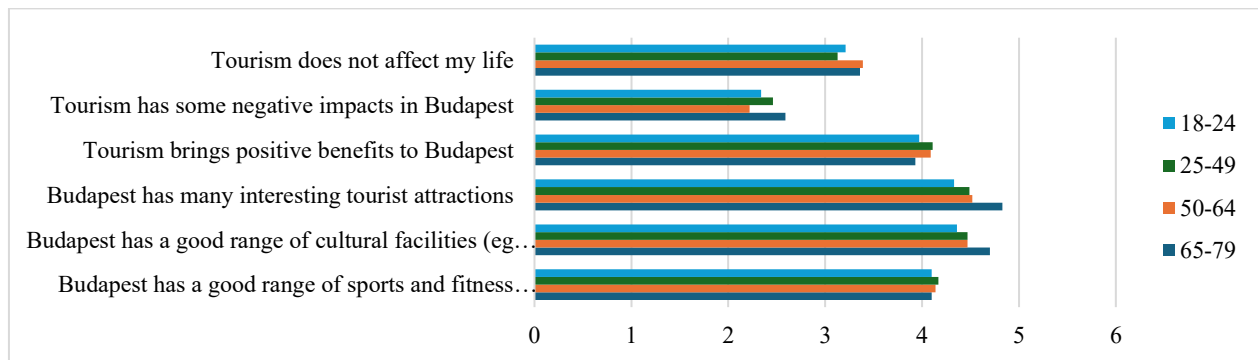
**Figure 2.** Responses relating to leisure, culture and tourism



**Source:** Figure by authors

Figure 3 shows some of the differences expressed by respondents from different age groups. On average, all groups are positive about cultural and sports facilities, as well as tourist attractions. Reactions to tourism are varied, but they are more neutral or positive than negative.

**Figure 3.** Variations according to age relating to leisure, culture and tourism



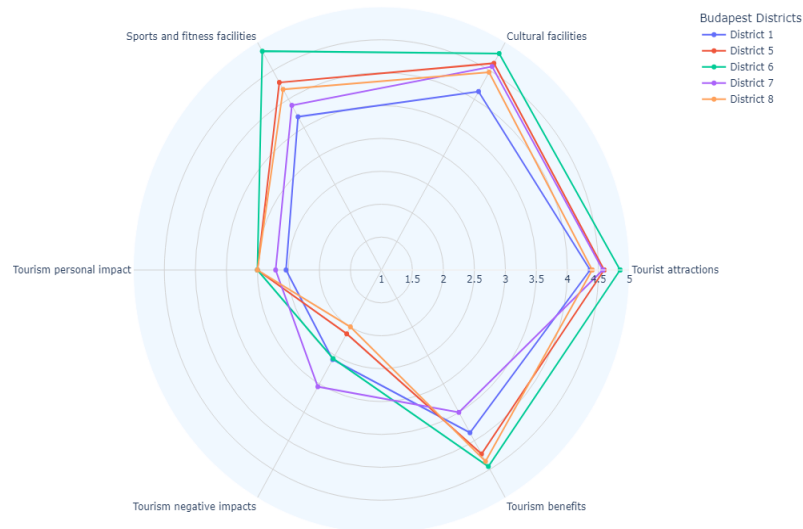
**Source:** Figure by authors

There are not many significant variations according to gender, but similarly to older residents aged 65+, women feel more positive about the facilities and attractions, but slightly more negative about the impacts of tourism.

Some of the findings confirm the research of Pérez Garrido et al. (2022) that the impacts of overtourism are mainly concentrated in the centre of Budapest. In the more heavily touristed districts (I, V, VI, VII), residents gave higher scores for tourist attractions and cultural facilities, (above 4.5). but they also expressed stronger concerns about tourism's negative impacts. This is especially true of District VII (mean=3.2), reflecting the challenges of overtourism in Budapest's 'party quarter'. Residents in middle-ring districts (e.g. VIII, IX, XIII) demonstrated more

moderate attitudes across all dimensions. Their evaluation of sports and fitness facilities was notably higher than inner districts, possibly due to more available space for recreational infrastructure. Residents in outer districts responded that tourism did not affect their life much. However, they consistently rated sports facilities and cultural facilities favourably. Figure 4 illustrates the variations in the responses in the central districts showing clearly that the negative impacts of tourism are felt most in District VII, the heart of the ‘party quarter’ (please note that ‘tourism personal impact’ refers to how far tourism affects their life).

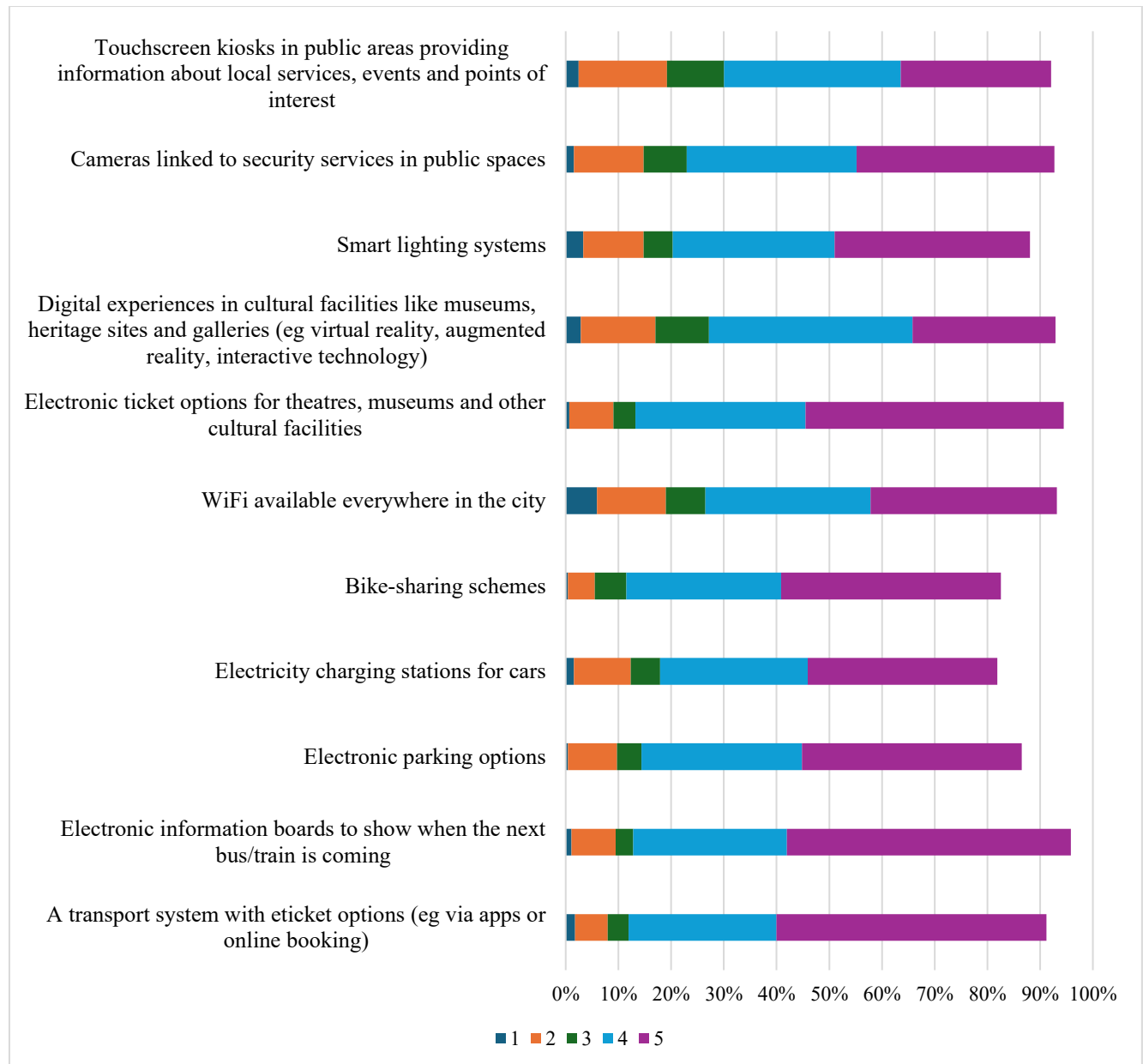
**Figure 4.** Perceptions of tourism and facilities by district



**Source:** Figure by authors

The questionnaire respondents were asked to consider a list of smart tools or systems that could exist in a smart city and to rank their importance. Figure 5 shows the results of this question that relate to transport, security, leisure, culture and information provision. It was thought that these systems could also be important for tourists.

**Figure 5.** Do you agree that a smart city should have the following?

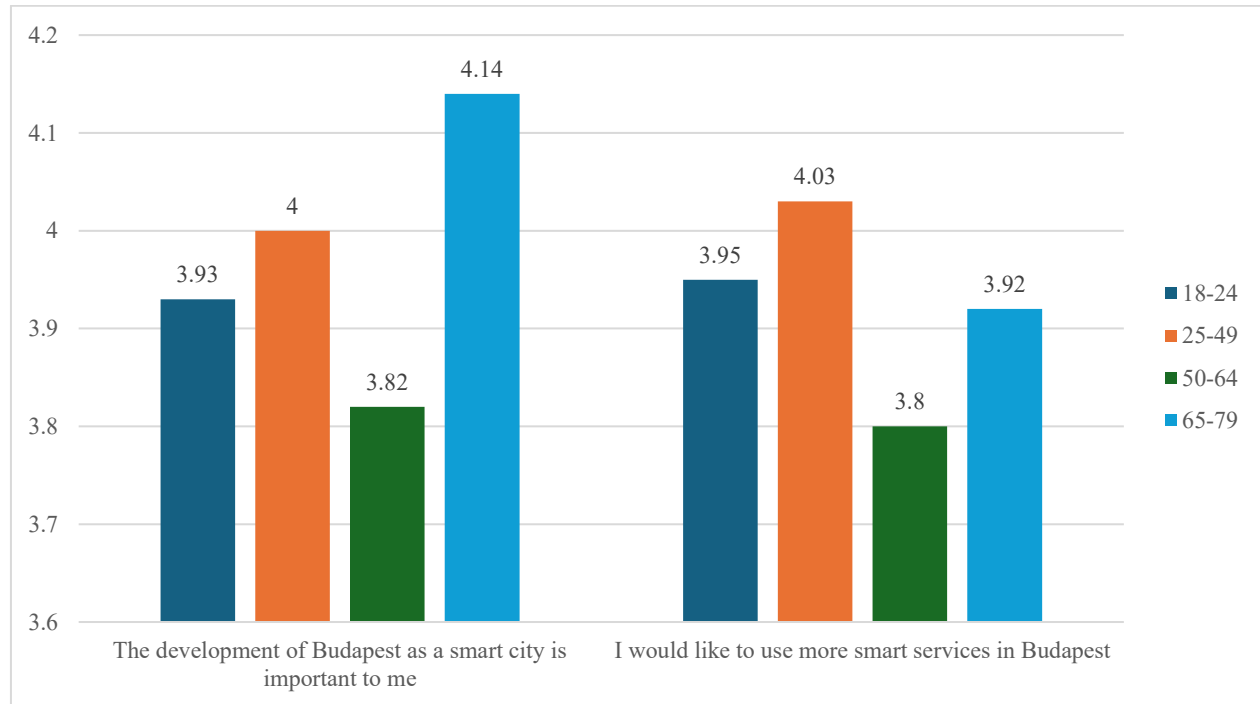


**Source:** Figure by authors

Respondents were positive about using most of the smart tools listed, particularly tools relating to transport, parking and ticketing, including for cultural attractions. Interestingly, they seem to be slightly less interested in digital experiences in cultural facilities. Surprisingly, the oldest residents in the sample (65+) were the most positive about smart city tools. It should be noted that these residents were in a minority (only 9% of the total sample) and maybe this topic represented more of a novelty for them than for younger respondents (e.g. 18-24 year olds). It is also interesting to note that women ranked every statement higher than men, and employed residents (representing 72% of the sample) also ranked the smart tools higher.

Respondents were subsequently asked about their attitudes to Budapest becoming a smart city and the responses were very positive with more than 73% of respondents ranking these statements 4 or 5. Whereas the results did not differ much for gender, they were significantly different according to age. It seems slightly contradictory that older residents (65+) would like the city to become smarter but they do not necessarily want to use more smart services! These responses show a typical gap between perceptions and behaviour, and confirm that older residents are likely to be more inhibited in terms of technology readiness (a result also noted in the case of smart tourism in Budapest by Coronel Padilla & Smith, 2023).

**Figure 6.** Attitudes to Budapest as a Smart City by Age



**Source:** Figure by authors

However, city challenges like overtourism in Budapest might need to be addressed by smart systems that are largely invisible to residents and tourists. As stated earlier (e.g. Pérez Garrido et al., 2022), these might relate to managing visitor flows, calculating capacity, traffic management, or identifying types of tourists, length of stay or spending. Budapest could start to implement more smart solutions, for example, digital tourism management platforms that incorporate real-time monitoring of tourist flows through IoT sensors strategically placed throughout the city, with particular emphasis on high-pressure areas in Districts VI and VII. The platform could feature sophisticated noise level monitoring capabilities and a user-friendly mobile application enabling residents to provide immediate feedback on tourism impacts in their neighbourhoods. Smart zoning solutions could help to divert tourists away from busy attractions and entertainment venues to avoid overcrowding, highlighting alternative areas and activities. Centralized digital booking systems can also help to manage capacity and flow in cultural and other attractions, while comprehensive mobile applications can help to enhance experiences for residents and tourists alike.

## 4.6. Conclusion

The questionnaire data in this research focused on residents rather than tourists, unlike some previous studies on overtourism (e.g. Remenyik et al., 2021). It also integrates a social perspective into the field of smart cities research, which has been largely dominated by economic and technological studies. It aimed to address a gap in smart city and quality of life research, as well as the Budapest-specific research by Fekete (2023) by capturing data on social as well as leisure, culture and tourism issues. It took into consideration the impacts of overtourism, as well as the possible solutions offered by smart city tools.

The findings reveal that proximity to the city centre correlates with both higher appreciation of tourism-related amenities but also greater concern about tourism's negative impacts. This spatial differentiation has important implications for urban planning and tourism management, suggesting the need for district-tailored approaches to tourism development and facility provision that consider local contexts and resident needs. The decentralized district management system in Budapest offers opportunities, but also presents challenges for coordinated tourism planning. For example, it may hinder the development of city-wide strategies or those that cross district boundaries.

The research showed that smart city developments in Budapest are viewed positively by local residents and that smart tools and systems could be used to address some of the challenges of overtourism. However, it is important to note that there is always a gap between stated interest and actual behaviour (demonstrated by older residents, for example). Both this and previous research (e.g. Pérez Garrido et al., 2022) suggest that overtourism is mainly concentrated in central districts of the city, therefore solutions are needed that divert tourists away from these central areas geographically and help to diversify forms of tourism away from 'party tourism' towards cultural or other forms of special interest tourism. In addition to enjoying ruin pubs, research has shown that tourists are significantly motivated by culture and gastronomy, as well as thermal baths and spas (Pinke-Sziva et al., 2019). Previous studies have also indicated that tourists would be willing to travel outside the centre of Budapest for cultural and gastronomic experiences, including festivals and outdoor experiences (Smith, Pinke-Sziva & Berezvai, 2023). The transport system in Budapest is viewed as efficient, reliable and affordable by residents with many networks extending to the suburbs and neighbouring towns. Smart transportation systems would be instrumental in facilitating experience creation for tourists outside the centre of the city.

## 4.7. Limitations

The research only focused on the perceptions and experiences of residents. In order to address smart tourism developments more fully, it would be necessary to collect data on tourist opinions of the same issues too. Although one study already researched technology use and attitudes of different generations of tourists in Budapest (Coronel Padilla & Smith, 2023), the focus was on individual use of smart tools rather than wider use of smart systems for planning and management. It would be important to approach this topic from the perspective of stakeholders involved in urban planning and management, as well as technology companies and designers. The sample size was relatively representative compared to the Census (2022), but older residents were under-represented and residents from different districts were not represented proportionally. A notable methodological limitation lies in the study's reliance on self-reported perceptions

through structured questionnaires. While this approach provides valuable insights into resident experiences, it may not fully capture the complex interplay between tourism impacts and quality of life indicators. The use of primarily Likert-scale measurements, while effective for quantitative analysis, may oversimplify residents' nuanced experiences and fail to account for contextual factors that influence their perceptions of tourism impacts. For this, focus groups could provide a more informative method. More longitudinal research would be needed to monitor residents' quality of life over time as smart systems are developed and implemented. This could be combined with research on tourists' experiences of the city and smart technology, as well as their interactions with local residents.

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## 5. TOURISM AND QUALITY OF LIFE IN SMART CITIES: A RESEARCH STUDY OF BUDAPEST<sup>1</sup> (ARTICLE A4)

**Reference:** Smith, M. K., Chang, S. and Michalkó, G. (2025). Tourism and Quality of Life in Smart Cities, *Turizmus Bulletin*, (accepted)

### **A turizmus és életminőség kapcsolata az okos városokban: egy budapesti vizsgálat eredményei**

Authors: Melanie Kay Smith<sup>2</sup> – Songling Chang<sup>3</sup> – Gábor Michalkó<sup>4</sup>

This study examines tourism's impact on quality of life (QoL) in smart cities, focusing on Budapest. While smart city QoL research often prioritizes transport, safety, and sustainability, tourism remains underexplored. This resident-focused study addresses that gap by analyzing how tourism affects perceptions of QoL, particularly regarding leisure, culture, and smart service use. Based on a representative questionnaire from all city districts, the study compares subjective attitudes within a broader QoL framework. Findings show that residents appreciate Budapest's cultural and leisure offerings, though concerns persist over housing, healthcare, and education. Tourism is mostly viewed positively, especially for cultural assets and infrastructure, but negative views are noted in over-touristed areas like the "party quarter." Smart services related to transport and e-ticketing are well received, though use is mainly utilitarian. While many support smart development, a gap may exist between intention and actual use. The study calls for urban strategies balancing tourism and resident wellbeing, highlighting the potential of smart tools to manage tourist flows and improve urban liveability.

A tanulmány a turizmus életminőségre gyakorolt hatását vizsgálja az okos városokban, kitüntetetten Budapesten. Míg az okos városok életminőség-orientált kutatásai leggyakrabban a közlekedést, a biztonságot és a fenntarthatóságot helyezik előtérbe, a turizmusra sokkal kevesebb hangsúlyt helyeznek. A helyi lakosságra fókuszáló tanulmány ezt a hiányosságot igyekszik pótolni azzal, hogy feltárja hogyan befolyásolja a turizmus a budapestiek életminőségéről alkotott képét, különösen a szabadidő, a kultúra és az intelligens szolgáltatások használata tekintetében. A lakóhelyre (Budapest kerületeire) reprezentatív kérdőívezés alapján a tanulmány a szubjektív attitűdöket egy tágabb életminőség modellben hasonlítja össze. Az eredmények azt mutatják, hogy a lakosság nagyra értékeli Budapest kulturális és szabadidős kínálatát, ugyanakkor a lakhatással, az egészségügyi ellátással és az oktatással kapcsolatban aggodalmát fejezi ki. A turizmus

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<sup>2</sup> associate professor, Budapest University of Economics and Business, [smith.melanie@uni-bge.hu](mailto:smith.melanie@uni-bge.hu)

<sup>3</sup> PhD-student, Corvinus University of Budapest, [songling.chang@stud.uni-corvinus.hu](mailto:songling.chang@stud.uni-corvinus.hu)

<sup>4</sup> scientific advisor, HUN-REN CSFK Geographical Institute; professor, University of Pannonia, [michalko.gabor@csfk.org](mailto:michalko.gabor@csfk.org)

megítélése többnyire pozitív, különösen a kulturális kínálat és az infrastruktúra tekintetében, de negatív véleményekkel találkozunk a nemkívánatos mértékű turizmus által sújtott városrészekben, például a bulinegyedben. A tömegközlekedéssel és az elektronikus jegyértékesítéssel kapcsolatos intelligens szolgáltatások kedvező fogadtatásban részesültek, használatukkal sok idő és energia megspórolható. Sokan támogatják az intelligens fejlesztéseket, a szándék és a tényleges használat közti rés feltétlenül szűkítendő. A tanulmány olyan városi stratégiákat sürget, amelyek egyensúlyt teremtenek a turizmus és a lakosság jólléte között, kiemelve az intelligens eszközökben rejlő lehetőségeket a turistaáramlások irányítására és a városi élhetőség javítására.

**Keywords:** smart city, quality of life, resident perceptions, urban tourism, Budapest

**Kulcsszavak:** okos város, életminőség, helyi lakosság észlelése, városi Turizmus Budapest

## 5.1. Introduction

There have been numerous studies that examined the domains and indicators that form part of quality of life (QoL) in smart cities, yet relatively few include tourism. The role of tourism in QoL has become an increasingly important topic given the exponential growth of tourism in the pre-COVID era, especially in cultural cities. Despite a relatively short period of ‘under-tourism’, many urban destinations are slowly returning to pre-COVID numbers of tourists, but with the added complication of housing crises and rampant inflation. This has had an unprecedented negative impact on the lives of many local residents leading to widespread protests, especially in Spain. It was hoped that smart solutions and tools might be able to solve some of the problems of overtourism in terms of diversification of products or the diversion of tourist flows. They are also playing an increasingly important role in the everyday lives of citizens and in the services that are used by residents and tourists alike (e.g. transport, leisure, culture). In our study, we argue that tourism is closely connected to leisure and culture, and tourists make use of several infrastructural elements that are important also for residents (e.g. transport systems). The primary data collection undertaken in the Hungarian capital city of Budapest focuses on residents and their perceptions of and attitudes to QoL domains, which includes tourism.

We aim to answer the following questions:

- Where does tourism feature in the definitions that are used to describe QoL in smart cities?
- Where does tourism fit in the domains and indicators that are used to measure QoL in smart cities?
- Which other domains of QoL in smart cities are inter-connected to tourism?
- What are the attitudes of local residents towards QoL and tourism in an emerging smart city (Budapest)?
- What is the level of technology acceptance and readiness of residents in a smart city QoL study (Budapest)?

## 5.2. Quality of Life in Cities

Numerous studies have explored quality of life (QoL) in cities, using terms like wellbeing, life satisfaction, or liveability. Common indices include the Economist Intelligence Unit's Global Livability Index, Mercer Quality of Living City Ranking, Monocle's Most Livable Cities Index, Numbeo QoL Index, Oxford Economics' Global Cities Index, and the Global Liveable and Smart Cities Index. This study adopts the term 'quality of life' as it is most widely used in smart cities literature (CHANG & SMITH, 2023), although many indicators used also reflect residents' perceptions of wellbeing, satisfaction, and liveability. Urban liveability is defined as a city's capacity to create conditions that enable residents to thrive and enjoy a high QoL (DEL MAR MARTINEZ-BRAVO et al., 2019). Liveable cities are typically evaluated across domains such as healthcare, education, housing, public transport, safety, sustainability, cultural opportunities, and community support (TENNAKOON & KULATUNGA, 2019). They also promote business, work, and leisure, while prioritising social as well as economic and environmental aspects (LLOYD, FULLAGAR & REID, 2016; AHMED, HALAFAWY & AMIN, 2019). Despite methodological differences, these systems share a focus on the availability and quality of basic amenities (SHEIKH & VAN AMEIJDE, 2022). According to SHEIKH & VAN AMEIJDE (2022), liveability concerns services and amenities, while QoL considers how these shape human experience. ZHU et al. (2022) distinguish between 'livability of environment'—referring to natural, built, and social conditions—and 'life-ability of person,' meaning the potential for self-development and enjoyment, including leisure and culture.

QoL metrics and rankings have faced criticism. Some argue that they rely on objective indicators for benchmarking, while overlooking residents' everyday experiences (LLOYD, FULLAGAR & REID, 2016). Variability in rankings can also stem from differing methodologies or weighting systems (SHEIKH & VAN AMEIJDE, 2022). Balancing objective and subjective aspects—such as service provision versus user satisfaction—remains challenging, as does comparing distinct domains like healthcare and social interaction (AHMED, HALAFAWY & AMIN, 2019). This study focuses specifically on subjective resident perceptions, addressing a gap in earlier smart city QoL research (CHANG & SMITH, 2023; CSUKÁS & SZABÓ, 2022).

### 5.2.1 Tourism, Cities and Quality of Life

ZHANG AND REN (2024) suggest that subjective assessments of liveability are typically shaped by perceived satisfaction and overall happiness with living conditions. Several studies discuss liveability in tourism contexts, highlighting tourism's potential to enhance it through infrastructure, economic growth, and environmental preservation (CROES et al., 2024). Tourism can positively influence urban atmospheres, as PAIVA (2023) notes, while KANG et al. (2022) emphasize the role of cultural ambience in shaping residents' liveability. However, the concept of liveability—rooted in social interaction (AHMED, HALAFAWY & AMIN, 2019)—can be strained in tourism hubs due to overcrowding, social exclusion, and inequality. Thus, researchers are re-examining host-guest dynamics, particularly in the context of overtourism. While tourism can enrich city

atmospheres, PAIVA (2023) cautions that it may also negatively affect liveability and cause tensions between tourists and locals.

In Sopot, Poland, for instance, residents acknowledged tourism's economic benefits (e.g., jobs, income), but viewed its cultural, social, and environmental impacts less favorably (CROES et al., 2024). TANG et al. (2022) found that tourism's positive effect on liveability diminishes as its intensity rises, potentially becoming negative once thresholds of specialization or visitor density are exceeded. KANG et al. (2022) similarly argue that popular tourist cities are not always highly liveable: "a good tourist city is not necessarily a very liveable one" (p.11). ZHANG AND REN (2024) add that rising living costs—especially housing—along with deteriorating infrastructure and parking shortages, further reduce urban quality for locals: "Locals see their cities transforming in ways that cater more to tourists than to the long-term sustainability of the community" (p.2).

UYSAL et al. (2025) reviewed two decades of QoL and tourism research, highlighting growing interest in resident wellbeing. This study contributes by examining resident attitudes toward tourism—how people perceive and respond to tourism growth. Although broader QoL dimensions are included, they are not always directly tourism-related. Importantly, many residents in large cities have limited contact with tourists—except those living near major attractions. Our study captures these spatial disparities.

## 5.2.2 Smart Cities and Quality of Life

Smart cities are expected to be responsive to communities and enhance quality of life (QoL) (DEL-REAL et al., 2023; WANG & ZHOU, 2023). GIFFINGER et al. (2010) identified six core dimensions: smart economy, mobility, environment, people, governance, and smart living. These have become widely accepted in smart city research. Smart living is often considered synonymous with QoL or its most critical domain, with QoL as its primary objective (SHAMI et al., 2022; OZKAYA & ERDIN, 2020; SMITH et al., 2024). A recent review listed housing, healthcare, safety, leisure, culture, and tourism as key elements of smart living (CHANG & SMITH, 2023). While our study covers these elements, we focus here on findings related specifically to tourism.

Tourism is included in the 'soft domain' of smart cities alongside education, culture, innovation, and social inclusion (JI et al., 2021), seen as vital to fulfilling citizens' higher needs. ORTEGA-FERNANDEZ et al. (2020) include tourism with other domains like housing and cultural facilities, proposing that smart city platforms should integrate services across governance, mobility, environment, wellbeing, and tourism—such as Valencia's example. Similarly, CANTUARIAS-VILLESSUZANNE et al. (2021) frame tourism as part of smart living, arguing for "co-creation of value between tourists and residents" (p.7).

Both ORTEGA & MALCOLM (2020) and CSAPO & VÉGI (2023) focus on smart tourism destinations (STDs), which aim to enhance sustainability, improve visitor conditions, and ensure equitable benefit distribution among locals. They suggest integrating information and communication technology (ICT) into tourism infrastructure to support resource allocation, information access, and improved experiences. While studies often assess tourists' tech readiness—such as in Budapest (CORONEL PADILLA & SMITH, 2023)—similar attention should be paid to residents who also rely on e-ticketing and booking systems in daily life.

JI et al. (2021) place tourism-related questions in the smart living domain, e.g., online tourism information. Smart living is widely equated with QoL and regarded as the key smart city

domain (OZKAYA & ERDIN, 2020). Although tourist attractions may be considered less vital than safety, they still contribute to QoL. Tourism's role has at times been underrepresented in QoL studies, but recent concerns about overtourism—rising costs, resident displacement, wellbeing impacts—have highlighted its importance. These issues have been documented in Budapest before and after COVID-19 (SMITH et al., 2019; PÉREZ GARRIDO et al., 2022).

### **5.3. Budapest: Quality of Life and Tourism in an Emerging Smart City**

According to the OECD Better Life Index (2019), Hungary performs well in work-life balance and social connections but lags in income, education, health, environmental quality, and life satisfaction. The EUROPEAN COMMISSION (2023) reported relatively low satisfaction in Budapest from 2019–2023, especially in healthcare, housing, air pollution, and interpersonal trust. Nonetheless, the ECONOMIST INTELLIGENCE UNIT (2024) ranked Budapest 32nd globally, praising its stability, healthcare, culture, environment, education, and infrastructure. It was labeled “the most liveable city in Eastern Europe,” scoring 92/100, though still behind Vienna (98.4) and Copenhagen (98).

Despite more than a decade of smart city initiatives, Budapest ranked below the regional average in smart city development (CSÉCSEI, 2020; CSUKÁS & SZABÓ, 2021). Earlier critiques pointed to insufficient understanding of local needs (CSUKÁS & SZABÓ, 2021), and a later study highlighted the lack of citizen perspectives (CSUKÁS & SZABÓ, 2022). The 2017 Smart City Vision of Budapest aimed to create a sustainable, inclusive, and digitally supported city (MUNICIPALITY OF BUDAPEST, 2017). Hungary's 2018 Digital Tourism Strategy promoted digital transformation across public and private sectors (HAPP & IVANCSÓ-HORVÁTH, 2018). Government and municipal efforts focused mainly on e-government, health, mobility, and air quality (CSUKÁS & SZABÓ, 2022). Numerous apps were introduced to assist tourists, especially for transport and wayfinding (BERENDE, 2015), and private smart parking solutions emerged (SMART LYNX, 2021). CORONEL PADILLA & SMITH (2023) found tourists primarily use smart tools for practical purposes like navigation and information.

Smart city research in Budapest still lacks comprehensive data on citizen needs. To address this, the present study centers on resident perceptions of QoL and tourism. Previous research noted problems in affordability, infrastructure, pollution, cleanliness, and safety (FEKETE, 2023), and found that while 83% of citizens used smart tools (CENSUS, 2022), only 40% understood the concept of a smart city. Another study linked wellbeing to gentrification and overtourism (NAMAZ & TVERGYÁK, 2023). Like ours, that research included tourism as a QoL domain alongside leisure and culture, supported by infrastructure such as transport and environment.

Budapest is well known for cultural tourism, but pre-COVID studies found that cheap nightlife increasingly rivaled heritage attractions. This led to overtourism in Districts VI and VII—the so-called “party quarter” (SMITH et al., 2019). The district's ruin bars became hotspots for disruptive tourist behavior and were linked to the highest density of Airbnb units (PÉREZ GARRIDO et al., 2022). Locals, particularly over 50, reported night noise, intoxication, litter, and public urination. Some (18%) considered relocating (SMITH, PINKE-SZIVA & Olt, 2019). In 2019, tourist numbers were estimated at double the optimum level (PÉREZ GARRIDO et al., 2022). More recent trends show a shift toward gastronomy and atmosphere over museums and

monuments, though culture remains a primary motivator (SMITH, PINKE-SZIVA & BEREZVAI, 2023). City Park (Liget), undergoing redevelopment since 2015, aims to boost green space and cultural leisure for both residents and tourists. Its role in urban wellbeing is now being studied (SMITH, PINKE-SZIVA & PUCZKÓ, 2024).

Governance in Budapest is fragmented across 23 districts, the central municipality, and the national government—often causing coordination issues. Regulations vary across districts, for instance regarding closing hours of bars. Smart tools could help manage tourism more evenly, steering visitors away from overcrowded zones. PÉREZ GARRIDO et al. (2022) suggest using centralized systems to collect tourist data and regulate flow, optimize parking and attraction capacity, and even support housing and traffic management.

## 5.4. Research Methods

A questionnaire was designed for local residents in Budapest following the example of other smart city and QoL researchers (e.g. OH, 2020; CHEN & CHAN, 2021; JI et al., 2021; SHAMI et al., 2022). Building on previous smart city and QoL studies, 6 smart city domains (after GIFFINGER et al., 2010), 24 QoL indicators using 37 related statements and 17 smart services were identified that could be used to measure resident QoL in smart cities (see Appendix 1 for more details). FEKETE (2023) noted that only 40% of residents in Budapest were familiar with the concept of a smart city and even fewer could name any smart solutions. For this reason, the researchers firstly listed a number of smart tools that are commonly used in cities and asked respondents which of these were most important for a smart city. This already gave them some ideas about what smart tools or solutions exist, thus making the second and third questions easier to answer. These were adapted from CHEN and CHAN (2023):

- The development of Budapest as a smart city is important to me
- I would like to use more smart services in Budapest

A 5-point Likert scale was used for the statements. The questionnaire was designed in Hungarian, English and Mandarin Chinese to also capture data from Budapest's foreign population (5.8%) and largest minority (1.8% Chinese) (HCSO, 2023).

Expert researchers provided feedback on the questionnaire and a pilot study was undertaken with 30 respondents (as recommended by PERNEGER, et al., 2015) in the three languages. A quota sampling technique was adopted as far as possible based on the most recent Census data (HCSO, 2022) for demographic characteristics.

Data was collected online using distribution via the researchers' personal networks with snowball sampling, and the questionnaire was posted several times on Budapest's district forums and ex-patriate networks in three languages. More than half of the responses were gathered online, after which the researchers observed imbalances in the sample according to the Census (HCSO, 2022), e.g. a relatively lower response from men, older residents and citizens from different districts of the city. An attempt was made to redress the imbalance as far as possible by distributing the questionnaire in public places using paper copies and QR codes (e.g. in the largest City Park). In addition, the European Football Championships were taking place in the city at that time, which represented an opportunity to question more men in outside spaces near big screens before and

after matches. The sample demonstrates a relatively balanced gender distribution; however, individuals aged 65 and above are under-represented. All 23 districts are included in the sample, though representation varies significantly—from 1% in District XXIII to 9% in District VIII. Overall, central districts are more prominently represented than suburban or peripheral areas. Additionally, the sample exhibits a higher level of educational attainment compared to the national average. For this study, we selected the domains, indicators and statements that were most relevant to tourism. In summary: 4 domains of smart cities, 11 QoL indicators with 22 related statements and 12 smart services (see Appendix 1). The data cleaning and analysis was done using Power BI, Excel and Python.

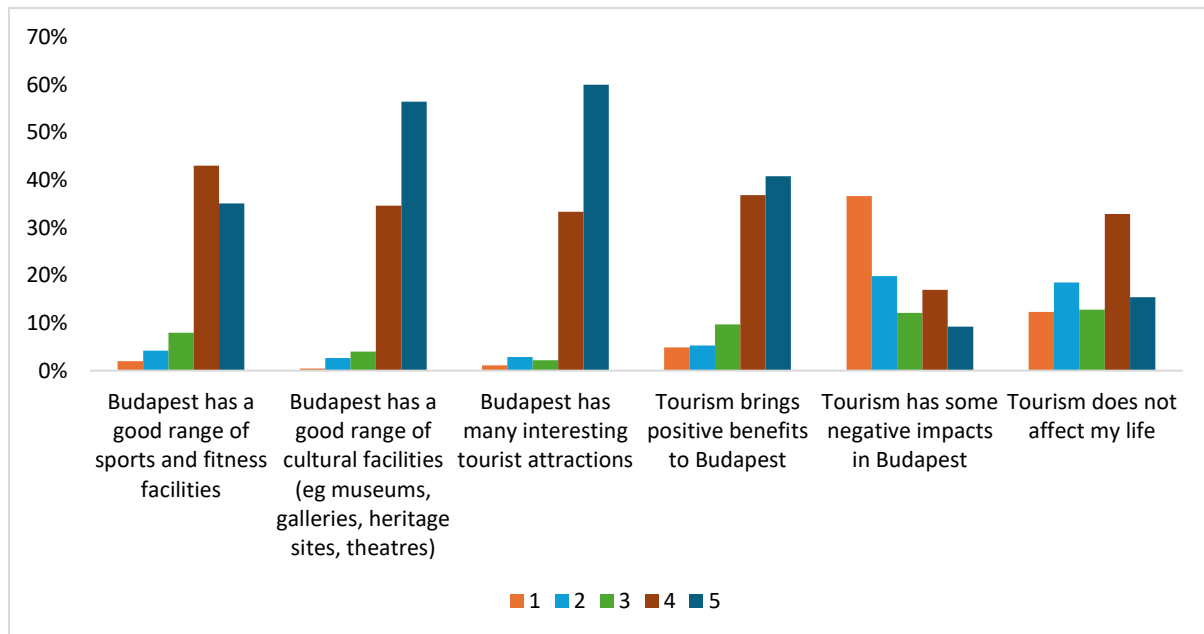
## 5.5. Findings

In terms of overall QoL (24 QoL indicators), respondents are least satisfied with the cost of housing (only 24% rated it 4 or 5), the healthcare system (28% rated it 4 or 5), education (35% rated it 4 or 5), and the salary level compared to the cost of living (40% rated it 4 or 5). Responses to environmental issues (which were ranked quite low in Budapest in OECD 2019 and FEKETE 2023) were somewhat mixed in our findings: 46% find the air quality quite good (rated 4 or 5); 44% find the city quite clean, but older residents and women are less satisfied with cleanliness. 60% are satisfied with the green spaces and 65% are unconcerned about noise. 66% of respondents find the city safe (although it was highlighted as a problem by FEKETE, 2023), but it should be noted that female respondents feel less safe than males (rated 3.3 compared to 3.91). Men also find the city friendlier than women (3.3 compared to 2.98), with 46% of respondents overall finding the city open and friendly. 55% of respondents seem to find the city fairly sustainable and luckily, only 1% of respondents thought that Budapest's status as a sustainable city was "Not relevant to me".

Foreign respondents represented 15% of the sample (around 68 residents). Their responses were broadly similar to those of the Hungarian residents with the exception of the education system (many foreigners pay for private schools because of language barriers). They share the same concerns about housing, but express even higher satisfaction with public transport, the cleanliness of the streets the image of the city. They also show a greater appreciation for the green spaces (it should be noted that many expatriates live closer to the Buda hills).

Respondents are very positive about transport overall, with more than 70% finding it easy to get way around using efficient, reliable and affordable public transport. 41% think there are enough bike lanes. Parking was rated lower with only around 15% finding it adequate and only 21% finding it affordable. In terms of atmosphere, image, culture, leisure provision and tourism, the results are very positive. 75% of respondents have a positive image of Budapest, 65% of respondents agree that the city has a good atmosphere, and 61% feel a sense of community. As the results were slightly mixed regarding the friendliness of the city (as noted above), it is assumed that atmosphere and image perceptions are derived from other factors too (e.g. environment, culture). 91% of respondents agree that Budapest has a good range of cultural facilities such as museums, galleries, heritage sites and theatres and 93% thinks that the city has many interesting tourist attractions. Residents also consider that Budapest has a good range of sports and fitness facilities (78% rated this statement with 4 or 5). Older residents and women are slightly more positive about cultural and tourist attractions. Figure 1 shows the results of these questions, as well as some of the general data about tourism, which is discussed in more depth below.

**Figure 1: Attitudes to Leisure, Culture and Tourism in Budapest**



In terms of tourism, almost half of the respondents do not feel that tourism actually affects their life (shown as ‘Tourism personal impact’ in Figure 2), but deeper analysis revealed that this depended on which area of the city they are living in. 78% consider that tourism brings positive benefits compared to only 26% who consider the impacts of tourism to be negative (rated 4 or 5). The gender differences are minimal, with women feeling slightly more negative about the impacts of tourism. However, residents living in districts that are located in the so-called ‘party quarter’ discussed earlier (e.g. VI and VII) and in the heavily visited districts of V (where the Parliament building is located), I (the Castle area), and the increasingly popular District VIII (e.g. where the Hungarian National Museum is located) often rated the impacts as tourism as more negative. This is especially true of District VII (see Figures 2 and 3). On the other hand, these areas showed the highest ratings for cultural facilities and attractions (above 4.5).

**Figure 2: Opinions about leisure, culture and tourism in the most heavily touristed districts of Budapest**

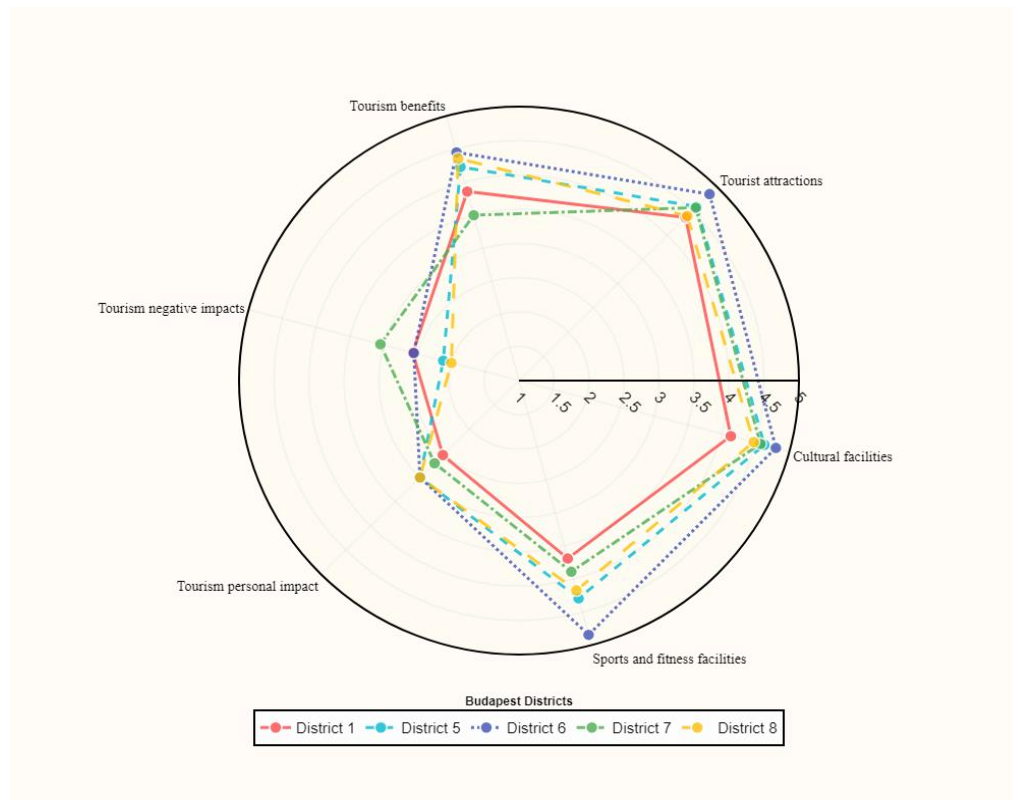
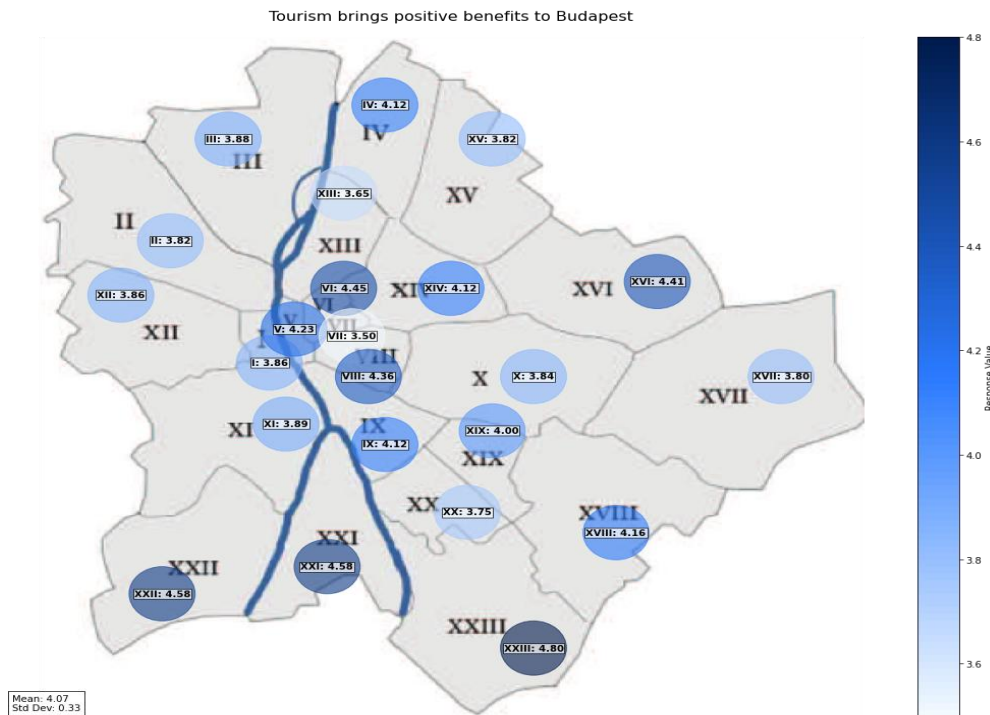


**Figure 3: Positive impacts of tourism by district**



Respondents were asked about their attitudes to Budapest becoming a smart city with the following results:

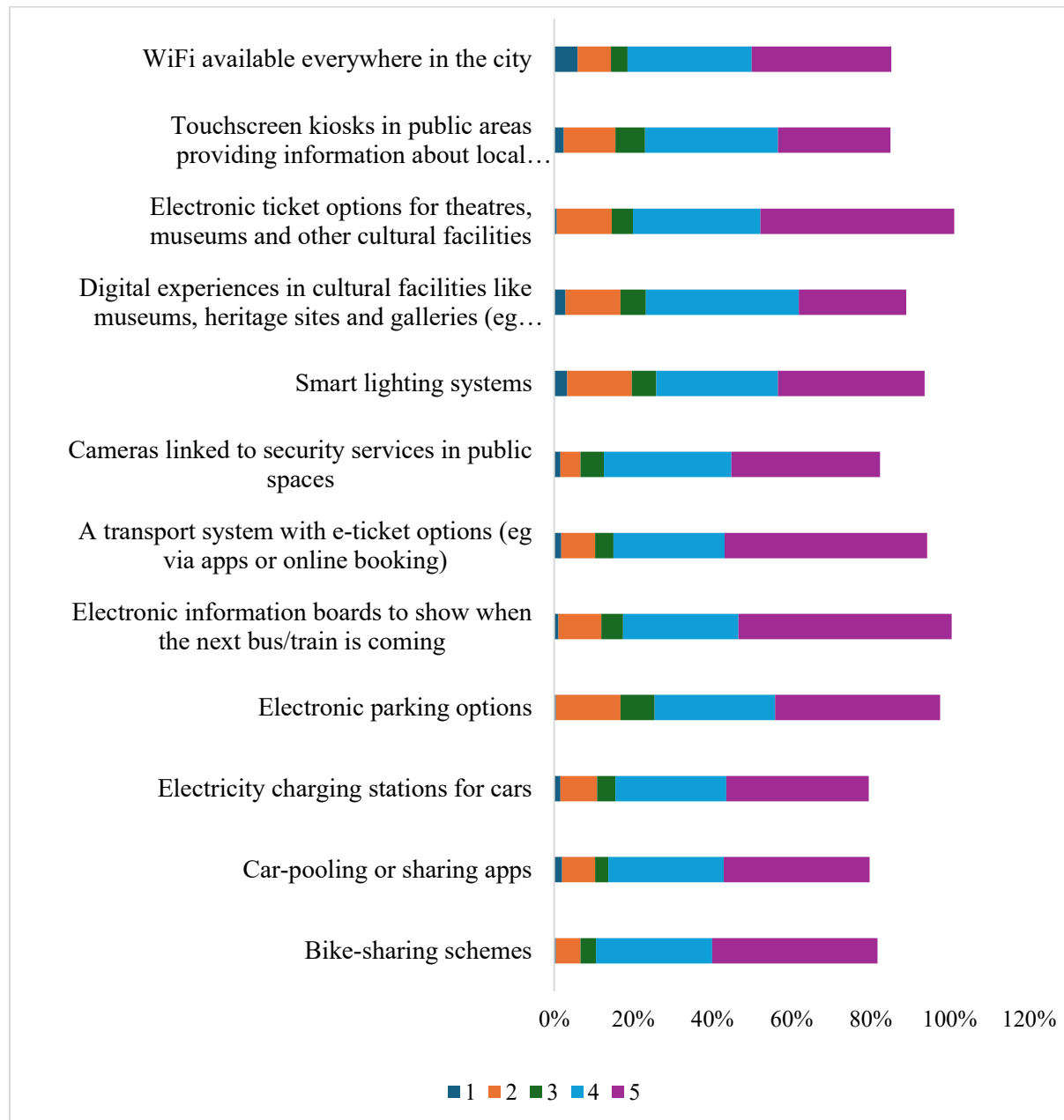
- 74% of respondents rated the statement 4 or 5 that Budapest becoming a smart city was important to them
- 73% said that they would like to use more smart services in Budapest

Although there were no significant gender differences for these statements, women rated every statement for smart city services higher than men (but it should be noted that this response does not measure actual usage). For example, older residents were more positive about Budapest becoming a smart city, but they did not necessarily want to use more smart services! This suggests a gap between perceptions and actual behaviour, which would require further research. Foreign residents seem to be less interested or involved in smart services (possibly because of language barriers), as more than half responded 'not relevant to me'. This was especially true of e-mobility (transport, parking, car pooling, electric car charging), smart lighting and security surveillance, and e-ticketing for cultural and leisure amenities.

It should be noted that our listed services were mostly utilitarian (functional/practical) rather than hedonistic (relating to enhanced enjoyment). Interestingly, the one statement that could be considered to be more hedonistic and connected to experience creation ('Digital experiences in cultural facilities like museums, heritage sites and galleries') was the one that was rated quite low. Figure 4 shows the results for the smart services that are most relevant to tourism (also listed in Appendix 1). It can be seen that the most positive responses relate to transport information

provision and e-ticketing for transport and cultural attractions, as well as bike-sharing schemes and e-parking.

**Figure 4: Attitudes to the smart services that are most relevant to tourism**



## 5.6. Conclusion

The results of this study partly concur with previous studies, for example, the OECD (2019) also noted under-performance in income and health; housing and healthcare problems were mentioned in the EUROPEAN COMMISSION's (2023) quality of life report; and FEKETE (2023) emphasized the housing issue. In this study, housing was rated lowest (over 50% of respondents rated this aspect below the median score of 3, especially the working population). This issue should be given some attention given the protests about overtourism in Spain, which are mainly focused on unaffordable housing.

The ECONOMIST INTELLIGENCE UNIT (2024) report on liveability had noted Budapest's advancement in recent years. Although the exact details of the scoring were not made public, in addition to healthcare and education, the criteria include environment, infrastructure, stability and culture. In our study, healthcare and education were not rated very highly and responses to the environment were mixed (e.g. less than 50% viewed the city as clean, but more than 60% of residents appreciate the number of green spaces and do not suffer much because of noise levels). A relatively high number of respondents find the city safe, although perceptions of safety were rated lower amongst women and older residents. Despite mixed opinions about the friendliness of the city (especially among women), more than 60% of residents feel a sense of community, and the image of the city is mainly positive.

Interestingly, those domains of QoL that are most closely related to tourism, i.e. transport, leisure, culture, atmosphere and positive benefits of tourism were rated higher than any others. This is especially true of cultural and tourist attractions, which were rated positively by over 90% of respondents. Even in those districts where the impacts of tourism were considered to be more negative, residents still appreciate the leisure and cultural offer of the local area. This suggests that any concerns about the negative impacts of tourism are mainly confined to certain districts in the centre of the city and need targeted management.

In terms of smart services, the study mainly focused on utilitarian or functional tools, which facilitate information finding, transport systems or e-ticketing. Smart solutions for safety and security are less likely to be visible to residents. Interestingly, the one tool that was more hedonic in nature relating to digital experience creation in cultural facilities was rated lower than most others. The responses to Budapest becoming a smart city were largely positive, including the perception of using more smart services. This bodes well for future developments in Budapest and the shift towards smarter approaches to improving QoL.

The sample for this study was relatively well balanced in comparison to the city CENSUS Data (2022), however, older residents were under-represented, certain districts of the city were over-represented, and the sample was quite highly educated, which might bias their responses. The questions that were asked about perceptions of Budapest as a smart city and associated tools only captured perceptions rather than usage. Respondents tend to over-state their intentions, so further research would be needed to measure their actual behaviour. It would also be important to question a broader sample of residents from the most heavily touristed districts of the city to understand better how the impacts of tourism should be managed.

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**Appendix 1: Quality of life elements in the questionnaire that were most closely connected to tourism**

| <b>Domains of smart cities</b><br>(Giffinger et al., 2010)                                                                                                                                                      | <b>Questionnaire statement</b>                                                                                                                                                                                                                                    | <b>Associated smart service (where applicable)</b>                                                                                                                                                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Tourism</b><br><i>(Smart living domain)</i><br>(Ortega and Malcolm 2020, Ozkaya and Erdin 2020, Cantuarias-Villessuzanne et al. 2021, Ji et al. 2021, Shami et al. 2022)                                     | <ul style="list-style-type: none"> <li>• The city has many interesting tourist attractions</li> <li>• Tourism brings positive benefits to the city</li> <li>• Tourism has some negative impacts on the city</li> <li>• Tourism does not affect my life</li> </ul> | <ul style="list-style-type: none"> <li>• WiFi available everywhere in the city</li> <li>• Touchscreen kiosks in public areas providing information about local services, events and points of interest</li> </ul>                  |
| <b>Culture</b><br><i>(Smart living domain)</i><br>(Ortega and Malcolm 2020, Ozkaya and Erdin 2020, Bielińska-Dusza et al. 2021, Cantuarias-Villessuzanne et al. 2021; Csukás and Szabó 2021; Shami et al. 2022) | <ul style="list-style-type: none"> <li>• The city has a good range of cultural facilities (e.g. museums galleries, heritage sites) (after Shami et al. 2022)</li> </ul>                                                                                           | <ul style="list-style-type: none"> <li>• Electronic ticket options for theatres, museums and other cultural facilities</li> <li>• Digital experiences in cultural facilities like museums, heritage sites and galleries</li> </ul> |
| <b>Leisure</b><br><i>(Smart living domain)</i><br>(Oh 2020, Ji et al. 2021)                                                                                                                                     | <ul style="list-style-type: none"> <li>• The city has a good range of sports and fitness facilities (after Oh 2020).</li> </ul>                                                                                                                                   | <ul style="list-style-type: none"> <li>• Not applicable - N/A</li> </ul>                                                                                                                                                           |
| <b>Safety</b><br><i>(Smart living domain)</i><br>(Oh 2020, Ortega and Malcolm 2020, Ozkaya and Erdin 2020, Bielińska-Dusza et al. 2021,                                                                         | <ul style="list-style-type: none"> <li>• Budapest feels safe, including at night (after Shami et al. 2022)</li> </ul>                                                                                                                                             | <ul style="list-style-type: none"> <li>• Smart lighting systems</li> <li>• Cameras linked to security services in public spaces</li> </ul>                                                                                         |

|                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cantuarias-Villesuzanne et al. 2021, Shami et al. 2022)                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                   |
| <b>Environment</b><br>( <i>Smart environment domain</i> )<br>(Oh 2020, Ji et al. 2021, Shami et al. 2022)                                                                                                                               | <ul style="list-style-type: none"> <li>• It is a clean city</li> <li>• It seems to be a sustainable city</li> <li>• There are enough attractive green spaces</li> </ul>                                                                                                                                  | <ul style="list-style-type: none"> <li>• N/A</li> </ul>                                                                                                                                                           |
| <b>Social issues</b><br>( <i>Smart people domain</i> )<br>(Ortega and Malcolm 2020, Ozkaya and Erdin 2020, Bielińska-Dusza et al. 2021, Csukás and Szabó 2021, Ji et al. 2021, Shami et al. 2022, Chen and Chan 2023; Zhu et al., 2022) | <ul style="list-style-type: none"> <li>• The people seem open and friendly</li> </ul>                                                                                                                                                                                                                    | <ul style="list-style-type: none"> <li>• N/A</li> </ul>                                                                                                                                                           |
| <b>Atmosphere</b><br>( <i>Smart people domain</i> )<br>(Kang et al., 2022, Paiva, 2023)                                                                                                                                                 | <ul style="list-style-type: none"> <li>• The city has a good atmosphere</li> </ul>                                                                                                                                                                                                                       | <ul style="list-style-type: none"> <li>• N/A</li> </ul>                                                                                                                                                           |
| <b>Image</b><br>( <i>Smart people domain</i> )<br>(Chen & Chan, 2023)                                                                                                                                                                   | <ul style="list-style-type: none"> <li>• I have a positive image of the city in my mind</li> </ul>                                                                                                                                                                                                       | <ul style="list-style-type: none"> <li>• N/A</li> </ul>                                                                                                                                                           |
| <b>Public transport</b><br>( <i>Smart mobility domain</i> )<br>(Bielińska-Dusza et al. 2021, Ji et al., 2021, Oh, 2020, Ortega-Fernandez et al., 2020,                                                                                  | <ul style="list-style-type: none"> <li>• It is easy to find my way around by public transport</li> <li>• The public transport system is efficient and reliable</li> <li>• The public transport system is affordable</li> <li>• I mainly use an app or electronic tickets for public transport</li> </ul> | <ul style="list-style-type: none"> <li>• A transport system with e-ticket options (e.g. via apps or online booking)</li> <li>• Electronic information boards to show when the next bus/train is coming</li> </ul> |

|                                                                                                                                                         |                                                                                                                                                                                                                                                         |                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ozkaya & Erdin, 2020, Cantuarias-Villessuzanne et al. 2021, Del Real, Ward & Sartipi, 2023)                                                             |                                                                                                                                                                                                                                                         |                                                                                                                                                                         |
| <b>Parking</b><br>( <i>Smart mobility domain</i> )<br>(Oh, 2020; Cantuarias-Villessuzanne et al. 2021, Ji et al., 2021, Del Real, Ward & Sartipi, 2023) | <ul style="list-style-type: none"> <li>• There are enough parking spaces</li> <li>• Parking is affordable</li> <li>• Electronic parking systems work well in the city</li> <li>• It is easy to find a recharging station for an electric car</li> </ul> | <ul style="list-style-type: none"> <li>• Electronic parking options</li> <li>• Electricity charging stations for cars</li> <li>• Car-pooling or sharing apps</li> </ul> |
| <b>Cycling</b><br>( <i>Smart mobility domain</i> )<br>(Oh, 2020, Cantuarias-Villessuzanne et al. 2021)                                                  | <ul style="list-style-type: none"> <li>• There are enough bike lanes</li> </ul>                                                                                                                                                                         | <ul style="list-style-type: none"> <li>• Bike-sharing schemes</li> </ul>                                                                                                |

## **6. SMART CITIES AND QUALITY OF LIFE IN BUDAPEST: AN URBAN CONSUMER PERCEPTION-BASED APPROACH (ARTICLE A5)**

**Reference:** Chang, S. (2025) Smart Cities and quality of life in Budapest: Implications for city management, *Hungarian Journal of Marketing & Management*.

### **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 consumer's 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 filled in by interviewers in different districts of the city.

### **MOST IMPORTANT RESULTS**

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

### **RECOMMENDATIONS**

To build on the city's strengths (e.g. efficient transport system, cultural attractions, good atmosphere) and to address more negative elements (e.g. cleanliness, lack of parking). The city could be made safer for certain groups of residents (e.g. women) and the number of local green

spaces could be increased for older residents who might find it harder to access central locations. Sustainability needs to be communicated more prominently, and residents should be encouraged to use smart tools, especially those who seem less confident (e.g. older residents).

*Keywords:* Smart cities; quality of life; residents; urban consumers; city management; Budapest

## **6.1. Introduction**

This study addresses the importance of quality of life (QoL) within smart city (SC) frameworks with the aim of developing a comprehensive indicator system that positions residents or urban consumers at the centre of SC development, while formulating recommendations for enhancing 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 urban consumers' multidimensional quality of life indicators 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.

The aim of this investigation is 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 considered to be timely because of Budapest's low performance in European QOL indices and the noticeable paucity of empirical data which reveals residents' perceptions and needs.

## **6.2. 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 is meant to improve the quality of life for its people and their way of living, 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, 2021; Braga et al., 2021; Ozkaya & Erdin, 2020). Various scholars have expanded this framework: Cantuarias-Villesuzanne 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 smart governance's importance 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 power relations issues (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 different and needs to be measured and managed differently.

The literature suggests that the SC domain of smart living is the 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 mainly focused on smart living, but it also incorporated some of the most important aspects of smart cities such as economic issues like employment, salaries and cost of living, as well as transport efficiency and affordability. The questionnaire also asked respondents how far 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 life of a city are an integral part of a city's socio-economic image and brand (Piskóti & Nagy, 2019). People are 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 wellbeing (Zhang & Li, 2022). Many of the aspects of quality of life examined in this study can help to shape residents' positive place image.

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

## **6.3. 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 relating to healthcare, housing, air pollution and lack of trust in other people (European Commission, 2023). More recent studies suggest that gentrification, clash of interest over land use and overtourism have contributed to “disrupted wellbeing” (Namaz & Tvergyák, 2023). Budapest, like many cities in Central and Eastern Europe, tended to follow the Western pattern of prioritising economic growth over environmental protection and social cohesion (Vesalon & Crețan 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 relate to environmental and transport 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 rather autonomously making holistic city management challenging. This can lead to conflicts over development priorities and regulations, funding and resource allocation. This is especially problematic if developments span more than one district.

The image and branding of Budapest has changed frequently over the years and it has not always been consistent. In recent years (especially since COVID), there has been an attempt to re-brand 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).

## 6.4. 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**

|                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Phase I. Systematic review of smart city and quality of life literature</b>                                                                                                                                                                                                                                                  |
| 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                                                                                      |
| <b>Phase II. Development of SCQOL domains and indicators</b>                                                                                                                                                                                                                                                                    |
| 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; Vidasova & Cronemberger, 2020). Smart tools for |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| each domain were identified through previous research and AI-generated suggestions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Phase III. Pilot test</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <p>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.</p> <p>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 regarding housing affordability and education levels.</p>                                                              |
| <b>Phase IV. Questionnaire distribution</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <p>The questionnaire was initially distributed through online platforms such as district resident forums, ex-patriate 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.</p> |

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) was meticulously examined and aligned as far as possible by utilizing 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 aligned with the population proportions for gender ( $P\text{-value} \Rightarrow 0.05$ ) and nationality ( $P\text{-value} > 0.05$ ). Minor discrepancies appeared in the distribution of age, education attainment, profession, civil status, property ownership, accommodation status, and residential district. Specifically, the sample contained more disproportionately young adults, singles, highly

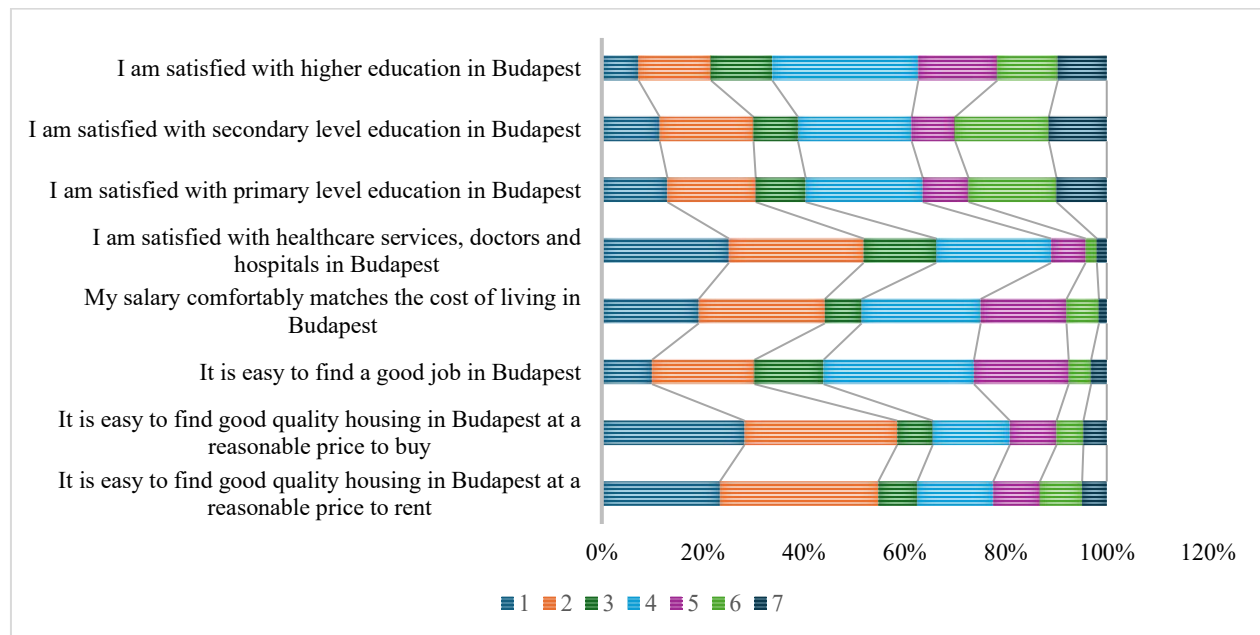
educated people and central district residents (especially Districts I, V, VIII). This can be partly explained by some these demographics' greater access to online questionnaires or the distribution of face-to-face questionnaires in mainly central locations in the city. Despite these limitations, the sample achieved a reasonable representation.

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

## 6.5. 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 shows the data for some of the fundamental elements of quality of life relating to health, housing, jobs and education.

**Figure 1. Repones relating to economy, housing and education**



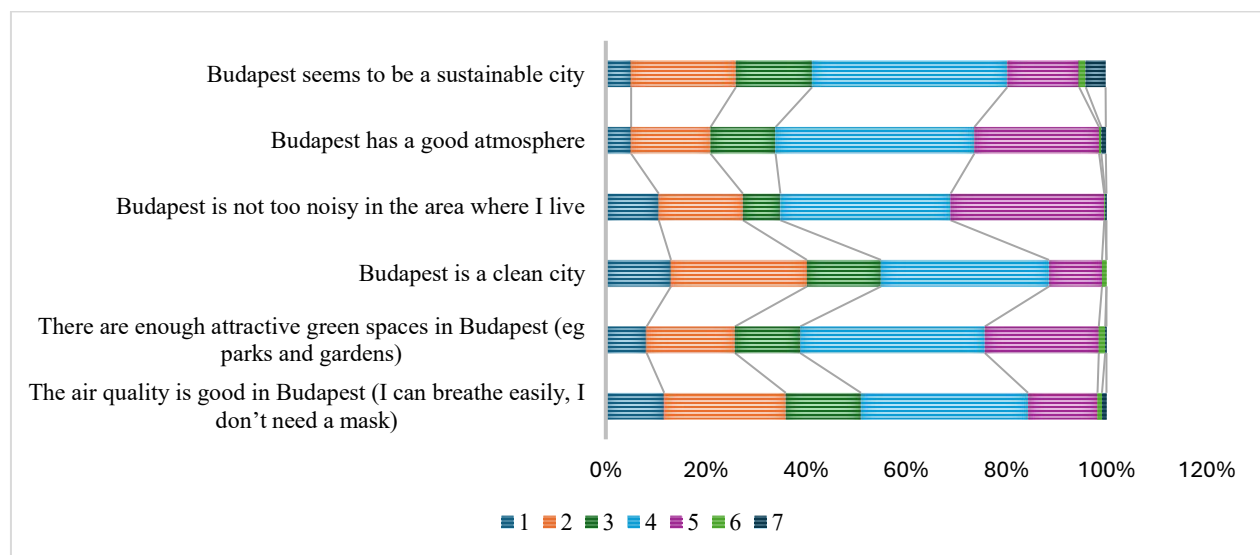
**Source: author's own**

Attitudes vary in 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 score with 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 degree), followed by Bachelor's diploma holders.

Figure 2 shows data for issues that relate to the environmental domain of quality of life, such as cleanliness, greenness, sustainability, atmosphere and noise.

**Figure 2. Responses relating to environment**



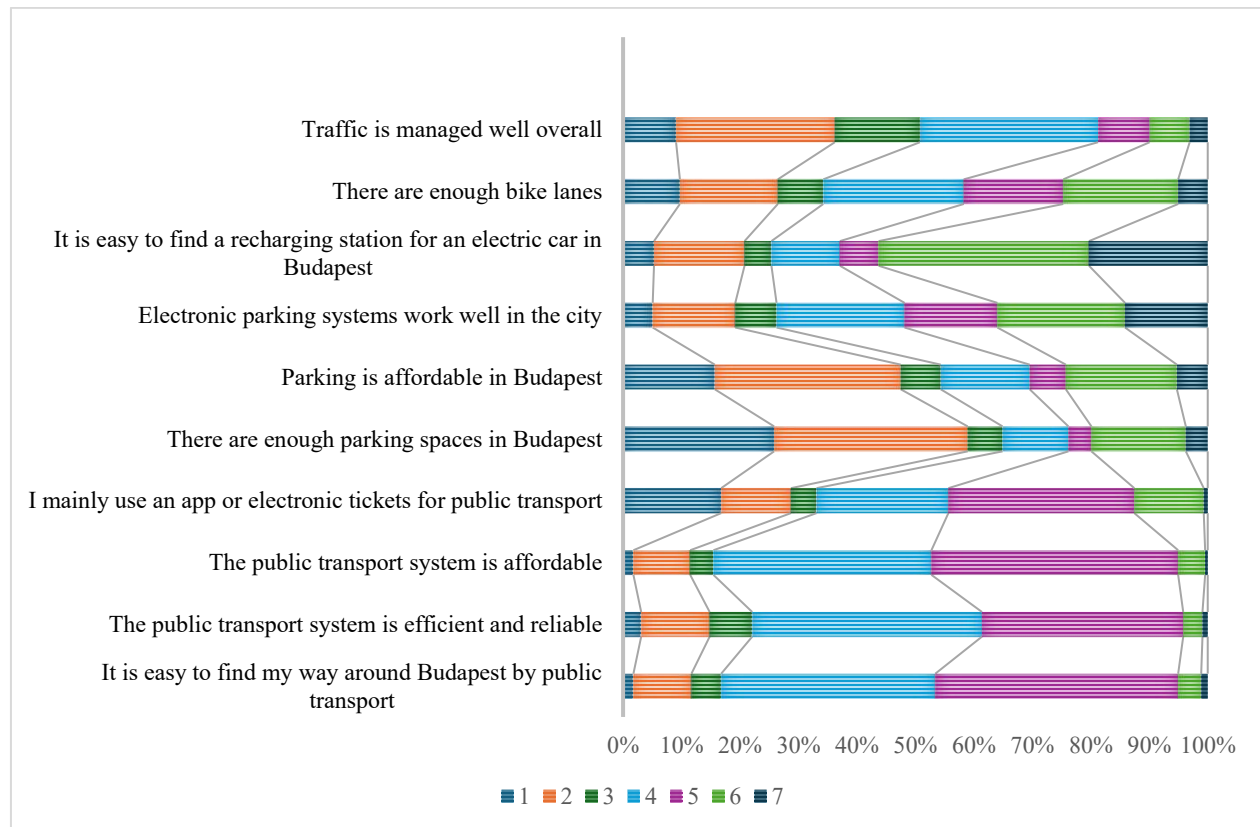
**Source: author's own**

Notable is the somewhat positive evaluation of environmental quality indicators, specifically sustainability measures, urban atmosphere, and noise levels in residential areas. More than 60% do not find the area they are living 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 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 connected to transport.

**Figure 3. Responses relating to transport**



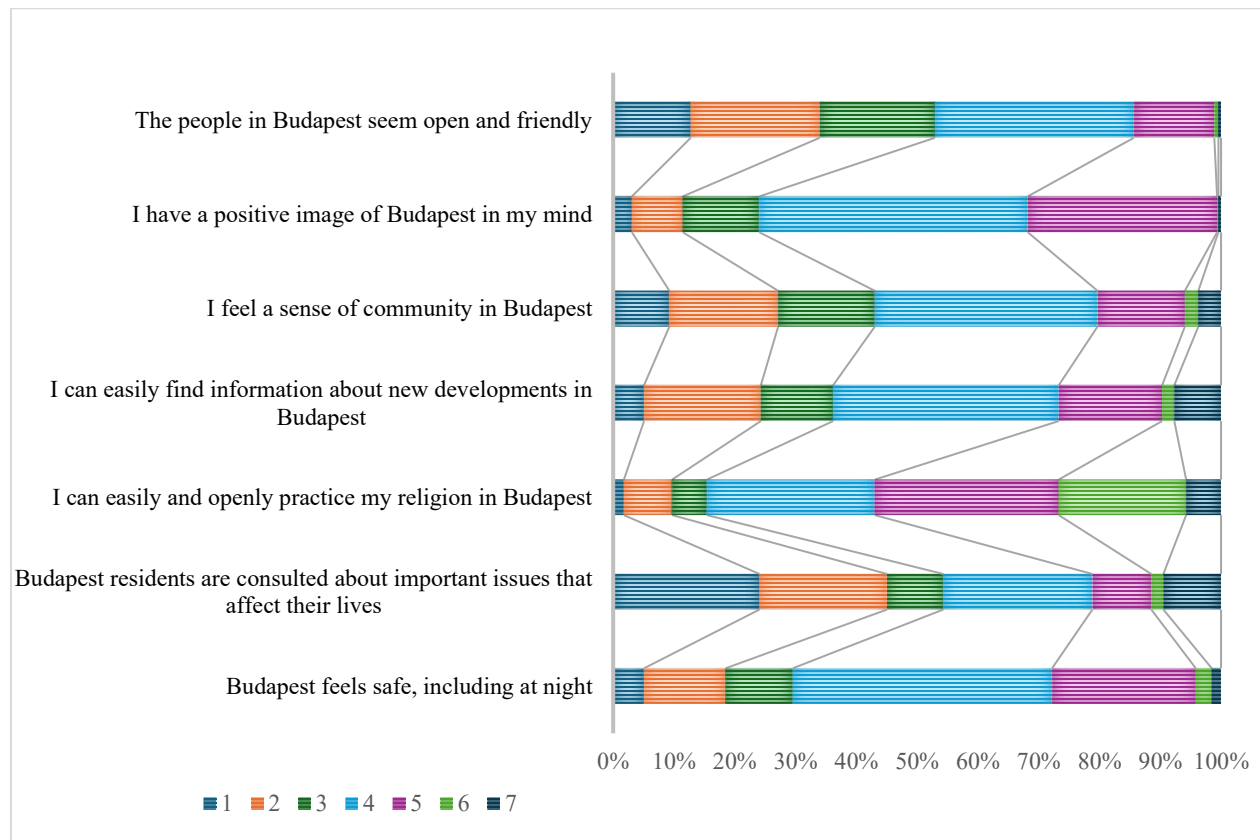
**Source: author’s own**

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 less 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 shows data relating to the social dimensions of quality of life, including friendliness, sense of community, consultation and perceived safety.

**Figure 4. Responses relating to social issues**



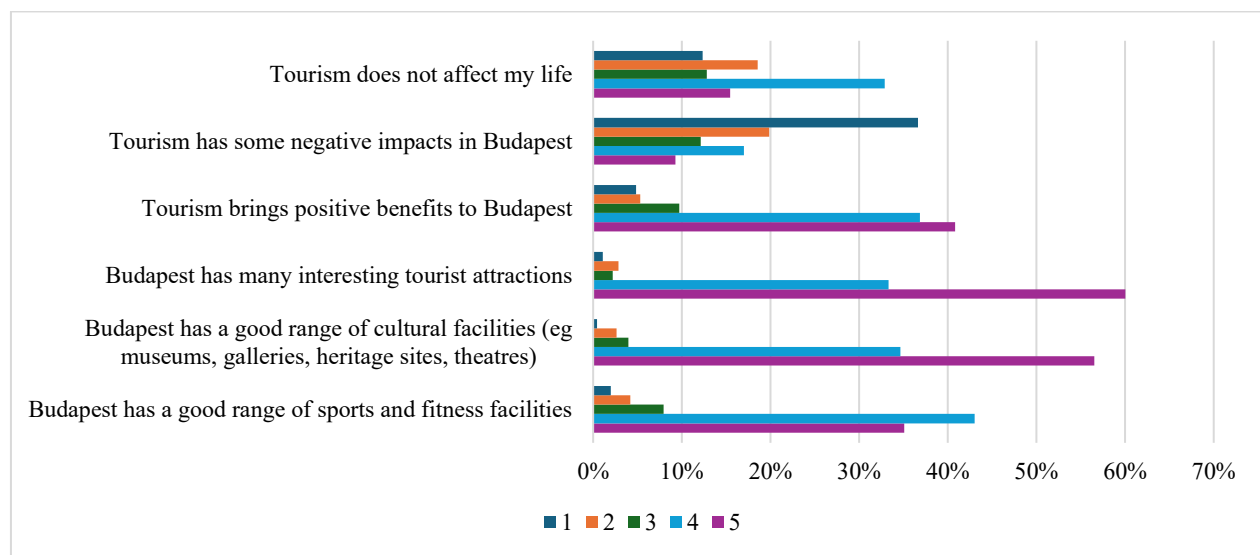
**Source: author's own**

The overall attitude towards social issues is mostly positive in Figure 4. More than 75% of respondents have a positive image of Budapest (ranked 4 or 5), regardless of age, and 66% of residents find the city relatively safe (ranked 4 or 5), including the oldest residents (aged 65+). However, females feel less safe than males (3.51 versus 3.91). The findings about whether Budapest seems open and friendly were rather mixed. There were no strong age variations, but

male respondents found it friendlier than females (3.3 versus 2.98). A couple of concerns emerging from the analysis about the deficiency in public consultation processes and the relative difficulty in finding 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 live in central districts (e.g. those visited frequently 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 are 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 to most smart tools, particularly those relating to mobility, parking, and ticketing for cultural attractions, although they show less interest in digital experiences at cultural facilities. In terms of attitudes towards using smart tools, the findings reveal that the oldest residents (65+) were surprisingly 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 (consisting of statements about cost of living and job opportunities) exhibits the greatest disparity according to educational attainment with University-level individuals' (Bachelor's, Master's and PhD degree) responses correlating with more favorable 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 engaging 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 self-reported happiness in Hungary was the lowest among 30 countries worldwide in a recent IPSOS (2025) study. A t-test showed that the largest gap between Hungarian and foreign residents occurs 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 (relating to transport and parking), smart solutions, smart people (relating 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. \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

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, which 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.

## **6.6. 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 be applicable to other post-socialist CEE cities which have followed similar trajectories to Budapest. They could also be used to measure quality of life in smart cities more globally. Indeed, although every context and community varies, the domains and indicators are applicable to almost any city that hopes to enhance 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, for example, the lack of affordable housing or inadequate parking provision.

It is important to capitalize on the city's proven assets through further enhancement of the already efficient public transportation infrastructure, strategic promotion of existing cultural attractions, and preservation of 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 residing in district VII face significant concerns over negative impacts of tourism regardless of high cultural facility ratings. This has implications for overtourism management in central districts.

Gender, educational attainment and nationality significantly affect residents' perceptions of different facets of smart cities. Educational attainment significantly influences their perceptions of job opportunities, attitudes to the environment and sustainability, and smart tools. The greatest divide is observed between Master's or PhD holders 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 suggest that while mobility and transportation services have achieved widespread adoption and satisfaction, there remain significant variations in the implementation and consumer preference patterns for educational, administrative, and security services. This finding points to potential areas for focused development in Budapest's smart city initiatives. In terms of digital integration, it would be useful to introduce user-friendly smart technology training programs, especially for older residents, accompanied by clear, 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.

## **6.7. 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 under-represented 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 as 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 undertaking some stakeholder interviews or a Delphi Study to gain further insights and make future recommendations for planning and management.

One major challenge is the fact 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**

| <b>Domain of smart cities</b>                                                                                                                                                                                                                                                           | <b>Indicators</b>                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| <b>Smart economy</b><br><br>(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<br><br>Jobs                                                                   |
| <b>Smart governance</b><br><br>(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<br><br>Consultation<br><br>Complaints                                  |
| <b>Smart mobility</b><br><br>(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<br><br>Parking<br><br>Cycling<br><br>Traffic                                |
| <b>Smart environment</b><br><br>(Liu et al., 2020; Oh, 2020; Shami et al., 2022; Zhu et al., 2022)                                                                                                                                                                                      | Air quality<br><br>Green spaces<br><br>Cleanliness<br><br>Noise levels<br><br>Sustainability |
| <b>Smart people</b><br><br>(Cornejo Ortega and Malcolm, 2020; Ozkaya and Erdin, 2020; Bielińska-Dusza et al., 2021; Del-Real et al., 2023; Csukás and Szabó, 2021; Cantuarias-Villesuzanne et al., 2021; Ligarsky and Wolny, 2021; Pira, 2021; Shami et al., 2022; Chen and Chan, 2023) | Education<br><br>Social issues<br><br>Image<br><br>Atmosphere                                |
| <b>Smart living</b>                                                                                                                                                                                                                                                                     | Housing<br><br>Healthcare                                                                    |

|                                                                                                                                                                                                                                    |         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| (Oh, 2020; Ortega and Malcolm, 2020; Ozkaya and Erdin, 2020; Bielińska-Dusza et al., 2021; Cantuarias-Villesuzanne et al., 2021; Csukás and Szabó, 2021; Ji et al, 2021; Ligarsky and Wolny, 2021; Pira, 2021; Shami et al., 2022) | Safety  |
|                                                                                                                                                                                                                                    | Leisure |
|                                                                                                                                                                                                                                    | Culture |
|                                                                                                                                                                                                                                    | Tourism |

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

| Comparison group         | Difference | P-value (adj) |
|--------------------------|------------|---------------|
| <b>Smart Economy</b>     |            |               |
| 2-1                      | 0.945      | 0.000***      |
| 3-1                      | 1.080      | 0.000***      |
| 4-1                      | 0.869      | 0.001***      |
| <b>Smart Environment</b> |            |               |
| 2-1                      | 0.476      | 0.013*        |
| <b>Smart Living</b>      |            |               |
| 2-1                      | 0.368      | 0.003**       |
| 3-1                      | 0.382      | 0.004**       |
| 4-1                      | 0.346      | 0.008**       |
| <b>Smart Mobility</b>    |            |               |
| 3 - 1                    | 0.428      | 0.011*        |
| 4 - 1                    | 0.391      | 0.019*        |
| <b>Smart Solutions</b>   |            |               |
| 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”.

## 7. DISSERTATION CONCLUSION

In addressing the research gaps previously identified in smart cities literature, this Dissertation contributed to the underexplored area of smart cities and quality of life, specifically focusing on citizens' needs. Previous literature on smart city-related quality of life focused mainly on technological and economic aspects of smart cities, whereas this study prioritised social aspects and residents' needs. This citizen-centric approach aligns with Szarek-Iwaniuk and Senetra's (2020) Smart City 3.0, which places citizens at the centre of urban development initiatives, and Wang and Zhou's (2023) assertion that successful SC transformation and meaningful QoL improvements depend on cities' simultaneous investment in both technological infrastructure (ICT) and human capital resources. In Table 6, responses to research questions as well as the primary theoretical and empirical contribution of our studies have been summarised. More specifically, the subsequent section beneath Table 6 provides a concise summary of each research question and primary findings.

**Table 6. A summary of responses to research questions and contributions**

| Research Question                                                                          | Aim                                                                        | Methodology                                      | Answers and Contributions                                                                                                                                                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RQ1. How can quality of life be defined and conceptualised in the context of a smart city? | Systematic review of current and latest relevant research to identify gaps | Systematic Literature Review (SLR), PRISMA Model | This SLR demonstrates the central importance of quality of life to smart cities. Investigations into the significant dimensions and measures of SCQoL can assist urban developers in prioritizing and investing in smart services which meet residents' needs. There is still a discrepancy between residents' needs and policies. |
| RQ2. How can residents' quality of life be measured in a smart city?                       | Summarise SCQoL domains and indicators, design questionnaire               | Structured questionnaire design                  | Six domains of SCQoL were identified including smart economy (related to cost of living, jobs), smart mobility (related to public transport, parking, cycling and traffic), smart environment (covering air quality, green spaces, cleanliness, noise levels and sustainability), smart governance (related to information         |

|                                                                                            |                                      |                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------|--------------------------------------|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                            |                                      |                                                      | provision, consultation, complaints), smart people (education, social issues, image, atmosphere). The main domains of smart living and their relevant indicators include housing, health, safety, education, environment, social cohesion, leisure, culture and tourism. This research synthesized a valid measurement instrument based on six established domains of SC.                                                                                                                                                                                                                                                                                                                                                                                                                       |
| RQ3. What are residents' attitudes to smart city developments and smart tools in Budapest? | Main findings from the questionnaire | Survey, Python programming language, Power BI, Excel | <p>Smart Living emerged as the most valued domain, followed by Smart People and Smart Mobility, while Smart Economy and Smart Governance ranked lowest. Although governance is central to strategic smart city management, it often remains invisible to residents.</p> <p>The vision of Budapest becoming a smarter city is supported by the majority of residents (including elderly residents, but they are hesitant about using smart services).</p> <p>Residents appreciate utilitarian and functional smart services (e.g. e-ticketing or mobility apps).</p> <p>Our findings provide practical recommendations for urban planners and policy makers about that most important quality of life issues, the most preferred smart services, and gaps in residents' needs and interests.</p> |
| RQ4. What is the relationship between tourism and quality of life in Budapest              | Study of the role of tourism in      | R programming language (including                    | The domains of quality of life (QoL) most closely related to tourism, namely transport, leisure, culture, atmosphere and the                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

|                                                                                                              |                                                                                    |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| and how can smart tools assist in the management of tourism?                                                 | residents' quality of life                                                         | lavvan package)        | <p>positive benefits of tourism, were given higher ratings than any others. In the districts where the impacts of tourism were considered to be more negative, residents nevertheless expressed appreciation for the leisure and cultural amenities available in their local area.</p> <p>Overall, concerns regarding the deleterious impacts of touristification are predominantly confined to specific districts in the city centre, thereby necessitating targeted management interventions in those areas.</p> |
| RQ5. What are the implications for smart city planning and management to improve residents' quality of life? | To make recommendations for urban planners and managers, as well as municipalities | R programming language | <p>The lowest-ranked issues in this research—economy, health, education, and housing—generally extend beyond the scope of city governance control.</p> <p>Although findings are most directly applicable to post-socialist cities with similar growth patterns to Budapest, our findings and the tools offer broader utility for any city prioritizing smart living as a mechanism for enhancing QoL, . Urban researchers and policy makers can utilize our SC scale to evaluate residents' quality of life.</p>   |

*Source: own complication*

The first study (A1), a systematic literature review showed that quality of life issues have emerged as central components in smart city development. Citizens exhibit heightened positive attitudes and increased support for smart city initiatives when they perceive direct benefits to their lifestyle, local economic growth, infrastructure enhancement, transport improvements, safety advancements, and

contributions to community image and pride. The study identified gaps between policies and citizens' needs, emphasizing the importance of resident engagement in smart solutions and long-term strategic planning.

The second study (A2) advances the development of smart city quality of life domains and indicators, with particular emphasis on smart living measurements for resident quality of life assessment. Smart living prioritizes social indicators, distinguishing it from broader QoL frameworks that encompass economic and environmental dimensions. The research examines critical domains of smart living, including housing, health, safety, education, environment, social cohesion, leisure, culture, and tourism, alongside their corresponding indicators. Through methodological review of previous studies, this research provides a foundational framework for smart city questionnaire design. The methodology's applicability extends to smart cities globally, but with specific relevance to post-socialist urban contexts.

The third study (A3) focuses on residents' attitudes to tourism, leisure and culture within the context of broader QoL issues measured in the quantitative questionnaire. Many of these broader QoL aspects are also important for tourists, for example, public transport, attractions, green spaces and safety. The findings show that residents have positive perceptions of Budapest regarding safety, image and public transport, as well as cultural attractions, sports facilities and green spaces. Respondents expressed mixed sentiments regarding friendliness and cleanliness, which could also affect tourists. Perceptions of tourism varied according to the district that residents were living in, and it was clear that although residents living in central districts appreciate the leisure and cultural attractions, tourism affects their life more negatively. This has implications for the management of overtourism in central districts.

The fourth study (A4) examined more general aspects of QoL, as well as some of the smart tools that residents think are most important for a smart city. The findings underline that the most prominent concerns involve housing quality and affordability, followed by healthcare services and the imbalance between wages and living costs. Residents rate public transport highly but are not so happy with the parking situation and overall traffic management. Many residents view Budapest as lacking in cleanliness and sustainability. The study identifies limited resident participation in governance (e.g. consultation), which is crucial for Budapest's smart city development, benefiting

both policy understanding and decision-making processes. In terms of smart tools, transportation-related services (mobile apps, ticketing, electronic information boards) were rated highly. There is still scope for improving engagement with other services, but overall, residents are positive about Budapest becoming a smarter city.

The fifth study (A5) returns to the topic of tourism to focus in more detail on the relationship between tourism and QoL. It highlights the necessity for context-sensitive urban management approaches that balance tourism development with resident wellbeing. Although residents express concerns about housing affordability, healthcare, and education, the topic of tourism generally elicits positive perceptions, particularly regarding cultural and tourist attractions and leisure infrastructure. However, slightly more negative responses were recorded in the most heavily touristed areas (e.g. the ‘party quarter’ in Districts VI and VII). Residents show widespread support for smart city development despite potential discrepancies between intended and actual usage of smart tools (e.g. among older residents). The research suggests that smart technologies could help to effectively manage tourist flows and improve quality of life for residents.

The sixth study (A6 – as yet, unpublished) addresses residents’ perceptions, attitudes and priorities to quality of life domains measured using several indicators and connected smart services. Differentiations are identified according to key demographic factors, such as gender, age and education. The results show that residents are most concerned about the smart living domain, especially housing, healthcare and cost of living in smart cities. They are ambivalent about environmental issues, whereas they are relatively positive about social issues, leisure and cultural provision. The most popular smart tools are connected to smart mobility, especially public transport usage. The study provides recommendations that could help to inform city planners and managers about the most important quality of life issues, the most used smart services, and gaps in residents’ needs and interests.

Nevertheless, the present research is not without its limitations. A methodological limitation lies in the study's reliance on a structured, quantitative questionnaire, which may not fully capture residents’ deeper experiences. For this, focus groups could provide a more informative method. Furthermore, more longitudinal research would also be needed to monitor residents’ quality of life over time as smart systems are developed and implemented. This could be combined with research

on tourists' experiences of the city and smart technology, as well as their interactions with local residents.

In future research, analysing the disparities between policies and practice remains crucial (Nunes et al. 2021), particularly given the frequent mismatch between citizens' needs and service design (Chen and Chan 2023). Smart governance, despite its lower visibility to citizens and consequently lower rankings in SC and QoL studies compared to other domains (Ozkaya and Erdin 2020; Braga et al., 2021), forms the foundation of urban development, planning and management, as well as the design and implementation of smart systems. Recommendations need to be made for specific contexts and standardised approaches rarely succeed without meaningful adaptation to local conditions. Governance should adopt longer-term, strategic approaches with demonstrable citizen involvement in decision-making processes rather than merely providing information to passive recipients (Mills et al, 2022). The contributions of these studies not only expanded the theoretical understanding of SCQOL but also provided practical frameworks for city policymakers, planners and managers, supporting more resident-orientated practices. This includes the potential to manage tourism-related challenges in city centres and to improve the contribution of smart solutions in urban management more generally.

Technology advances are occurring at a dramatic rate and Artificial Intelligence (AI) has emerged as a transformative technology with the potential to revolutionize urban development planning and implementation. The importance of AI in the context of smart cities should be factored into all future research studies, despite the challenges (Szpilko et al., 2023) and even if the results reveal mixed results in terms of quality of life improvements (Alfaro-Navarro et al., 2024). Previous studies have shown that there is a need for good governance in the context of smart cities (Pazos-García, 2025), which means clearer information provision and better communication from governments (Hartley, 2023). There is also a need to educate residents better in order to improve their digital capabilities (Wijayasinghe and Sachitra, 2024). Our research identifies residents' priorities and preferences and the extent to which they are willing to support smart developments and to use smart services. The results are largely positive, but the future depends on support and communication from city agencies, planners and developers on the road to developing quality of life in smart cities.



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