Smart Cities in Poland

Towards sustainability and a better quality of life?

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Quality of life and its determinants

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2 Quality of life and its determinants

2.1 The essence and measurement of the quality of life

Quality of life (QOL) is an interdisciplinary problem of interest to specialists in many areas of science. It is not easy to define the very concept of QOL, which can be understood in different ways. The concept of QOL is still a concept that is sometimes contested in the literature (Prutkin and Feinstein, 2002; Schalock, 2004; Al-Qawasmi, 2019). There is a consensus among researchers that QOL is a multidimensional construct consisting of subjective and objective dimensions covering various aspects of human experience (McCrea et al., 2006; Lora et al., 2010; Von Wirth et al., 2014; Al-Qawasmi, 2020; Wolniak and Jonek-Kowalska, 2021a, 2021b).

The World Health Organization (WHO) defines the QOL as follows: "An individual's perception of his or her position in life in the context of the culture and value systems, in which he or she lives and in relation to his or her goals, expectations, standards and concerns" (WHOQL, 2012). Initially, the WHO definition was the most widely used definition of QOL. In subsequent years, it was expanded to include issues related to how well a person functions in his or her life and how he or she perceives his or her well-being in terms of physical, mental or social aspects of his or her functioning (Hays and Reeve, 2010; Köves et al., 2017; Cai et al., 2021). It can be said that QOL is a concept that encompasses all factors affecting an individual's life.

The concept of urban QOL can be defined as the general well-being of people and societies, who live in cities, along with the quality of the environment, in which they live (Slavuj, 2011; Al-Qawasmi, 2020). It can be said that the quality of urban life consists of both objective attributes (external attributes of the environment and urban space) and subjective attributes (a person's individual observations and perception of tangible and intangible conditions).

A concept derived from the concept of QOL in relation to urban QOL is the concept of urban QOL. It is very important in analyzing issues related to the QOL or urban QOL to take into account subjective perceptions of the phenomenon. Subjective perceptions are important, because many key issues in people's lives, such as the quality of the urban environment, sense of security, sense of social solidarity, sentimental attachment and quality of neighborhood relationships, are difficult to measure using objective indicators (Lora et al., 2010). The literature sometimes criticizes the use of subjective indicators, because of their low reliability, as respondents may differ in their assessment, due to cultural differences, for example (Lora et al., 2010; Al-Qawasmi et al., 2021).

The modern concept of QOL is an interdisciplinary one, influenced by elements such as health, satisfaction of basic material needs (food, clothing, housing), material security (job security, salary), organization of life and work, leisure time that can be spent on personal activities, family and social ties, contacts with nature, education and knowledge, level of independence and personal freedom (Abunazel et al., 2019; Ramirez-Rubio et al., 2019; Gusul and Butnariu, 2021). Given the complexity and multifaceted nature of factors affecting QOL, it is now insufficient to use a single economic indicator, e.g., GDP per capita, as the most important indicator, by which to measure socioeconomic progress. Nowadays, when considering the issue of QOL in the context of sustainable urban development, it is necessary to go beyond the simple measurement of economic values and consider the category of QOL as the most important criterion that can be used in assessing socioeconomic progress (Dawood, 2019). For this to be done, a systematic, holistic approach must be implemented to take into account not only objective factors but also subjective elements, along with the sociocultural context (Rykun et al., 2020; Przybyłowski et al., 2022). To this end, it is necessary to use such methods of measuring the QOL that will ensure the comparability of urban development data through a system of indicators. One of the methods that can be used here is ISO 37120:2018, which will be described in more detail in the next subsection of this publication.

Literature references describe numerous methods of measuring the QOL. Standard indicators used include issues, such as wealth, employment, environment, physical and mental health, education, recreation or leisure time.

One approach to measuring the QOL is to use what is known as The Quality of Life Scale (QOLS), which consists of reliability, validity and utilization. The QOLS was originally an instrument measuring five major areas of QOL, such as material and physical well-being; relationships with other people; social, community and civic activities; personal development and fulfillment; and recreation. The questionnaire was used to

measure the QOL as traditionally understood by the WHO definition. In subsequent years, the questionnaire was supplemented with another category – independence, the ability to do things for oneself. Each of the five main categories contained subcategories, which are shown in Table 2.1.

QOL can be measured at both the aggregate and discrete levels. The objective approach to measuring the QOL involves measuring the QOL at the aggregate level by assessing individual physical elements of the environment that contribute to human well-being. Issues, such as: the number or proportion of habitable buildings (homes, schools, hospitals, offices, etc.), infrastructure (e.g., roads, railroads, airports, electricity, sewage and water networks), economic status (GDP, income, employment or assets), environmental status (pollution and climate change) and social services (healthcare, climate change, recreation, education) (Leitmann, 1999; Mohit, 2013). The subjective approach treats QOL as a concept consisting of discrete domains, usually disaggregated at the individual level and more concerned with cognitive experiences, feelings and behavioral dimensions, according to individuals' individual criteria for evaluating and perceiving life (Zayyanu and Abubakr, 2019).

One of the commonly used framework models for improving the QOL in a city is the model proposed by Mitchell, which is shown in Figure 2.1. The model considers the division of QOL into six main areas. Each of the six areas listed can be divided into further components:

1 Health: physical health, mental health;
2 Physical environment: nuisance, climate, pollution, visual perception;
3 Natural resources, goods and services: natural resources, goods, social services;

Table 2.1 Quality of Life Scale

Category	Scale items
Material and physical well-being	Material well-being and financial security
	Health and personal safety
Relationships with other people	Relationships with parents, siblings and other relatives
	Having and raising children
	Relationships with spouses or significant others
	Relationships with friends
Social, community and civic activities	Activities related to helping or encouraging others
	Activities related to local and national governments
Personal development and fulfillment	Intellectual development
	Personal understanding
	Occupational role
	Creativity and personal expression
Recreation	Socializing
	Passive and observational recreational activities
	Active and participatory recreational activities

Source: Burckhardt and Anderson (2003).

Figure 2.1 The quality of life model.

Source: Mitchell et al. (1995), Zayyanu and Abubakr (2019).

4 Community development: community structure, social network, political participation;
5 Personal development: individual development by learning, individual development by recreation;
6 Security: crime and security, housing, personal economic security.

2.2 Determinants of the quality of life in urban communities

An example of a tool that can be used to measure the QOL is the methodology used in the development of European reports – Report on the QOL in European Cities. For this approach, the following dimensions of urban QOL were used, which are characterized in Table 2.2 (Report, 2020):

• Satisfied with living in the city;
• Safe and inclusive city;
• Getting a job, finding a house and earning a living;
• Moving around the city;

- Culture, squares, parks and healthcare in the city;
- Healthy cities;
- Quality of local public administration.

Table 2.2 Quality of Life in European Cities scale

Category	Characteristics
Satisfied with living in the city	Quality of life depends on aspects that someone else can verify and aspects that only an individual can verify. For example, one's income can be verified, but not whether a person is satisfied with that income (Eurostat, 2016). This is also true for many other issues, such as employment, air pollution, public transportation and safety. Only conducted surveys can reveal people's actual experiences, opinions, feelings and their observations.
	Many quality-of-life issues depend on where people live. From housing costs to clean air, from cultural amenities to transportation, to opportunities, such as access to museums, and risks, such as crime, therefore, where they live (Burger et al., 2020).
Safe and inclusive city	The United Nations 2030 Agenda for Sustainable Development aims to make cities inclusive. The UN has defined an inclusive city as follows: It is a place, where everyone, regardless of economic means, gender, race, ethnicity or religion, has the opportunity and is entitled to participate fully in the social, economic and political opportunities that cities offer (Glatz and Eder, 2019).
	The New Urban Agenda stipulates that cities should prioritize safe, inclusive, accessible, green and high-quality public spaces that are family-friendly, enhance social and intergenerational social interaction, promote social cohesion, inclusion and safety (Hansmaler, 2013).
Getting a job, finding a house and earning a living	Finding a job, a home and earning enough money to live decently is the key to a high quality of life. This includes issues, such as whether it is easy to find a job, find a home and cover expenses.
Moving around the city	Important sites in the city should be accessible to people living in and outside the city.
	Urban transportation can generate problems, such as congestion, traffic accidents, noise and air pollution, as well as greenhouse gases. Consequently, urban transportation networks need to optimize infrastructure use, provide efficient services and encourage a shift to more sustainable modes of transportation (Lättman et al., 2016).
	Transportation in cities should emit less pollution. Achieving sustainable transportation means putting users first and providing them with more affordable, accessible, healthier and cleaner alternatives to their current transportation habits. Furthermore, the Urban Agenda for the EU26 emphasizes that good public transportation is essential for cities and encourages the exchange of best practices between cities.

(*Continued*)

Table 2.2 (Continued)

Category	Characteristics
Culture, squares, parks and healthcare in the city	Cities often have significant cultural venues, events or programs that can attract large and diverse audiences and contribute to their individual and collective well-being (Blessi et al., 2016; Fancourt and Steptoe, 2018; Grossi et al., 2012; Grossi et al., 2019). Cultural and artistic activities can stimulate people's imagination and emotional responses (Ascenso et al., 2021), foster social interaction or healthy lifestyles (Jones et al., 2013), as well as help improve cognitive, creative and relational abilities that improve residents' quality of life and make them feel part of the community (Wilson et al., 2017). With a view to promoting cultural participation and its welfare effects, cities should work toward making a wide range of cultural activities available and providing opportunities for active participation in them. In the urban context, green spaces (i.e., parks, public gardens and nearby forests) can play a dual role: on the one hand, they can improve air quality by absorbing pollutants, soaking up rainwater and preventing flooding; on the other hand, they provide opportunities for leisure and sports activities, facilitate social interaction and thus improve the quality of urban life.
Healthy cities	Although air quality has improved over the past decade, air pollution in many European cities exceeds EU air quality standards. Excessive air pollution has a significant negative impact on human health. In addition, long-term exposure to air pollution can have a large negative impact on health. Exposure to PM2.5 is estimated to have caused more than 400,000 premature deaths in 2016 (EEA, 2019). Noise pollution is also linked to health problems. An estimated 50 million people in urban areas in Europe are exposed to excessively high levels of traffic noise at night, which can disrupt their sleep. According to the World Health Organization, prolonged exposure to such noise levels can cause elevated blood pressure and heart attacks. The elderly, children and people with poor health are more vulnerable to environmental health risks than the general population (EEA, 2018). In addition, lower socioeconomic status groups (unemployed, people with low incomes or lower levels of education) also tend to be more negatively affected by environmental health hazards, due to their greater exposure and susceptibility, especially in urban areas. A city's cleanliness affects its attractiveness and reputation for both residents and visitors. It can also affect residents' assessment of their quality of life, satisfaction with public spaces, their perception of the quality of public services and their overall satisfaction with the city in which they live.

(*Continued*)

Table 2.2 (Continued)

Category	Characteristics
Quality of local public administration	High-quality public management is associated with higher economic growth, greater impact of public and cohesion policy investments (Rodríguez-Pose and Garcilazo, 2015; European Commission, 2017), higher levels of innovation, less emigration and higher life satisfaction. Also, the quality of governance at the local level varies significantly within the EU (Charron et al., 2010, 2019; European Commission, 2017).
	Improving the quality of institutions (at all levels of governance) is, therefore, at the heart of the EU and its EU cohesion policy. In the current cohesion policy programming period, 2014–2020, as well as in the upcoming 2021–2027 period, the European Commission is encouraging member states to invest more in capacity building and promoting structural reforms to make the functioning of public administration more efficient and transparent.

Source: Report (2020).

Surveys using the QOL in European Cities scale methodology are conducted annually. Based on the latest research, the following conclusions can be drawn regarding the QOL in European cities (Report, 2020):

- A high level of QOL in northern EU cities and an increase in QOL in eastern EU cities are observed.
- Job satisfaction is high in most cities.
- People feel safer in smaller cities.
- Theft and robbery are more common in large cities and especially in national capitals.
- Cities are seen as a better place for immigrants to live, compared to the rest of the country.
- Most cities are seen as better places to live for the LGBT community, compared to the rest of the country.
- Smaller cities are more elderly friendly.
- Cities outside the countries' capitals are seen as better places to live for young families with children.
- There are problems finding jobs in cities in the south of the EU.
- In most capitals, it is difficult to find a good apartment at a reasonable price.
- In western and northern EU cities, more people are satisfied with the state of their finances.

- Cars are used less frequently in national capitals.
- In larger cities, public transportation is used more intensively.
- Few cities are characterized by high use of bicycles as a means of transportation.
- Satisfaction with public transportation is correlated with its frequent use by residents.
- In order to achieve high satisfaction with public transportation, connections must be frequent.
- Residents of smaller cities are more satisfied with cultural infrastructure.
- The greater the access to green public spaces, the higher the level of resident satisfaction.
- People living in non-capital cities are more satisfied with their public spaces.
- Capital city residents are less satisfied with healthcare.
- More residents are concerned about air quality in cities in the southern and eastern EU.
- Residents consider smaller cities cleaner.
- It is more difficult to follow procedures in public administration in capital cities.
- Online access to city information is easier in northern and western EU cities.
- Perceptions of corruption at the local level vary widely among European Union cities.

ISO 37120 is one of the tools increasingly used in recent years to measure the QOL. ISO 37120:2018 is a solution for measuring the QOL for city services. The standard was published by the International Organization for Standardization in 2018. ISO 37120:2018 focuses on indicators for city services and QOL, offering guidance for city management based on inter-city compatible metrics. It helps cities learn from each other, enabling uniform comparison across a wide range of performance measures, and supports city policy development and prioritization. It is applicable to any city, municipality or local government that wants to measure its performance in a comparable and verifiable way, regardless of size or location.

The standard is designed to enable a uniform assessment of the functioning and achievements of the cities' involvement and is intended to allow a detailed evaluation of their spheres of activity. The criteria used in the standard allow observing and evaluating changes on an annual basis, as well as providing the ability to compare performance with other cities (McCarney, 2015; Komsta, 2016; Fijałkowska and Aldea, 2017).

The standard defines 100 indicators, along with the methodology adopted for their calculation, which can be used by cities of all sizes to measure and control the level of their development from the following

points of view: social, economic and environmental (Lehner et al., 2018; Lennova et al., 2018). All indicators have been grouped into 17 thematic areas regarding individual aspects of the city's functioning, which are given as follows (ISO 37120:2018):

 1 Economy;
 2 Education;
 3 Energy;
 4 Environment;
 5 Finance;
 6 Governance,
 7 Health,
 8 Crisis management;
 9 Local government bodies;
10 Recreation;
11 Security;
12 Solid waste;
13 Telecommunication and innovations;
14 Transportation;
15 Urban planning;
16 Wastewater management;
17 Water and wastewater management.

The indicators are divided into 46 primary and 54 secondary indicators. In addition, the standard includes various types of profile indicators that allow cities to decide which ones are most relevant for comparison (Salerno-Kochan, 2016). The indicators included in the standard can be used worldwide by city and business leaders, urban planners, designers, academics and experts to create sustainable, integrated and prosperous cities (Hejduk, 2018; Malinowska and Kurkowska, 2018). The indicators used in ISO 37120:2018 are summarized in Table 2.3. Only core indicators are included in the table.

The standard focuses on three main aspects (Fijałkowska and Aldea, 2017):

1 Transparency in data presentation;
2 Decision accountability;
3 Innovation in becoming a world leader in the implementation of the highest standards of service delivery by the city.

The benefits of ISO 37120:2018 are (ISO 37120:2018; Fijałkowska and Aldea, 2017):

• more efficient management of the city and a higher level of quality in the city's services;

Table 2.3 City core indicators used in ISO 37120:2018

Category	Core indicators
Economy	• City's unemployment rate
Education	• Percentage of female school-aged population enrolled in school
	• Percentage of students completing primary education: survival rate
	• Percentage of students completing secondary education: survival rate
	• Primary education student-teacher ratio
Energy	• Total end-use energy consumption per capita (GJ/year)
	• Percentage of total end-use derived from renewable sources
	• Percentage of city population with authorized electrical service (residential)
	• Number of gas distribution service connections per 100,000 population (residential)
	• Final energy consumption of public buildings per year (GJ/m^2)
Environment and climate change	• Fine particulate matter (PM2.5) concentration
	• Particulate matter (PM10) concentration
	• Greenhouse gas emissions measured in tons per capita
Finance	• Debt service ratio (debt service expenditure as a percentage of a city's own-source revenue)
	• Capital spending as a percentage of total expenditures
Governance	• Women as a percentage of total elected to city-level office
Health	• Average life expectancy
	• Number of in-patient hospital beds per 100,000 population
	• Number of physicians per 100,000 population
	• Under age five mortality per 1,000 live births
Housing	• Percentage of city population living in inadequate housing
	• Percentage of the population living in affordable housing
Population and social conditions	• Percentage of city population living below the international poverty line
Safety	• Number of firefighters per 100,000 population
	• Number of fire-related deaths per 100,000 population
	• Number of natural-hazard-related deaths per 100,000 population
	• Number of police officers per 100,000 population
	• Number of homicides per 100,000 population
Solid waste	• Percentage of city population with regular solid waste collection (residential)
	• Total collected municipal solid waste per capita
	• Percentage of the city's solid waste that is recycled
	• Percentage of the city's solid waste that is disposed of in a sanitary landfill
	• Percentage of the city's solid waste that is treated in waste-to-energy plants
Sports and culture	• Number of cultural institutions and sporting facilities per 100,000 population
Transportation	• Kilometers of public transport system per 100,000 population
	• Annual number of public transport trips per capita

(*Continued*)

Table 2.3 (Continued)

Category	Core indicators
Urban/local agriculture and food security	• Total urban agricultural area per • 100,000 population
Urban planning	• Green area (hectares) per 100,000 population
Wastewater	• Percentage of city population served by wastewater collection • Percentage of city's wastewater receiving centralized treatment • Percentage of population with access to improved sanitation
Water	• Percentage of city population with potable water supply service • Percentage of city population with sustainable access to an improved water source • Total domestic water consumption per capita (liters/day) • Compliance rate of drinking water quality

Source: ISO 37120:2018.

- provision of a framework for sustainable development and strategic planning of the city;
- obtaining international targets and benchmarks for the analyses to be carried out;
- benchmarking and local planning;
- information for city managers and decision-makers used in decision-making;
- access to data, including the possibility of increasing the reliability of these data through auditing and verification by external institutions;
- urban learning;
- greater credibility in the financial markets, greater chances of attracting investors and introduction of financing programs for activities;
- obtaining a sustainable development planning framework;
- transparency and openness of data for investment attractiveness;
- comparability of data on the city's decisions, its appearance and global benchmarking;
- the usefulness of the certificate in efforts to obtain city funding from EU funds.

In order to use the standard in cities to report a different range of data, a set of certification levels was used for the standard, which depend on how many of the listed indicators are monitored in a given city. Synthetically, the different certification levels of the standard are shown in Table 2.4.

The main advantage of the ISO 37120 standard comes not only from basing the assessment on a set of indicators but also from the possibility of comparing the results obtained and benchmarking the data between different cities undergoing the certification in question (Wang and Fox,

Table 2.4 Implementation levels of ISO 37120

Level	Characteristics
Aspiring	30–45 primary indicators
Bronze	46–59 indicators (46 primary and 0–13 secondary)
Silver	60–75 indicators (46 primary and 14–29 secondary)
Gold	76–90 indicators (46 primary and 30–44 secondary)
Platinum	91–100 indicators (46 primary and 45–54 secondary)

Source: ISO 37120:2018.

2017; McCarney, 2015;). The main problem with collecting this type of data is that it can be communicated between cities and that access is open. To ensure this, the World Council on City Data (WCCD) open data platform, based in Toronto, was opened (Kowalczyk, 2018). This platform coordinates all activities that are related to city data reported according to the ISO 37120 standard, as well as other normative solutions based on this standard. Individual cities that have obtained ISO 37120 certification are added to the organization's Global Cities Registry™ database for a period of one year. At the end of this period, they must go through the certification process again. All data reported by cities are posted on a specially developed virtual platform http://open.dataforcities.org/, which provides open access to them.

Furthermore, the World Council on City Data has set numerous goals that cities should successively achieve by monitoring and improving individual QOL indicators. Some of the most important goals are (McCarney, 2015) given as follows:

• Poverty eradication;
• Eradication of hunger;
• Good health of residents;
• Quality education;
• Ensuring gender equality;
• Access to clean water and cleaning supplies;
• Clean and cheap energy;
• Decent working conditions and economic growth;
• Industry, innovation and infrastructure;
• Inequality reduction;
• Promoting the idea of a sustainable city and a sustainable society;
• Responsible consumption and production;
• The fight against climate change;
• Sustainable use of water resources;
• Sustainable use of ecosystems on land;
• Peace, justice and strong institutions;
• Partnership to achieve the listed goals.

2.3   Problems and challenges of improving the quality of life in contemporary cities

Analyzing different approaches to urban QOL and measuring it, it is important to note the different types of problems and challenges modern societies have to face, which should be taken into account when planning a modern Smart City, in order to achieve a higher level of QOL for residents in this type of city.

Based on the analysis of the results of studies conducted in the field of QOL in European Union countries, the following main problems can be distinguished, which should be solved to improve the QOL of the population (The Future, 2019; Vardoulakis and Kinney, 2019; Mourtadis, 2021):

- Affordable housing – Some of the cities in Europe, where new residents are most likely to settle, have seen housing prices soar in recent years. This threatens housing affordability, as prices are rising faster than incomes and the availability of new housing is low. The recent increase in foreign and corporate investment in urban residential real estate has led to changing ownership patterns, raising concerns about the social fabric of the city and who can own the city and who can be responsible for citizens' rights to affordable housing. Short-term rental platforms, which are becoming increasingly popular, may cause excessive increases in real estate prices and negatively affect local QOL.
- Mobility – Urban mobility is one of the areas that will undergo the greatest changes in the future as a result of technological innovation and changing behavior of residents. The number of private vehicle owners is likely to decline, as mobility understood as a service, combining multiple modes of transportation, becomes increasingly popular in cities. Legislation and appropriate management measures will need to be adapted to this phenomenon to ensure that the new modes of transportation complement traditional public transportation, rather than compete with it. Autonomous electric vehicles can benefit cities by reducing air pollution and traffic congestion.
- Provision of services – In the future, specialized urban services, an essential element of a city, should be planned in a sustainable, efficient, reusable, sharable, modular, personalized and data-driven manner. The nature of public and commercial services in cities is constantly transforming. Specialized (regional) services require a large nearby market and are, therefore, more profitable in larger cities. Service delivery can be improved by promoting compact urban development, developing integrated land use and mobility plans, and using new technologies to facilitate service delivery.
- Aging – By 2070, life expectancy in the EU will rise to 88.2 years, and the old-age dependency ratio (the number of older people relative to

the number of people of working age) is expected to decline. While population aging is a global trend, it is of particular concern in regions, where the total population is declining, as is increasingly the case in Europe. An additional burden will be placed on the social welfare system, as rising costs of healthcare, pensions and social benefits will have to be met by a shrinking workforce, which could affect overall GDP and innovation. Cities will need to adjust their services in areas such as healthcare and mobility, as well as public infrastructure, housing and social policies to accommodate changing demographics.

- Urban health – Health outcomes can be improved by changing the urban structure of cities and towns: urban planning plays a crucial role in achieving health improvements.
- Social segregation – Integrated anti-segregation policies should take into account the diverse factors present in poor neighborhoods (e.g., health, housing and ethnicity). Urban policies that promote diversity can become drivers of innovation.
- Environmental footprint – Resource consumption affects not only local but also global sustainability. Providing water, energy and food security for urban populations puts significant pressure on the environment beyond city limits. Although water consumption in most economic sectors in Europe has declined since 1990, water availability problems are expected to increase. Lifestyle and behavioral changes can help urban residents significantly reduce their environmental footprint, such as switching to a healthy diet, reducing waste, using active or public transportation, or choosing sustainable energy sources.
- Climate action – Cities are responsible for high levels of energy consumption, and thus, generating about 70% of global greenhouse gas emissions, cities are particularly vulnerable to the effects of climate change. Cities are most effective in taking action to address climate change when they are connected to each other and to actors at the national and regional levels.
- Data availability and management.
- Management of emerging technologies.
- The changing role of society.
- Integrated policy design.

Notably, many of the problems related to the QOL in cities can be solved by introducing Smart Cities solutions. Several examples can be cited here (Woetzel et al., 2018; Li et al., 2019; 5 Ways, 2020):

- Improving public safety – The use of applications that could potentially reduce fatalities in homicides, fires and traffic accidents by 8–10%. Incidents of muggings, burglaries, car thefts and robberies could then be reduced by 30–40%. When it comes to crime, cities can use data to

make more efficient use of limited resources and personnel. For example, real-time crime mapping uses statistical analysis to find patterns of behavior and improve public safety. Predictive policing can anticipate crimes, and when they occur, applications such as home security systems, gunshot detection and smart surveillance can make law enforcement respond faster.

- Speeding up daily commutes – One aspect critical to improving QOL is improving residents' daily commutes. By 2025, cities that implement smart mobility applications can reduce commute times by an average of 15–20%. This is related to variables, such as the city's population density, commuting patterns and existing transit infrastructure. Installing IoT sensors on existing physical infrastructure can help solve traffic problems before they turn into breakdowns and delays. Applications that alleviate traffic congestion are most effective in cities, where driving and buses are the main forms of transportation. Smart synchronization of traffic signals can potentially reduce average commutes by more than 5% in developing cities, where many people travel by bus. Real-time navigation alerts inform drivers of delays, helping them choose the fastest route, while smart parking apps direct them to available spots.

- Better public health – Apps that help monitor, prevent and treat chronic diseases, such as diabetes and cardiovascular disease, have the greatest potential to improve the situation in developed countries. Remote patient monitoring systems may potentially reduce the health burden in high-income cities by more than 4%. These systems use digital devices to take key readings and then send them to doctors for evaluation. With these data, the patient and doctor would know if early intervention is needed, reducing complications and hospitalizations. Cities can also use the data and analysis to identify demographic groups that have a higher risk profile, allowing for more targeted medical interventions. If developing cities use infectious disease surveillance systems to stay ahead of fast-moving epidemics, a 5% reduction in cases is possible. Finally, telemedicine, which is a growing trend, particularly during the COVID-19 pandemic, could be a life-saving measure used in low-income cities that lack doctors.

- Cleaner and more sustainable environment – With the growth of urbanization, industrialization and consumption, human pressure on the environment is increasing. Applications, such as building automation systems, some mobile applications and dynamic analysis of electricity consumption, can help reduce emissions by 10–15%. Water consumption tracking combines advanced metering systems with digital feedback. This can encourage people to conserve and reduce consumption by 15% in cities, where residential water use is high. The biggest source of water waste in developing countries is water leakage from pipes. The use of sensors and analytics can reduce these losses by up to

25%. Applications, such as digital tracking, can reduce solid waste per capita by 10–20%. Through the use of smart apps, cities can reduce the amount of unrecycled solid waste by 30–130 kilograms per person per year and save 25–80 liters of water per person each day. As for air health, air quality sensors can identify sources of pollution and provide a basis for further action. Also, making real-time air quality information available to the public through smartphone apps allows individuals to take protective measures. Depending on the current level of pollution, this can reduce negative health effects by 3–15%.

- Strengthening social ties – McKinsey's analysis found that using applications such as digital channels to communicate with local officials, as well as digital platforms that lead to real-world interactions (such as Nextdoor and Meetup) can nearly triple the percentage of residents, who feel connected to their local government and double the percentage of those, who feel connected to their local community. Creating channels for two-way communication between local authorities and the public can make city governments faster and more responsive to residents' needs. Many city organizations now have an active presence on social networks, and others have created their own interactive applications for citizens. In addition to disseminating information, these channels create platforms for residents to collect data, report problems or express opinions on planning issues.

The challenges facing modern cities in terms of QOL depend, to some extent, on the geographic region. Each region has its own specificity, and consequently, slightly different challenges may be faced by city governments in terms of the factors that affect the improvement or deterioration of QOL. For example, in the case of Latin America, the following challenges can be identified to overcome to ensure that the QOL in cities improves (Liberlun, 2021):

- Structural social exclusion – Urban inequality runs persistent and deep, with major cities in many countries experiencing greater inequality than the country as a whole, and inequality in some cities increasing as the number of people living in poverty decreases (UN Habitat, 2016). The likelihood of living in a neighborhood with inadequate public services depends largely on ethnicity, place of birth and other characteristics beyond people's control. Latin American and Caribbean cities are underprovided with safe public green spaces, and their distribution and quality are uneven. Gaps in urban service provision particularly affect women, children, the elderly and the disabled, who make up about two-thirds of the city's population.
- Excessive pollution and poor mitigation and resilience to negative climate change – Cities can reduce toxic emissions and improve QOL by transforming their urban planning, urban environment and better

energy use. The region has made some progress in introducing energy- and water-efficient technologies in housing, but much remains to be done to reduce the environmental footprint of cities. Cities also have high levels of noise pollution, causing health problems and depressing real estate prices. Latin American and Caribbean cities are also highly vulnerable to disasters caused by natural risks and climate change.

- Stagnating urban productivity – Latin American and Caribbean productivity depends heavily on a few cities, creating the risk that economic shocks in these cities could destabilize the entire region's economy. Poor infrastructure between and within cities undermines productivity. Also, burdensome city regulations increase costs for small entrepreneurs and contribute to the persistence of lack of employment formality. Also, Latin American cities are failing to take full advantage of the opportunities that innovation in the built environment provides for increasing urban productivity.
- Weak urban governance – Latin America's urban governance institutions have limited capacity to address the complex and interdisciplinary problems they face. Most city governments have limited fiscal autonomy, insufficient financial and human resources, and little access to data and technology. Municipal governments are still lagging behind in using digital technologies to engage in open dialog with residents.

Bibliography

5 Ways Smart Cities Improve the Urban Quality of Life. (2020). https://stefanini.com/en/insights/news/5-ways-smart-cities-improve-the-urban-quality-of-life, [access data: 3.10.2022].

Abunazel, A., Hammad, Y., Abd AlAziz, M., Gouda, E., Anis, W. (2019). Quality of life indicators in sustainable urban areas. *The Academic Research Community publication, 3*, 78.

Al-Qawasmi, J. (2019). Exploring indicators coverage practices in measuring urban quality of life. *Proceedings of the Institution of Civil Engineers: Urban Design and Planning, 172*(1), 26–40. htps://doi.org/10.1680/jurdp.18.00050

Al-Qawasmi, J. (2020). Measuring quality of life in urban areas: toward an integrated approach. *Journal of Environmental Science and Natural Resources, 25*(2), 67–74. htps://doi.org/10.19080/IJESNR.2020.25.556158

Al-Qawasmi, S.M., Asfour, O., Aldosary, A.S. (2021). Assessing urban quality of life: Developing the criteria for Saudi cities. *Frontier in Built Environment*. https://doi.org/10.3389/fbuil.2021.682391

Ascenso, A., Augusto, B., Silveira, C., Roebeling, P., Miranda, A.I. (2021). Impacts of nature-based solutions on the urban atmospheric environment: A case study for Eindhoven, The Netherlands, *Urban Forestry and Urban Greening, 57*, 126870.

Blessi, G.T., Grossi, E., Sacco, P.L., Pieretti, G., Ferilli, G. (2016). The contribution of cultural participation to urban well-being. A comparative study in Bolzano/Bozen and Siracusa, Italy. *Cities, 50*, 216–226.

Burckhardt, C.S., Anderson, K.L. (2003). The quality of life scale (QOLS): Reliability, validity, and utilization. *Health and Quality of Life Outcomes, 1*, 60–70. https://doi.org/10.1186/1477-7525-1-60

Burger, M.J., Morrison, P.H., Hendriks, M., Hoogerbrugge, M.M. (2020). Urban-rural happiness differentials across the world. In: Helliwell, J.F., Layard, R., Sachs, J., De Neve, J.E. (eds) *World Happiness Report 2020.* Sustainable Development Solutions Network: New York.

Cai, T., Verze, P., Truls, E., Johansen, B. (2021). The quality of life definition: Where are we going? *Uro Journal of Urology, 1*, 14–22. htps://doi.org/10.3390/uro1010003

Charron, N., Dijkstra, L., Lapuente, V. (2010). Regional governance matters: Quality of government within European Union Member States. *Regional Studies, 48*(1), 68–90.

Charron, N., Lapuente, V., Annoni, P. (2019). Measuring quality of government in EU regions across space and time. *Papers in Regional Science, 98*(5), 1925–1953.

Dawood, S.R.S. (2019). Sustainability, quality of life and challenges in an emerging city region of George Town, Malaysia. *Journal of Sustainable Development, 12*, 35.

European Commission. (2017). *Seventh report on economic, social and territorial cohesion.* Publications Office of the European Union: Luxembourg.

European Environmental Agency. (2018). *Unequal exposure and unequal impacts: Social vulnerability to air pollution, noise and extreme temperatures in Europe*, EEA Report No 22/2018. Publications Office of the European Union: Luxembourg.

European Environmental Agency. (2019). *Air quality in Europe – 2019 Report, EEA Report No 10/2019.* Publications Office of the European Union: Luxembourg.

Eurostat. (2016). *Analytical report on subjective well-being*, 2016 edition. Publications Office of the European Union: Luxembourg.

Fancourt, D., Steptoe, A. (2018). Community group membership and multidimensional subjective well-being in older age. *Journal of Epidemiology and Community Health, 72*(5), 376–382.

Fijałkowska, J., Aldea, T. (2017). Raportowanie zrównoważonego rozwoju miasta. Norma 37120, *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu, 478*, 174–183.

Glatz, C., Eder, A. (2019). Patterns of trust and subjective well-being across Europe: New insights from repeated cross-sectional analyses based on the European Social Survey 2002–2016. *Social Indicators Research, 148*, 417–439.

Grossi, E., Tavano Blessi, G., Sacco, P.L., Buscema, M., Blessi, G.T., Sacco, P.L., Buscema, M. (2012). The interaction between culture, health and psychological well-being: Data mining from the Italian culture and well-being project. *Journal of Happiness Studies, 13*(1), 129–148.

Grossi, E., Tavano Blessi, G., Sacco, P.L. (2019). Magic moments: Determinants of stress relief and subjective wellbeing from visiting a cultural heritage site. *Culture, Medicine and Psychiatry, 43*(1), 4–24.

Gusul, P.F., Butnariu, A.R. (2021). Exploring the relationship between smart city, sustainable development and innovation as a model for urban economic growth. *Annals of the University of Oradea: Economic Science, 30*, 82–91.

Hajduk, S. (2018). The smartness profile of selected European cities in urban management – A comparison analysis. *Journal of Business Economics and Management, 19*(6), 797–812.

Hanslmaier, M. (2013). Crime, fear and subjective well-being: How victimization and street crime affect fear and life satisfaction. *European Journal of Criminology, 10*(5), 515–533.

Hays, R.D., Reeve, B.B. (2010). Measurement and modeling of health-related quality of life. In: Killewo, J., Heggenhougen, H.K., Quah, S.R. (eds) *Epidemiology and Demography in Public Health*. Academic Press: San Diego, CA, 195–205.

ISO 37120:2018, Sustainable cities and communities—Indicators for city services and quality of life, 2018.

Jones, M., Kimberlee, R., Deave, T., Evans, S. (2013). The role of community centre-based arts, leisure and social activities in promoting adult well-being and healthy lifestyles. *International Journal of Environmental Research and Public Health, 10*(5), 1948–1962.

Komsta, H. (2016). Rankingi jako narzędzia oceny Inteligentnego Miasta. *Logistyka, 1*, 22–24.

Köves, B., Cai, T., Veeratterapillay, R., Pickard, R., Seisen, T., Lam, T.B., Yuan, C.Y., Bruyere, F., Wagenlehner, F., Bartoletti, R. (2017). Benefits and harms of treatment of asymptomatic bacteriuria: A systematic review and meta-analysis by the European Association of Urology Urological Infection Guidelines. *Panel European Urology, 72*, 865–868.

Kowalczyk, A. (2018). Normalizacja standardów w administracji samorządowej. *Przegląd Komunalny, 11*, 79–81.

Lättman, K., Margareta, F., Olsson, L.E. (2016). Perceived accessibility of public transport as a potential indicator of social inclusion. *Social Inclusion, 3*(4), 36–45.

Lehner, A., Erlacher, C., Schlögl, M., Wegerer, J., Blaschke, T., Steinnocher, K. (2018). Can ISO-defined urban sustainability indicators be derived from remote sensing: An expert weighting approach, *Sustainability, 10*(4), 1268.

Leitmann, J. (1999). Can city QOL indicators be objective and relevant? Towards a participatory tool for sustaining urban development. *Local Environment, 4*(2), 169–180.

Lennova, T., Golovcova, I., Mamedov, E., Varfolomeeva, M. (2018). *The integrated indicator of sustainable urban development based on standardization*. International Science Conference on Business Technologies for Sustainable Urban, Article number 01039.

Li, D., Cheng, T., Genderen, J.L., Shao, Z. (2019). Challenges and opportunities for the development of MEGACITIES. *International Journal of Digital Earth, 12*(12), 1382–1395. doi: 10.1080/17538947.2018.1512662

Liberlun, N. (2021). *Four challenges our cities can overcome*, https://blogs.iadb.org/ciudades-sostenibles/en/four-challenges-our-cities-can-overcome/, [access data: 3.10.2022].

Lora, E., Powell, A., van Praag, B., Sanguinetti, P. (2010). Preface. In: Lora, E., Powell, A., van Praag, B.M.S., Sanguinetti, P. (eds) *The Quality of Life in Latin American Cities: Markets and Perception*. The Inter-American Development Bank: Washington, DC, xix–xxiv.

Malinowska, E., Kurkowska, A. (2018). Norma ISO 37120 narzędziem pomiary idei zrównoważonego Rozwoju miast, *Zeszyty Naukowe Politechniki Śląskiej, seria: Organizacja i Zarządzanie, 118*, 363–382.

McCarney, P. (2015). The evolution of global city indicators and ISO 37120: The first International standard on city indicators. *Statistical Journal of the IAOS, 31*, 131–142.

McCrea, R., Shyy, T.-K., Stimson, R. (2006). What is the strength of the link between objective and subjective indicators of urban quality of life? *Applied Research in Quality of Life, 1*, 79–96. https://doi.org/10.1007/s11482-006-9002-2

Mitchell, G., May, A., McDonald, A. (1995). PICABUE: A methodological framework for the development of indicators of sustainable development. *International Journal of Sustainable Development & World Ecology, 2*(2), 104–123.

Mohit, M.A. (2013). Objective analysis of variation in the regional quality of life in Malaysia and its policy implications. *Procedia – Social and Behavioral Sciences, 101*, 454–464.

Mourtadis, K. (2021). Urban planning and quality of life: A review of pathways linking the built environment to subjective well-being. *Cities, 115*, 103229. https://doi.org/10.1016/j.cities.2021.103229

Patel, U., Rakshit, S., Ram, S.A., Irfan, Z.B. (2019). Urban sustainability index: Measuring performance of 15 metropolitan cities of India. *South Asian Journal of Social Studies and Economics, 3*, 1–11.

Prutkin, J.M., Feinstein, A.R. (2002). *A History of Quality of Life Measurements*. Yale Medicine Thesis Digital Library, 424. Available at: http://elischolar.library.yale.edu/ymtdl/424.

Przybyłowski, A., Kałaska, A., Przybyłowski, P. (2022). Quest for a tool measuring urban quality of life: ISO 37120 standard sustainable development indicators. *Energies, 15*, 2841. htps://doi.org/10.3390/en15082841

Ramirez-Rubio, O., Daher, C., Fanjul, G., Gascon, M., Mueller, N., Pajín, L., Plasencia, A., Rojas-Rueda, D., Thondoo, M., Nieuwenhuijsen, M. (2019). Urban health: An example of a 'health in all policies' approach in the context of SDGs implementation. *Global Health, 15*, 87.

Report on the Quality of Life in European Cities. (2020). *Luxembourg: Publication Office of the European Union*. https://ec.europa.eu/regional_policy/sources/docgener/work/qol2020/quality_life_european_cities_en.pdf, [access data: 3.10.2022].

Rodríguez-Pose, A. (2013). Do institutions matter for regional development? *Regional Studies, 47*(7), 1034–1047.

Rodríguez-Pose, A., Garcilazo, E. (2015). Quality of government and the returns of investment: Examining the impact of cohesion expenditure in European regions, *Regional Studies, 49*(8), 1274–1290.

Rykun, A.Y., Chernikova, D.V., Sukhushina, E.V., Beryozkin, A.Y. (2020). Measuring the quality of life in Urban areas: The feasibility of using the index approach. *Zhurnal Issled. Sotsial'noi Polit, 18*, 283–298.

Salerno-Kochan, M. (2016). Norma ISO 37120. *Próba oceny jakości życia w miastach*, [w:] M. Salerno-Kochan (red.), Wybrane aspekty zarządzania jakością. Kraków: Polskie Towarzystwo Towaroznawcze.

Schalock, R.L. (2004). The Concept of Quality of Life: What We Know and Do Not Know. *Journal of Intellectual Disability Research, 48*(3), 203–216. htps://doi.org/10.1111/j.1365-2788.2003.00558.x

Slavuj, L. (2011). Urban quality of life - a case study: The city of rijeka | Kvaliteta života – studija slučaja: Grad Rijeka, *Hrvatski Geografski Glasnik, 73*(1), 99–100.

The future of Cities. Opportunities, Challenges and the way forward. (2019). European Commission, Luxembourg, Publications of European Union, https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjXiZOv2sT6AhVokIsKHQN4CogQFnoECAUQAQ&url=https%3A%2F%2Fpublications.jrc.ec.europa.eu%2Frepository%2Fbitstream%2FJRC116711%2Fthe-future-of-cities_online.pdf&usg=AOvVaw33of1EEL09bsQOwDHW0qcE, [access data: 3.10.2022].

UN Habitat. (2016). *Urbanization and development. Emerging Futures, Word Cities report,* Nairobi, Kenya, https://unhabitat.org/sites/default/files/download-manager-files/WCR-2016-WEB.pdf, Nairobi, Kenya, [access data: 3.10.2022].

Vardoulakis, S., Kinney, P. (2019). *Grand Challenges in Sustainable Cities and Health, Frontiers in Sustainable Cities.* https://doi.org/10.3389/frsc.2019.00007

Von Wirth, T., Hayek, U.W., kunze, A., Neuenschwander, N., Stauffacher, M., Scholz, R.W. (2014). Identifying urban transformation dynamics: Functional use of scenario techniques to integrate knowledge from science and practice, *Technological Forecasting & Social Change, 89*, 115–130. https://doi.org/10.1016/j.techfore.2013.08.030

Wang, Y., Fox, M.S. (2017). *Consistency analysis of city indicator data*, 15th International Conference on Computers in Urban Planning and Urban Management, 355–369.

WHOQOL: Measuring Quality of Life. World Health Organization (2012), https://www.who.int/toolkits/whoqol, [access data: 3.10.2022].

Wilson, N., Gross, J., Bull, A. (2017). *Towards cultural democracy: Promoting cultural capabilities for everyone*, https://www.kcl.ac.uk/Cultural/culturalenquiries/Towards-cultural-emocracy/Towards-Cultural-Democracy-2017-KCL.pdf, [access data: 3.10.2022].

Woetzel, J., Remes, J., Boland, B., Lv, K., Sinha, S., Strube, G., Means, J., Law, J., Cadena, A., Tann, V. (2018). *Smart cities: Digital solutions for a more livable future*, McKinsey Global Institute, https://www.mckinsey.com/capabilities/operations/our-insights/smart-cities-digital-solutions-for-a-more-livable-future#part1, [access data: 3.10.2022].

Wolniak, R., Jonek-Kowalska, I. (2021a). The level of the quality of life in the city and its monitoring. *Innovation (Abingdon), 34*(3), 376–398.

Wolniak, R., Jonek-Kowalska, I. (2021b). The quality of service to residents by public administration on the example of municipal offices in Poland. *Administration Management Public, 37*, 132–150.

Zayannu, M., Abubakr, I.R. (2019). *Improving the quality of life of urban communities in developing countries*. In: Leal Filho et al. (eds) *Responsible Consumption and Production, Encyclopedia of the UN Sustainable Development Goals.* Springer: Cham. https://doi.org/10.1007/978-3-319-71062-4_25-1