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Highlighting gaps in technology acceptance research: A call for integrating happiness and well-being into smart city development

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ABSTRACT

Today's world is dealing with various challenges such as global warming, overpopulation, resource allocation, uneven economic development and many others. Most of these issues are not novel; however, since the number of global populations living in urban areas is expected to increase, these problems will become more and more difficult to manage. Some of these challenges and issues refer to fast urbanization, old infrastructure or the difficulty of properly managing new technologies in cities. Smart city initiatives are frequently viewed as solutions to these challenges, but the reliance on technology alone may be misleading. Despite the widespread adoption of advanced technologies in urban areas to overcome several problems, there is a lack of research on their impact on residents' overall well-being and happiness. Our paper addresses this gap by critically evaluating existing technology acceptance models, which have primarily focused mostly on usage intention and use behaviour, to identify their limitations in addressing the complex effects of technology on well-being. The aim was therefore to explore the extent to which technology can contribute to increased happiness in smart cities and how existing research streams address this relationship. To achieve our aim, we employ a mixed-methods approach, namely integrating the IMD Smart City Index and Happy City Index to explore the connection between "smartness" and "happiness" a scoping review and bibliographic analysis of over 5000 papers on technology adoption, complemented with an empirical survey of 193 millennials on their attitudes towards smart technology and well-being.

Through an extensive literature review, this paper highlights the overlooked research on smart city to improve well-being by proposing that future research should focus on expanding technology acceptance frameworks that should include measures for happiness and well-being. Our findings highlight the importance for continued research into the impact of technology on well-being and the necessity for a holistic approach that merges technological advancements and well-being in smart city development. This study emphasizes the need for future research to expand technology acceptance frameworks to include measures for happiness and well-being, providing a more comprehensive understanding of the role of technology in enhancing urban life.

Introduction

The smart city concept has attracted considerable interest as a promising response to the diverse challenges that burden urban environments. The rapid urbanization and the increasing population in cities have put a pressure on resources, infrastructure, and quality of life. Several issues and problems are not new; however, many of them are becoming more and more challenging to manage. More than 65 % of the world population is likely to live in urban areas by the year 2050 (Hämäläinen, 2020). Therefore, it is essential to prioritize the problems emerging in large cities. Smart city initiatives aim to address these challenges through the proper integration of technology in everyday operations. By managing advanced data collection and analysis, smart city projects can optimize the allocation of resources, improve infrastructure management, and enhance service delivery to meet the diverse needs of urban residents (Zhang & He, 2020). These initiatives should also stream to address the citizens' needs and aspirations (Colding, Nilsson & Sjöberg, 2024). An important challenge thus involves maintaining the unique characteristics of metropolitan areas without negatively impacting the environment or living standards, particularly for future generations. Consequently, the focus must be on properly developing technologies that emphasize sustainability and enhance overall well-being.

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The smart city concept is fundamentally based on digital transformation, emphasizing the critical role of adopting information and communication technology to achieve the smartness of the city (Osman, Elragal & Ståhlbröst, 2022). Yet, focusing primarily on smartness may not guarantee enhanced individual well-being or a sustainable future. The spread of modern technologies promises transformative benefits for urban living, from enhanced efficiency to improved public services. Nevertheless, the rapid adoption of such technologies raises essential questions about their broader impact on human well-being and happiness. It has been claimed that technology is like "double-edged sword", since it offers significant benefits and broadens access to online services, but also risk exacerbating social exclusion and digital divides (Colding et al., 2024).

While the focus of smart cities has traditionally been on technological advancements and sustainable practices (Silva, Khan & Han, 2018), the impact on individual well-being has received limited attention. Existing research in the field of smart cities has predominantly focused on technological aspects such as data analytics, internet of things, and information systems. Despite the fact that variety of novel technologies contribute to well-informed decision making (Bibri, Krogstie, Kaboli & Alahi, 2024), there is a clear gap in the literature regarding how smart city technologies specifically contribute to residents' happiness and well-being. Existing research on smart city technologies has primarily focused on their usage intention and use behaviour, neglecting the important impacts they can have on residents' happiness and well-being.

Existing research has established technology acceptance models as one of the main frameworks for understanding technology adoption (Davis, 1989; Venkatesh, Morris, Davis & Davis, 2003). These conventional models traditionally underscore the significance of perceived usefulness and ease of use as pivotal predictors of technology acceptance. While technology acceptance models offer valuable insights into the determinants of technology use, their focus has been limited to functional aspects, neglecting the potential effects on individual happiness and well-being. Although adoption models have faced criticism for appearing to reach a point of diminishing returns in knowledge advancement, primarily due to their widespread utilization in research (Shachak, Kuziemsky & Petersen, 2019), it is essential, as highlighted by recent critiques, for future research initiatives to thoroughly examine and evaluate existing frameworks. This is particularly important in understanding the impact of smart government services on the well-being of citizens, as emphasized by Hartanti, Abawajy and Chowdhury (2022).

Therefore, to address this gap, this paper focuses on two research questions, namely (1) *to what extent can technology contribute to the increased happiness in smart cities* and (2) *to what extent are existing research streams dealing with technology acceptance focusing on happiness or well-being*. In order to address the following research questions, the paper firstly provides a literature review on smart cities from the technology perspective and well-being perspective together with theoretical models of technology adoption. Next, to comprehensively address the relationship between smart city initiatives and residents' well-being and happiness, a mixed methods approach was used. By combining the analysis of indices, a scoping review and literature mapping, and an empirical survey, our study aims to capture a multidimensional perspective on the interplay between smart technologies and happiness. Our research integrates the IMD Smart City 2023 Index and the Happy City Index 2023 to explore the connection between "smartness" and "happiness" supplemented by a bibliometric analysis of over 5000 papers on technology adoption and an empirical survey of 193 millennials on their attitudes towards smart technology and well-being.

This phased approach ensures a coherent flow of analysis, moving from broad patterns to specific insights, and enables detailed research on how smart city technologies impact well-being and happiness, both in theory and practice. Therefore, this approach allowed us to not only identify patterns and correlations in existing data but also to offer a foundation for future research and practical recommendations that are presented in the discussion section.

Literature review

Smart city: The role of technology in managing urban issues

The notion of a smart city is a multifaceted and widely studied concept, yet it lacks a universally accepted definition. It is generally agreed that the integration of information technology is vital for smart cities, affecting economic, managerial, and social areas (Van den Bergh & Viaene, 2016). Consequently, smart cities integrate different essential elements of modern urban life, such as smart technology, smart mobility, smart government, smart living, smart economics, smart environment, smart architecture, and smart citizens (Ismagilova, Hughes, Dwivedi & Raman, 2019). Although technology is crucial in the development of smart cities, simply deploying it is not enough to ensure societal benefits (Zhao, Song, Chen & Dai, 2024). Smart cities are deeply connected with big data and the Internet of Things concept that facilitate the development and management of public information services through the collection of automatic data. The interplay among technology, society, the economy, and the environment is vital for securing the current and future well-being of citizens (Ruggieri, Ruggeri, Vinci & Poponi, 2021). Therefore, it is essential to balance economic priorities with social interests, with technology playing a crucial supportive role in this process (Cambra-Fierro, López-Pérez, Melero-Polo, Pérez & Tejada-Tejada, 2024).

While several studies have already been undertaken from a technological perspective (Chatterjee & Kar, 2017), gaps remain in the understanding of personal perceptions and considerations (Ismagilova et al., 2019). Recent studies have also additionally aimed at defining the concept of smart cities (Duygan, Fischer, Pärli & Ingold, 2022; Lom & Pribyl, 2021), yet comprehensive insights into how digital technologies can foster sustainable futures in smart cities are still lacking. After all, it's crucial to explore the connections between technology adoption and personal characteristics (Shabanpour, Golshani, Shamshiripour & Mohammadian, 2018), and to examine how individual behaviour can be transformed towards a sustainability-oriented attitude.

The fast growth of urban areas has accelerated the deployment of various digital technologies across smart cities (Chourabi et al., 2012; Zhao et al., 2024). These innovations are crucial for digital transformation and present an important role in forming smart city initiatives (Sharma, Misra, Dwivedi & Rana, 2023; Tomičić Pupek, Pihir & Tomičić Furjan 2019). By integrating these technologies with improved governance and leveraging human capital, smart cities can present positive societal change (Kummitha & Crutzen, 2017). Nonetheless, ongoing urbanization and urgent sustainability issues present difficult challenges for smart cities (Colldahl, Frey & Kelemen, 2013), which may even impact well-being. Addressing these challenges involves tackling social and environmental sustainability, ensuring sustainable economic growth, high quality of life, efficient use of natural resources, and implementing intelligent governance systems (Caragliu, Del Bo & Nijkamp, 2011).

Consequently, definitions of smart cities can be divided into those that are sustainability-oriented and those that are not (Tura & Ojanen, 2022). A sustainability-oriented definition posits that smart cities utilize digital technology not just to enhance existing networks and services for residents and organizations, but also to reduce pollution and conserve resources, precisely, to seamlessly integrate technology and environmental strategies (Bibri et al., 2024). This encompasses improvements in urban transit networks, improved water and waste management systems, and efficient heating and lighting solutions. Additionally, it involves fostering a more

responsive local government, making provisions for an aging population and ensuring safer public spaces.

To achieve a smart city, enhanced community engagement and the strategic use of technology are essential for generating positive impacts within the community. Besides, smart city technologies should also elevate the overall standard of living for its residents. While various initiatives and solutions in smart cities have the potential to improve the quality of life (Nikitas, Michalakopoulou, Njoya & Karampatzakis, 2020), it is crucial that residents also recognize and value these improvements in their daily lives.

Smart cities, as one of the drivers of innovation in the digital age, can use advanced technologies to build sustainable, user-centred and open innovation ecosystems in order to enhance environmental and communication technologies and facilitate the community-led co-creation of innovative living and working environments (Schaffers et al., 2011). This perspective can be viewed as a definition of smart cities that emphasizes the role of technology in driving innovation aimed towards community improvement across different areas (Scuotto, Ferraris & Bresciani, 2016). The implementation of the smart city concept, therefore, has the potential to make a growing number of cities around the world more efficient, more technologically advanced, and by doing so, improve the quality of life for residents (Jonek-Kowalska & Wolniak, 2023). However, determining the impact and significance of technology in smart cities still continues to be highly challenging (Colding et al., 2024).

Integration of well-being in smart city

Numerous definitions of well-being can be found in the literature, but they all concur on its inherently multidimensional nature (Rogers et al., 2012; Sebestyén, Trájer, Domokos, Torma & Abonyi, 2024). Well-being is a multidimensional concept that refers to the overall condition of an individual's life (Sarker et al., 2024). Well-being can be delineated into objective well-being (OBW), pertaining to life circumstances, and subjective well-being (SWB), related to individual perception (Sebestyén et al., 2024). For example, OWB stands for material wealth and physical health, while SWB refers to quality of social relationships or feelings of happiness (Rogers et al., 2012). Subjective well-being metrics, like a happiness index, provide insights into individuals' social and emotional states in different situations but, however, they are challenging to interpret and compare across different people (Rogers et al., 2012). Further, subjective well-being can be divided into (Keyes et al., 2008)

- Hedonic stream, refereeing to feelings towards life. This stream is manifested trough research on emotional well-being, avowed happiness and satisfaction with life.
- Eudaimonic stream, referring to functioning in life. This has been measured with psychological well-being and social well-being.

Incorporating well-being into smart city frameworks is crucial for sustainability, as it ensures that economic growth, environmental preservation, and technological innovation collectively contribute to the overall life of residents. Research on sustainability has gained momentum due to global initiatives such as the Paris Agreement, the United Nations' 2030 Agenda, and the Sustainable Development Goals (SDGs) (Dinçer, El-Assadi, Saad & Yüksel, 2024; Saraji, Streimikiene & Kyriakopoulos, 2021). Shifting focus towards sustainability and well-being could be the most feasible path for future development, with sustainability encompassing the fulfilment of human physical, emotional, and social needs (Rogers et al., 2012). The significance of well-being in the context of the previously mentioned 2030 Agenda for Sustainable Development Goals cannot be overstated (Vukovic & Mingaleva, 2023), precisely as SDG 3 refers to "Ensuring healthy lives and promoting well-being for all at all ages". Sustainability is defined trough three pillars: economic, environmental and social sustainability (Fraga-Lamas, Lopes & Fernández-Caramés, 2021). The latter focuses on improving the well-being of individuals and communities, ensuring social equity and justice, and promoting access to essential services and opportunities for all members of society (Rogers et al., 2012). Despite existing research confirming that smart city initiatives can positively influence the life quality of citizens (Jonek-Kowalska & Wolniak, 2023), well-being stands for much brother concept, beyond just "life quality" (Eichholtzer, Driscoll, Patrick, Galletta & Lawson, 2024).

It is evident that the transformative impact of urbanization, driven by various socio-cultural and environmental processes, significantly influences overall human conditions, including health and well-being (Sebestyén et al., 2024). There has been some recent research on how smart city initiatives can contribute well-being, but the majority of that research examines objective well-being (physical health), such as urban green spaces (Sarker et al., 2024), smart transport (Ruggieri et al., 2021) or approaches to architectural design (Makanadar, 2024). However, as smart cities rapidly advance, there is a growing awareness and concern concerns about residents' subjective well-being (Yu et al., 2020). The intricate nature of well-being necessitates sophisticated, multivariate measurement methods that encompass the physical, economic, social, and environmental dimensions alongside the mental state of a city (Sebestyén et al., 2024).

This shift towards well-being-driven smart city research acknowledges that the success of smart cities should not be measured solely by technological advancements or economic growth, but also by the extent to which they enhance the overall well-being and happiness of their residents (Zhang & He, 2020). Moreover, incorporating well-being into smart city planning can have substantial benefits. For example, one of the recent policy recommendations for socially sustainable smart cities is to "maximise the benefit of digital technology, ensuring a comprehensive approach to societal well-being" (Colding et al., 2024).

However, the incomplete evidence regarding which aspects of cities genuinely contribute to the subjective well-being of residents has been recently highlighted (Morris, 2023). The intuitive belief that factors such as robust health, efficient transportation and education systems, accessible and appealing land use, high incomes, reduced inequality, low unemployment, a cost-effective living environment, cleanliness, low crime rates, ample leisure and cultural opportunities, and aesthetic appeal contribute to citizens' happiness is widely accepted.

While the integration of digital technologies holds promise for addressing sustainability challenges (Geyda, Fedorchenko, Lysenko, Svistunova & Khasanov 2021), the potential of digitalization extends beyond to become a tool for fostering sustainable development and improving citizens' quality of life, contingent upon the provision of practical solutions that positively impact their daily experiences (Schaffers, Ratti & Komninos, 2012). Governments and public agencies across various levels are embracing the concept of "smartness" to characterize their policies and programs focused on sustainable development, economic growth, enhanced quality of life, and improved well-being and happiness for their citizens (Jonek-Kowalska & Wolniak, 2023). However, when considering the three major aspects of sustainability, the majority of existing research on smart city literature focuses on economic sustainability, with <2 % focusing on social sustainability, while the remaining studies address environmental considerations (Colding et al., 2024). Nevertheless, it is noteworthy that there is a surprising scarcity of research exploring the particular characteristics of cities that influence the subjective well-being of their residents (Morris, 2023). Further research efforts are needed as one of the potential issues is that technology in smart city can further foster the digital divide, providing well-being only to citizens that have adequate skills for using it (Colding et al., 2024).

Theoretical models shaping the landscape of technology adoption

One of the key factors for evaluating technology is the usage by users because if the technology is not used, no success can be achieved (DeLone & McLean, 2003). Due to the pronounced importance of usage, technology acceptance, and all factors influencing it have been a focal point for almost 30 years (Mukti & Rawani, 2016; Venkatesh & Davis, 1996). One of the first models that dealt with the investigation of intention to use is Davis's model from 1989 called the Technology Acceptance Model (TAM) (Davis, 1989). The TAM model, rooted in the "Theory of Reasoned Action" and the "Theory of Planned Behaviour", focuses on why end users better accept and use certain technologies than others (Petter, DeLone & McLean, 2008). That is, it emphasizes the attitudes and beliefs of end users in the context of technology acceptance (Lu, Lin, Lo & Wu, 2012). TAM was developed in 1989 with the purpose of measuring technology usage (Davis, 1989) and quickly became the dominant model for researching factors influencing technology acceptance (Marangunić & Granić, 2015). To enhance its predictive ability, Venkatesh and Davis (2000) introduced TAM 2, which later evolved into TAM 3. Later, the Unified Theory of Acceptance and Use of Technology (UTAUT) model, an extension of TAM, became one of the most comprehensive models (Venkatesh et al., 2003) with several additional extensions.

Research in the field of technology acceptance models has predominantly focused on cognitive and utilitarian factors such as perceived usefulness and ease of use (Venkatesh et al., 2003). They encompass four primary determinants, namely social influence, performance expectancy, effort expectancy, and facilitating conditions, along with up to four moderators influencing the core relationships, including gender, age, experience, and voluntariness of use (Venkatesh et al., 2003).

While much of the research on technology acceptance models primarily explores how technology impacts users' intention to use or actual usage behavior (García-Monleón, Erdmann & Arilla, 2023; Manfreda, Ljubi & Groznik, 2021), it frequently neglects the broader implications for users' well-being and overall happiness. Technology acceptance models have also been facing criticism for their limited further contribution to knowledge (Mogaji, Viglia, Srivastava & Dwivedi, 2024; Shachak, Kuziemsky & Petersen, 2019). Recent research has started to investigate the psychological effects of technology, suggesting a considerable opportunity for TAM to integrate happiness and well-being as important results (Lin, Zhao, Yu & Wu, 2019). Another recent research has somehow tackled this issue by examining how information system success model, developed by DeLone and McLean (2003), can impact on social well-being (Jahan, Hoque, Hossain, Hoon & Pipul, 2024). Research revealed that social networking services have positive influence on social well-being, confirming that strong social ties and supportive relationships fosters a sense of belonging, security, and overall well-being (Jahan et al., 2024). In smart city context, there are assumptions that, for example, dashboards with traffic and pollution data can ensure citizens to make more informed decisions and thus improve their well-being (Miranda et al., 2024). Another recent experimental research reviled that usage of metaverse among elderly people increased overall well-being. This improvement at psychological level was also confirmed through monitoring physical health indicators (Gao et al., 2024). Nevertheless, this is a developing field that needs more theoretical and empirical advancement in order to completely comprehend the relationship between technology acceptance and human well-being.

Emerging research indicates that the inclusion of well-being and happiness in technology acceptance studies could lead to more holistic models that better reflect the complexities of human-technology interaction. For instance, (Bargas-Avila & Hornbæk, 2011) highlighted the importance of user experience (UX) in technology adoption, suggesting that positive UX could lead to improved well-being. Moreover, recent studies have begun to explore how technology use affects psychological well-being, with findings suggesting that technology designed with user well-being in mind can enhance life satisfaction (Lin et al., 2019).

Methodology

In the paper, a mixed methods approach has been applied, consisting of three parts: a comparative analysis of the IMD Smart City Index and Happy City Index, a scoping review and bibliographic analysis on smart technology adoption literature, and a web-based survey assessing individual attitudes towards smart technologies and well-being.

The first phase builds on quantitative data from established indices to explore the relationship between smart city rankings and happiness, providing a macro-level overview of the trends and correlations. In the second phase, we conduct a scoping review to map the existing research landscape, identify gaps, and contextualize our findings within the broader academic studies on technology acceptance and well-being. Additionally, the third phase involves an empirical survey that captures personal experiences and perceptions, and therefore supplementing our analysis with micro-level insights that reflect the lived realities of residents.

The integration of these methods enables us to ensure that our conclusions are grounded in both data-driven analysis and theoretical basis, offering a deeper understanding of the role of technology in enhancing urban well-being.

In the first part of the analysis, the IMD Smart City 2023 Index (IMD World Competitiveness Center and (IMD), 2023) was merged with the Happy City Index 2023 (Institute for Quality of Life & Ltd., 2023). Despite various indices measuring the "smartness" of the city such as Cities in Motion Index, Innovation Cities Index, Smart City Governments and many others, we found the Smart City Index useful for our research due to its holistic nature, global coverage and smart city elements orientation. Besides, it was claimed to be reliable and versatile (Lai & Cole, 2023). The IMD Smart City Index is based on citizens' perceptions of their city's infrastructure and technological applications. In 2023, around 20,000 city residents were surveyed regarding their living priorities, ranging from the need for affordable housing and improving traffic congestion to securing pleasing employment and ensuring the availability of green spaces. The index is built on two pillars: existing infrastructure (Structures) and technological provisions and available services (Technology). Both pillars are evaluated across five areas: health, safety, mobility, activities, opportunities, and governance. In the 2023 index there were 141 cities analysed.

Even while considering happiness, there are various indices such as City Wellbeing Index, The Happiness Index and others; however, we selected The Happy City Index due to its clear methodology presentation and global inclusion (more cities analysed compared to other indices). The Happy City Index methodology is structured around five key categories important for making happy urban spaces: Citizens, Governance, Environment, Economy, and Mobility. These categories are formed based on 24 areas of activity, reflecting the various determinants of urban happiness. The citizens category focuses on the well-being, health, and education of the urban population; Governance evaluates the effectiveness, transparency, and public engagement of city management; Environment category assesses sustainable practices, green spaces, and pollution levels; Economy category examines employment rates, innovation, and the economic stability of the city; while Mobility focuses on public transport efficiency, traffic congestion, and accessibility within the city. In the 2023 index there were 200 cities analysed.

In our analysis we match cities that appeared in both listings, resulting in a total of 104 cities worldwide. Besides the available rankings in both indices and scores for happiness index, we manually extract 2.080 responses from the smart city index in order to

separately calculate the score relevant for the technology pillar. For all these cities and respective countries also Human Development Index (HDI) was captured. After initial data preparation SPSS software was used to analyse the relationships between the rankings, individual scores and respective HDI. Cities were classified into three groups based on the HDI, namely high (>0.9), middle (between 0.8 and 0.9) and low HDI (lower than 0.7).

The second part aimed to analyse existing scientific corpus on the adoption of smart technology, published in peer-reviewed scientific journals. For this purpose, we employed multiple methods, including a scoping literature review and a bibliometric analysis. Scoping reviews are conducted to compile evidence and evaluate the extent of existing literature on a particular subject (Manrique Rueda et al., 2024). This method involves a thorough examination of literature, providing researchers with the opportunity to delve into the existing body of evidence within a specific subject area or to explore a broader research question (Lista Rossetti, Luz Tortorella, Bouzon, Gao & Chan, 2023). In addition, bibliometric analysis serves as a cohesive framework for systematically mapping a specific knowledge domain Zupic and Čater (2015), and we used well know tool VOSviewer (Jan & Ludo, 2010).

Aligned with the scoping review methodology, first step was to define eligibility criteria (Tricco et al., 2018). We defined that, to be included in this scoping review all papers needed to be relevant to smart technology acceptance or adoption. No restrictions were set regarding the date of publications, but publications should have been written in English. As for information sources, this scoping review excluded books, chapters and grey literature (Manrique Rueda et al., 2024). Further step was to define the search strategy (Obreja, Rughiniș & Rosner, 2024), that it included keywords relevant to posed research questions. Precisely, the search strategy included keywords related to smart technology and either acceptance or adoption. The same search query was executed on the Web of Science (WoS) and Scopus databases, chosen for their extensive coverage of peer-reviewed papers (Ahi & Searcy, 2015). WoS and Scopus are commonly used when examining social science literature, such as in Mijac, Jadric and Cukusic (2024). Search queries used were:

Scopus: (TITLE-ABS-KEY (technolog*) AND TITLE-ABS-KEY (smart) AND (TITLE-ABS-KEY (adoption) OR TITLE-ABS-KEY (acceptance))) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (LANGUAGE, "English"))

Web of Science: (((TS=(smart)) AND TS=(technolog*)) AND (TS=(adoption)) OR TS=(acceptance))

Inclusion criteria has been set to peer-reviewed journal papers written in English. As for WoS, we included only papers published in ESCI-expanded, SSCI and ESCI. There has not been exclusion regarding year of publishing, but duplicate studies, redundant studies and studies out of scope were excluded. After agreeing upon inclusion, exclusion and quality criteria, selection of sources has been conducted. In scoping reviews, the data extraction process, known as charting the results, was conducted using Excel and the Power BI tool to ensure comprehensive analysis and visualization.

In the third phase, we conducted a web-based questionnaire centred around technology interest, smart city-related services, and their potential impact on the life satisfaction and social well-being. The survey was conducted online from February 5, 2024, to April 6, 2024. A total of 193 millennials actively took part in the survey, with a notable 76 % of them residing in urban areas. The survey instrument included a series of questions designed to capture respondents' perceptions and attitudes towards smart technologies and their effects on well-being. The items used in questionnaire were developed based on previously validated instruments and tailored to the specific context. For measuring attitudes towards technology, we adopted items from Edison and Geissler (2003). Life satisfaction items were derived from research conducted by Yu et al. (2020), and items concerning social well-being were adopted from Fleury-Bahi et al. (2022). For a more detailed analysis of the received answers, we used SPSS software and, for data visualization, the Power BI tool.

Results

Relationship between the smart city and happiness

Firstly, we focused on examining the correlation between smart city rankings and happiness rankings. This correlation was determined to be statistically significant, with a Pearson correlation coefficient of 0.681 (significance level of 0.001).

Fig. 1 presents a scatter plot of Happiness rank and Smart city rank together with HDI of respective country. The plot's axes have different scales since in our analysis only cities appearing in both indices were included, while we kept their original ranks for each index. Lower rank numbers indicate better cities, implying that cities positioned towards the bottom-left corner excel according to both smart city and happiness criteria. However, as evident from the Fig. 1, there is a considerable dispersion among the cities.

The cities highlighted with circles are those that either excel or lag in both indices. Cities in the top-right corner have particularly low happiness ranks (below 150) and low smart city ranks (below 100), while cities in the bottom-left corner excel in both smart city rank and happiness rank. However, as evident from the figure, while several cities rank highly in smart city indices, they exhibit comparatively lower in happiness rankings. Yet, since ranking provides limited insight without a clear indication of how successful a particular city really is, we examined the individual happiness score for each city. Firstly, we compared the scores with the human development index for that particular city (Fig. 2).

The highest possible score for happiness was 1700, and for the Human Development Index (HDI), it was 1.00. Cities located in the top-right corner are considered superior from both the happiness and HDI perspectives. The figure includes a threshold line that indicates the level surpassed by the top 25 cities in terms of happiness, representing the so-called "golden cities" as noted in The Happy City Index. A notable finding from Fig. 2 is that the majority of cities achieved commendable HDI scores, with 71 % of them having an HDI higher than 0.900; however, many of these cities scored significantly lower in terms of happiness.

This discrepancy highlights the need for an additional analysis. Therefore, we focused on the smartness of each city by calculating the individual scores that each of the analysed cities obtain related to the technology pillar in the Smart City Index and compare it with the happiness scores (Fig. 3). The technology pillar refers to the range of technological facilities and services accessible to city residents that support urban living and is well-connected with the smart city definition. It would be expected that higher availability of different technological facilities is directly related to increased happiness. However, technology and focusing on technology was not found as relevant factor for the happiness.

The analysis reveals diverse relationships between technology and happiness across cities with different HDI levels. In cities with the highest country HDI, an increase in technological facilities and services correlates with a decrease in happiness, suggesting that beyond a certain point, technology alone may not contribute to, and may even detract from, overall happiness. Yet, it should be noted that smart city technology related scores are obtained based on individual perceptions and in countries with higher HDI expectations from the technological facilities are also higher.

For cities with middle HDI, technology's impact on happiness is quite neutral, while in cities with the lowest HDI, additional technology appears to significantly increase happiness. This indicates that while technology has a crucial role in the development of smart cities particularly at the beginning, its influence on enhancing well-being may diminish over time. Without integrating other factors important

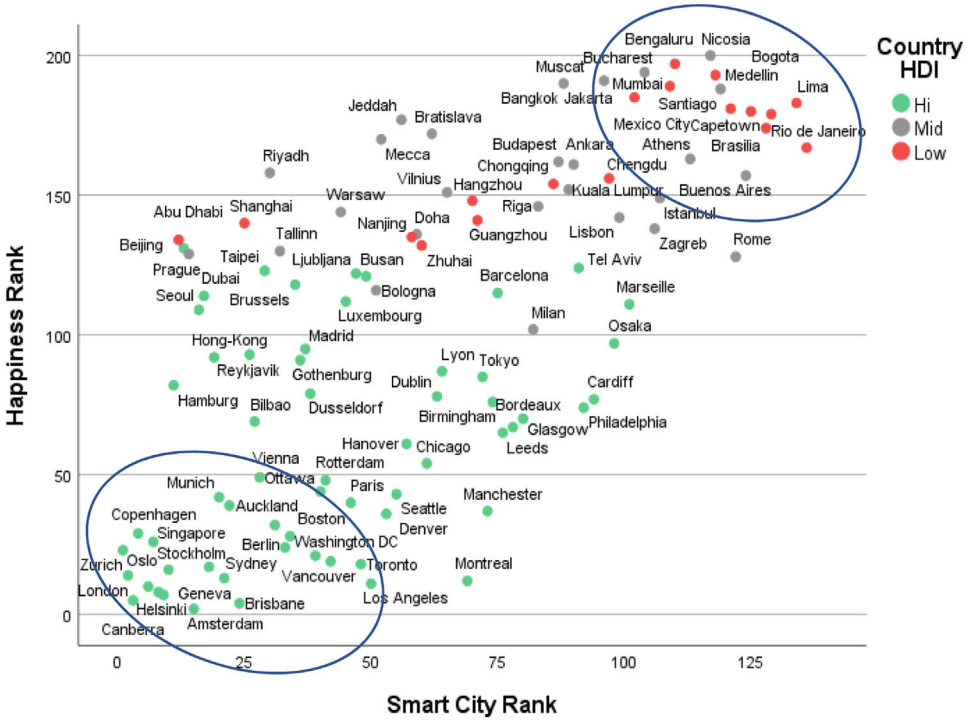

Fig. 1. Smart city and happiness relation (ranking).

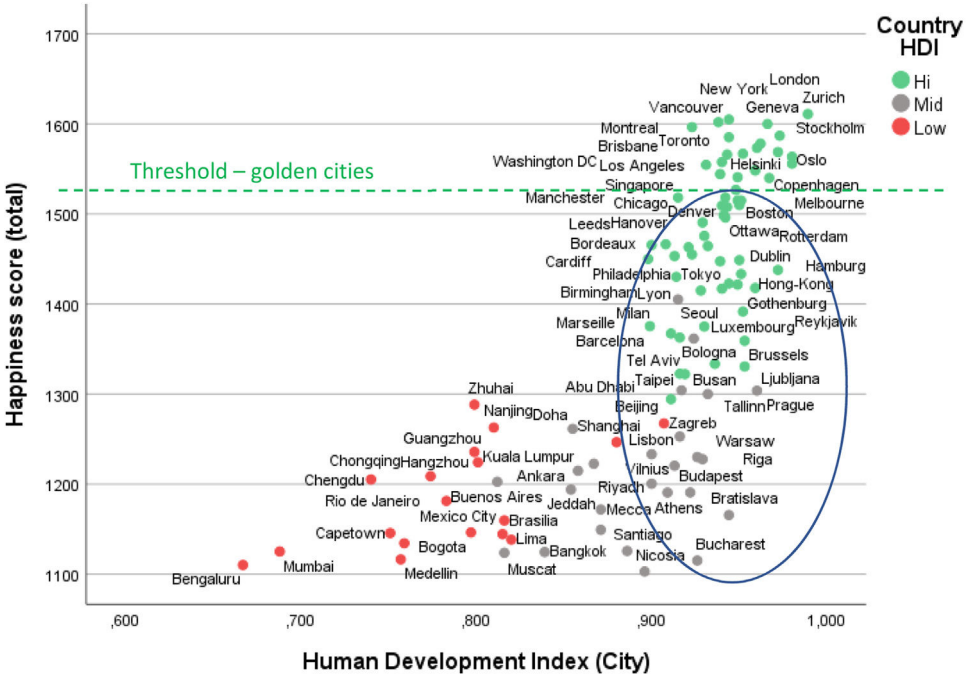

Fig. 2. Relation between human development index and happiness score.

for well-being and reliance on technology alone could eventually have even a negative impact on happiness. The finding also explains why particular technology-oriented cities or very high-tech cities can still face with residents not being satisfied with the living conditions in these cities.

This observation suggests that solely focusing on increasing smart city scores or enhancing the "smartness" of a city by providing additional technological features is not necessarily leading to increased happiness with that city. Therefore, we wanted to further examine the research stream dealing with technology adoption in order to shed light on factors that are in the focus of majority researchers and to contextualize our findings within the broader academic discussions on technology acceptance and well-being.

Insights from bibliographic analysis on technology adoption research

Given the findings above, and to provide an answer to our second posed research question we wanted to deeply analyse the scientific literature while focusing of research dealing with smart technology adoption or acceptance. After employing the search query, full

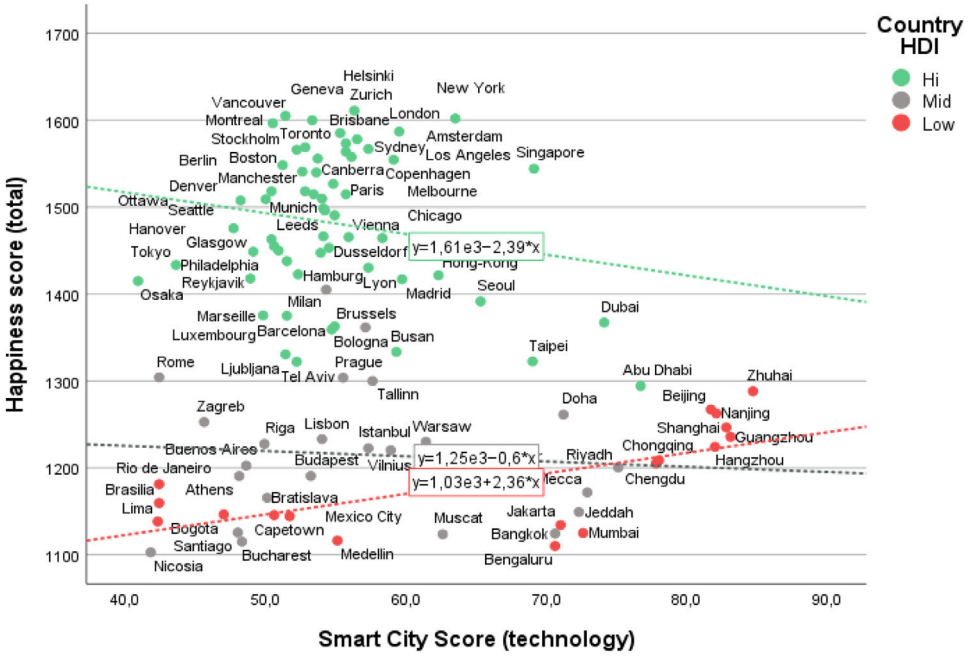

Fig. 3. Relation between smart city technology related score and happiness score.

bibliographic datasets were downloaded from Scopus (n = 4876) and WoS (n = 4957). Bibliographic databases were imported into software tool VOSviewer (Bušelić & Banek Zorica, 2020; Eck & Waltman, 2011), and co-occurrences map of all keywords have been prepared. There was no need to remove duplicates before importing the databases, as the VOSviewer automatically removes them upon import (Van Eck & Waltman, 2022). We have chosen to conduct keywords' analysis as keywords since they consist of nouns or phrases that represented the core subject of a publication. Out of total 21,208 keywords identified, after setting the minimum number of occurrences per keyword to 5, 1783 keywords meet the threshold. The keywords with the greatest total link strength were selected (n = 1000) for preparing the co-occurrence map.

However, upon conducting a thorough analysis, we revealed that identified scientific papers can be further categorized into five major clusters, with well- being noticeably lacking (Fig. 4). The

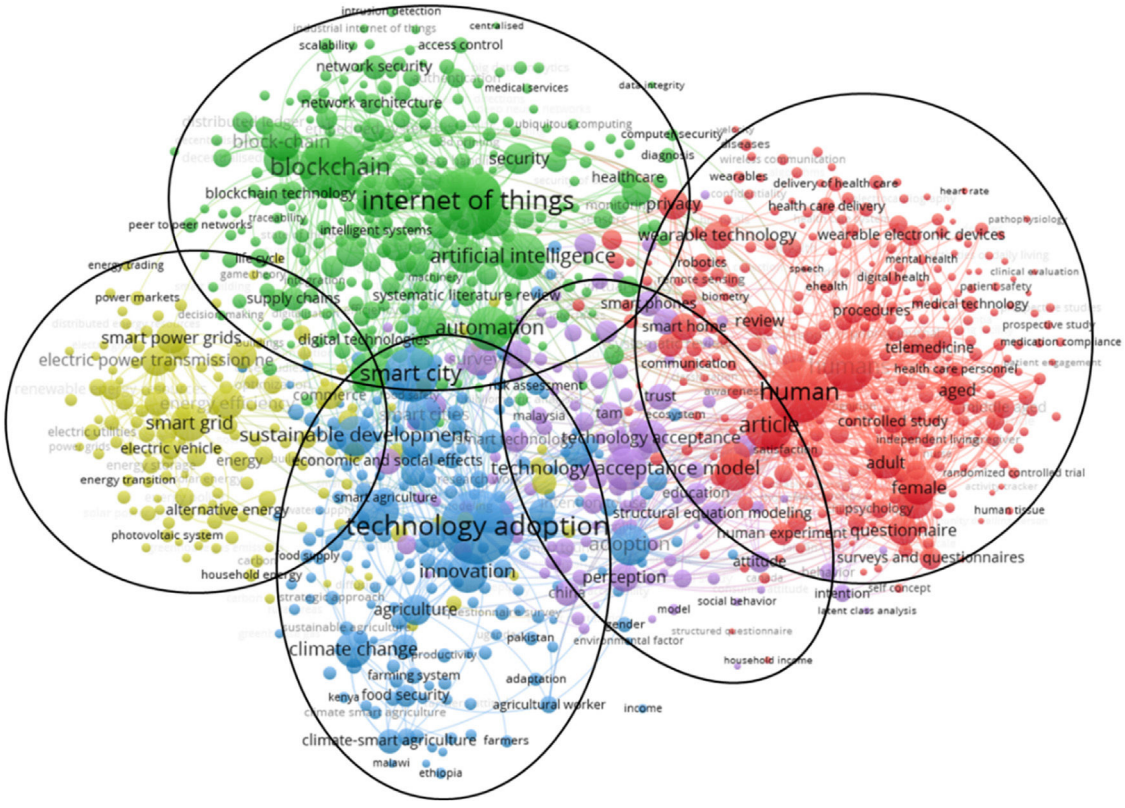

Fig. 4. Co-occurrence analysis of papers dealing with technology adoption.

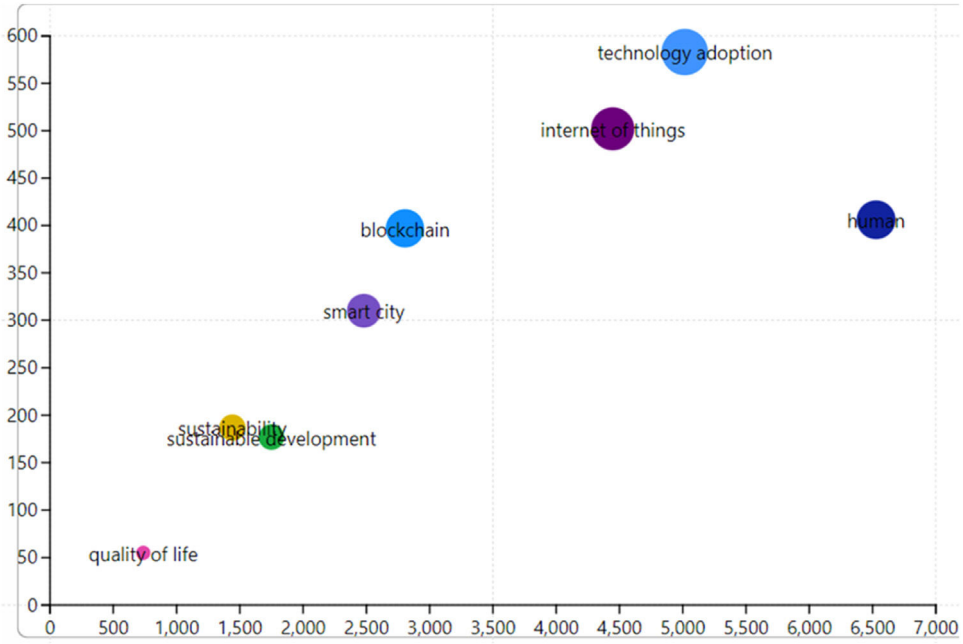

Fig. 5. Comparison of keywords related to research question and leading keywords from selected literature landscape.

predominant focus of research is primarily centred around (1) *human related factors* (such as, wearable technology, digital health, biometry, daily life). This cluster is marked with the red colour. The second (green) cluster is related to (2) *the exploration of underlying new technologies and concepts* (such as, blockchain, artificial intelligence, sensors, 3D printing, embedded systems). Blue cluster represents concepts related to (3) *the adoption of new technologies in different domains* (such as, agriculture, farming, and climate). Fourth cluster, marked with yellow colour, tackles (4) the *examination of energy related technologies*. The smallest cluster is marked with the purple colour, and it tackles (5) *theoretical aspects of technology acceptance* (such as, TAM, UTAUT, intention to use, social influence, intention). The results are in Fig. 4.

Interestingly, the lack of a specific cluster related to well-being and happiness concepts suggests that current research focuses mainly on facilitating the adoption process rather than examining the effects of smart technology on well-being. Following the keyword mapping process, we exported a comprehensive list that includes the frequency of occurrences and link strengths of keywords. A link represents a co-occurrence relationship between two keywords. According to the VOSviewer manual, each link is given a strength, represented by a positive numerical value. A higher value signifies a stronger link (Van Eck & Waltman, 2022). The total link strength reflects the number of publications where the two keywords co-occur (Guo et al., 2019). Subsequently, we verified the absence of terms related to “well-being" within the context of “happiness” in the dataset. To be more precisely, among all exported keywords only one keyword relevant to well-being was identified, as well as one keyword in regard to quality of life. It is interesting to point out that none of the gathered keywords is related to happiness. However, there were six keywords closely related to the sustainability concept: “sustainability”, “sustainable development”, “sustainable agriculture”, “environmental sustainability”, “sustainable cities”, and “sustainable development goal”. To visually convey these insights, Fig. 5 in continuation showcases only relevant keywords, each appearing at least 50 times in the dataset. Additionally, the figure also shows the top 5 keywords with the highest occurrence rates: "technology adoption", "internet of things", "blockchain", "smart city", and "human." The X-axis represents link strength, while the Y-axis corresponds to the number of occurrences.

The results of the keywords cluster analysis (Fig. 4) revealed that none of the clusters even remotely mention the concept of "well-being", which further implies that, although some research has touched upon this concept (as revealed incomprehensive keywords list analysis), the authors did not consider it as one of the foci themes of the paper (it was not listed as a keyword).

This observation underscores a notable gap in the extensive literature on technology adoption. Despite the substantial and extensive corpus of literature, there is a conspicuous absence of a dedicated focus on the concepts of well-being and happiness. Consequently, we aimed to conduct a more in-depth examination of the research stream.

Scoping review of papers dealing with technology adoption

To provide answer to our second research question and to complement the results from bibliometric analysis we conduced scoping review. After employing the search strategy and taking into consideration defined inclusion and exclusion criteria two databases were acquired and subsequently amalgamated, comprising 4957 records from WoS and 4876 records from Scopus. Following this merger, 4056 duplicate entries were identified and removed, leaving 5777 unique records for further analysis. To ascertain if studies fall outside the scope, we established quality criteria (Q1) based on whether papers included keywords such as: happy*, sustain*, well-being, and life quality. The second quality criteria was to keep papers that specifically incorporated only the three keywords: happy, well-being, and life quality (Q2).

Post-download and deduplication, an in-depth analysis was carried out, encompassing meticulous consideration of exclusion, inclusion, and quality criteria. List of sources was gathered, and in-depth analysis of the papers was carried out in Excel tool. Following these rigorous evaluations, 128 records met the criteria and were selected for inclusion in the scoping review. The detailed procedure is visually represented in Fig. 6 for clarity and continuity (Page et al., 2021).

Results are also in line with the result from bibliographic analysis evidencing that well-being and happiness have been neglected. Precisely, in-depth analysis showed that from initially 5777 papers, only 2 % paper somehow tackles these mentioned concepts.

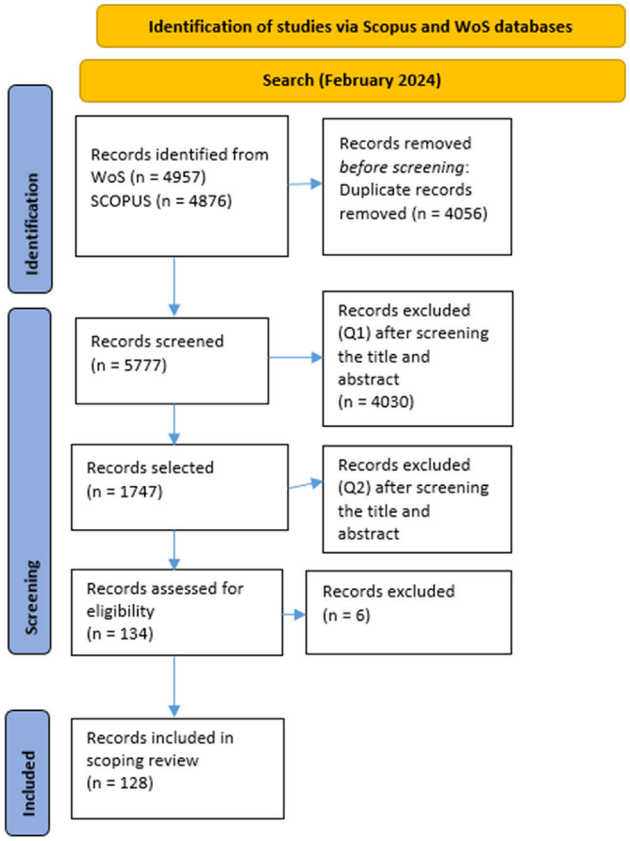

Fig. 6. Search, retrieval, and screening flowchart adopted from Page et al. (2021).

Moreover, the 128 selected papers were categorized based on their respective domains. The predominant focus of these papers revolves around specific themes, with a substantial number addressing topics such as "smart housing" (n = 32), "smart healthcare" (n = 32), and "general smart technology applications" (n = 17). Additionally, a noteworthy subset of papers delves into the broader domain of "Smart City initiatives" (n = 13). Furthermore, the selected papers were categorized according to the target group of the study. Notably, an intriguing observation emerged, revealing that nearly half of the examined papers specifically targeted elderly users (44 %) in their papers. Additionally, a significant portion of the papers focused on the study of patients and individuals with disabilities. These results are presented in Fig. 7 in continuation.

All papers included in this review (n = 128) were published in the range from 2009 to 2024. However, papers from smart city domain are relative recently published (2018).

The latest findings highlight that utilizing smart devices to access public services has the potential to enhance citizens' overall well-being. According to Hartanti et al. (2022), such services contribute to an improved safety experience, enhanced usefulness, and increased convenience for citizens. It is worth noting, however, that the measurement of well-being in this context is specifically gauged through safety experience, usefulness experience, and convenience experience. Findings from Javed et al. (2022) also point out that smart city is vital to improving the well-being and quality of citizens' life advocating for prioritizing the citizen-centric approach.

Authors Chib, Alvarez, & Todorovic (2022) and van Hoof, Marston, Kazak, & Buffel (2021) delve into the intricacies of the digital divide, specifically examining the acceptance of smart city technologies among elderly individuals. Meanwhile, Tantau & Şanta (2021) directs attention to citizen well-being, particularly within the context of energy policies. Additionally, a comprehensive literature review on urban interventions targeting human well-being (Buttazzoni, Veenhof & Minaker, 2020) and an exploration of key drivers in public creation (Lopes, Macadar & Luciano, 2019) further enrich our understanding of the multifaceted dimensions of smart city research.

These insights revealed that the predominant focus of selected papers is on practical applications rather than a comprehensive exploration of well-being-related factors. There is also a significant gap in understanding the impact of smart technologies on the well-being of diverse demographic groups, warranting further investigation. Additionally, the evidenced limited focus on specific well-being dimensions in this context calls for a more nuanced exploration. Therefore, we aimed to conduct quantitative research to gather insights regarding the current state of perception of smart city, well-being, and life satisfaction.

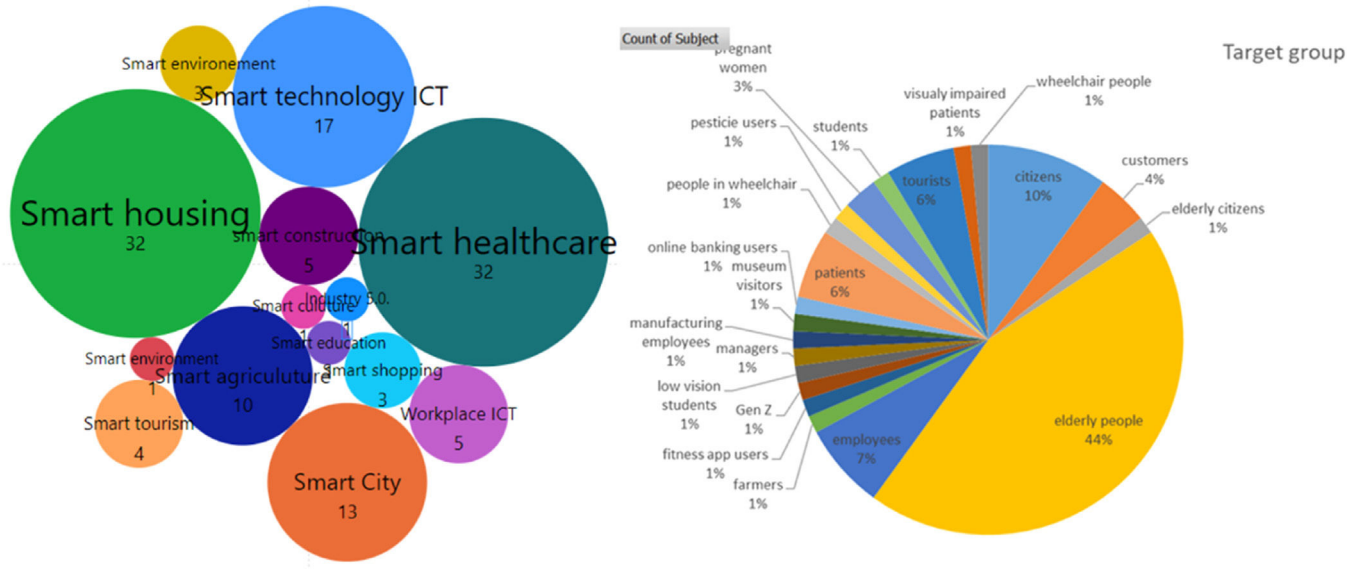

Fig. 7. Domains and participants of selected papers.

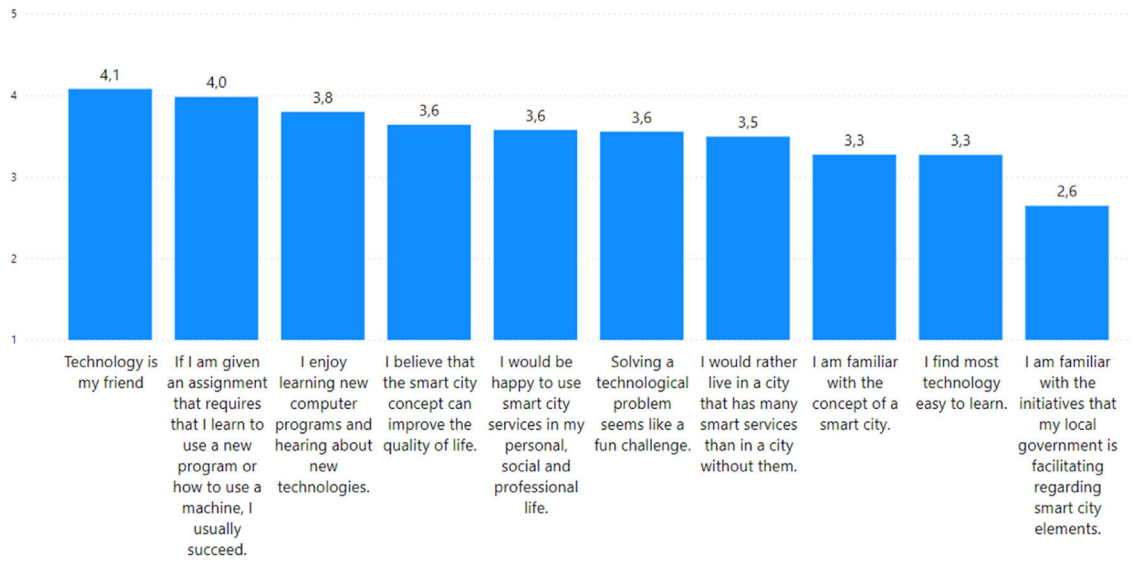

Fig. 8. Millennials' attitudes toward technology and smart city.

Attitude of millennials towards smart technology and well being

To complement the results of comparative analysis and to provide answer to our first research question we additionally aimed to explore millennials' views on the topics discussed by conducting a web-based survey. The data indicate a clear need for more targeted research into the intersection of smart technology and well-being. Most individuals in our sample reported no difficulty in using new technologies and are neither worried about their future employment prospects nor fearful of keeping up with technological advancements. Furthermore, the majority of respondents perceive smart cities as enhancing the quality of life (Fig. 8).

The analysis focused on life satisfaction (Yu et al., 2020) and social well-being (Fleury-Bahi et al., 2022) revealing a notable and statistically significant correlation (Pearson correlation of 0.360, significance level of 0.01). Additionally, a positive and significant correlation emerged among millennials, linking their well-being to their eagerness to e-participate in city consultations using digital tools (Pearson correlation of 0.308, significance level of 0.01). Moreover, millennials displayed a noteworthy association between their well-being and their inclination to express ideas for improving services in the city/municipality using digital tools (Pearson correlation of 0.176, significance level of 0.05).

These results underscore the imperative for further research in this domain, specifically in exploring the intricate relationship between technology and social well-being. A smart city, by definition, constitutes a complex amalgamation of technologies aimed at enhancing the living conditions of individuals. While individuals exhibit a positive disposition towards embracing new technologies and believe in the potential of smart cities to address contemporary challenges, there remains a need for additional research endeavours. Hence, further investigation, incorporating the dimensions of happiness, well-being, and sustainability, is essential to garner a more comprehensive understanding of the intricate interplay between technology and well-being within the context of smart cities.

Discussion

We observe that cities have not only evolved into "smart" cities but have also long been labelled as such, offering a range of services under this umbrella. Alongside, there's a growing emphasis on sustainability. However, while sustainability encompasses economic, social, and environmental dimensions, our paper finds that most research primarily focuses on environmental sustainability targeting tangible aspects like energy efficiency, waste, and water management. It is crucial for cities to consider all sustainability dimensions in their long-term strategies, especially social sustainability. Despite being under-researched, social sustainability is crucial, particularly given the challenges posed by an aging population. This demographic shift could limit the benefits of smart technologies, as older generations may not embrace these advancements as readily as younger ones.

While the terms "smart" and "sustainable" are often used interchangeably, it is important to distinguish between the two. Increased smartness can enhance environmental sustainability, but it may also negatively affect social sustainability and, therefore, overall happiness. This delicate balance is rarely addressed in both theory and practice, and neglecting it could result in irreversible consequences. For instance, research has shown a positive influence of social networks on well-being (Jahan et al., 2024), echoing similar findings by Gao et al. (2024) in their research on the metaverse which highlights how smart technologies can shape social sustainability. This is expected, as the primary advantage of social networks is enhancing communication and connection among individuals. However, other smart applications may not prioritize these aspects; in fact, they could have the opposite effect. For example, a healthcare app: while it may offer cost and time efficiencies in scheduling services, it reduces personal interactions between patients and healthcare providers. This raises important questions: Do the cost savings outweigh the potential loss of personal connection or what is more important: lowering costs or overall well-being? Cities should therefore proceed with caution when implementing smart sustainable solutions, ensuring these initiatives are thoughtfully designed to consider not just the benefits but also the potential adverse effects they may entail.

Our research aimed to explore the relationship between smart city technologies and residents' well-being, focusing on how technological advancements contribute to happiness in urban environments. By employing a mixed-methods approach, we integrated data from the IMD Smart City Index and the Happy City Index, conducted a scoping review and bibliographic analysis of over 5000 papers on technology adoption, and surveyed 193 millennials on their attitudes toward smart technology and well-being. Our key findings relate to various important aspects.

First, we identified some level of correlation between smart city and happiness. We found a statistically significant correlation between smart city rankings and happiness rankings. This suggests that cities perceived as "smart" by their residents also tend to have higher happiness levels. However, a notable discrepancy was

observed among cities with high Human Development Index (HDI) scores but low happiness levels, indicating that technological advancements alone do not guarantee increased happiness.

Second, we also examined the impact of technology on well-being. Our analysis revealed diverse relationships between technology and happiness across cities with different HDI levels. In cities with high HDI, an increase in technological facilities and services correlated with a decrease in happiness, suggesting that beyond a certain point, technology alone may not enhance and may even detract from overall happiness. In cities with middle HDI, the impact of technology on happiness was neutral, while in cities with low HDI, additional technology significantly increased happiness. This indicates that technology plays a crucial role in the early stages of development, but its influence on well-being shifts with developmental progress. Our findings extend the existing body of research on smart cities and well-being. Lin et al. (2019) found that residents' experiences of safety, usefulness, and convenience in smart cities positively impact their subjective well-being. Our study supports these findings by demonstrating a significant correlation between smart city rankings and happiness rankings. However, by highlighting the varying impact of technology on happiness across different HDI levels we include an aspect not previously explored.

Third, we identified gaps in existing research endeavour. The bibliographic analysis and scoping review also support our findings, showing a significant focus on technology with only a small number of the examined papers addressing well-being and happiness in the context of technology adoption. Most such research focused on practical applications such as smart housing and smart healthcare, with limited attention to the broader implications of technology on social and subjective well-being (Sebestyén et al., 2024). The limited studies that do explore well-being therefore primarily concentrate on health, despite well-being encompasses much more than just health or smart housing.

Fourth, with the empirical survey of millennials, we further examined the relationship between smart technologies and well-being. Our findings revealed a positive correlation between their willingness to e-participate in city consultations using digital tools and their social well-being and life satisfaction. Millennials showed greater satisfaction when they could interact with smart city services through digital platforms, thus feeling more involved in urban governance. This suggests that for technology to positively influence happiness, it must be complemented by broader initiatives that promote social well-being, inclusivity, and community-building. After all, the technology has the potential to enhance well-being by fostering greater civic engagement and participation (Jonek-Kowalska & Wolniak, 2023), yet it needs to be wisely used since it can also be an obstacle.

While technology can be a key driver of urban happiness, especially in less developed urban environments, its effectiveness is depending on the context in which it is deployed. The findings highlight the need for smart city initiatives to move beyond a purely technological focus and address the broader social and psychological dimensions of urban well-being. Policymakers, urban planners, and researchers must work together to understand and integrate the subjective aspects of well-being into future smart city projects, ensuring that technology contributes to a holistic sense of happiness and quality of life.

Theoretical implications

Our study provides important insights for the future development of smart cities by highlighting the complex relationship between technological advancements and residents' well-being. By conducting a mixed-methods approach, we comprehensively examined smart technology acceptance and its implications for urban happiness. Rapid urbanization and outdated infrastructure present significant challenges for cities, further intensified by the resistance to changing habits and the complexity of integrating advanced technologies (Javed et al., 2022; United Nations, 2018). The pivotal role of empowered citizens in driving urban change underscores the significance of smart citizenship. However, this process is complex and includes aspects like change management, technology adoption, inclusiveness, and well-being.

Notably, much of the existing research on smart cities often fails to address these interconnected aspects (Chen, 2023), and the rapid development of smart cities has also elevated additional concerns regarding the well-being of citizens (Yu et al., 2020). The impact of urbanization through various socio-cultural and environmental processes influences the overall human conditions, encompassing health and well-being (Sebestyén et al., 2024). Despite the potential of citizens' happiness as a key indicator of quality of life, few studies have incorporated it into smart city planning (Chen, 2023).

Therefore, we aimed to explore the extent to which technology can contribute to increased happiness in smart cities and how existing research streams address this relationship. Despite the promise of smart cities to address these challenges through efficiency and intelligent management, our findings indicate that merely enhancing technological facilities does not necessarily translate to increased happiness. These findings somewhat correspond to the conclusions put forth by Chen (2023), asserting that technological innovations may not be an effective means to augment urban happiness despite the fact that they can have the potential to address these challenges (Geyda et al., 2021). Moreover, the utilization of technologies enabling self-expression, social interaction, and the sharing of assets and knowledge can empower smart citizens to become engaged, enthusiastic, and well-informed decision-makers (Zandbergen & Uitermark, 2020).

To further understand these dynamics, we conducted a detailed literature review that revealed a significant gap in current research: a notable lack of focus on happiness and well-being within technology acceptance studies. While there were several extensions of technology acceptance models, such as adding factors like innovativeness, risk, and trust (Slade et al., 2015), and herd behavior (Erjavec & Manfreda, 2022) among many others, including a call for a new post-adoption perspective approach (Schwarz & Chin, 2024), a deeper analysis showed that only 2 % of the reviewed literature specifically addressed happiness and well-being. These findings should guide future empirical research. Additionally, future studies should also broaden the scope to include social sustainability and examine the impact of technology on happiness. Evidence suggests that high-tech cities do not necessarily correlate with higher resident satisfaction.

Our study therefore extends existing research by offering new insights into the theoretical framework surrounding smart cities and well-being. It underscores the need for future research to incorporate subjective well-being and happiness into smart city development models, recognizing that technology alone is insufficient for ensuring resident satisfaction.

Implications for practice and policy

To develop and implement smart city projects successfully, it is essential for policymakers, communities, and organizations to collaborate closely on a unified vision. This collaborative effort requires identifying and overcoming potential barriers, investing in essential resources and infrastructure, and nurturing a culture of experimentation and innovation. Such actions may enable smart cities to fully leverage their capabilities to create resilient, sustainable, and thriving urban spaces capable of addressing the global challenges ahead. Moving towards a more sustainable direction is becoming inevitable (Dabbous, Aoun Barakat & Tarhini, 2024). Our research offers some insights and important practical implications in order to achieve this direction.

First, inclusive smart city planning. Future smart city initiatives should aim to be inclusive, bridging the digital divide and ensuring that advancements benefit all residents. This includes addressing generational barriers in adopting smart technologies and implementing programs that bridge the digital divide (Colding et al., 2024). Providing digital literacy programs for older adults can help them engage with smart city technologies, enhancing their quality of life.

Second, a holistic approach to well-being. Smart city projects should integrate both objective and subjective aspects of well-being. This means considering not only physical infrastructure and technological advancements but also social and psychological factors that contribute to residents' happiness. For instance, urban planners should design public spaces that promote social interaction and community engagement, which are crucial for subjective well-being (Morris, 2023).

Third, citizen-centric design. Policymakers and urban planners should adopt a citizen-centric approach, ensuring that smart city solutions are designed with residents' needs and preferences in mind. This involves engaging citizens in the planning process through participatory methods such as public consultations and digital platforms for feedback. The positive correlation between millennials' willingness to e-participate and their well-being highlights the importance of involving residents in decision-making processes.

Fourth, balanced development strategies. Urban planners should adopt balanced development approaches that consider a wide range of factors, from economic opportunities to environmental quality and social infrastructure. This ensures that technological advancements lead to improvements in residents' overall quality of life. Integrating green spaces and sustainable transport options can enhance environmental sustainability and well-being. One of the key findings from our study is that in cities with lower HDI levels, technology significantly contributes to happiness. However, as cities become more developed, the effect of additional technology on well-being diminishes or even turns negative. Policymakers must acknowledge that the benefits of smart city technologies are not evenly distributed and may intensify existing inequalities. To prevent this, smart city initiatives must prioritize inclusivity, ensuring that technological advancements are accessible to all residents, regardless of their socioeconomic status or digital literacy. Bridging the digital divide is critical for ensuring that all urban residents, particularly those in disadvantaged communities, can benefit from smart city innovations.

A practical recommendation is to implement community-driven smart technology programs that engage residents in co-designing solutions that meet their specific needs. Research by Bakici et al. (2013) supports the notion that citizen participation in smart city initiatives is crucial for their success, as it fosters a sense of ownership and ensures that technological solutions are aligned with local priorities. Policymakers should consider expanding digital literacy programs and creating participatory platforms that allow citizens to contribute to the decision-making processes regarding urban technology deployment.

Fifth, monitoring and evaluation. Implementing comprehensive well-being metrics to monitor and evaluate smart city initiatives is crucial. These metrics should include indicators for both objective and subjective well-being, allowing policymakers to assess the effectiveness of projects in enhancing residents' quality of life. Regular assessment can help identify areas for improvement and ensure that smart city initiatives remain aligned with residents' needs and expectations (Jonek-Kowalska & Wolniak, 2023). Besides, cities can track residents' happiness alongside traditional performance indicators, such as traffic management efficiency or energy consumption reduction, to measure the overall success of smart city projects. This would ensure a more holistic approach to urban development, one that places human well-being at the core of technological innovation.

Sixth, a context sensitive approaches. Policymakers should adopt flexible and context-sensitive approaches to smart city development, recognizing that one-size-fits-all strategies are unlikely to succeed. Urban planners should collaborate with local stakeholders, including residents, to co-create smart city solutions that address the unique needs and aspirations of each community. By doing so, they can ensure that smart city projects are not only technologically advanced but also socially and culturally relevant.

City planners and policymakers should therefore prioritize social sustainability in their long-term strategies. Urban development should focus on inclusivity, social equity, and the well-being of vulnerable groups such as the elderly. It is crucial to address generational barriers in adopting smart technologies by promoting technological inclusivity through programs that bridge the digital divide. Urban planners and sustainability experts should avoid overemphasizing environmental sustainability and instead adopt a holistic approach that integrates social well-being into smart city planning. This includes systematically evaluating the potential negative social impacts of smart technologies to ensure a balance between efficiency and human interaction.

Technology developers are encouraged to create user-centric smart solutions that enhance well-being, incorporating feedback from diverse demographic groups to ensure that these technologies promote social connectivity. Lastly, NGOs and community advocates should strive towards a broader understanding of well-being that includes mental health and social interaction. They also need to monitor the social impacts of smart city initiatives to ensure that inclusivity and social equity are at the forefront of these developments.

Limitations and future research opportunities

While our study provides valuable insights into smart technology adoption and well-being and happiness, it is crucial to acknowledge its limitations. Though inherent in the research design, these limitations are important to consider interpreting the findings appropriately and guide future research endeavours. First, a limitation of this study is that the first part of analysis relies on two selected indices, the IMD Smart City Index and the Happy City Index, to assess the relationship between smart city characteristics and residents' well-being. Yet, the decision to use these indices was justified in the methodology section. However, future research should consider incorporating additional indices and metrics to provide a more comprehensive analysis. Second limitation of the paper is that only the cities that have the data for both the IMD Smart City 2023 Index and the Happy City Index 2023 were included in the further analysis. Yet, due to global coverage of cities in both indices, we were still able to capture >100 cities. These indices also have their own limitation arising from subjective opinions; however, by comparing different sources and analysing the data from various sources, we try to minimize the limitations.

Another limitation of this study is its exclusive focus on papers related to technology adoption or acceptance, without including "happiness" or "well-being" as search keywords. However, this was intentional, as the research aimed to specifically analyse the scope and focus of literature on technology adoption and acceptance only. Additionally, the review exclusively relied on the Scopus and WoS databases. Despite that WoS and Scopus are the primary bibliographic databases traditionally recognized as the most extensive sources of information, some other databases could be of interest for future studies to explore different focuses across various disciplines. This constitutes a notable limitation, constraining the breadth of the research. Furthermore, there could be other relevant papers addressing the same topic without employing these specific keywords we used, resulting in their omission from the review. Lastly, in the web-based questionnaire, millennials on the voluntary basis participated not presenting a representative sample of the population.

Given the rapid development of smart cities, the increasing number of smart technologies, and the growing importance of residents'

well-being, it is crucial to explore the literature on the acceptance of smart technology, which is proved to be very scarce. As recent papers also noted, discussions about smart cities frequently emphasize technological products rather than citizens' quality of life, drawing criticism for overlooking the fundamental aspects of urban living, namely human well-being and happiness (Lara, Da Costa, Furlani & Yigitcanlar, 2016; Macke, Casagrande, Sarate & Silva, 2018).

Future research could focus on integrating diverse indices to deepen the understanding of complex relationship between smartness and happiness. Another research direction should also focus on critically examining technology acceptance models, adapting them to address sustainability, well-being, and happiness among evolving urban challenges. This approach will help refine existing models to better encompass these critical factors, offering a comprehensive framework for future smart city initiatives.

Conclusion

Living in cities is increasingly attractive due to the diverse opportunities they offer, such as employment, education, and cultural activities. However, these benefits often come with challenges like pollution, congestion, and healthcare issues due to high population densities. The smart city concept is often proposed as a mean to address these challenges, suggesting that technological advancements can significantly enhance urban living. Yet, in order to make smart city initiatives truly effective, they must go beyond mere technological implementation to integrate considerations of sustainability and resident holistic well-being as well.

This paper highlights that while technological advancements are crucial for the development of smart cities, their direct impact on enhancing residents' happiness is not straightforward. The findings suggest that enhancing technology does not necessarily translate to higher happiness levels, emphasizing the need for a comprehensive approach that considers other well-being factors including social, environmental, and psychological factors. Future urban development should not only focus on efficiency and technological integration but also ensure that these advancements lead to improvements in the quality of life for all city residents.

By expanding the current understanding of smart cities to include well-being and happiness, policymakers and planners can foster urban environments that not only promote technological progress and complexity but also provide satisfying living conditions. Therefore, future research should focus on deeply exploring these relationships and examining the potential for integrating them into existing technology acceptance models, ensuring that the progress of smart cities truly enhances the lives of their inhabitants.

Declarations of interest

none

CRediT authorship contribution statement

Anton Manfreda: Writing – original draft, Visualization, Supervision, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Tea Mijač:** Writing – original draft, Visualization, Methodology, Formal analysis, Data curation, Conceptualization.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used chatGPT in order to improve the language readability in some parts. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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