

SMART LIVING AND QUALITY OF LIFE: DOMAINS AND INDICATORS

Melanie Kay Smith^a, Songling Chang^b,
Gábor Michalkó^{c, d}

^aBudapest Business University, Budapest, Hungary,

^bCorvinus University of Budapest, Budapest, Hungary,

^cUniversity of Pannonia, Veszprém, Hungary, Hungary,

^dHUN-REN CSFK Geographical Institute, Budapest, Hungary

Keywords:

smart cities;
smart living;
quality of life;
residents;
Budapest

Abstract: Smart living appears as 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, a 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.

Email: smith.melanie@uni-bge.hu

Initial submission: 04.06.2024; Revised submission: 11.09.2024; Final acceptance: 19.09.2024

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)

Introduction

The 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).

Smart cities should put people first and use technology as a tool predominantly in the service of citizens (Trencher 2019). 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 resurgence (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 a SC should be intertwined with and responsive to its community (Del-Real et al. 2023). Cities can only achieve an effective transformation to a 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 et al. 2024). Rachmawati et al. (2024) suggest that 'liveability' should be one of the main purposes of the urban future and the use of ICT in sustainable smart cities can enhance wellbeing as well as ensure collaboration among stakeholders and to battle climate change.

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 the local residents, and it 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 of 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 on 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 during their post-socialist transition and the implications for QoL and smart developments.

Methodology

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 and Gudrun 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 the local residents based on the smart living domain of smart cities. This questionnaire was designed with the residents of the Hungarian capital city of 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). Also, 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 judgement. 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.

Results

Systematic review

In the previous literature, six dimensions of SC were identified as smart economy, smart mobility, smart environment, smart people, smart governance and smart living (Giffinger and Gudrun 2010). Several authors have used these same domains in

subsequent studies (Ortega-Fernández et al. 2020, Ozkaya and Erdin 2020, Bielińska-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: 2).
- “Urban smartization will ultimately improve quality of citizens’ lives (smart living)” (Shami et al. 2022: 2).
- “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 the 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 the standards of living (Lytras et al. 2021) using advanced integrated services based on information and communication

technologies and the 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 (economic, environmental, transport and governance, Muvuna et al. 2020) aiming to increase the efficiency and effectiveness of municipal services while 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 the citizens’ needs and the 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 it is often responsible for decisions about design and the 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 (de Guimarães et al. 2020, Mills et al. 2022). On the one hand, 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 et al. (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.

Discussion on sustainability should be aligned with the SDG₁₁ goals to make cities sustainable, safe and resilient (United Nations 2015). Some SC studies focus specifically on resilience (Bruzzone et al. 2021) and several definitions of SC that focus on QoL include sustainability as an important objective (Edge et al. 2020, Ortega-Fernández et al. 2020, Szarek-Iwaniuk and Senetra 2020, Ligarski and Wolny 2021). Cantuarias-Villesuzanne 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”.

Numerous indicators have been used in past studies to define the domains of smart cities, including smart living (Annex 1 offers a summary of selected recent literature on this topic). But it is important to consider 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 labour-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 to increase the number of green spaces, for example. Mobility issues may affect the residents’ quality of life in terms of their commuting to work or the 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-Villesuzanne 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 attractivity, 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 the residents' security (Ortega-Fernández et al. 2020, Vidasova and Cronemberger 2020, Braga et al. 2021, Cantuarias-Villessuzanne et al. 2021). This includes also the risks associated with data privacy and protection (Sharif and Pokharel 2022) as 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 characterised 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 the disabled, as well as effective settlement policies for the 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 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 tourist attraction is the least important. Also, several authors have suggested the most important domains of smart living revolve mainly around housing, social cohesion, security, housing, culture, and education (Table 1).

Table 1. Suggested domains of smart living

Authors	Suggested domains of smart living
Bielińska-Dusza et al. (2021)	Housing quality Health condition Individual security Education facilities Economic welfare/social cohesion Cultural facilities Tourism attractiveness
Oh (2020) (for "subjective quality of life")	Housing (including facilities and environment) Health and wellbeing (including physical and mental health) Safety and convenience Urban environment
Ortega and Malcolm (2020)	Housing quality Citizen security Social cohesion Cultural facilities Tourism
Ozkaya and Erdin (2020)	Housing quality Health conditions Individual safety Education facilities Social cohesion Cultural facilities Tourist attractiveness
Cantuarias-Villessuzanne et al. (2021)	Healthcare Security Education Tourism
Csukás and Szabó (2021)	Housing Health Social cohesion Culture

Authors	Suggested domains of smart living
Ji et al. (2021)	Welfare and social inclusion service, e.g. to reduce barriers for minority groups in social learning and participation Public spaces management service, e.g. maintenance E-democracy service, e.g. electronic voting service Online city-tourism information service
Pira (2021)	Health (including life expectancy) Safety (e.g. crime levels) Education Culture and wellbeing (living conditions, inequality, quality of life ranking)
Shami et al. (2022)	Housing and building Health and hygiene Security Public education Social cohesion and participation The environment and natural resources Culture
Zhu et al. (2022)	Reliable and efficient physical infrastructures Accessible and secured ICT infrastructures
Chen and Chan (2023) (for “smart livelihood SCQOL-LIVE”)	Way of life Personal life quality A feeling of belonging in my city The image of my city to others Community pride Opportunities to use smart technologies Citizens’ participation in government decision-making process

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 (Figure 1), including questionnaires with the local residents. QoL research often employs questionnaires that focus on subjective wellbeing and the citizens’ perceptions on the domains of SC (de Guimarães et al. 2020, Oh 2020, Vidasova and Cronemberger 2020, Bielińska-Dusza et al. 2021, Ji et al. 2021, Simonofski et al. 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 connect their research to smart governance, urban planning and management (Vidasova 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).

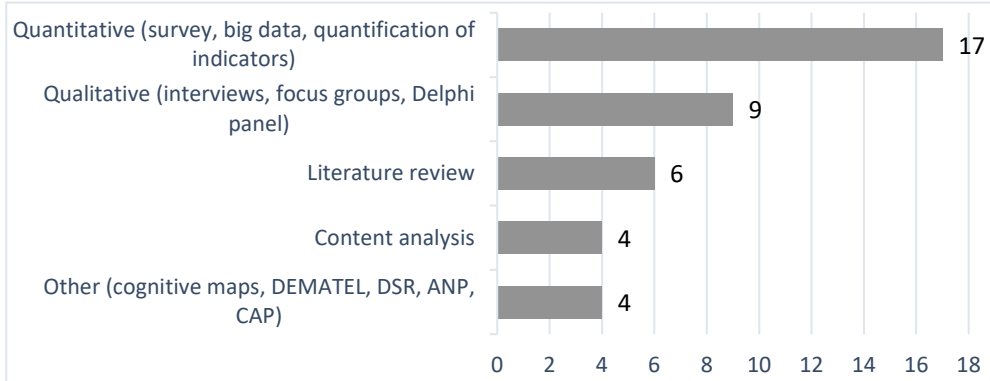


Figure 1. Summary of research methods used in past studies of QoL in SC

Several studies used mixed research methods (e.g. those listed under the ‘Other’ category in Figure 1). 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 (Ortega-Fernández et al. 2020, Pira 2021), some having a specific focus on QoL (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 the local context is essential. Nevertheless, applying the global principles of sustainability or good practice in citizen participation can work well in many different territorial contexts.

Context for Research

This section will demonstrate how the above information 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 of 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 Crețan 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 polarisation, income inequalities and the spatial differentiation of the society (Marciniczak et al. 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 et al. 2024). It is also important to mention the disappointments with post-socialist living, which offered relatively little security and state support in the absence of paternalistic authority (Shlapentokh and Shiraev 2002). Impoverishment, population decrease, and outmigration are common issues (Sýkora 2009, Marciniczak et al. 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 et al. 2024). It is also important to consider ethnic minorities living in border regions (Berceanu et al. 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 overtourism, all of which impact on the 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 (Figure 2), 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).

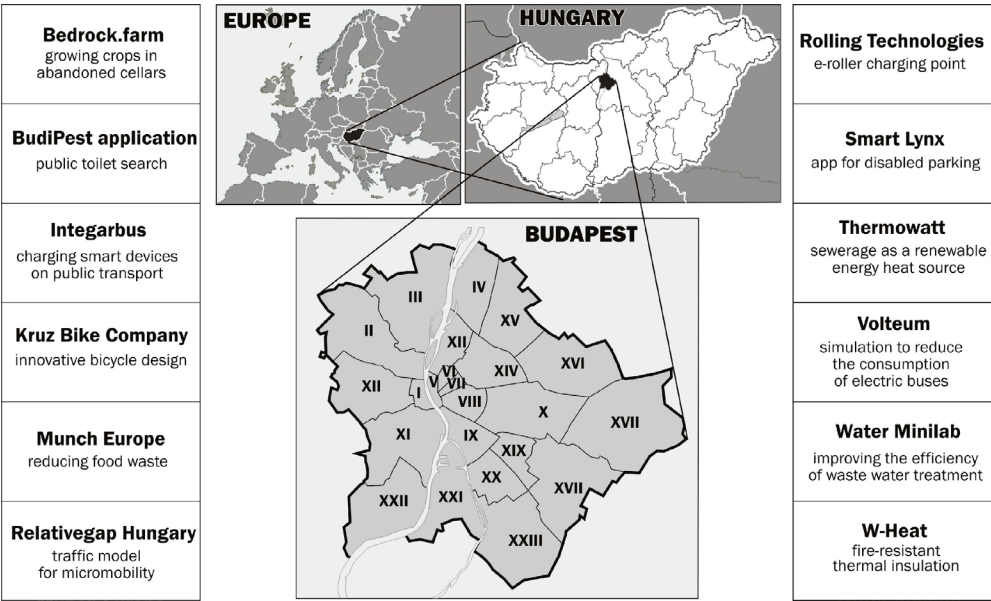


Figure 2. The winners of smart city projects organised by the City Hall in Budapest (2021). Source: Kaiser (2024)

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 the citizens. 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, while the 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 the 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 et al. (2024) that less educated, older and poorer citizens are not as likely to have easy access to the digital world.

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 the heat island effect, the 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):

- 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;
- And 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). Among the most important intentions of the Smart City Vision for Budapest (Figure 3), the emphasis on improving liveability and quality of life through sustainability and technology is notable.

Of course, health and education are also fundamental aspects of QoL, but health and education systems are affected by national government policies, and they 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 the 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 the resident perceptions of existing and ongoing urban developments.

Using the domains that occur most frequently in the previous research on smart living, the questionnaire design will focus on the following: housing, health, education, safety,

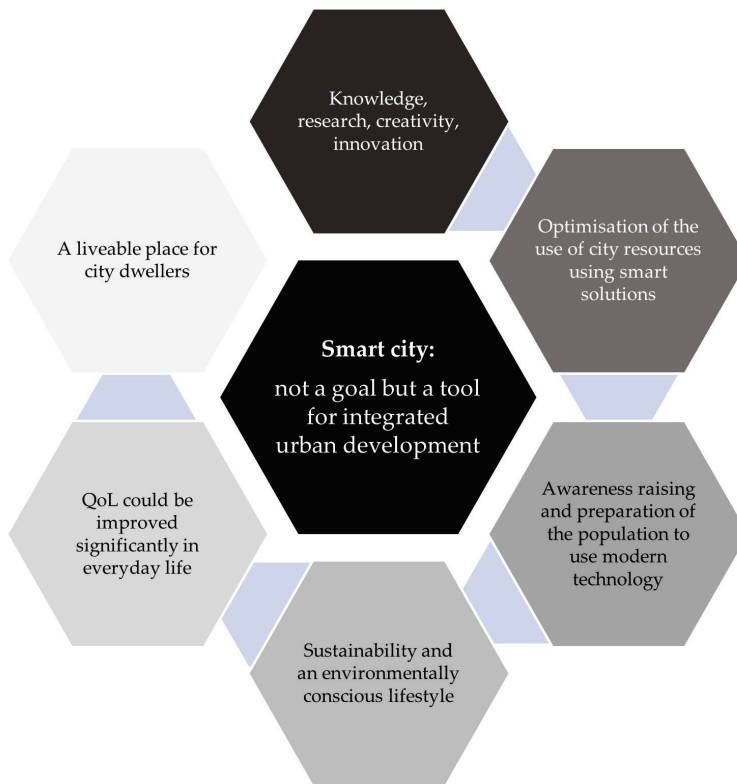


Figure 3. Smart city vision for Budapest

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).

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 sizable 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% of the total population) (HCSO 2023). The questionnaire will therefore be mainly distributed to Hungarian residents.

In addition to consulting the recent literature and previous studies, the proposed questionnaire statements (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 of 385 citizens, with a confidence level of 95% and a margin of error of 5% (Qualtrics 2023). This was calculated based on the total population of Budapest being of 1,685,342 people 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 people (de Guimarães et al. 2020, Oh 2020, Bielińska-Dusza et al. 2021, Ji et al. 2021, Simonofski et al. 2021, Vidasova and Cronemberger 2020, 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 the 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), while Perneger et al. (2015) suggest that thirty participants are 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 the respondents can be seen in the Notes column in Table 2.

Table 2. Questionnaire statements for Smart Living Questionnaire

Domain	Suggested statements	Notes
Housing (Oh 2020, Ortega and Malcolm 2020, Ozkaya and Erdin 2020, Bielińska-Dusza et al. 2021, Csukás and Szabó 2021, Shami et al. 2022)	- It is easy to find good quality housing in Budapest at a reasonable price to rent - It is easy to find good quality housing in Budapest at a reasonable price to buy	<i>In the pilot study, respondents emphasised the need to differentiate between buying and renting accommodation.</i>
Health (Oh 2020, Ozkaya and Erdin 2020, Bielińska-Dusza et al. 2021, Cantuarias-Villessuzanne et al. 2021, Csukás and Szabó 2021, Pira 2021, Shami et al. 2022)	- I am satisfied with healthcare services, doctors and hospitals in Budapest	<i>Inspired by “the healthcare system is adequate for my needs” (Ji et al. 2021).</i>
Safety (Oh 2020, Ortega and Malcolm 2020, Ozkaya and Erdin 2020, Bielińska-Dusza et al. 2021, Cantuarias-Villessuzanne et al. 2021, Pira 2021, Shami et al. 2022)	- Budapest feels safe including at night	<i>Inspired by “The city feels safe and secure, including at night” (Shami et al. 2022).</i>
Education (Ozkaya and Erdin 2020, Bielińska-Dusza et al. 2021, Cantuarias-Villessuzanne et al. 2021, Pira 2021, Shami et al. 2022)	- I am satisfied with the education provision in Budapest: - At primary level - At secondary level - At higher level	<i>In the pilot study, respondents suggested specifying which level of education (e.g. primary, secondary, higher).</i>
Environment (public and green spaces) (Oh 2020, Liu et al. 2020, Ji et al. 2021, Shami et al. 2022)	- There are enough attractive green spaces in Budapest (e.g. parks and gardens) - Budapest is a clean city - Budapest seems to be a sustainable city	<i>Inspired by the maintenance of public spaces (Ji et al. 2021); the importance of green spaces (Liu et al. 2020).</i>
Social cohesion (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 2022)	- The people in Budapest seem open and friendly - I feel a sense of community in Budapest	<i>Inspired by but simplified from: “I feel a sense of belonging in the city” (Chen and Chan 2021).</i>
Leisure (Oh 2020, Ji et al. 2021, Ligarski and Wolny 2021)	- Budapest has a good range of sports and fitness facilities	<i>Inspired by “There are enough sports and fitness facilities close to where I live” (Oh 2020).</i>

Domain	Suggested statements	Notes
		<i>Budapest has excellent new sports facilities in the centrally located city park, so we did not want to limit answers to local areas.</i>
Culture		
(Ortega and Malcolm 2020, Ozkaya and Erdin 2020, Bielińska-Dusza et al. 2021, Cantuarias-Villessuzanne et al. 2021, Csukás and Szabó 2021, Pira 2021, Shami et al. 2022)	- Budapest has a good range of affordable cultural facilities (e.g. museums, galleries, heritage sites, theatres)	<i>Inspired by “interesting and affordable museums and galleries” (Shami et al. 2022).</i>
Tourism		
(Bielińska-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)	- Budapest has many interesting tourist attractions - Tourism has many positive impacts on Budapest - Tourism has many negative impacts on Budapest	<i>Budapest suffered from ‘overtourism’ in the pre-COVID era and the residents were unhappy about the overcrowding and night noise. However, we wanted to balance the negative impact question with a positive one.</i>

Questionnaire distribution

Taking inspiration and methodological good practice from previous studies of SC and QoL (de Guimarães et al. 2020, Oh 2020, Bielińska-Dusza et al. 2021, Ji et al. 2021, Simonofski et al. 2021, Vidiasova and Cronemberger 2020, 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 representative as possible
- It will be posted on social media (e.g. online District Forums, Expat networks) but also distributed in public places (e.g. the City Park in the centre of Budapest)

One more question will be included to capture the 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 the residents were familiar with the term ‘smart city’ and even fewer could name some smart solutions. Of these, the best known are 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 the residents are familiar with or most likely to use. In addition to the literature review, artificial intelligence (ChatGPT) made suggestions when tasked to: “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
- Wi-Fi 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. Also, 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 the 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
- Social inclusion: online complaint platforms where people can say what they find good or bad about the city

- Public spaces: Wi-Fi available everywhere in the city; touchscreen kiosks in public areas providing information about local services, events and points of interest
- 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

Conclusions

This paper has centralised the 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 the appropriate indicators for measuring smart living, including connections to smart solutions. Unlike the 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 the 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 allow 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 for identifying indicators for measuring the 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 to determine 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 the 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 are different, the domains and indicators are applicable to almost any city that hopes to enhance quality of life by prioritising smart living.

Acknowledgements

This research received funding within the OTKA K134877 project (National Research, Development and Innovation Office, Hungary).

References

- APPIO F. P., LIMA M., PAROUTIS S. (2019) Understanding smart cities: innovation ecosystems, technological advancements, and societal challenges, *Technological Forecasting and Social Change* 142, 1-14, <https://doi.org/10.1016/j.techfore.2018.12.018>.
- BARLETTA V. S., CAIVANO D., DIMAURO G., NANNAVECCHIA A., SCALERA M. (2020) Managing a Smart City Integrated Model through Smart Program Management, *Applied Sciences* 10 (2), 714, <https://doi.org/10.3390/app10020714>.
- BERCEANU I. C., POPA N., CREȚAN R. (2023) Towards a Regional Crossover Model? The Roles Played by Spatial Vicinity and Cultural Proximity Among Ethnic Minorities in an East-Central European Borderland, *Journal of Urban and Regional Analysis* 15 (2), 159-190, <https://doi.org/10.37043/JURA.2023.15.2.1>.
- BIELIŃSKA-DUSZA E., HAMERSKA M., ŻAK A. (2021) Sustainable Mobility and the Smart City: A Vision of the City of the Future: The Case Study of Cracow (Poland), *Energies* 14 (23), 7936, <https://doi.org/10.3390/en14237936>.
- BOCKMAN J. (2011) *Markets in the Name of Socialism: The Left-Wing Origins of Neoliberalism*, Stanford University Press, Redwood City, <https://doi.org/10.2307/j.ctvqsdzqv>.
- BRAGA I. F. B., FERREIRA F. A. F., FERREIRA J. J. M., CORREIA R. J. C., PEREIRA L. F., FALCÃO P. F. (2021) A DEMATEL analysis of smart city determinants, *Technology in Society* 66, 101687, <https://doi.org/10.1016/j.techsoc.2021.101687>.
- BRUZZONE M., DAMERI R. P., DEMARTINI P. (2021) Resilience Reporting for Sustainable Development in Cities, *Sustainability* 13 (14), 7824, <https://doi.org/10.3390/su13147824>.
- CANTUARIAS-VILLESSUZANNE C., WEIGEL R., BLAIN J. (2021) Clustering of European Smart Cities to Understand the Cities' Sustainability Strategies, *Sustainability* 13 (2), 513, <https://doi.org/10.3390/su13020513>.
- 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>.
- CHEN Z., CHAN I. C. C. (2023) Smart cities and quality of life: a quantitative analysis of citizens' support for smart city development, *Information Technology &*

- People 36 (1), 263-285, <https://doi.org/10.1108/ITP-07-2021-0577>.
- CHENIKI K., BAZIZ A., BOUGDAH H. (2020) Measuring the Capacity of Local Municipalities to Adopt an Urban E-Governance Policy using a Smart Synthetic Model, *Journal of Urban and Regional Analysis* 12 (2), 199-216, <https://doi.org/10.37043/JURA.2020.12.2.5>.
- COHEN B. (2014) The smartest cities in the world 2015: Methodology, Fast Company, Retrieved from: www.fastcompany.com.
- CONNELLY L. M. (2008) Pilot studies, *Medsurg Nursing* 17 (6), 411-412.
- CSÉCSEI N. (2020) Smart City Index 2020: Budapest among the most underdeveloped cities in the region, Retrieved from: dailynewshungary.com.
- CSUKÁS M. S., SZABÓ R. Z. (2018) Factors Hindering Smart City Developments in Medium-Sized Cities, *Theory, Methodology, Practice – Review of Business and Management* 14 (1), 3-14, <http://dx.doi.org/10.18096/TMP.2018.01.01>.
- CSUKÁS M. S., SZABÓ R. Z. (2021) The many faces of the smart city: Differing value propositions in the activity portfolios of nine cities, *Cities* 112, 103116, <https://doi.org/10.1016/j.cities.2021.103116>.
- CSUKÁS M., SZABÓ R. Z. (2022) What are the conditions to become smart? A systematic analysis of the smart city strategy and smart city development activities of Budapest, *Információs Társadalom* 22 (2), 9-26, <https://dx.doi.org/10.22503/infars.XXII.2022.2.1>.
- DASH A. (2022) Modeling the moderating effect of technology anxiety on the relationship between smart city-built environment and the quality of life of citizens, *Journal of Facilities Management*, <https://doi.org/10.1108/JFM-06-2022-0061>.
- D'ANIELLO G., GAETA M., ORCIUOLI F., SANSONETTI G., SORGENTE F. (2020) Knowledge-Based Smart City Service System, *Electronics* 9 (6), 965, <https://doi.org/10.3390/electronics9060965>.
- DE GUIMARÃES J. C. F., SEVERO E. A., FELIX JÚNIOR L. A., DA COSTA W. P. L. B., SALMORIA F. T. (2020) Governance and quality of life in smart cities: Towards sustainable development goals, *Journal of Cleaner Production* 253, 119926, <https://doi.org/10.1016/j.jclepro.2019.119926>.
- DEL-REAL C., WARD C., SARTIPI M. (2023) What do people want in a smart city? Exploring the stakeholders' opinions, priorities and perceived barriers in a medium-sized city in the United States, *International Journal of Urban Sciences* 27 (S1), 50-74, <https://doi.org/10.1080/12265934.2021.1968939>.
- DRAGAN A., CREȚAN R., BULZAN R. D. (2024) The spatial development of peripheralisation: The case of smart city projects in Romania, *Area* 56 (1), e12902, <https://doi.org/10.1111/area.12902>.
- EDGE S., BOLUK K., GROULX M., QUICK M. (2020) Exploring diverse lived experiences in the Smart City through Creative Analytic Practice, *Cities* 96, 102478, <https://doi.org/10.1016/j.cities.2019.102478>.

- EUROPEAN COMMISSION (2023) Report on the Quality of Life in European Cities, 2023, Publications Office of the European Union, Luxembourg, <https://doi.org/10.2776/182815>.
- FEKETE K. A. (2023) Budapest Residents' Views on Smart City Developments as Revealed by a Questionnaire Survey, *Modern Geográfia* 18 (2), 17-33, <https://doi.org/10.15170/MG.2023.18.02.02>.
- GIFFINGER R., GUDRUN H. (2010) Smart cities ranking: an effective instrument for the positioning of the cities?, *ACE: Architecture, City and Environment* 4 (12), 7-26, <https://doi.org/10.5821/ace.v4i12.2483>.
- HELBING D., FANITABASI F., GIANNOTTI F., HÄNGGLI R., HAUSLADEN C. I., VAN DEN HOVEN J., MAHAJAN S., PEDRESCHI D., POURNARAS E. (2021) Ethics of Smart Cities: Towards Value-Sensitive Design and Co-Evolving City Life, *Sustainability* 13 (20), 11162, <https://doi.org/10.3390/su132011162>.
- HUNGARIAN CENTRAL STATISTICAL OFFICE (2023) Census 2022, HCSO, Retrieved from: www.ksh.gov.hu.
- IVALDI E., PENCO L., ISOLA G., MUSSO E. (2020) Smart sustainable cities and the urban knowledge-based economy: a NUTS3 level analysis, *Social Indicators Research* 150, 45-72, <https://doi.org/10.1007/s11205-020-02292-0>.
- IVAN L., BEU D., VAN HOOFF J. (2020) Smart and Age-Friendly Cities in Romania: An Overview of Public Policy and Practice, *International Journal of Environmental Research and Public Health* 17 (14), 5202, <https://doi.org/10.3390/ijerph17145202>.
- JI T., CHEN J.-H., WEI H.-H., SU Y.-C. (2021) Towards people-centric smart city development: Investigating the citizens' preferences and perceptions about smart-city services in Taiwan, *Sustainable Cities and Society* 67, 102691, <https://doi.org/10.1016/j.scs.2020.102691>.
- KAUR N., FIGUEIREDO S., BOUCHARD V., MORIELLO C., MAYO N. (2017) Where have all the pilot studies gone? A follow-up on 30 years of pilot studies in Clinical Rehabilitation, *Clinical Rehabilitation* 31 (9), 1238-1248, <https://doi.org/10.1177/0269215517692129>.
- KESHAVARZI G., YILDIRIM Y., AREFI M. (2021) Does scale matter? An overview of the "smart cities" literature, *Sustainable Cities and Society* 74, 103151, <https://doi.org/10.1016/j.scs.2021.103151>.
- KIM B., YOO M., PARK K. C., LEE K. R., KIM J. H. (2021) A value of civic voices for smart city: A big data analysis of civic queries posed by Seoul citizens, *Cities* 108, 102941, <https://doi.org/10.1016/j.cities.2020.102941>.
- KITCHIN R. (2015) Making sense of smart cities: addressing present shortcomings, *Cambridge Journal of Regions, Economy and Society* 8 (1), 131-136, <https://doi.org/10.1093/cjres/rsu027>.
- KODAG S., KODAG A. (2023) Smart cities - spatial planning and disaster risk reduction of Pune city, India, *Disaster Prevention and Resilience* 2, 12, <http://dx.doi.org/10.20517/dpr.2023.11>.

- KRIVÝ M. (2018) Towards a critique of cybernetic urbanism: The smart city and the society of control, *Planning Theory* 17 (1), 8-30, <https://doi.org/10.1177/1473095216645631>.
- KUBINA M., ŠULYOVÁ D., VODÁK J. (2021) Managing Global Smart Cities in an Era of 21st Century Challenges, *Sustainability* 13, 2610, <https://doi.org/10.3390/su13052610>.
- LIGARSKI M., WOLNY M. (2021) Quality of Life Surveys as a Method of Obtaining Data for Sustainable City Development—Results of Empirical Research, *Energies* 14 (22), 7592, <https://doi.org/10.3390/en14227592>.
- LIU Q., ULLAH H., WAN W., PENG Z., HOU L., RIZVI S. S., HAIDERY S. A., QU T., MUZAHID A. A. M. (2020) Categorization of Green Spaces for a Sustainable Environment and Smart City Architecture by Utilizing Big Data, *Electronics* 9 (6), 1028, <https://doi.org/10.3390/electronics9061028>.
- LYTRAS M. D., VISVIZI A., CHOPDAR P. K., SARIRETE A., ALHALABI W. (2021) Information Management in Smart Cities: Turning end users' views into multi-item scale development, validation, and policy-making recommendations, *International Journal of Information Management* 56, 102146, <https://doi.org/10.1016/j.ijinfomgt.2020.102146>.
- MALMQVIST J., HELLBERG K., MÖLLÅS G., ROSE R., SHEVLIN M. (2019) Conducting the Pilot Study: A Neglected Part of the Research Process? Methodological Findings Supporting the Importance of Piloting in Qualitative Research Studies, *International Journal of Qualitative Methods* 18, <https://doi.org/10.1177/1609406919878341>.
- MARCINČZAK S., GENTILE M., STĘPNIAK M. (2013) Paradoxes of (Post)Socialist Segregation: Metropolitan Sociospatial Divisions Under Socialism and After In Poland, *Urban Geography* 34 (3), 327-352, <https://doi.org/10.1080/02723638.2013.778667>.
- MARCINČZAK S., TAMMARU T., NOVÁK J., GENTILE M., KOVÁCS Z., TEMELOVÁ J., VALATKA V., KÄHRIK A., SZABÓ B. (2015) Patterns of Socioeconomic Segregation in the Capital Cities of Fast-Track Reforming Postsocialist Countries, *Annals of the Association of American Geographers* 105 (1), 183-202, <https://doi.org/10.1080/00045608.2014.968977>.
- MENON U. K., GOPALAKRISHNAN S., UNNI C. S. N., RAMACHANDRAN R., POORNIMA B., SASIDHARAN A., ASHIKA M. S., RADHAKRISHNAN N. (2021) Pilot of a questionnaire study regarding perception of undergraduate medical students towards online classes: Process and perspectives, *Journal of Family Medicine and Primary Care* 10 (5), 2016-2021, https://doi.org/10.4103/jfmpc.jfmpc_2141_20.
- MILLS D., PUDNEY S., PEVCIN P., DVORAK J. (2022) Evidence-Based Public Policy Decision-Making in Smart Cities: Does Extant Theory Support Achievement of City Sustainability Objectives?, *Sustainability* 14 (1), 3, <https://doi.org/10.3390/>

- su14010003.
- MORRIS N. S., ROSENBLOOM D. A. (2017) Defining and Understanding Pilot and Other Feasibility Studies, *AJN American Journal of Nursing* 117 (3), 38-45, <https://doi.org/10.1097/01.NAJ.0000513261.75366.37>.
- MUNICIPALITY OF BUDAPEST (2017) SMART BUDAPEST: The Smart City Vision of Budapest, Retrieved from: www.budapest2024.org.
- MUVUNA J., BOUTALEB T., MICKOVSKI S. B., BAKER K., GHOREYSHI S. M., COOLS M., SELMI W. (2020) Information Integration in a Smart City System–A Case Study on Air Pollution Removal by Green Infrastructure through a Vehicle Smart Routing System, *Sustainability* 12 (12), 5099, <https://doi.org/10.3390/su12125099>.
- MYEONG S., PARK J., LEE M. (2022) Research Models and Methodologies on the Smart City: A Systematic Literature Review, *Sustainability* 14 (3), 1687, <https://doi.org/10.3390/su14031687>.
- NAMAZ L., TVERGYÁK K. K. (2023) Uncovering deep place meanings in the context of urban wellbeing: The case study of Budapest, *City and Environment Interactions* 17, 100095, <https://doi.org/10.1016/j.cacint.2022.100095>.
- NUNES S. A. S., FERREIRA F. A. F., GOVINDAN K., PEREIRA L. F. (2021) “Cities go smart!”: A system dynamics-based approach to smart city conceptualization, *Journal of Cleaner Production* 313, 127683, <https://doi.org/10.1016/j.jclepro.2021.127683>.
- OH J. (2020) Smart City as a Tool of Citizen-Oriented Urban Regeneration: Framework of Preliminary Evaluation and Its Application, *Sustainability* 12 (17), 6874, <https://doi.org/10.3390/su12176874>.
- ORTEGA J. L. C., MALCOLM C. D. (2020) Touristic Stakeholders’ Perceptions about the Smart Tourism Destination Concept in Puerto Vallarta, Jalisco, Mexico, *Sustainability* 12 (5), 1741, <https://doi.org/10.3390/su12051741>.
- ORTEGA-FERNÁNDEZ A., MARTÍN-ROJAS R., GARCÍA-MORALES V. J. (2020) Artificial Intelligence in the Urban Environment: Smart Cities as Models for Developing Innovation and Sustainability, *Sustainability* 12 (19), 7860, <https://doi.org/10.3390/su12197860>.
- OZKAYA G., ERDIN C. (2020) Evaluation of smart and sustainable cities through a hybrid MCDM approach based on ANP and TOPSIS technique, *Heliyon* 6 (10), e05052, <https://doi.org/10.1016/j.heliyon.2020.e05052>.
- PERNEGER T. V., COURVOISIER D. S., HUDELSON P. M., GAYET-AGERON A. (2015) Sample size for pre-tests of questionnaires, *Quality of Life Research* 24, 147-151, <https://doi.org/10.1007/s11136-014-0752-2>.
- PIRA M. (2021) A novel taxonomy of smart sustainable city indicators, *Humanities & Social Sciences Communications* 8, 197, <https://doi.org/10.1057/s41599-021-00879-7>.
- POPESCU C. (2014) Deindustrialization and urban shrinkage in Romania. What

- lessons for the spatial policy?, *Transylvanian Review of Administrative Sciences* 42, 181-202.
- QUALTRICS (2023) Sample size calculator, Retrieved from: www.qualtrics.com.
- RACHMAWATI R., REINHART H., ROHMAH A. A., SENSUSE D. I., SUNINDYO W. D. (2024) Smart Sustainable Urban Development for the New Capital City of Indonesia, *Journal of Urban and Regional Analysis* 16 (1), 85-113, <https://doi.org/10.37043/JURA.2024.16.1.4>.
- SHAMI M. R., RAD V. B., MOINIFAR M. (2022) The structural model of indicators for evaluating the quality of urban smart living, *Technological Forecasting and Social Change* 176, 121427, <https://doi.org/10.1016/j.techfore.2021.121427>.
- SHLAPENTOKH V., SHIRAEV E. (eds.) (2002) *Fears in Post-Communist Societies: A Comparative Perspective*, Palgrave, New York.
- SHARIF R. A., POKHAREL S. (2022) Smart City Dimensions and Associated Risks: Review of literature, *Sustainable Cities and Society* 77, 103542, <https://doi.org/10.1016/j.scs.2021.103542>.
- SIMONOFSKI A., HERTOGE E., STEEGMANS M., SNOECK M., WAUTELET Y. (2021) Engaging citizens in the smart city through participation platforms: A framework for public servants and developers, *Computers in Human Behavior* 124, 106901, <https://doi.org/10.1016/j.chb.2021.106901>.
- SMITH M. K., KLICEK T. (2020) Tourism Cities in Post-Communist Countries, in: Morrison A. M., Coca-Stefaniak J. A. (eds.), *Routledge Handbook of Tourism Cities*, Routledge, London, pp. 493-507, <https://doi.org/10.4324/9780429244605>.
- STOIAN C.-A., GROZA O., RUSU A. (2024) Assessing the Viability of Romania's Newly Established Metropolitan Areas, *Journal of Urban and Regional Analysis* 16 (1), 59-83, <https://doi.org/10.37043/JURA.2024.16.1.3>.
- SZAREK-IWANIUK P., SENETRA A. (2020) Access to ICT in Poland and the Co-Creation of Urban Space in the Process of Modern Social Participation in a Smart City—A Case Study, *Sustainability* 12 (5), 2136, <https://doi.org/10.3390/su12052136>.
- SÝKORA L. (2009) Post-Socialist Cities, in: Kitchin R., Thrift N. (eds.), *International Encyclopedia of Human Geography*, 387-395, Elsevier, Oxford, <https://doi.org/10.1016/B978-008044910-4.01072-5>.
- TOLI A. M., MURTAGH N. (2020) The concept of sustainability in smart city definitions, *Frontiers Built Environment* 6, 77, <https://doi.org/10.3389/fbuil.2020.00077>.
- TRENCHER G. (2019) Towards the smart city 2.0: Empirical evidence of using smartness as a tool for tackling social challenges, *Technological Forecasting and Social Change* 142, 117-128, <https://doi.org/10.1016/j.techfore.2018.07.033>.
- TREUDE M. (2021) Sustainable Smart City—Opening a Black Box, *Sustainability* 13 (2), 769, <https://doi.org/10.3390/su13020769>.

- TSENKOVA S. (2014) Planning trajectories in post-socialist cities: patterns of divergence and change, *Urban Research & Practice* 7 (3), 278-301, <https://doi.org/10.1080/17535069.2014.966513>.
- UNITED NATIONS (2015) Transforming our world: the 2030 Agenda for Sustainable Development, Retrieved from: sdgs.un.org.
- VALENCIA-ARIAS A., URREGO-MARÍN M. L., BRAN-PIEDRAHITA L. (2021) A Methodological Model to Evaluate Smart City Sustainability, *Sustainability* 13 (20), 11214, <https://doi.org/10.3390/su132011214>.
- VANOLO A. (2014) Smartmentality: The Smart City as Disciplinary Strategy, *Urban Studies* 51 (5), 883-898, <https://doi.org/10.1177/0042098013494427>.
- VESALON L., CREȚAN R. (2019) "Little Vienna" or "European Avant-Garde City"? Branding Narratives in a Romanian City, *Journal of Urban and Regional Analysis* 11 (1), 19-34, <https://doi.org/10.37043/JURA.2019.11.1.2>.
- VIDIASOVA L., CRONEMBERGER F. (2020) Discrepancies in perceptions of smart city initiatives in Saint Petersburg, Russia, *Sustainable Cities and Society* 59, 102158, <https://doi.org/10.1016/j.scs.2020.102158>.
- WANG C. (H.), STEINFELD E., MAISEL J. L., KANG B. (2021) Is your smart city inclusive? Evaluating proposals from the U.S. Department of Transportation's Smart City Challenge, *Sustainable Cities and Society* 74, 103148, <https://doi.org/10.1016/j.scs.2021.103148>.
- WANG M., ZHOU T. (2023) Does smart city implementation improve the subjective quality of life? Evidence from China, *Technology in Society* 72, 102161, <https://doi.org/10.1016/j.techsoc.2022.102161>.
- ZHU H., SHEN L., REN Y. (2022) How can smart city shape a happier life? The mechanism for developing a Happiness Driven Smart City, *Sustainable Cities and Society* 80, 103791, <https://doi.org/10.1016/j.scs.2022.103791>.

Smart Cities and Quality of Life domains and indicators

Authors	Indicators	Notes
Ivan et al. (2020)	There are eight domains of an age-friendly city, namely: • Social participation • Communication and information • Civic participation and employment • Housing • Transportation • Community support and health services • Outdoor spaces and buildings • Respect and social inclusion	
Oh (2020)	Several studies on citizen-centric urban planning suggested that “Subjective Quality of Life” can be classified into four categories: • <i>Subjective health issues</i> • <i>Subjective safety evaluation</i> • <i>Urban environment</i> • <i>Residential environment (e.g. housing)</i>	Quality of life variables were: • <i>Housing (including facilities and environment)</i> • <i>Urban environment</i> • <i>Health and wellbeing (including physical and mental health)</i> • <i>Safety and convenience</i>
Ortega-Fernandez et al. (2020)	Dimensions of a smart city: • Governance (including public services, taxation, transparency of data) • People (including creativity, social cohesion, qualifications) • Economy (including investment, competitiveness, entrepreneurship) • <i>Living (including housing quality, tourism, cultural facilities, citizen security, social cohesion)</i> • Environment (including pollution, energy efficiency, green buildings) • Mobility (including sustainable transport, traffic control, ICT infrastructure)	
		<i>In their Keyword ranking, ‘quality of life’ is the first.</i>
Ozkaya and Erdin (2020)	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 and ‘Smart Economy’ is ranked second.	<i>Cities which have good scores in the smart economy and smart living also get good scores in the general ranking.</i> <i>The concept of ‘Smart living (quality of life)’ was assessed by seven factors. While individual safety is the most important factor, tourist attraction is the last one.</i>

Authors	Indicators	Notes
Szarek-Iwaniuk and Senetra (2020)	A smart city is characterised by: • sustainable economic development, and • <i>a high quality of life</i> which are driven by: • investments in human and social capital • traditional (transport) • modern (ICT) infrastructure • responsible resource management • social participation	
Braga et al. (2021)	Smart city development depends on six critical pillars: • Smart economy • Smart governance • Smart mobility (including transport) • Smart environment • Smart people • <i>Smart ways of life (associated with locals' lifestyle choices and quality of life)</i>	The most important four pillars are: • People's involvement in constructing an intelligent, informed, educated society • Preserving the environment, managing energy, sustainability • Mobility and transport • Sustainable economic development
Cantuarias-Villesuzanne et al. (2021)	Seven dimensions of the smart city (described by the academic literature): • Smart architecture and technologies • Smart citizens • Smart economy • Smart environment • Smart government • Smart living • Smart mobility	<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> • <i>Security</i> • <i>Education</i> • <i>Healthcare</i> • <i>Tourism</i> • <i>Religion</i>
Ji et al. (2021)	Respondents' preferences about seven dimensions of SC services, including: • smart energy (four questions) • smart environment (six questions) • smart people (six questions) • <i>smart living (seven questions)</i> • smart transport (four questions) • smart safety (four questions) • smart health (four questions) <i>Among these dimensions, smart people and smart living represent the soft domain, and the others, the hard domain.</i>	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.
Kim et al. (2021)	Main topics of citizens' complaints in Seoul: • Health: public health, hygiene, etc. • Economy industry: payments for charges, prices, etc. • Traffic: public transportation, pedestrians, etc.	From 2006 to 2017, the three most important topics were traffic, the environment, and culture.

Authors	Indicators	Notes
	• Culture: sightseeing, cultural experiences, cyber subculture, etc. • Welfare: positive discrimination, labour welfare • Taxes: default, tax collection, etc. • Safety: firefighting, disaster prevention, declaration of emergency, etc. • Female: infant care, multi-children families, etc. • Housing: rentals, housing development, real estate policy, etc.	
Ligarski and Wolny (2021)	The identification of eight areas which, according to the respondents (in 76 cities), have the greatest impact on the quality of life: • <i>Living conditions in the city</i> • Public safety • Education • Housing • Future perspectives • Leisure opportunities • Transport and communication • Working conditions in the city	
Pira (2021)	Indicators for smart sustainable cities: • Socio-cultural (including health, education, culture, safety) • Economic (including housing, jobs, entrepreneurship) • Environmental (including green spaces, pollution, energy use) • Governance (including transport, data monitoring, internet and WiFi)	<i>The smart city 'Living' indicators are useful (adapted from Cohen 2014):</i> • <i>Culture and wellbeing (living conditions, inequality, quality of life ranking)</i> • <i>Health (including life expectancy)</i> • <i>Safety (e.g. crime levels)</i>
Sharif and Pokharel (2022)	The primary goals considered for a smart city project were: • <i>the enhancements in quality of life</i> • economy • transport and traffic • clean and sustainable environment • access to interaction with the government's relevant authorities	
Valencia-Arias et al. (2021)	Smart cities integrate six concepts: (1) smart economy, with high levels of innovation; (2) smart mobility, based on the adoption of sustainable and eco-friendly transportation systems; (3) smart environment, measured as the adequate management of natural resources; (4) smart communities, based on community training and the development of key skills for innovative ecosystems;	The evaluation (for transformation of cities into smart cities) is focused on six dimensions: (1) government (2) mobility (3) sustainability (4) people (5) economy (6) <i>quality of life</i>

Authors	Indicators	Notes
	<i>(5) smart life, a dimension that can be measured using social indicators that reflect the quality of life of citizens;</i> (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)	<i>Dimensions and indicators to measure the quality of smart living:</i> • <i>Health and hygiene</i> • <i>Security</i> • <i>Public education</i> • <i>Social cohesion and participation</i>	<i>Smart living shall encompass innovations concerned with improvement of healthcare, education, and social services as well as the enhancement of citizens' participation (electronic-government projects) which is to have positive effect on the environment, to reduce vulnerability, and to improve safety (Appio et al. 2019).</i>
Zhu et al. (2022)	Main features of a Smart City blueprint: • A city with accessible and secured ICT infrastructures • A city with reliable and efficient physical infrastructures • A city with productive and innovative economy • A city with equal and inclusive society • A city with sustainable and resilient environment • A city with participatory and transparent governance	Happiness Driven Smart City (HDSC) is supposed to have the following characteristics: • A city with <i>efficient and green physical infrastructure</i> • A city with <i>labour-friendly and innovative economy</i> • A city with <i>inclusive and attractive society</i> • A city with <i>sustainable and eco-friendly natural environment</i>
Chen and Chan (2023)	The five domains identified were the following: (1) smart environment (SCQOL-ENV), which includes seven items related to environmental and sustainability issues; (2) smart people (SCQOL-PPL), which includes six items related to social welfare and personal development; <i>(3) smart livelihood (SCQOL-LIVE), which includes seven items measuring an individual's way of life and community feelings, image and pride;</i> (4) smart economy and economic policy (SCQOL-ECON), which includes five items related to the economic impact and government support of SCD; (5) smart mobility (SCQOL-MOB), which includes four items measuring the city's public transportation, infrastructure and safety.	

**The references to smart living and quality of life are highlighted and presented in Italic.*