Assessing quality of life in German, French, Italian and Polish smart cities: Identifying the need for further development

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Abstract
The concept of smart cities has gained significant attention in recent years, as urban areas worldwide seek to leverage technology and innovation to enhance their residents' quality of life. It is agreed that one of the core objectives of the smart cities is the optimisation of quality of life and resident satisfaction. This research endeavours to explore the relationship between smart city rankings and quality of life in four European countries: Germany, France, Italy, and Poland. In doing so, we encountered a multitude of complexities and nuances. While the concept of smart cities holds great promise for urban development and enhancing residents' well-being, the current methodologies for comparing smart cities and assessing quality of life require refinement and standardization. Addressing these challenges will not only advance our understanding of the impact of smart city initiatives but also pave the way for more effective urban planning and policy decisions to improve the overall quality of life in urban areas.

Keywords: smart city, quality of life, urban development, ranking, innovation.

1. Introduction
The emergence of smart cities, characterized by their integration of cutting-edge technology, innovative urban planning, and sustainable development, has garnered significant attention as a transformative approach to urban living. The promise of enhanced quality of life for residents lies at the heart of the smart city concept. However, assessing the actual impact of smart city initiatives on residents' well-being poses a complex challenge. This research seeks to delve into the intricate relationship between smart city rankings and the quality of life in four European countries, namely Germany, France, Italy, and Poland.

While the idea of smart cities holds great potential for urban development and the improvement of residents' lives, it is crucial to critically examine the methodologies employed to assess these benefits. In the quest to measure the correlation between smart city attributes and quality of life, we encounter several formidable obstacles. These challenges include the inherent difficulty in accurately ranking smart cities, the limited availability of comprehensive and standardized data, and the nuanced nature of quality of life itself.

This study endeavours to shed light on these intricacies by navigating the complexities of evaluating quality of life in smart cities and elucidating the limitations of existing methodologies. In doing so, it underscores the need for further development in this field to refine measurement criteria and data collection techniques. The ultimate goal is to facilitate a more nuanced understanding of how smart city initiatives influence the well-being of urban residents and to guide future urban planning and policy decisions accordingly.

2. Literature Review

In the pursuit of understanding the intricate relationship between smart cities and the quality of life of their residents, it is imperative to embark on a comprehensive exploration of the existing body of literature.

Smart cities have emerged as a focal point for urban planners, policymakers, and researchers alike. They represent a paradigm shift in urban development, emphasizing the infusion of digital technologies, data-driven decision-making, and sustainable practices into urban environments. These innovations hold the potential to revolutionize urban living, enhancing efficiency, sustainability, and residents' overall well-being. Additionally, as demonstrated by Fabregue et al. [1] Smart Cities have a higher capacity of attracting and retaining highly educated individuals. However, the translation of smart city concepts into tangible improvements in quality of life is a multifaceted and dynamic process and involves governance of targeted policies [2]. The approach of smart city development towards citizen centrality and government-to-citizen-to-government relationships has transitioned from a technology-driven perspective, motivated by economic gain, to a simple focus on citizens [3]. Citing the establishment of smart cities with regards to citizen centrality, Engelbert et al. [4] accentuate the importance of involving citizens in the governing process.

Citizen centricity, a sociocultural concept, emphasizes the use of digitalized resources to enhance the well-being of individuals [5], [6]. Unlike a technology-centric approach, a citizen-centric approach places the demands and interests of citizens at the center of smart government [7]. This strategy has been utilized extensively in public policy and e-governance [8]. Citizens have evolved from “passive sensors” or consumers to active co-creators of their living surroundings [9]. They are the most significant internal element of smart city development [3], [10], [11] since they are the primary users and service targets in the smart city community [12].

As we will see in the next section, the principle of citizen centrality is at the core of initiatives within the European Union, being a key element to improve services – and smart applications in general – that would consequently enhance the overall quality of life of the city [13].

2.1. Smart Cities in the European Union

In the European context, the amount of smart city research recorded in academic literature was low before 2010 [14]. Only after the emergence of smart city schemes supported by the European Commission [15], was there an increase in scholarly papers and publications related to the subject. Additionally, the European Commission has been providing financial support and investing in smart city programmes since its inception. In 2016, 34 specialist projects were launched in the European Union [16].

Barcelona was among the first cities to receive the Smart City designation. In 2011, the municipality focused on technology transformation and experimentation by introducing new technologies. The aim was to improve city management, facilitate economic growth and enhance the welfare of citizens [17].Technology vendors benefiting from the top-down approach was one of the outcomes [18].

Among the implemented undertakings were e-government-driven approaches to service management and involving citizens, projects promoting sustainable growth in energy, mobility, and smart lighting, the inception of a public Wi-Fi network, and the evolution of a district named "22@" into a living laboratory [17], [19].

Moreover, as of January 2012, Lee et al. [20] recorded a total of 143 extant smart city schemes, with forty-seven located in Europe and thirty in the United States. To look at an Asian comparison, smart cities have been included in government plans for six provinces and fifty-one cities in China, as reported by the Chinese Smart Cities Forum [21].

The literature includes different initiatives and applications related to significant cities such as Santander, Manchester, and London [22], [23]. Primarily, sensor applications and network infrastructure for various categories are referenced. Furthermore, WiFi or IoT networks, parking solutions, waste management, traffic control, and monitoring air quality are a few other examples.

Jonek-Kowalska and Wolniak [24]. undertook an extensive study of 287 Polish cities and found that the mediocre living standards of the citizens, unstable financial condition of cities, and adverse demographic trends have made the realization of smart cities unfeasible for the majority of these places. As a result, the key areas of emphasis are human capital and social infrastructure [25]. Moreover, this analysis may expose the contrast and variety between cities receiving financial aid and those not, with a direct correlation to their size. As a result, municipal actions are associated with national and European financial sources, while official city documents [26] do not have a strategic plan for transforming into a smart city. Although urban areas have incorporated a variety of smart city initiatives into their

digital strategy, their implementation into daily operations remains limited [27]. Government entities commonly support these aforementioned efforts which are typically subsidised and executed via temporary collaborative alliances. Therefore, scalability is often viewed as a sizeable concern [28].

In their study on the implementation of the smart city concept in the Czech Republic, Smékalová and Kučera [29] found that investment activity was more concentrated in larger cities. This finding confirms the positive correlation between the city size and the European funds absorption capacity. Therefore, municipalities have given priority to specific apps and themes over the promotion of holistic plans in order to make the most of their smart city initiatives. Finland [30], Romania [31], Slovakia [32], Poland, and Ukraine [33] are just a few examples of countries that have prioritised initiatives to advance their information and communication technology infrastructures and electronic governance. Municipalities have been placing emphasis on initiatives pertaining to the advancement of information and communication technology infrastructures and electronic governance [34]. However, for nations like Hungary, the subject matter has not yet made any substantial transformations or influenced urban policy practices [35]. A differentiation is also made between the regional and national levels, for instance, Sweden, which has invested in a national digitisation council to assess if regional trials could be progressed [36].

Cities in general face growing challenges in enhancing their competitiveness for various reasons. The field of urban planning explores various strategic initiatives, develops novel approaches and tools, all aimed at guiding cities to better position themselves in the competitive urban landscape. An interesting outcome of these efforts is the surge in popularity of city rankings. The definition itself of “smart city” might be ambiguous due to its inherent challenges of development (e.g., data security, privacy, et cetera) that might make it less “intelligent” than the expected outcome of smart city projects [37].

Nevertheless, there is evidence suggesting that the public's focus on city rankings is primarily fixated on the rankings themselves, often overlooking their true significance [38].

As the multifaced and variegated smart-city-landscape reveals – even by focusing only on the European scenario [14], categorizing and ranking smart cities is consequently not only a complex task itself [39], but also intrinsically problematic in terms of comparison due to a lack of standardisation [40]. This will constitute one of the main challenges of our study, as explained in section 3.1.3.

2.2. Increasing Citizen Quality of Life through Innovation

Caragliu and Del Bo [41] found that applying smart city policies in European cities enhances urban innovation. Their research, which examined over three hundred towns, demonstrates that implementing these policies correlates with positive outcomes for the cities. Other scholars, however, contend that the development of smart cities may not necessarily yield positive results for urban areas. Lam and Ma [42] outline several concerns, including system vulnerability, personal privacy breaches, information islands, and the digital divide, that represent significant challenges to the advancement of smart cities. In addition, Grossi and Pianezzi [43] assert that smart city development may result in the diversion of resources and focus away from other crucial urban matters. Therefore, the success of smart city development cannot solely rely on technological innovation. Crucially, a well-designed policy framework that integrates people's perspectives is necessary. Customising these criteria accordingly is paramount.

Defining and measuring the success of smart city development is challenging; Albino et al. [44]attempted to establish performance criteria for evaluating smart city development and proposed that these measures should align with each city's vision and objectives.

Although enhancing citizens' quality of life (QOL) in economic, social, cultural, educational, and recreational domains is a principal objective of smart city development [44], its impact on individual citizens' lives (i.e., at the micro level) requires thorough investigation.

Research assessing the influence of smart city development on residents' QOL typically concentrates on objective metrics as a measure of citizens' QOL. These objective metrics are often infrastructure or environmental improvement measurements [45]. However, the literature largely overlooks citizens' subjective opinions regarding these objective QOL metrics. It remains uncertain whether inhabitants of smart cities rate their quality of life higher than those in non-smart cities [46]. The varying perceptions of the impact of smart individuals who experience a positive effect of smart city development on their QOL are likely to show more backing towards future projects.

Given text adheres to the principles and lacks context. As telecommunications, buildings, healthcare, and education are utility-based services significantly affecting citizens' daily lives, the two primary objectives of smart city development are to optimise infrastructure to better meet citizens' needs and to enhance citizens' quality of life [47]. Thus, the improved version is: Therefore, it is crucial to measure QOL for the success of smart city development [48]. The term "smart participation"

refers to the participation of multiple entities, including the government, commercial enterprises, and the public, in the development of smart cities [49]. In contrast, previous studies have centred around citizens' service requirements. On the other hand, prior research has emphasised the services needed by citizens. Citizens are essential to the development of smart cities as they are the end-users of smart services and offer valuable feedback about their efficacy [50]. However, there has been little investigation of this area in earlier research on smart city development.

Capdevila and Zarlenga [51] and Dumay [52] argue that smart cities are built upon the combination of human and social capital, along with access to information and communication technology infrastructure. This combination enables economic growth, improves the well-being of citizens and enhances their quality of life. Albino et al. [44] argue that the configuration of a smart city impacts the standard of living of its citizens, by creating informed, educated and engaged inhabitants.

To further investigate this topic, more studies are necessary. In Section 3, we will analyse data to attempt establish a correlation between recognised smart cities and their quality of life

2.3. The City's "Smartness" and Quality of Life

Before proceeding to data analysis, in this Section it is paramount to review current literature on the correlation between a city "smartness" and its higher quality of life. Additionally, to have a complete understanding of the topic, we will go through the main issues surrounding the evaluation of quality of life (QOL) in general.

Objective and subjective factors can be used to quantify quality of life [53]. Objective QOL primarily represents the physical circumstances of life, including financial wealth, social position, health, degree of education, political voice, living conditions, and environmental factors [54], [55]. Subjective QOL is primarily comprised of two domains: long-term cognitive evaluations of living situations and short-term emotional responses to life events. The former is mostly determined by people's overall life satisfaction, whereas the latter represents their real feelings, such as pleasure, anxiety, depression, and sadness [55]. This is comparable to subjective happiness [56]. In empirical investigations, subjective quality of life emphasizes happiness, demonstrating the predominance of good impacts over negative emotions [54], whereas subjective well-being differentiates between positive and negative emotions.

Several research have investigated the effects of smart city development on subjective quality of life. Using data from Eurostat's Urban Audit Perception Survey

from 23 Central and Eastern European cities, Stankovi'c et al. [57] calculated a composite indicator (infrastructure, liveability and housing conditions, environment, employment and finance, governance, urban safety, trust and social cohesion) to measure smart city performance and concluded that there was a weak correlation between city ranking based on perceived smart performances and life satisfaction of citizens.

Vàzquez et al. [58] analysed the gaps between the current (actual perception) and ideal (the importance of each item to improving citizens' QOL) urban involvement in these six smart dimensions and revealed the contribution of smart city development to citizens' QOL using survey data from 272 college students in Spain. Using survey responses from 428 residents of a smart city in China and the structural equation model, Yu et al. [59]concluded that perceived smart city development (smart infrastructure, smart public service, smart public administration, and smart environmental protection) improves residents' emotional well-being primarily by increasing convenience.

The findings imply that the development of smart cities has a positive impact on the quality of life of their inhabitants. Moreover, smart transportation, smart economics, and smart lifestyle contribute to an increased willingness among citizens to support future smart city initiatives. Additionally, Zhu et al. [60] have introduced a Happiness-Driven Smart City model, comprising bottom-layer components, medium-layer features, and top-layer objectives, that is grounded in an objective perspective. By conducting a case study on Manchester's smart city initiatives, its efficacy has been proven.

Past research, which evaluated smart city progress, primarily relied on questionnaires. These questionnaires, however, don't always align with actual progress made, and consequently, lacking are studies on how objective smart city growth correlates with subjective quality of life. These questionnaires, however, don't always align with actual progress made, and consequently, lacking are studies on how objective smart city growth correlates with subjective quality of life. Research has focused primarily on smart performance, including smart ranking and smart dimensions, while largely neglecting smart city investment, which could provide more valuable insights for smart city practices. Furthermore, previous studies have typically evaluated quality of life using a composite indicator or a perceived relevance or satisfaction of individual questionnaire items, rather than addressing both long-term life satisfaction and short-term emotions simultaneously. Insufficient information is available for future SCI to enhance people's quality of life, as subjective QOL is multidimensional, and different variables may provide radically different findings. In addition, the macro environment can also affect a

person's subjective QOL, although these studies have been conducted at the city or individual level, and few research projects have included both the macro and micro levels.

Previous studies have shown the positive correlation between education and individual happiness and life satisfaction. Additionally, the contribution of human capital to pleasure and life satisfaction is observable in both regional and metropolitan areas. Empirical evidence from Florida et al. [61] and Glaeser et al. [62] on metropolitan regions in the United States has revealed the beneficial impact of local human capital levels, which are chiefly manifested in the following indicators. Firstly, the development of human capital contributes to the creation of a secure, all-encompassing, and low-crime urban environment, which can have a directly positive impact on the mental wellbeing and overall satisfaction of individuals. Individuals with a higher level of education are more cognizant of the threats of environmental contamination and play an active role in environmental conservation [63]. Moreover, they are more accepting of diversity and less likely to engage in criminal activities [64]. Secondly, an elevated degree of regional human resources can enhance the standards of public amenities, thereby augmenting personal contentment and well-being.

Individuals with higher levels of education tend to be more attentive to public services, which in turn allows them to better influence local governments to provide better services [65], [66]. Conversely, a city with a higher level of human capital enabling economic growth may generate more tax revenue and thus be able to afford better public infrastructure [65]. Thirdly, a concentration of individuals with higher education and greater abilities will facilitate enterprise agglomeration due to reduced firm searching costs for talent and improved firm-worker matching efficiency, leading to the creation of additional employment opportunities [65]. Improved employment prospects can additionally enhance subjective quality of life, particularly for those with lower skills and education [67]. Finally, educated individuals are more politically engaged [68]. Not only can citizens enhance the quality of governmental decision-making but also they can elect government leaders who reflect the majority's will and do practical things for the public. This enables them to more efficiently solve public problems and accomplish significant civic objectives. These changes in political conduct are advantageous for establishing a stable and democratic society, contributing to a greater sense of ownership and well-being among the populace [68].

Research based on findings from China [65] and the United States [61] indicates that adverse human capital externalities can reduce the happiness and life satisfaction of individuals. When surrounded by highly qualified or competent

individuals with high salaries or impressive occupations, a person may experience stress or a decrease in happiness due to social comparison. This is particularly true for East Asians, who tend to use those superior to themselves as benchmarks [65]. A high concentration of human capital can lead to an escalation in housing expenses, posing challenges for individuals seeking homeownership, which is coveted in Chinese culture upon marriage. This not only engenders apprehension and discontent for unmarried young adults (primarily men) but also distresses their parents, who fret over providing shelter for their children [61], [65].

The enhancement of quality of life is a crucial feature for the development of smart cities [69]– [70], [71], [72]. However, as the concept of smart cities is still fairly recent, there are several research gaps regarding the factors that impact the quality of life of citizens. Nilssen [73] suggests that the notion of smart cities is somewhat enigmatic owing to its complex nature, which generates both optimism and doubt. Shen et al [74] have found that there are limited studies investigating the consequences of policy initiatives employed in smart cities. In relation to the concept of smart cities and their correlation with quality of life, the research already conducted is of noteworthy relevance [75] [76] [77] [78] [79]. These studies have all underlined the importance of quality of life as a fundamental element for the advancement of smart city development. De Jong et al. [80] and Wolfram [81]suggest that there is a lack of research on the impact of smart city initiatives on the quality of life of residents.

Recently, a study conducted by Wang and Zhou [82]analysed three key indicators to assess subjective quality of life: life satisfaction, the frequency of experiencing positive emotions, and the frequency of experiencing negative emotions such as depression. The results of the study revealed that information and communication technology had a detrimental effect on both life satisfaction and the frequency of positive emotions but did not have a significant impact on negative emotions. Conversely, human capital had a positive influence on life satisfaction and the frequency of positive emotions but was associated with a decrease in the frequency of negative emotions. Moreover, the study found that both ICT and human capital could influence subjective QOL through their effects on perceived government corruption and government performance. Finally, the influence of investments in smart cities on subjective QOL varied significantly depending on factors such as age and education level. The study suggests policy recommendations aimed at enhancing subjective QOL through the effective utilization of smart investments.

3. Data Analysis

This section delves into the heart of the research, where we examine patterns, correlations, and insights that shed light on the impact of smart city initiatives on

the well-being of individuals within urban environments. We will leverage a diverse set of data sources, including smart city rankings, quality of life indices, demographic and socioeconomic data, and residents' subjective perceptions.

3.1. Methodology

We have outlined a methodology to assess the correlation between Quality of Life in Smart Cities and their Smart City Ranking with the data at our disposal.

3.1.1. Data Collection

We gathered data on smart city rankings from renown sources such as international organizations, research institutions, and governmental reports. We ensured that the selected rankings encompass a range of criteria, including technology adoption, infrastructure development, and sustainability initiatives. Particularly, we elaborated on the IMD Smart City Observatory 2019 (International Institute for Management Development, 'Smart City Index Report', IMD, 2019. Accessed: Nov. 15, 2023. [Online]. Available: https://www.imd.org/research-knowledge/competitiveness/reports/imd-smart-city-index-2019/), 2020 [84], 2021 [85], 2023 [86] reports; the IESE Business School 2022 *Cities in Motion Index* report [87]; and the Technische Universität Wien *europeansmartcities 3.0* project financed by the European Commission (EUSC) [88].

The IMD annual series assesses the perceptions of residents – surveying around 100 of them – on issues related to structures and technology applications available to them in their city. Then, dividing cities in quartiles depending on their Human Development Index (HDI), ranks them globally. The main issue encountered with this categorisation is the absence of strict objective criteria or in-depth investigation on factual programmes, instead, the IMD report bases itself on citizen subjective perceptions. Additionally, there is an understandable problem related to the little surveyed sample and a lack of transparency about who is being interviewed (e.g., age, social status, residency within the city, et cetera). Finally, we reckon that it is a reputable ranking, especially within the European Union, to assess general programmes.

The IESE report proposes a conceptual model based on the study of a large number of success stories and in-depth interviews with city leaders, businesspeople, academics and experts involved in city development. The model proposes a set of steps that span diagnosis of the existing situation, the development of a strategy, and its subsequent implementation. For the matter of our research. the main issues encountered in this report are related to dependable variables such as the interviews and the future programmes, upon which a lot of emphasis is placed.

Finally, the latter EUSC project identified 77 cities out of 1,600 in the EU27+NO+CH area and for each one of them evaluated 6 key components of smart cities (i.e., Smart Economy, Smart Mobility, Smart Environment, Smart People, Smart Living and Smart Governance) depending on actual projects put in place. The main issue with this ranking is that it is quite old.

As we can see, these rankings are very different in terms of collection of data, categorization and assessment, showing the inherent difficulty of qualifying smart cities.
Subsequently, we collected data on quality-of-life indices or satisfaction levels in the selected cities, ensuring that data covers a variety of quality-of-life dimensions, including healthcare, education, safety, environmental quality, and social cohesion. We used NUMBEO quality of life index [89]and data from the European Commission *Report on the Quality of life in European cities* (henceforth "EU Report") which are both based on citizen surveys [90].

3.1.2. Data Analysis

First of all, we categorized cities as smart cities if they were cited at least once in one of the mentioned reports. Particularly, we assigned 1 "smart city point" per citation in the reports and created a Smart City Indicator (SCI) by summing each citation. However, considering that each report conducted peculiar and different surveys, for the IMD Smart City Reports we assigned only 1 "smart city point" even if the city was mentioned more than once. Additionally, we opted to not consider the actual ranking of the city, given that they were not comparable between them.

We then assigned either a NUMBEO or EU Report quality of life indicator (respectively QOLIn or QOLIe) to as many cities as possible for each country, taking into consideration both smart cities and non-smart cities.

Finally, we performed a statistical analysis to determine the extent of correlation, if any, between smart city rankings and quality of life indicators. We used Pearson correlation coefficients to identify relationships and potential influencing factors between quality of life (either from NUMBEO – QOLIn or EU Report – QOLIe) and smart city indicators. Then, we looked at the correlation between quality of life and GDP per capita to evaluate any difference or similarity between the first and second Pearson ρ. The hypothesis of SCI influencing quality of life more than GDP is verified if:

$$\rho 1 = \frac{cov(SCI,QOLIe)}{\sigma(SCI)\sigma(QOLIe)} > \rho 2 = \frac{cov(GDP,QOLIe)}{\sigma(GDP)\sigma(QOLIe)} \quad (1)$$

And

$$\rho 1 = \frac{cov(SCI,QOLIn)}{\sigma(SCI)\sigma(QOLIn)} > \rho 2 = \frac{cov(GDP,QOLIn)}{\sigma(GDP)\sigma(QOLIn)} \quad (2)$$

Where:

SCI – Smart City Indicator equal to the sum of citations in smart city reports
QOLIe – Quality of Life Indicator with EU Report data
QOLIn – Quality of Life Indicator with NUMBEO data
GDP – Gross Domestic Product per capita

3.1.3. Challenges and Limitations

Most of the challenges acknowledged and faced by our study are related to data availability. The first is the outright lack of data on the matter: with regards to quality of life, we have experienced the absence of data at the city/NUTS3 level that could be standardized enough to be comparable – even taking into account cultural-macro differences. Whereas the main issues with smart city rankings are the lack of standardisation and the subjectivity of some criteria. In fact, we faced the difficulty of calculating and weighting our SCI index on the actual smart city rank and opted to sum how many times the city was considered to be a smart city.

3.2 Germany

Germany is the country of which we were able to retrieve the most data, including 10 major cities. As it can be seen in Table 1. below, we combined both NUMBEO and EU Report data with our SCI derived from smart city reports. Finally, we were able to gather the 2021 GDP for each one of the cities.

We then proceeded to calculate the Pearson correlation for EU Report data with SCI and compared it with the Pearson correlation between GDP per capita and QOLIe. As we can see from Table 2. below, there is a higher correlation between QOLIe and SCI (0.48307), rather than QOLIe and GDP (0.34236). However, when using NUMBEO data to make the same calculations, the result is very much the opposite: the correlation between SCI and QOLIn is negative (-0.21508), meaning that smart cities do not contribute to the quality of life registered. Additionally, and most notably, the NUMBEO quality of life index is almost entirely correlated to the GDP per capita of the city (0.93238).

Taken into consideration all the limitations of the research and all the future developments needed, we can conclude that in the German scenario, quality of life is more related to the overall wealth of the city, here represented here by GDP per capita.

Table 1. Germany datasheet

City	Cities in Motion 2022	IMD 2019	IMD 2020	IMD 2021	IMD 2023	EUSC 2014	Smart City Index (SCI)	NUMBEO Quality of Life (QOLIn)	EU Report Satisfaction of Living (QOLIe)	2021 city GDP per capita
Dortmund							0		95.86%	€ 41,880.00
Essen							0		89.85%	€ 46,673.00
Hamburg	17		6	8	11		2	172	96.57%	€ 70,620.00
Leipzig							0		95.85%	€ 39,695.00
Munich	11		17	15	20		2	182	95.73%	€ 86,529.00
Rostock							0		93.58%	€ 40,656.00
Stuttgart	48						1	179		€ 87,513.00
Berlin	5	19	21	21	33		2	162		€ 45,074.00
Cologne	44						1	169		€ 61,845.00
Frankfurt	41						1	178		€ 97,270.00

Source: See Section 3.1.1.

Table 2. Germany results

INDEX	Proof (SCI/QOLIe)	Counterproof (GDP/QOLIe)	Proof (SCI/QOLIn)	Counterproof (GDP/QOLIn)
PEARSON	0.48307	0.34236	-0.21508	0.93238

Source: Author's own calculation

3.3. France

For France we were able to retrieve data from 6 major cities. As it can be seen in Table 3. below, we combined EU Report data with our SCI derived from smart city reports. Finally, we were able to gather the 2016 regional GDP for each one of the cities.

We then proceeded to calculate the Pearson correlation for EU Report data with SCI and compared it with the Pearson correlation between GDP per capita and QOLIe. As we can see from Table 4. below, the result highly invalidates the hypothesis of section 3.1.2: the correlation between SCI and QOLIe is almost completely negative (-0.82554), meaning that smart cities do not contribute at all to the quality of life registered. Additionally, the correlation between QOLIe and regional GDP per capita is also (less) negatively correlated (-0.39433). This is due mostly to the "Paris" variable, which has a very high regional (Île-de-France) GDP per capita ($ 69,423.00) and a comparably low satisfaction of living (85.43%).

Taken into consideration all the limitations of the research with regards to the lack of data and the "Paris" case, it is unpractical to make final conclusions. However, it can be stated that – considering Table 3. data – in France the EU Report satisfaction of living is generally more linked to the regional GDP, rather than the SCI.

Table 3. France datasheet

City	Region	Cities in Motion 2022	IMD 2019	IMD 2020	IMD 2021	IMD 2023	EUSC 2014	Smart City Index (SCI)	EU Report Satisfaction of Living (QOLIe)	2016 regional GDP per capita
Rennes	Brittany							0	96.77%	$ 35,272.00
Bordeaux	Nouvelle-Aquitanie				68	78		1	92.73%	$ 35,000.00
Strasbourg	Grand Est							0	90.63%	$ 34,249.00
Lille	Hauts-de-France	84			82	84		2	87.68%	$ 32,363.00
Paris	Île-de-France	3	39	47	49	46		2	85.43%	$ 69,423.00
Marseille	Provence-Alpes-Côte d'Azur	76		83	91	101		2	81.98%	$ 38,213.00

Source: See Section 3.1.1.

Table 4. France results

INDEX	Proof (SCI/QOLIe)	Counterproof (GDP/QOLIe)
PEARSON	-0.82554	-0.39433

Source: Author's own calculations

3.4. Italy

As for France, we were able to retrieve data for 6 major Italian cities. As it can be seen in Table 5. below, we combined EU Report data with our SCI derived from smart city reports. Finally, we were able to gather the 2015 metropolitan GDP for each one of the cities.

We then proceeded to calculate the Pearson correlation for EU Report data with SCI and compared it with the Pearson correlation between GDP per capita and QOLIe. As we can see from Table 6. below, the result once again invalidates the hypothesis of section 3.1.2: the correlation between SCI and QOLIe is almost neutral (-0.02634), meaning that smart cities do not directly contribute to the quality of life registered. Moreover, the correlation between the EU report overall satisfaction of living and regional GDP per capita is significantly positively correlated (0.78918).

These results are mostly due to the well-renown divide between Northen and Southern Italy. In fact, when taking into consideration Southern cities (notably Naples and Palermo) these register both a low QOLIe (70.01% and 62.83% respectively) and low GDP per capita (€ 18,149.00 and € 18,229.00 respectively); however, when it comes to SCI, Naples has been qualified as smart city, negatively impacting the SCI/QOLIe Pearson. Additionally, the capital of Italy, Rome, has the highest SCI (2) but a comparatively low satisfaction (74.26%), negatively impacting as well the SCI/QOLIe Pearson.

Taken into consideration all the limitations of the research with regards to the lack of data and to the issues regarding smart city ranking/categorization, it can be stated that – after recognising a discrepancy between Southern and Northen Italy, as well as a need to better evaluate the SCI – in Italy the EU Report satisfaction of living is much more correlated to the overall wealth of the city, represented here by the GDP per capita.

Table 5. Italy datasheet

City	Cities in Motion 2022	IMD 2019	IMD 2020	IMD 2021	IMD 2023	EUSC 2014	Smart City Index (SCI)	EU Report Satisfaction of Living (QOLIe)	2015 metropolitan GDP per capita
Bologna		41	50	48	51		1	92.40%	€ 38,918.00
Verona							0	92.57%	€ 31,858.00
Turin	97						1	87.34%	€ 30,304.00
Rome	65	97	97	111	122		2	74.26%	€ 34,625.00
Naples	122						1	70.01%	€ 18,149.00
Palermo							0	62.83%	€ 18,229.00

Source: See Section 3.1.1.

Table 6. Italy results

INDEX	Proof (SCI/QOLIe)	Counterproof (GDP/QOLIe)
PEARSON	-0.02634	0.78918

Source: Author's own calculations

3.5. Poland

For Poland we have a clear limitation in terms of data: we were able to retrieve QOL data only from 4 cities. As it can be seen in Table 7. below, we combined both

NUMBEO and EU Report data with our SCI derived from smart city reports. Finally, we were able to gather the 2021 regional GDP for each one of the cities. We then proceeded to calculate the Pearson correlation for EU Report data with SCI and compared it with the Pearson correlation between GDP per capita and QOLIe. As we can see from Table 8. below, the result invalidates the hypothesis of section 3.1.2: the correlation between SCI and QOLIe is negative (-0.65667), meaning that being smart cities does not contribute at all to the quality of life registered. However, the correlation between the EU report overall satisfaction of living and regional GDP per capita is also (less) negatively correlated (-0.194). This is due mostly – as for the French scenario – to the "Warsaw" variable, which has a very high regional GDP per capita (€ 33,200.00) and a comparably low satisfaction of living (92.17%).

When using NUMBEO data to make the same calculations, the result differ but signal the same tendency as above: the correlation between SCI and QOLIn is negative (-0.22661), meaning that smart cities do not contribute to the quality of life registered. Additionally, and most notably, the NUMBEO quality of life index is positively correlated to the GDP per capita of the city (0.33044).

Taken into consideration all the limitations of the research with regards to the lack of data and the "Warsaw" case, it can be stated that – considering Table 7. data – in Poland the EU Report satisfaction of living and the NUMBEO quality of life index are more linked to the regional GDP, rather than the SCI.

Table 7. Poland datasheet

City	Region	Cities in Motion 2022	IMD 2019	IMD 2020	IMD 2021	IMD 2023	EUSC 2014	Smart City Index (SCI)	EU Report Satisfaction of Living (QOLIe)	2016 regional GDP per capita
Gdansk	Pomerania							0	139.6	97.16%
Bialystok	Podlaskie						53	1		93.77%
Warsaw	Warsaw	62	14	48	41	44		2	137.8	92.17%
Krakow	Lesser Poland		47	69	76	79		1	132	89.77%

Source: See Section 3.1.1.

Table 8. Poland results

INDEX	Proof (SCI/QOLIe)	Counterproof (GDP/QOLIe)	Proof (SCI/QOLIn)	Counterproof (GDP/QOLIn)
PEARSON	-0.65667	-0.194	-0.22661	0.33044

Source: Author's own calculation

4. Conclusions

The primary challenges identified in this research include the difficulty in ranking smart cities accurately, the paucity of comprehensive and standardized data, and the complexities involved in evaluating quality of life in a holistic manner. Smart city rankings, often relying on a variety of factors such as technology adoption, infrastructure development, and sustainability initiatives as perceived by citizen, do not consistently correlate with residents' overall satisfaction and well-being. This discrepancy poses a substantial obstacle to drawing meaningful conclusions about the impact of smart city initiatives on quality of life.

Moreover, the lack of uniform data collection and reporting across different cities and countries further complicates the comparative analysis. Quality of life assessment encompasses a wide range of subjective and objective indicators, including but not limited to healthcare, education, safety, environmental quality, and social cohesion. The absence of standardized metrics and the inconsistency in data availability hinder researchers' ability to make accurate cross-city and cross-country comparisons.

In light of these challenges, this study underscores the necessity for further development in the field of smart city research. To facilitate a more comprehensive and reliable assessment of quality of life in smart cities, there is a pressing need for the establishment of universally accepted measurement criteria and data collection methodologies. Additionally, a more nuanced approach to evaluating the multifaceted nature of quality of life, considering residents' perceptions and experiences, should be incorporated into future research endeavours.

Our investigation began with a literature review regarding QOL and smart cities, revealing afterwards that the conventional metrics used to assess these cities do not consistently align with the actual quality of life experienced by residents. The disconnect between technological advancement perceived by citizen and the actual well-being underscored the limitations of existing ranking methodologies, signalling a need for refinement and revaluation.

Simultaneously, our exploration of quality-of-life assessment brought to light the multifaceted nature of well-being. While objective indicators such as healthcare, education, and environmental quality provide important insights, they only tell part of the story. Residents' subjective perceptions and experiences constitute an equally vital aspect of quality of life, one that often eludes quantitative measurement.

As we ventured into data analysis, statistical calculations unveiled intriguing correlations and disparities. The literature review presented in this study suggested

that while smart city initiatives hold the potential to enhance certain aspects of quality of life, when analysing data, it is revealed that they are not a guaranteed panacea for all urban challenges. The findings emphasized the need for a more nuanced understanding of the interplay between technology-driven urban development and residents' actual well-being.

Our hypothesis was invalidated in all 4 country scenarios, with the exception of the German SCI/QOLIe Pearson correlation. Particularly, we found that in most cases both the NUMBEO quality of life or the EU Report overall satisfaction of living were either positively or more correlated to GDP per capita rather than the QOLIe/QOLIn. Taking into consideration the limits and challenges faced, we found a tendency for QOL being increasingly correlated to the actual wealth of the city, rather than to being a “smart” one.

Throughout our journey, we encountered challenges, from data availability and standardization issues to the inherent subjectivity of quality-of-life assessment. These challenges, though formidable, underscored the complexity of the topic and illuminated avenues for future research and refinement.

In conclusion, this study contributes to the evolving discourse on smart cities and quality of life by highlighting the need for further development and more comprehensive methodologies. While the promise of smart cities remains tantalizing, our study underscores the importance of not only advancing technological infrastructure but also crafting policies and urban planning strategies that prioritize the diverse well-being of urban residents.

As we envision the cities of the future, it is imperative that we continue to explore the intricate balance between innovation and inclusivity, between digital advancement and the human experience. By doing so, we can forge a path toward smarter, more equitable, and more liveable cities that truly enhance the quality of life for all their inhabitants.

References

[1] B. Fabregue, L. Portal and C. Cockshaw, "‘Using smart people to build smart cities: how smart cities attract high skilled workers, retain them, and become innovative (Belgium, Netherlands, Denmark, Poland)’," *Smart Cities Reg. Dev. SCRD J. vol. 7,* 2023.

[2] L. Portal and B. Fabregue, "‘Establishing Participative Smart Cities: Theory and Practice’," *Smart Cities Reg. Dev. SCRD J.,* Vols. vol. 6, Art. no. 2, 2022.

[3] E. M. Sánchez-Teba and G. J. Bermúdez-González, "‘Are Smart-City Projects Citizen-Centered?’," *Soc. Sci.,* Vols. vol. 8, no. 11, Art. no. 11, 2019.

[4] J. Engelbert, L. v. Zoonen and F. Hirzalla, "‘Excluding citizens from the European smart city: The discourse practices of pursuing and granting smartness’," *Technol. Forecast. Soc. Change,* vol. vol. 142, p. 347–353.

[5] C. Malhotra, "'A Design Framework for Evolving a Citizen-Centric Information Society'," *in Handbook of Research on Cultural and Economic Impacts of the Information Society, IGI Global,* p. 25–41, 2015.

[6] T. Hunter, P. Worthy, S. Viller and B. Matthews, "'Designing for citizen-centric smart cities: supporting people's needs of a community garden'," *, Proc. 30th Aust. Conf. Comput.-Hum. Interact.,* p. pp. 162–166.

[7] W. Castelnovo, G. Misuraca and A. Savoldelli, "'Smart Cities Governance: The Need for a Holistic Approach to Assessing Urban Participatory Policy Making'," *Soc. Sci. Comput. Rev.,* Vols. vol. 34, no. 6, p. pp. 724–739, 2016.

[8] L. Sundberg, "'Value Positions and Relationships in the Swedish Digital Government'," *Adm. Sci.,* Vols. vol. 9, no. 1, Art. no. 1, 2019.

[9] G. Trencher, "'Towards the smart city 2.0: Empirical evidence of using smartness as a tool for tackling social challenges'," *Technol. Forecast. Soc. Change,* vol. vol. 142, p. pp. 117–128, 2019.

[10] S. Myeong, Y. Jung and E. Lee, "'A Study on Determinant Factors in Smart City Development: An Analytic Hierarchy Process Analysis'," *Sustainability,* Vols. vol. 10, no. 8, p. pp. 1–17, 2018.

[11] M. S. Khan, M. Woo, K. Nam and P. K. Chathoth, "'Smart City and Smart Tourism: A Case of Dubai', Sustainability," Vols. vol. 9, no. 12, Art. no. 12, 2017.

[12] L. Qi and J. Guo, "'Development of smart city community service integrated management platform'," *Int. J. Distrib. Sens. Netw.,* Vols. vol. 15, no. 6, 2019.

[13] S. Al-Nasrawi, "'Planning and Designing Smart Sustainable Cities: The Centrality of Citizens Engagement'," *in Innovations in Smart Cities Applications Volume 4, M. Ben Ahmed, İ. Rakıp Karaş, D. Santos, O. Sergeyeva, and A. A. Boudhir, Eds., in Lecture Notes in Networks and Systems. Cham: Springer International Publishing,* p. pp. 83–95, 2021.

[14] D. Correia, J. L. Marques and L. Teixeira, "'The State-of-the-Art of Smart Cities in the European Union'," *Smart Cities,* Vols. vol. 5, no. 4, Art. no. 4, 2022.

[15] R. Jucevičius, I. Patašienė and M. Patašius, "'Digital Dimension of Smart City: Critical Analysis'," *Procedia - Soc. Behav. Sci.,* vol. vol. 156, p. pp. 146–150, 2014.

[16] A. Akande, P. Cabral, P. Gomes and S. Casteleyn, "'The Lisbon ranking for smart sustainable cities in Europe'," *Sustain. Cities Soc.,* Vols. vol. 44,, p. 475–487, 2019.

[17] J. Ferrer, "'Barcelona's Smart City vision: an opportunity for transformation'," *Field Actions Sci. Rep. J. Field Actions,* 2017.

[18] I. Calzada, " '(Smart) Citizens from Data Providers to Decision-Makers? The Case Study of Barcelona'," *Sustainability, ,* Vols. vol. 10, no. 9, Art. no. 9 , 2018.

[19] R. Bolici and L. Mora, "'The Development Process of Smart City Strategies: The Case of Barcelona'," 2016.

[20] J. H. Lee, M. G. Hancock and M.-C. Hu, "'Towards an effective framework for building smart cities: Lessons from Seoul and San Francisco'," *Technol. Forecast. Soc. Change,* vol. vol. 89, p. pp. 80–99, 2014.

[21] J. Yang, T. Lee and W. Zhang, "Smart Cities in China: A Brief Overview," *IT Prof.,* Vols. vol. 23, no. 3, p. pp. 89–94, 2021.

[22] L. Sanchez, "'SmartSantander: IoT experimentation over a smart city testbed'," *Comput. Netw.,* vol. vol. 61, p. pp. 217–238, 2014.

[23] B. N. Silva, M. Khan and K. Han, "'Towards sustainable smart cities: A review of trends, architectures, components, and open challenges in smart cities'," *Sustain. Cities Soc.,* vol. vol. 38, p. pp. 697–713, 2018.

[24] I. Jonek-Kowalska and R. Wolniak, "'Economic opportunities for creating smart cities in Poland. Does wealth matter?'," *Cities,* vol. vol. 114, 2021.

[25] G. Masik, I. Sagan and J. W. Scott, "'Smart City strategies and new urban development policies in the Polish context'," *Cities,* p. 2021, vol. 108.

[26] C. Alpopi and R. Silvestru, "'Urban development towards smart city a case study'," 2016.

[27] G. Siokas, A. Tsakanikas and E. Siokas, "'Implementing smart city strategies in Greece: Appetite for success'," *Cities,* vol. vol. 108, 2021.

[28] W. v. Winden and D. v. d. Buuse, "'Smart City Pilot Projects: Exploring the Dimensions and Conditions of Scaling Up'," *J. Urban Technol.,* Vols. vol. 24, no. 4, p. pp. 51–72, 2017.

[29] L. Smékalová and F. Kučera, "'Smart City Projects in the Small-Sized Municipalities: Contribution of the Cohesion Policy'," *Sci. Pap. Univ. Pardubice Ser. Fac. Econ. Adm.,* Vols. vol. 28, no. 2, Art. no. 2, 2020.

[30] D. Busch and M. B. J. v. Rijn, "'Towards Single Supervision and Resolution of Systemically Important Non-Bank Financial Institutions in the European Union'," *Eur. Bus. Organ. Law Rev.,* Vols. vol. 19, no. 2, p. pp. 301–363, 2018.

[31] C. I. Rotună, C. E. Cîrnu and A. Gheorghiță, "'Implementing smart city solutions: smart city map and city drop'," *Calitatea Vieții,* Vols. vol. 28, no. 3, Art. no. 3, 2017.

[32] A. Kona, D. Guťan and P. Horváth, "'Slovak Republic on the way to build Smart Cities based on KPIs with first Slovak Smart City Index'," *Sci. Pap. Univ. Pardubice Ser. Fac. Econ. Adm.,* Vols. vol. 28, no. 4,, 2020.

[33] R. Lozynskyy, V. Pantyley and A. Sawicka, "'Smart city concept in Poland and Ukraine: implementation instruments, problems and successes of cities'," *Bull. Geogr. Socio-Econ. Ser.,* Vols. no. 52, Art. no. 52, 2021.

[34] C. Alexopoulos, L. Euripidis, D. E. Kolokotronis, N. Vogiatzis and Y. Charalabidis, "'A Methodology for Participatory Planning of Smart City Interventions'," *Bull. Geogr. Socio-Econ. Ser.,* 2021.

[35] K. Varró and Á. Szalai, "'Discourses and practices of the smart city in Central Eastern Europe: insights from Hungary's "big" cities'," *Urban Res. Pract., vol. 15, no. 5,* p. pp. 699–723, 2022.

[36] C. Premat, "'Smart Cities in a Digital Nation: Are Swedish Cities Enough Innovative?'," *in Smarter as the New Urban Agenda: A Comprehensive View of the 21st Century City, J. R. Gil-Garcia, T. A. Pardo, and T. Nam, EPublic Administration and Information Technology. , Cham: Springer International Publishing,* p. pp. 207–224, 2016.

[37] B. F. G. Fabrègue and A. Bogoni, "'Privacy and Security Concerns in the Smart City'," *Smart Cities,* Vols. vol. 6, no. 1, Art. no. 1, 2023.

[38] R. Giffinger and H. Gudrun, "'Smart cities ranking: an effective instrument for the positioning of the cities?'," *ACE Archit. City Environ.,* Vols. vol. 4, no. 12, p. pp. 7–26, 2010.

[39] C. K. Toh, "'Smart city indexes, criteria, indicators and rankings: An in-depth investigation and analysis'," *IET Smart Cities,* Vols. vol. 4, no. , p. pp. 211–22, 2022.

[40] B. Benamrou, B. Mohamed, A. Bernoussi and O. Mustapha, "'Ranking models of smart cities'," *in 2016 4th IEEE International Colloquium on Information Science and Technology (CiSt),* p. pp. 872–879, 2016.

[41] A. Caragliu and C. F. D. Bo, "'Smart innovative cities: The impact of Smart City policies on urban innovation'," *Technol. Forecast. Soc. Change,* vol. vol. 142, p. pp. 373–383, 2019.

[42] P. T. I. Lam and R. Ma, "'Potential pitfalls in the development of smart cities and mitigation measures: An exploratory study'," *Cities,* vol. vol. 91, p. pp. 146–156, 2019.

[43] G. Grossi and D. Pianezzi, "'Smart cities: Utopia or neoliberal ideology?'," *Cities,* vol. vol. 69, p. pp. 79–85, 2017.

[44] V. Albino, U. Berardi and R. M. Dangelico, "'Smart Cities: Definitions, Dimensions, Performance, and Initiatives'," *J. Urban Technol.,* Vols. vol. 22, no. 1, p. pp. 3–21, 2015.

[45] M.-A. Doran and S. Daniel, "'Geomatics and Smart City: A transversal contribution to the Smart City development'," *Inf. Polity,* Vols. vol. 19, no. 1,2,, p. pp. 57–72, 2014.

[46] M. Uysal, M. J. Sirgy, E. Woo and H. (. Kim, "'Quality of life (QOL) and well-being research in tourism'," *Tour. Manag,* vol. vol. 53, p. pp. 244–261, 2016.

[47] P. Lee, W. C. Hunter and N. Chung, "'Smart Tourism City: Developments and Transformations'," *Sustainability,* Vols. vol. 12, no. 10, Art. no. 10, 2020.

[48] J. Desdemoustie, N. Crutzen and R. Giffinger, "'Municipalities' understanding of the Smart City concept: An exploratory analysis in Belgium'," *Technol. Forecast. Soc. Change,* vol. vol. 142, 2019.

[49] G. Li, Y. Wang, J. Luo and Y. Li, "'Evaluation on Construction Level of Smart City: An Empirical Study from Twenty Chinese Cities'," *Sustainability,* Vols. vol. 10, no. 9, Art. no. 9, 2018.

[50] R. A. Shichiyakh, D. A. Klyuchnikov, S. P. Balashova, S. N. Novoselov and N. N. Novosyolova, "'Smart City as the Basic Construct of the Socio-economic Development of Territories'," *Int. J. Econ. Financ. Issues,* Vols. vol. 6, no. 1, Art. no. 1, 2016.

[51] I. Capdevila and M. I. Zarlenga, "'Smart city or smart citizens? The Barcelona case'," *J. Strategy Manag,* Vols. vol. 8, no. 3, p. pp. 266–282, 2015.

[52] J. Dumay, "'A critical reflection on the future of intellectual capital: from reporting to disclosure'," *J. Intellect. Cap.,* Vols. vol. 17, no. 1, p. pp. 168–184, 2016.

[53] C. McCauley and B. A. Bremer, "'Subjective Quality of Life Measures for Evaluating Medical Intervention'," *Eval. Health Prof.,* Vols. vol. 14, no. 4, p. pp. 371–387, 1991.

[54] P. Liao, "'Parallels Between Objective Indicators and Subjective Perceptions of Quality of Life: A Study of Metropolitan and County Areas in Taiwan'," *Soc. Indic. Res.,* Vols. vol. 91, no. 1, p. pp. 99–114, 2009.

[55] J. Thomas and J. Evans, "'There's more to life than GDP but how can we measure it?'," *Econ. Labour Mark. Rev.,* Vols. vol. 4, no. 9, p. pp. 29–36, 2010.

[56] L. Camfield and S. M. Skevington, "'On Subjective Well-being and Quality of Life'," *J. Health Psychol,* Vols. vol. 13, no. 6, p. pp. 764–775, 2008.

[57] J. Stanković, M. Džunić, Ž. Džunić and S. Marinković, "'A multi-criteria evaluation of the European cities' smart performance: Economic, social and environmental aspects'," *Zb. Rad. Ekon. Fak. U Rijeci Časopis Za Ekon. Teor. Praksu Proc. Rij. Fac. Econ. J. Econ. Bus.,* Vols. vol. 35, no. 2, p. pp. 519–550, 2017.

[58] J. L. Vázquez, A. Lanero, P. Gutiérrez and C. Sahelices, "'The Contribution of Smart Cities to Quality of Life from the View of Citizens'," *Innovative and Sustainable Ecosystems: Best Practices and Implications for Quality of Life, J. Leitão, H. Alves, N. Krueger, and J. Park, Eds., in Applying Quality of Life Research. , Cham: Springer International Publishing,* p. pp. 55–66, 2018.

[59] C. Yu, B. Ye, C. Lin and Y. J. Wu, "'Can Smart City Development Promote Residents' Emotional Well-Being? Evidence From China'," *IEEE Access,* vol. vol. 8, p. pp. 116024–116040, 2020.

[60] H. Zhu, L. Shen and Y. Ren, "'How can smart city shape a happier life? The mechanism for developing a Happiness Driven Smart City'," *Sustain. Cities Soc.,* vol. vol. 80, p. p. 103791, 2022.

[61] R. Florida, C. Mellander and P. J. Rentfrow, "'The Happiness of Cities'," *Reg. Stud.,* Vols. vol. 47, no. 4, p. pp. 613–627, 2013.

[62] E. L. Glaeser, J. D. Gottlieb and O. Ziv, "'Unhappy Cities'," *J. Labor Econ.,* Vols. vol. 34, no. S2, p. pp. S129–S182, 2016.

[63] O. Sapci and J. F. Shogren, "'Environmental quality, human capital and growth'," *J. Environ. Econ. Policy,* Vols. vol. 7, no. 2, p. pp. 184–203, 2018.

[64] J. V. Winters, "'Human capital, higher education institutions, and quality of life'," *Reg. Sci. Urban Econ.,* Vols. vol. 41, no. 5, p. pp. 446–454, 2011.

[65] Q. Guo and H. Qian, "'Negative human capital externalities in well-being: evidence from Chinese cities'," *Reg. Stud.,* Vols. vol. 55, no. 6, p. pp. 1046–1058, 2021.

[66] J. V. Winters and Y. Li, "'Urbanisation, natural amenities and subjective well-being: Evidence from US counties'," *Urban Stud.,* Vols. vol. 54, no. 8, p. pp. 1956–1973, 2017.

[67] B. Nikolaev, "'Does Higher Education Increase Hedonic and Eudaimonic Happiness?'," *J. Happiness Stud.,* Vols. vol. 19, no. 2, p. pp. 483–504, 2018.

[68] K. Milligan, E. Moretti and P. Oreopoulos, "'Does education improve citizenship? Evidence from the United States and the United Kingdom'," *J. Public Econ,* Vols. vol. 88, no. 9, p. pp. 1667–1695, 2004.

[69] P. Hall, "'Creative Cities and Economic Development'," *Urban Stud.,* Vols. vol. 37, no. 4, p. pp. 639–649, 2000.

[70] M. Thuzar, "'Urbanization in Southeast Asia: Developing Smart Cities for the Future'," *in Regional Outlook, ISEAS Publishing,* p. pp. 96–100, 2011.

[71] M. Nilssen, "'To the smart city and beyond? Developing a typology of smart urban innovation'," *Technol. Forecast. Soc. Change,* vol. vol. 142, p. pp. 98–104, 2019.

[72] L. Shen, Z. Huang, S. L. S. W. Wong and Y. Lou, "'A holistic evaluation of smart city performance in the context of China'," *J. Clean. Prod.,* vol. vol. 200, p. pp. 667–679, 2018.

[73] E. Ismagilova, L. Hughes, Y. K. Dwivedi and K. R. Raman, "'Smart cities: Advances in research—An information systems perspective'," *Int. J. Inf. Manag.,* vol. vol. 47, p. pp. 88–100, 2019.

[74] L. Shen, Z. Huang, S. W. Wong, S. Liao and Y. Lou, "'A holistic evaluation of smart city performance in the context of China'," *J. Clean. Prod,* vol. vol. 200, p. pp. 667–679, 2018.

[75] E. Ismagilova, L. Hughes, Y. K. Dwivedi and K. R. Raman, "'Smart cities: Advances in research—An information systems perspective'," *Int. J. Inf. Manag.,* vol. vol. 47, p. pp. 88–100, 2019.

[76] G. F. Camboim, P. A. Zawislak and N. A. Pufal, "'Driving elements to make cities smarter: Evidences from European projects'," *Technol. Forecast. Soc. Change,* vol. vol. 142, p. pp. 154–167, 2019.

[77] F. P. Appio, M. Lima and S. Paroutis, "'Understanding Smart Cities: Innovation ecosystems, technological advancements, and societal challenges'," *Technol. Forecast. Soc. Chang,* vol. vol. 142, p. pp. 1–14, 2019.

[78] A. Paaso, D. Kushner, S. Bahramirad and A. Khodaei, "'Grid Modernization Is Paving the Way for Building Smarter Cities [Technology Leaders]'," *IEEE Electrification Mag.,* Vols. vol. 6, no. 2, p. pp. 6–10, 2018.

[79] J. Carvalho, R. Costa, S. Marnoto, C. Sousa and J. Vieira, "Resource-based view of city quality: Scales development and validation," *Growth Change,* Vols. vol. 50, no. 3, p. pp. 856–879, 2019.

[80] M. d. Jong, S. Joss, D. Schraven, C. Zhan and M. Weijnen, "'Sustainable–smart–resilient–low carbon–eco–knowledge cities; making sense of a multitude of concepts promoting sustainable urbanization'," *J. Clean. Prod.,* vol. vol. 109, p. pp. 25–38, 2015.

[81] M. Wolfram, "'Cities shaping grassroots niches for sustainability transitions: Conceptual reflections and an exploratory case study'," *J. Clean. Prod.,* vol. vol. 173, p. pp. 11–23, 2018.

[82] M. Wang and T. Zhou, "'Does smart city implementation improve the subjective quality of life? Evidence from China'," *Technol. Soc.*, vol. vol. 72, p. p. 102161, 2023.

[83] "International Institute for Management Development, 'Smart City Index Report', IMD, 2019. Accessed: Nov. 15, 2023. [Online]. Available: https://www.imd.org/research-knowledge/competitiveness/reports/imd-smart-city-index-2019/".

[84] "International Institute for Management Development, 'Smart City Index Report', IMD, 2020. Accessed: Nov. 15, 2023. [Online]. Available: https://imd.cld.bz/Smart-City-Index-2020".

[85] "International Institute for Management Development, 'Smart City Index Report', IMD, 2021. Accessed: Nov. 15, 2023. [Online]. Available: https://imd.cld.bz/Smart-City-Index-2021".

[86] "International Institute for Management Development, 'Smart City Index Report', IMD, 2023. Accessed: Nov. 15, 2023. [Online]. Available: https://www.imd.org/wp-content/uploads/2023/04/smartcityindex-2023-v7.pdf".

[87] "IESE Business School, 'Cities in Motion Index', University of Navarra, 2022. Accessed: Nov. 15, 2023. [Online]. Available: https://media.iese.edu/research/pdfs/ST-0633-E.pdf".

[88] "Technische Universität Wien, 'europeansmartcities 3.0'. Accessed: Nov. 21, 2023. [Online]. Available: https://www.smart-cities.eu/?cid=-1&ver=3".

[89] "NUMBEO, 'Quality of Life'. Accessed: Nov. 15, 2023. [Online]. Available: https://www.numbeo.com/quality-of-life/".

[90] European Commission, "Report on the Quality of life in European cities," *EU*, 2020.