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The perceived importance of urban design qualities for walkability in Czech city centres: An expert-based assessment

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Abstract

Walkability is essential for promoting sustainable mobility, public health, and urban vitality in cities. This article examines the perceived importance of urban design qualities (UDQ) on walkability in Czech city centres. Based on expert ratings in questionnaires (n = 46) and a follow-up workshop (n = 8), the study provides an expert-weighted framework for planning institutions. The research determined that according to experts, the two most significant UDQ are Tidiness (19.7%) and Safety & Sensations (19.2%). This result, where UDQs such as Complexity and Imageability were lower ranked, contrasts with findings in Western countries and confirms that the importance of basic walking conditions (safety and maintenance) still persists in Czech city centres. The most important individual indicators that shape attractive walkable urban environments in the Czech Republic are Traffic Density & Speed, Street Furniture, the Condition of Buildings, Pavements and Vegetation. Based on this empirical evidence, insights relevant to the broader Central and Eastern Europe are discussed.

Keywords: Urban design qualities, walkability, city centre, Central and Eastern Europe, Czech Republic

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1. Introduction

Walkability can be defined as the degree to which a street is 'pedestrian-friendly', i.e. the ability of the urban environment to motivate its residents to walk, not only for the transportation purposes but also for leisure (Moura et al., 2017). Its positive effects include improvements in both the physical and mental health of residents (Adkins et al., 2017; Talen & Koschinsky, 2013), promoting social interaction, and strengthening local community bonds (Rogers et al., 2011; Wheeler, 2013). Economic benefits include supporting local retail and services, the availability and variety of which can be essential for the attractiveness and vitality of a city centre (Litman, 2003; Matan, 2011). Promoting pedestrian mobility also contributes to a more sustainable urban environment. In addition to local effects such as noise reduction or improved air quality (Bocconcino et al., 2021), walking as a transportation mode exhibits minimal carbon footprint across both its operational and productive phases, aligning strongly with global climate mitigation objectives (Bozovic, 2025; Gössling, 2023).

Today's city centres are undergoing a fundamental transformation of their function, accelerated by the digitisation of the economy, the rise of remote work, the shift of retail into online environments, changes in consumer behaviour, and the growing pressure for climate neutrality (Carmona, 2021; Carmona, 2022; Moreno et al., 2021). The importance of traditional economic pillars of urban centres (retail, services, offices) is declining, opening an opportunity to rethink the sources of socio-economic

vitality (Carmona, 2019; Van Nieuwerburgh, 2023). In this context, walkable urbanism constitutes a strategic tool for adapting city centres to new conditions, as it reflects the growing demand for accessibility, proximity, and for high-quality urban environments (Forouhar et al., 2025; Carmona, 2021).

The long-term benefits of walking and quality public space have resulted in an increased interest not only among the professional community but also among planning institutions (Blečić et al., 2020). This interest is also reflected in the development of walkability evaluation methods. Research is moving from initial qualitative approaches to empirically validated and internationally comparable frameworks (Ewing & Handy, 2009; Ewing et al., 2013). While popular macro-scale tools like Walk Score™ provide a useful global estimate of walkability based on destination proximity, their wider application is limited as they inherently fail to capture crucial micro-scale urban design qualities (UDQ), aesthetics, and regional specificities (Bereitschaft, 2017; Carr et al., 2010; Hall & Ram, 2018). At the same time, research shows that urban design evaluation is more effective when using differentiated weighting of factors as well as participatory approaches that consider the needs of local communities (Fonseca et al., 2020; Forsyth, 2015; Garau et al., 2024; Gössling, 2023; Hooi & Pojani, 2020; Talen & Koschinsky, 2013).

This need for a context-sensitive assessment is particularly evident in the contested role of car use in Czech city centres, where walkability improvements often intersect with expectations

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of accessibility and parking availability. Although according to Krajhanzl et al. (2021) 62% of the Czech population supports regulation of car traffic in city centres as part of climate policy, it was found by survey of Czech municipalities that regulation of traffic in city centres is the most frequent local conflict, reported by 81% of municipalities (Ježek, 2019). Thus, this research is motivated by increasing attractiveness of walking as the most climate neutral mode of transport rather than just regulation of cars that can meet resistance from local communities. The aim of this study is to evaluate the importance of and to operationalise UDQ (Imageability, Human Scale, Transparency, Enclosure, Complexity, Safety & Sensations, Tidiness) for Czech Republic's city centres walkability. Recently, several studies have successfully addressed various methodology aspects of walkability assessment across the Central and Eastern Europe (CEE), including comprehensive bibliometric reviews of post-socialist studies (Rišová, 2020), spatial safety perceptions (Rišová & Sládeková Madajová, 2020), micro-scale pedestrian barriers (Horak et al., 2025) network-based liveability (Natera Orozco et al., 2019) and expert-based assessments of urban design transformation (Strommer et al., 2025). However, despite this growing research, systematic approaches explicitly applying the concept of UDQ remain underdeveloped. Therefore, the research gap addressed in this study is not a general absence of walkability research in CEE, but rather the specific absence of an expert-weighted UDQ framework adapted to the context of Czech city centres. This study provides a methodological framework that enables planning institutions to better account for the factors influencing walkability within their territories.

The analytical framework of the research is detailed in the next section, which focuses on the conceptualisation of UDQ and their impact on walkability. Thereafter, the Methodology section includes the selection of indicators for each UDQ (literature review), the approach to weighting the UDQ and indicators (expert questionnaire survey), and the involvement of stakeholders in the validation of the results (workshop). The Results section presents an analysis of the perceived importance of UDQ for walkability in Czech Republic's city centres. The last section of this paper discusses the results in the context of previous studies in CEE, their implications for practice, and recommendations for further research.

2. Urban design and walkability

The analytical framework of this article, considers both objective and subjective urban characteristics and features that influence the attractiveness of walking in an area. Drawing on environmental psychology, it assumes that the way pedestrians perceive objective urban characteristics is influenced by sensory and cognitive constants and processes. The resulting walkability and observable walking behaviour is relatively predictable, although not independent from individual and cultural contexts (Ewing & Handy, 2009, pp. 67–68). The framework can thus resemble the epistemology applied in behaviouralism in human geography (*cf.* Golledge, 2006, pp. 76–78).

The analytical framework (Ewing et al., 2013) represents one of the most empirically validated and widely used methodological approaches for UDQ assessment (Hamidi & Moazzeni, 2019; Hooi & Pojani, 2020; Ruiz-Padillo et al., 2018; Talen et al., 2023). Due to its accessibility and international applicability, it facilitates comparisons of the importance of UDQ across different contexts. At the same time, however, it is essential to consider regional specificities, as cultural, economic, and political factors can influence the importance of individual UDQ (Bartzokas-Tsiompras et al., 2023; Cysek-Pawlak & Pabich, 2021). Ewing et al. (2013) initially identified 51 perceptual qualities from urban design literature. The eight most frequently cited qualities were then

subjected to extensive visual assessment surveys using expert ratings of video clips and inter-rater reliability testing. Three qualities (Legibility, Linkage, and Coherence) were subsequently dropped due to their high subjectivity and low measurement reliability. The remaining five key UDQ (Imageability, Enclosure, Human Scale, Transparency, and Complexity) were successfully operationalised and retained, as they could be objectively and reliably linked to measurable physical features of the streetscape (Ewing & Handy, 2009; Ewing et al., 2013). Consequently, within this validated structure, specific physical elements – such as pedestrian infrastructure or urban greenery – do not form standalone UDQs but act as their constituent variables. The connection of selected UDQs to the pedestrian behaviour was then validated in New York main streets. Researchers conducted four iterations of manual pedestrian counting and web-based counting using Google Street View (and two other similar web tools) for control on 588 street segments. Field audit of UDQs and statistical analysis (using control variables) of association of UDQs and pedestrian counts was performed, providing final validation of the framework (Ewing et al., 2013).

Thus, the framework provides tools to objectively and effectively assess subjective street environment qualities, enabling the investigation of their impact on pedestrian activity and well-being (Yoshimura et al., 2022). More recent works have extended the original concept of UDQ to include two additional dimensions: Safety & Sensations and Tidiness (Carmona, 2019; Hooi & Pojani, 2020), which are also considered in this study.

Imageability refers to the quality of the physical environment that shapes a place's identity and influences its perception by both residents and visitors (Lynch, 1960). A key aspect of this concept is the visual attractiveness of the urban environment, which facilitates the memorability of specific locations and contributes to a sense of belonging and safety (Ewing et al., 2013). Cities with high imageability are characterised by clearly defined architectural elements, prominent buildings, plazas, parks, and other locations that serve as mental landmarks for space users (Yoshimura et al., 2022). A visually cohesive environment not only enhances the aesthetic value of a city, but also fosters social interaction, pedestrian activity, and local business revenues (Fonseca et al., 2022; Yoshimura et al., 2022).

The degree to which urban streets and public spaces are visually defined by buildings, walls, trees, and other vertical elements plays a key role in their spatial demarcation – a concept known as Enclosure (Appleyard & Lintell, 1972; Jacobs, 1961). Well-defined street spaces contribute to greater clarity, aesthetics, as well as safety (Bosselmann, 2018; Ewing et al., 2013). Empirical studies show that locations with well-defined street boundaries are not only more frequently used by pedestrians, but also promote social interactions, natural orientation within the city, and the overall vitality of commercial zones (Bartzokas-Tsiompras et al., 2023; Fonseca et al., 2022; Yoshimura et al., 2022). Further research suggests that the continuity of the street frontage and the appropriate ratio between building height and street width are key factors influencing the perception of enclosure and its impacts on the urban environment (Bosselmann, 2018; Carmona, 2019; Gehl, 2013).

The Human Scale concept refers to elements that are visually accessible and perceivable at an average walking speed, approximately 5 km/h (Ewing et al., 2013). It emphasises the scale and detailing of the public space that corresponds to human proportions and allows for natural interaction between pedestrians and the urban environment. Aspects of Human Scale, such as the presence of street furniture or public art, contribute to the perception of space as safe, welcoming, and aesthetically valuable (Carmona, 2019; Carmona, 2021; Gehl, 2013; Jacobs, 1961). Beyond the aesthetic aspect, these elements also have a significant

functional impact – they promote orientation in space, allow for rest and relaxation, and extend the amount of time people spend in urban environments (Carmona, 2019; Yoshimura et al., 2022). Research confirms that human-scale environments contribute to increased levels of social interaction and a higher-quality of life (Fonseca et al., 2022).

Transparency refers to the degree of connection between the interior and exterior of buildings, with the visual and physical permeability of the street storefront being a key element (Ewing et al., 2013). This concept plays a key role in the design of safe public spaces where natural social interactions are fostered (Carmona, 2019; Yoshimura et al., 2022). Simultaneously, transparency contributes to the economic vitality of an area by supporting local businesses and naturally increasing the attractiveness of city streets (Bosselmann, 2018; Ewing & Handy, 2009). Jane Jacobs (1961) pointed out that the presence of active street-level frontages with shop windows and cafes promotes safety through ‘eyes on the street’, enabling a natural surveillance of public space. In addition, Yoshimura et al. (2022) showed that the presence of active frontages led to an increase in commercial activity and rising property values.

Complexity refers to the visual and functional richness of the environment experienced by pedestrians (Jacobs, 1961). Visual complexity includes architectural variety, the presence of public art, and aesthetically diverse facades that contribute to the distinctiveness of urban locations (Carmona, 2019; Gehl, 2013). Cities with a high level of complexity are perceived as more attractive to pedestrians and foster spontaneous social interactions, economic activity (Fonseca et al., 2022), perceptions of safety, and the overall quality of public space (Blečić et al., 2020; Ewing et al., 2013). Functional complexity encompasses cafes, cultural community centres, and specialty shops, contributing to urban vitality and stimulating city dynamics (Florida, 2002). Yoshimura et al. (2022) found that neighbourhoods with a higher representation of public art, cultural facilities, and diverse architectural elements attract a broader spectrum of visitors and residents (Mack et al., 2017). Public art – whether in the form of murals, sculptures, or temporary installations – helps activate public space and reinforces its identity (Naughton, 2022).

Safety & Sensations assesses the level of perceived safety and the sensory qualities of an environment. Studies have shown that an increased level of safety contributes to better walkability (Brown et al., 2007; Mehta, 2008). Perception of safety is associated with the spatial legibility, traffic volume, traffic speed, and the presence of protective elements such as pedestrian crossings, traffic islands and deceleration features (Bereitschaft, 2017; Ewing et al., 2013). Empirical studies have concluded that people prefer public spaces that provide a reasonable level of culturally acceptable sensory stimuli (Appleyard & Lintell, 1972; Mehta, 2008).

Tidiness, referring to the cleanliness and maintenance of public space, directly influences aesthetic value, perceptions of safety, and overall walkability (Appleyard & Lintell, 1972; Gehl, 2013). Poor maintenance of buildings, pavements, or public greenery can lead to a deterioration in quality of life (Bereitschaft, 2017; Brown et al., 2007) and economic vitality (Ewing et al., 2013; Carmona, 2019). Vacant spaces and accumulated litter contribute to the impression of a neglected environment, which can result in reduced pedestrian activity and an overall degradation of public space (Bosselmann, 2018; Dičiūnaitė-Rauktienė et al., 2018; Yoshimura et al., 2022). Research confirms that illegal graffiti can negatively influence the perception of space and lower the sense of safety (Appleyard, 1980; Bereitschaft, 2017).

In CEE cities, urban design in city centres must be understood through the lens of layered historical urban structure, socialist heritage and post-socialist transformation. Before the socialist period, many city centres in CEE were characterised by compact

urban design with a diversity of uses that promoted urban vitality and pedestrian mobility. However, during the socialist era, urban development was dominated by functional zoning, modernist planning principles and large-scale residential projects, often located outside the historical centres. As a result, centres were frequently weakened by underinvestment, while the quality of public spaces and urban structure were often subordinated to sectoral planning logics and car-oriented modernisation (Bartzokas-Tsiompras et al., 2023; Hirt, 2013; Poklewski-Koziełł et al., 2023; Sýkora & Bouzarovski, 2012). After 1990, post-socialist transformation introduced new set of pressures. Market liberalisation, privatisation and property restitution contributed to fragmented urban development and intensified spatial inequalities (Tsenkova & Nedović-Budić, 2006; Stanilov, 2007). At the same time, rapid automobilisation exposed mismatch between urban infrastructure and new mobility demands, particularly in city centres that had not been designed for dramatic growth in private car use (Pojani & Stead, 2015; Sýkora & Bouzarovski, 2012). These dynamics were further reinforced by suburbanisation, retail decentralisation and outmigration of wealthier households, which weakened the economic base of many traditional centres and reduced their capacity for reinvestment (Balsas, 2021; Stanilov, 2007; Sýkora & Bouzarovski, 2012; Turok & Mykhnenko, 2007). As Rišová (2020) notes, despite the growing need to counter these car-oriented planning legacies, walkability research in post-socialist countries remains limited and often lacks a comprehensive spatial perspective.

3. Methodology

Based on an extended literature review (Appleyard, 1980; Bartzokas-Tsiompras et al., 2023; Bereitschaft, 2017; Carmona, 2019; Carmona, 2021; Cysek-Pawlak & Pabich, 2021; Ewing et al., 2013; Fonseca et al., 2022; Hamidi & Moazzeni, 2019; Hooi & Pojani, 2020; Ruiz-Padillo et al., 2018; Yoshimura et al., 2022), a matrix of 23 measurable indicators has been constructed, and categorised per each UDQ (see Fig. 1).

These indicators have been selected to:

- Reflect the environmental complexity of city centres in the Czech Republic: for example, aesthetics and visual appeal were included as factors promoting a positive user experience (Bartzokas-Tsiompras et al., 2023; Cysek-Pawlak & Pabich, 2021; Ewing et al., 2013).
- Be quantifiable: indicators such as pavement quality and street width were chosen for straightforward measurement (Huang et al., 2024).
- Show a proven link with walkability: studies have shown that features such as the availability of services or the presence of public spaces directly increase pedestrian activity (Cysek-Pawlak & Pabich, 2021; Ewing et al., 2013; Hamidi et al., 2020; Moura et al., 2017).

The weighting of indicators was used to determine the relative importance of individual UDQ aspects in the Czech context. In total, 68 representatives from academia, local government, non-profit organisations, and the private sector were surveyed; 46 responses were included (66% return rate). The diversity of respondents provided a comprehensive perspective on the relevance of UDQ for the walkability of Czech city centres. The expert survey was conducted online over the course of one month (May 2022). The questionnaire was designed in the LimeSurvey Professional environment (<https://www.limesurvey.org/>). Prior to the data collection, the questionnaire was pilot tested. The pilot revealed that some respondents had difficulties grasping the precise nature of certain UDQs. To ensure a consistent understanding across evaluators, each UDQ in the final online questionnaire was explicitly described in two to three sentences and accompanied

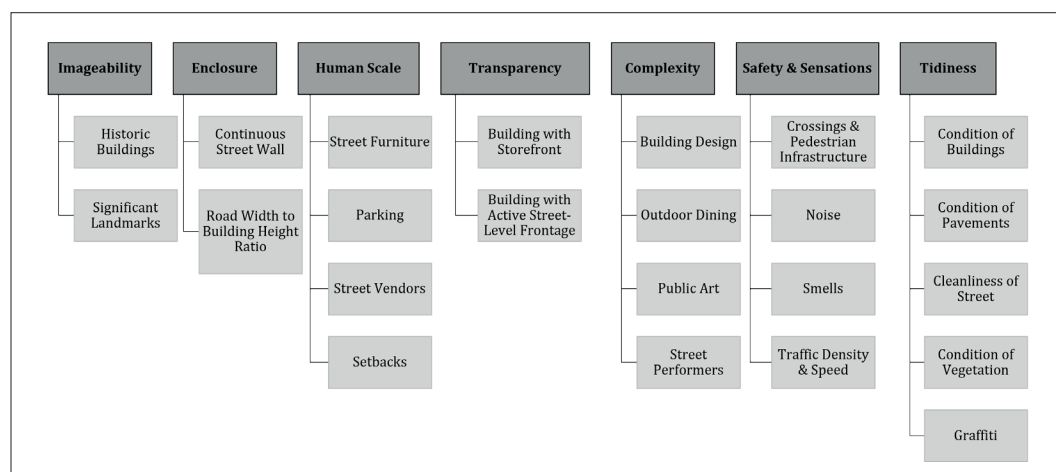


Fig. 1: Urban Design Qualities matrix
Source: Authors' conceptualisation

by visual illustrations documenting both high and low values of the given quality. This visual operationalisation approach directly builds on the foundational methodology of Ewing et al. (2013), who note that evaluating abstract streetscape features often involves a high degree of subjective judgement and requires photographic examples to achieve reasonable inter-rater reliability. This visual operationalisation was deemed a crucial technique to maintain a consistent interpretation in an online-based survey.

Respondents were asked to assign numerical weights. To capture the hierarchical nature of the framework, a two-step weighting process was employed. First, respondents distributed 100 points among the specific indicators within each respective UDQ. Second, respondents were asked to distribute a total of 100 points across the seven UDQs.

Data were analysed using IBM SPSS Statistics. The resulting weights were determined by the arithmetic mean. The non-parametric Kendall's Coefficient of Concordance (Kendall's W) was applied to determine the level of agreement among evaluators, ranging from 0 to 1. The closer the value of W to 1, the higher the agreement among respondents (Emerson, 2023). Following the completion of the main questionnaire survey, a qualitative validation workshop was held. Feedback on the questionnaire survey results was provided at the workshop involving experts from academia (human and physical geographers, architects), policy makers (development and planning departments) and the private sector (real-estate development company) ($n = 8$). Because the preceding questionnaire survey was strictly anonymous, it cannot be definitively established whether these 8 workshop participants were among the 46 experts who completed the survey. However, there was a deliberate geographical distinction between the two research phases: while the online questionnaire targeted professionals across various regions and city sizes in the Czech republic to capture a macro-level perspective, the validation workshop intentionally involved a specific group of experts with deep local knowledge of a selected regional centre. This approach allowed for a qualitative validation of the nationwide results against a specific local context. The discussion focused on the interpretation of the results in relation to planning practice and validation of the relevance of the indicators for the Czech context and needs. All participants signed an informed consent form in accordance with the ethical codex of the hosting institution. The consent confirms that their participation and responses may be processed and used for scientific purposes.

4. Results

The results presented (Tab. 1, Fig. 2)¹ show that the two highest ranked UDQ were Tidiness (19.7%) and Safety & Sensations (19.2%). This underscores the emphasis placed by the experts on aspects such as cleanliness, maintenance of public infrastructure, and the perception of safety and comfort (Traffic Density & Speed, Noise, Smells). These two qualities were followed by Human Scale (16.0%) and Complexity (13.4%), confirming the importance of pedestrian-oriented amenities (Street Furniture, Setbacks, Parking) and visual and functional diversity (Building Design, Outdoor Dining, Public Art). Less important, but still relevant, were Imageability (11.8%), Transparency (10.1%), and Enclosure (9.8%).

For Tidiness, indicators weights were distributed relatively evenly across the condition of buildings, pavements, vegetation, and street cleanliness. The presence of Graffiti received the lowest weight (9.3%), whereas the Condition of Pavements (23.3%) and the Condition of Vegetation (22.6%) scored relatively high. Overall, this UDQ is characterised by a higher level of agreement among evaluators (Kendall's W) and is also one of those with the highest overall weights within the assessed UDQ.

Under Safety & Sensations, the highest weight was assigned to Traffic Density & Speed (34.1%), followed by Crossings & Pedestrian Infrastructure (26.8%), Noise (21.4%) and finally Smells

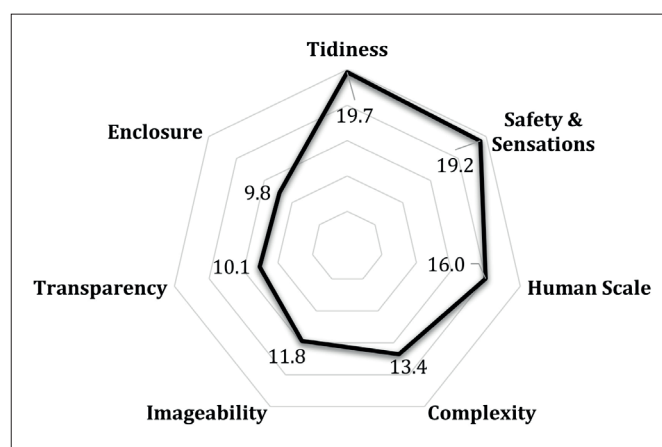


Fig. 2: Perceived importance of Urban Design Qualities in the context of walkability (%)
Source: Expert survey ($n = 46$)

¹ For an overview of descriptive statistics, including standard deviations (SD) and medians for the weights assigned, see Appendix 1.

UDQ	UDQ weight (%)	Kendall's W of UDQ	Indicator	Indicator weight within UDQ (%)	Final aggregated weight of indicator (%)	Ranking score (position of indicator)
Tidiness	19.7	0.401	Condition of Buildings	23.9	4.7	23.54 (3 rd)
			Condition of Pavements	23.3	4.6	22.95 (4 th)
			Condition of Vegetation	22.6	4.5	22.26 (5 th)
			Cleanliness of Street	20.9	4.1	20.59 (6 th)
			Graffiti	9.3	1.8	9.16 (20 th)
Safety & Sensations	19.2	0.278	Traffic Density & Speed	34.1	6.6	26.19 (1 st)
			Crossings & Pedestrian Infrastructure	26.8	5.2	20.58 (7 th)
			Noise	21.4	4.1	16.44 (10 th)
			Smells	17.7	3.4	13.59 (13 th)
			Street Furniture	38.3	6.1	24.51 (2 nd)
Human Scale	16.0	0.357	Parking	27.3	4.4	17.47 (8 th)
			Setbacks	17.8	2.8	11.39 (16 th)
			Street Vendors	16.6	2.7	10.62 (18 th)
			Building Design	32.2	4.3	17.26 (9 th)
Complexity	13.4	0.355	Outdoor Dining	29.0	3.9	15.54 (11 th)
			Public Art	25.0	3.4	13.40 (14 th)
			Street Performers	13.8	1.9	7.40 (22 nd)
			Historic Buildings	56.0	6.6	13.22 (4 th)
Imageability	11.8	0.146	Significant Landmarks	44.0	5.2	10.38 (15 th)
			Building with Active Street-Level Frontage	68.4	6.9	13.82 (12 th)
Transparency	10.1	0.586	Building with Storefront	31.6	3.2	6.38 (23 rd)
			Continuous Street Wall	55.2	5.4	10.82 (17 th)
Enclosure	9.8	0.052	Road Width to Building Height Ratio	44.8	4.4	8.78 (21 st)

Tab. 1: Perceived importance of Urban Design Qualities, their indicators and the level of agreement among experts

Source: Expert survey (n = 46), authors' conceptualisation

Notes:

- To estimate indicator importance, the aggregated weight of each indicator was calculated as $AW_{i,j} = (W_j^{UDQ} \cdot W_{j,i}^{ind})/100$.
- To correct for the branching effect associated with the unequal number of indicators across UDQs, a normalised count-neutral weight was computed as $NCW_{ij} = AW_{i,j}/(W_j^{UDQ}/n_j) = (n_j \cdot W_{j,i}^{ind})/100$, where n_j denotes the number of indicators within the j -th UDQ.
- The final ranking of indicators across all UDQs was then based on the ranking score $RS_{i,j} = W_j^{UDQ} \cdot NCW_{ij}$.

(17.7%). The distribution of weights among individual indicators thus reflects the highest representation of factors directly related to traffic conditions and the quality of infrastructure, while sensory stimuli such as Noise and Smells were ranked lower. The overall weight of this UDQ is 19.2%, placing it among the most significant UDQ. The level of agreement among evaluators, as expressed by Kendall's W (0.278), is lower than for some other UDQ, although not the lowest within the analysed sample.

In the case of Human Scale, Street Furniture achieved the highest weight (38.3%), followed by Parking (27.3%), Setbacks (17.7%) and finally Street Vendors (16.6%). The overall weight reached 16.0%, making it a moderately-ranked UDQ. Kendall's W = 0.357 indicates a moderate level of agreement.

For Complexity, Building Design (32.2%) recorded the highest weight, followed by Outdoor Dining (29.0%) and Public Art (25.0%). The lowest value was recorded for Street Performers (13.8%). The overall group weight is 13.4% and Kendall's W = 0.355 indicates a moderate level of agreement.

Significant Landmarks (56.0%) received a slightly higher weight in the UDQ Imageability compared to Historic Buildings (44.0%). The overall weight of the UDQ is 11.8%, making it less significant. Kendall's W = 0.146 indicates a lower level of agreement.

Within Transparency, the indicators are divided between Buildings with Storefront that may be (un)occupied or (non) transparent (31.6%) and Buildings with Active Street-Level Frontage, i.e. with utilised and open facades (68.4%). This UDQ achieves an overall weight of 10.1% and its Kendall's W is 0.586, the highest level of agreement.

In the evaluation of the Enclosure quality, the Continuous Street Wall (55.2%) shows a slightly higher weight than the Road

Width to Building Height Ratio (44.8%). The overall weight of UDQ shows the lowest value (9.8%) and its Kendall's W = 0.052 represents the lowest level of agreement.

Kendall's Coefficient of Concordance (W) demonstrates high variability for individual UDQ. The highest values were found for Transparency (0.586) and Human Scale (0.357), indicating that there was a higher level of agreement among evaluators on the importance of the above qualities. The lowest values for Enclosure (0.052) and Imageability (0.146) indicate less consensus among the experts, and thus higher variability in the perceived importance of the two qualities.

The ranking score (hereafter RS), which accounts for the varying number of indicators across UDQs, allows for the comparison of individual indicators across different UDQ. The values range from 26.19 to 6.38. The quartile distribution of Ranking score was used to interpret the results (Fig. 3, Tab. 2).

There are six key indicators in the first quartile: Traffic Density & Speed (Safety & Sensations), Street Furniture (Human Scale), Condition of Buildings; Condition of Pavements; Condition of Vegetation; Cleanliness of Street (all Tidiness). These indicators play a vital role in the perception and functionality of public space. The second and third quartiles include 11 other indicators that still have a significant impact on walkability. These indicators appear across all UDQ. Indicators in the fourth quartile include 6 indicators. While these indicators were perceived as less important, their presence still affects the overall quality of the urban environment. The distribution of weights reveals that none holds overwhelmingly dominant or negligible importance. Both higher and lower values appear across all UDQ, indicating a broad spectrum of relevant factors that contribute to the urban design quality of city centres.

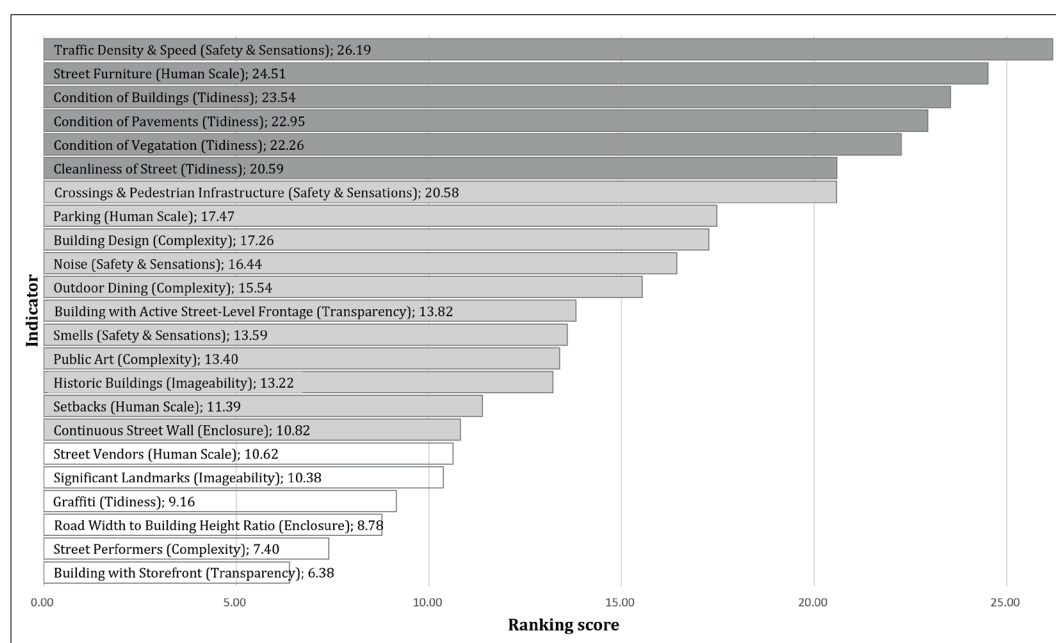


Fig. 3: Perceived importance of UDQ indicators. Note: Ranking score removes the influence of number of indicators in UDQ
Source: Expert survey (n = 46)

Quartile	No. of indicators	Indicators	Sum of RS	Average RS
1 st quartile – key indicators influencing UDQ	6	Traffic Density & Speed; Street Furniture; Condition of Buildings; Condition of Pavements; Condition of Vegetation; Cleanliness of Street	140.0	23.3
2 nd and 3 rd quartile – moderately important UDQ indicators	11	Crossings & Pedestrian Infrastructure; Parking; Building Design; Noise; Outdoor Dining; Building with Active Street-Level Frontage; Smells; Public art; Historic Buildings; Setbacks; Continuous Street Wall	163.5	14.8
4 th quartile – less significant UDQ indicators	6	Street Vendors; Significant Landmarks; Graffiti; Road Width to Building Height Ratio; Street Performers; Building with Storefront	52.7	8.8

Tab. 2: Summary of perceived importance of Urban Design Qualities' indicators
Source: Expert survey (n = 46), authors' conceptualisation

Workshop participants agreed that Safety & Sensations as well as Tidiness, which received the highest weights in the questionnaire survey, indeed constitute a basic framework for any walkability intervention. The attending experts reassured that without a sense of safety and without careful maintenance of the street environment (cleanliness, pavement condition, greenery) it is difficult to attract more pedestrians to the streets. The discussion also included several specific remarks. For example, Building with Active Street-Level Frontage was among the indicators with moderate importance, however, the experts emphasised the negative trend of long-term vacant retail units, which in turn create areas with a reduced sense of safety. The risk of vacant retail spaces is also evidenced by the significantly higher weight assigned to active storefronts (68.4) compared to the presence of storefronts regardless of their use (31.6). Regarding the Traffic density & speed indicator, there was clear consensus that individual car traffic was the main risk factor, whereas public transport and cyclists were not perceived as dominant sources of danger. It is also worth noting that for Enclosure, more attention needed to be paid during the workshop to explaining the meaning of its indicators – suggesting that the indicators are more complicated to interpret and that their understanding could be supported by illustrative examples or visual aid during a planning phase. This was also evident in the lowest agreement among the respondents on the importance of Enclosure (Kendall's W = 0.052). Overall, the workshop, while largely confirming the results of the questionnaire survey, provided some important contextualisation and practical insights.

5. Discussion and conclusion

This research showed the highest significance of UDQ Tidiness, Safety & Sensations, Human Scale, and Complexity, which together account for 68.3% of the total weight. The range of UDQ weights (from 9.8% to 19.7%) shows that there are real differences in the level of importance to each UDQ, as perceived by experts. At the same time, however, none of the UDQ received a negligible weight, indicating that all the analysed qualities have some relevance within the walkability assessment. This fact reinforces the credibility and transferability of the framework proposed by Ewing et al. (2013) to the CEE contexts and confirms the need for adaptation through quantitative weighting. The conceptual contribution of this study stands also in highlighting the need to additionally consider UDQ Tidiness and Safety & Sensations to the original framework, when applying it to CEE city centres.

CEE cities often face problems related to incomplete infrastructure, damaged pavement surfaces, a lack of greenery, poor lighting, and vandalism, all of which reduce both the perceived and real quality of public space (Poklewski-Koziński et al., 2023). Moreover, safety in CEE city centres is affected by heavy car traffic and insufficient traffic calming measures, especially in city centres that historically were not designed to accommodate current traffic levels of motor traffic (Bartzokas-Tsiompras et al., 2023; Istrate et al., 2020). One key empirical finding consists in the highest importance assigned to UDQ of Tidiness and Safety & Sensations in the Czech Republic, together accounting for 38.9% of the total weight of all seven UDQ. These findings corroborate the emphasis

on Safety & Cleanliness reported by Fonseca et al. (2022) and Carmona (2019), who found that the presence of well-maintained buildings, public greenery, and clean streets directly influence the level of public space use. The expert assessment of physical attributes of UDQ confirms that the importance of basic walking conditions still persists in CEE city centres. Compared to Western European cities, where this domain has long been systematically addressed (Carmona, 2019), there is an urgent need to improve the level of physical maintenance, comfort, and safety in CEE centres. This is the basis for any further planning interventions or development of other UDQ. This is empirically supported in the studied CEE context by the case of Łódź (Cysek-Pawlak & Pabich, 2021), where improvements in cleanliness and public amenities led to an increase in pedestrian activity.

While research in Western European cities (Ewing et al., 2013; Fonseca et al., 2022; Hamidi & Moazzeni, 2019) shows the importance of a diverse and stimulating environment (Complexity), in CEE this UDQ is ranked as less essential than, for example, Tidiness. Given the historical development of CEE cities toward large mono-functional housing districts or degradation of more diverse city centres, the enhancement of Complexity is now often seen as an important regeneration strategy (Bartzokas-Tsiompras et al., 2023; Cysek-Pawlak & Pabich, 2021). The findings of this study confirm that the Human Scale and Complexity together account for 29.4% of the total UDQ weight, empirically confirming their importance for creating a welcoming, socially active, and functionally diverse urban environment in CEE.

The findings show that Imageability is of relatively lower importance in CEE compared to Western cities, where the visual attractiveness of public spaces is often perceived as key to orientation within and experience of the urban environment (Ewing et al., 2013; Lynch, 1960). The lower rating of Imageability in CEE may be related to the fact that iconic or landmark elements are not as common in many CEE city centres or are not perceived as a key tool for improving walkability. However, it should be noted that respondents rated the general importance of these UDQ, not their actual occurrence. Furthermore, in different types of city centres (from historic to post-industrial) the term 'imageability' may refer to different elements. As mentioned during the workshop, while castles or cathedrals may serve as iconic elements in historical cities, industrial heritage may play this role in industrial cities. This culturally specific interpretation should be considered in the future when contextualising indicators at the local level.

Transparency and Enclosure received the lowest weights in the expert assessment of all seven UDQ. This slightly differs from some Western European studies where these factors are often considered key (Ewing & Handy, 2009; Yoshimura et al., 2022). This difference may be interpreted by the fact that in CEE the street-level frontage is often inactive, and commercial activity has shifted to shopping malls (Bartzokas-Tsiompras et al., 2023). On the other hand, the indicator Continuous Street Wall (under Enclosure) achieved a relatively high weight, which can be interpreted by the perception of the problem of vacant lots by Czech experts that disrupts the continuity of the street wall (cf. Bereitschaft, 2017; Istrate et al., 2020). The findings thus reflect the realities of CEE city centres, where the need for traffic calming measures, physical maintenance, and vacant street space reuse often outweighs the importance of visual and interactive qualities emphasised in Western cities.

Considering the individual indicators, the core attributes point of walkability in Czech city centres, as perceived Czech experts, are represented by six indicators: Traffic Density & Speed, Street Furniture, Condition of Buildings, Pavements, Vegetation and Cleanliness of Street. The results clearly indicate the need to prioritise fundamental physical and safety concerns. The high perceived importance of Traffic Density & Speed in our results is

strongly supported by empirical evidence from CEE studies and confirms the legacy of urban challenges associated with socialist urban development, which prioritised automobile transport over pedestrians (Řišová, 2000; Poklewski-Kozieł et al., 2023; Strommer et al., 2025). Furthermore, regarding the remaining indicators in the first quartile, Horak et al. (2025) demonstrate that mass construction in the socialist era, along with post-socialist transformation, often resulted in the neglect of public spaces and the degradation of physical infrastructure. As argued by Istrate et al. (2020), such physical degradation of the streets remains a major barrier to walkability. These findings are further corroborated by Strommer et al. (2025), whose expert assessment in Budapest identified identical priorities.

We acknowledge several limitations. The data collection presented in this study was carried out exclusively in the Czech Republic. Although there are some commonalities across the CEE region due to similar historical development and a shared semi-peripheral position (Bartzokas-Tsiompras et al., 2023; Cysek-Pawlak & Pabich, 2021), the existence of significant inter-regional differences cannot be excluded. Therefore, the results should be interpreted as illustrative of the Czech context, and caution is advised when generalising them for other CEE countries. Future research should aim to deepen the understanding of the importance of UDQs across different spatial, cultural, and social contexts, including potential variations depending on the hierarchical level or size of cities (e.g. metropolitan cities, regional centres, and small towns). The scope of this study is strictly limited to an expert-based assessment and behavioural validation is beyond the scope of the study. While this study builds on expert assessment of indicators, one key direction for future research is to validate them through a combination of UDQ field auditing and the observation of actual pedestrian walking behaviour in specific locations. The framework elaborated by Ewing et al. (2013) was originally designed for compact, high-intensity use urban environments, typical of city centres. Its application to, for example, housing estates or hybrid development zones in CEE, may be methodologically challenging and require adaptation or the addition of new indicators.

Grounded in Czech city centres, our expert-weighted UDQ framework highlights a pragmatic path for CEE: prioritise politically feasible, high-impact basics (tidiness, safety, and traffic calming) as the foundation for walkability, followed by frontage activation with clear visuals and local contextualisation.

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Appendices

Appendix 1: Descriptive statistics of expert ratings

UDQ Category	UDQ Weight (%)	Kendall's W	SD	Median	Indicator	Indicator Weight (%)	SD	Median
Tidiness	19.7	0.401	8.36	20.0	Condition of buildings	23.9	8.53	20.0
					Condition of sidewalks	23.3	7.21	21.0
					Condition of vegetation	22.6	7.76	20.0
					Cleanliness of street	20.9	6.70	20.0
					Graffiti	9.3	6.79	10.0
Safety & Sensations	19.2	0.278	6.72	20.0	Traffic density & speed	34.1	14.00	34.5
					Crosswalks & ped. infrastructure	26.8	12.52	25.0
					Noise	21.3	7.96	20.0
					Smells	17.7	8.18	20.0
					Street furniture	38.3	14.06	40.0
Human Scale	16.0	0.357	8.23	15.0	Parking	27.3	14.17	27.2
					Setback	17.8	11.41	15.0
					Street vendors	16.6	8.55	20.0
					Building design	32.2	14.78	30.0
					Outdoor dining	29.0	9.11	30.0
Complexity	13.4	0.355	5.98	14.0	Public art	25.0	9.41	23.5
					Street performers	13.8	7.60	12.5
					Significant landmark	56.0	14.83	60.0
					Historic buildings	44.0	14.83	40.0
					Building with active storefront	68.4	16.23	70.0
Transparency	10.1	0.586	4.63	10.0	Building with storefront	31.6	16.23	30.0
					Contiguous street wall	55.2	18.26	60.0
Enclosure	9.8	0.052	6.72	10.0	Road width to building height	44.8	18.26	40.0

Notes:

- UDQ Weight (%) represents the share of total weight allocated by experts to each UDQ category.
- Kendall's W measures the level of concordance among expert assessments within a given category.
- Standard deviation (SD) captures the dispersion of expert ratings around the central tendency.
- Median indicates the central value of the rating distribution.
- Indicator Weight (%) represents the proportion of weight assigned to a given indicator within its respective UDQ category.