Knowledge management model and public policy dilemmas: the case of a disused asbestos factory

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Abstract

This study presents a participatory approach to support decision-making in the regeneration of disused urban spaces. Based on the scenario-building approach, the methodology combines online surveys and text analysis tools to collect and analyse citizens' perceptions, needs and expectations. This methodology enables the analysis of large textual datasets to systematically map community priorities and provide insights for urban regeneration projects. The approach has been applied to the project of the former Fibronit industrial site in Bari in the "Parco della Rinascita", demonstrating how data-driven citizen engagement can improve the alignment of public initiatives with community aspirations. The integration of participatory frameworks and digital tools offers a replicable model for sustainable and inclusive urban planning, promoting resilient and cohesive communities and setting a new standard for public perception analysis in decision-making processes.

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Keywords

Urban Regeneration; Community Involvement; Knowledge model

Introduction

The failure of urban transformation approaches that neglect the needs of local communities has often resulted in poor recognition and use of spaces by the population (Solitare and Lowrie, 2012; Green, 2018). This underscores the critical importance of directly involving citizens in decision-making processes. In the context of urban transformation, initiatives for the redevelopment of disused areas, land-use conversion, and the integration of public green spaces require a careful analysis of community perceptions and expectations. Perception, defined as the process of acquiring and interpreting sensory information (Bell, 1999), is shaped by a combination of sensory stimuli and personal memories (Bundy et al., 2002). This approach not only enables the design of interventions that genuinely address local needs but also ensures greater utilization and satisfaction with the regenerated spaces.

Projects adopting co-design methods and continuous dialogue with local stakeholders have successfully integrated community needs, enhancing the quality and effectiveness of the implemented solutions. A striking example is the redevelopment of the disused industrial areas of Hafen City, Hamburg (V. Eleftheriou J. Knieling, 2017). In this project, local administrations, residents, and private actors collaborated through workshops and participatory forums to define the uses of the spaces. The design incorporated local needs by integrating open public spaces, pedestrian pathways, and sustainable mobility infrastructures. This

approach made HafenCity a virtuous model of urban regeneration, where continuous dialogue successfully balanced economic development with quality of life.
Another significant case is that of Christchurch, New Zealand, after the 2011 earthquake (Brand and Nicholson, 2016). The city's reconstruction followed a participatory approach involving residents in decisions about the future of urban spaces. Through consultation platforms and design workshops, the community contributed to redesigning green areas and public spaces, such as the "Green Frame," a green belt encircling the city centre. This intervention strengthened the community's sense of belonging and created a resilient and sustainable urban environment.
In this context, digital technologies have proven to be valuable allies, facilitating data collection and analysis and making participatory processes more inclusive. The use of digital platforms, such as online surveys, interactive forums, and participatory georeferencing tools, has expanded the opportunities to engage a broader and more diverse audience. These tools enable the collection of relevant input even from groups that might otherwise be excluded from traditional participatory processes.
Based on these premises, this study proposes an innovative methodology to gather and analyse community needs and expectations regarding the transformation of a disused urban area. The methodology, based on scenario building, combines online surveys with advanced textual analysis tools to map perceptions, needs, and preferences. This approach provides a detailed and systematic overview of the priorities expressed by citizens, offering an effective model for designing shared interventions. The methodology can contribute to creating more resilient, inclusive, and sustainable communities, providing public administrations with a tool to accelerate urban regeneration processes through participatory practices and shared methodologies.

This methodology was applied to the redevelopment project of the former Fibronit area in Bari, known as the "Parco della Rinascita." The document is structured into six sections: following this introduction, Section 2 outlines the adopted methodology, followed by the presentation of the case study in Section 3. Section 4 analyses the results, Section 5 offers a critical discussion, and the document concludes with final considerations in Section 6.

Methodology

In order to gather the needs and expectations of the community regarding their vision for the former Fibronit industrial area in Bari, the methodology outlined in Figure 1 was adopted.

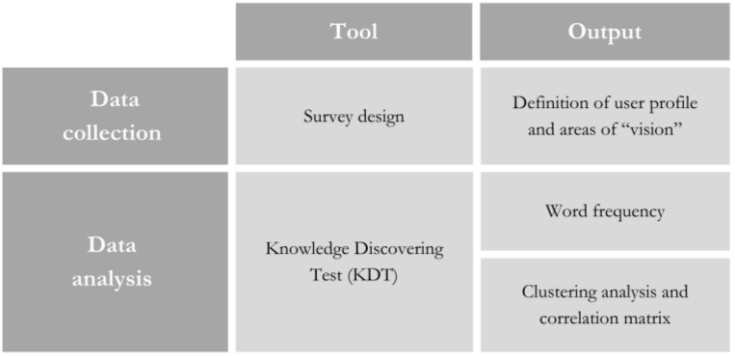

Figure 1 – Methodology process

The methodology is divided into two main phases: (i) data collection and subsequent analysis. For the data collection phase, an online questionnaire was developed. The objective was to define user profiles and identify areas of interest, referred to as 'visions', on which to investigate the community's expectations and perceptions for the

construction of the scenarios envisaged; (ii) the analysis phase involved processing the data using Knowledge Discovering Test techniques.

Survey design

The data collection phase involved the development of an online questionnaire. The choice to use an online questionnaire was driven by the ability to reach a significant number of respondents asynchronously, while facilitating the orderly and systematic collection of data (Van Selm and Jankowski, 2006; Brown et al., 2022).
The questionnaire was created using Google Forms and distributed via snowballing on social media channels such as Facebook and WhatsApp, from February to May 2023.
The construction of the questionnaire began with the definition of the objectives for data collection, which was instrumental in guiding the formulation of the questions.
The objective of the questionnaire was to collect the needs and expectations of the community regarding their vision for the former Fibronit industrial area of Bari. To achieve this goal, the theoretical framework inspired by the theory of scenario construction (Kakhee, 1991) was employed. Scenarios are not used as predictions of the future, but as explorations of possible outcomes based on variable hypotheses, drivers and policy choices. This approach helps planners and policymakers better understand the potential risks, opportunities and consequences of different development paths (Khakee, 1991 emphasizes that scenarios should be constructed systematically, incorporating a mix of quantitative data and qualitative insights. This inclusiveness ensures that scenarios reflect diverse perspectives and priorities, enhancing their relevance and credibility.

Specifically, the questionnaire was divided into two sections: (i) Demographic Characterization; (ii) Characterization of the citizens' visions, actions and the definition of the scenario.
For the demographic characterization, variables commonly used in the literature to describe the cognitive-perceptual framework (Luo et al., 2022; Trop et al., 2023) were employed. These variables included gender, age, neighbourhood of residence, direct experience of the presence and history of the facility, and its impact on the surrounding environment and human health.
For the characterization of investigation areas, four open-ended questions were formulated to four thematic areas. Each thematic area represented a "vision" of the area. For each thematic area, citizens were asked to define between one and three actions aimed at achieving the vision.
The visions were selected based on the areas investigated during the project's participatory phase, specifically: (i) symbolic value of the park; (ii) environmental quality; (iii) recreational activities and well-being; and (iv) safety and usability.

Knowledge discovering text analysis

The framework for extracting knowledge and meaningful information from textual documents is known as Knowledge Discovery in Texts (KDT). It employs data mining techniques, natural language processing (NLP) and other methodologies to identify patterns, relationships, trends or implicit knowledge in texts. KDT methods also include text processing techniques such as tokanalysis, stopword removal, stemming or lemmatisation, as well as entity analysis, relation extraction, opinion analysis (commonly called 'sentiment analysis'), categorisation and text clustering. The two most common frequency measures

in the process are absolute frequency and relative (or normalized) frequency. The former represents the number of times a term appears in a specific set of documents, while the latter represents the proportion of a term's absolute frequency relative to the total length of the document or corpus.

Word frequency can be used to identify the most common keywords in a corpus or to pinpoint the most relevant concepts within a specific domain. Additionally, term frequency can serve as input for more complex analytical algorithms, such as topic analysis, document classification, or text retrieval.

The visualization of word frequency analysis results can also be graphically represented through bar charts or word clouds. These visual representations allow for quick identification of the most frequent words and highlight key themes within the documents.

Further advances in research may include ontology-based natural language processing, concept extraction, social media topic analysis and machine learning (Feldman and Sanger, 2007).

The process consists of a sequence of operations that begins with the 'data preparation' phase. This phase includes the collection and organisation of data from various sources, the selection of relevant variables for analysis and finally the transformation of the data into a format suitable for the application of data mining algorithms (Figure 2), (Aggarwal and Zhai, 2012).

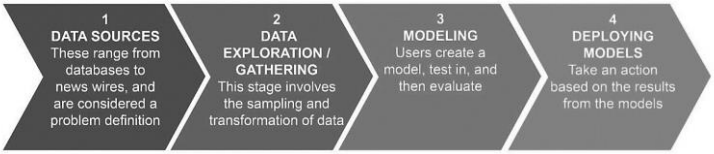

Figure 2 - Knowledge-discovering text process. Inspired by Aggarwal and Zhai (2012).

Clustering analysis and correlation matrix

The analysis of the results was conducted through the application of "clustering" models and "correlation matrices."
Clustering analysis is performed by grouping similar documents, texts, or terms based on semantic, structural, or lexical characteristics. The goal is to identify homogeneous groups of information within a larger, often unstructured dataset without requiring predefined labels or categories. The model used for clustering is based on the "k-means" algorithm, widely employed to divide a dataset into a predefined number of clusters. This algorithm attempts to find "k" centroids (central points) that represent each cluster. In the case study, the k-means algorithm—commonly used for clustering numerical data—was adapted for text processing by employing appropriate similarity measures for textual data, such as the Jaccard distance. The Jaccard distance calculates the similarity between two words as the ratio of the intersection to the union of their feature sets. Correlation analysis aims to identify relationships between words or terms within one or more documents to uncover significant associations and understand their co-occurrence or semantic relationship.

For the analyses in this case, the "correlation matrix" technique was used. This technique provides a tabular representation with chromatic indices of the correlations between terms in the dataset, commonly referred to as a "heatmap" (Srivastava et al., 2009).

Case study

The city of Bari is one of the provincial capitals of the Apulia region and has a population of approximately 313,164 residents (ISTAT 2021).
In recent years, urban policies have focused on the adaptive reuse of former industrial areas. Sites that were once abandoned or underutilized have been transformed into cultural and recreational spaces.
Among these is the "Parco della Rinascita" (*Renaissance Park*) project, located on the site of a former asbestos manufacturing plant. The former Fibronit plant is a decommissioned industrial site where asbestos-containing products were manufactured.
The industrial activity at Fibronit ceased in 1985. It had generated a large amount of processing waste, including asbestos sludge and dust, all classified (Presidential Decree No. 915 of 1982) as "toxic and hazardous waste" and subsequently (Legislative Decree No. 22 of 1997) as "hazardous waste."
For the realization of the project, a modification to the General Urban Plan was made for the former Fibronit area, changing its land use designation from "tertiary activities zone" to "type B public green space (neighbourhood green space)."
The Parco della Rinascita covers an area of 146,850.70 square meters and is centrally located between the neighbourhoods of Madonnella, Japigia, and San Pasquale (Figure 3).

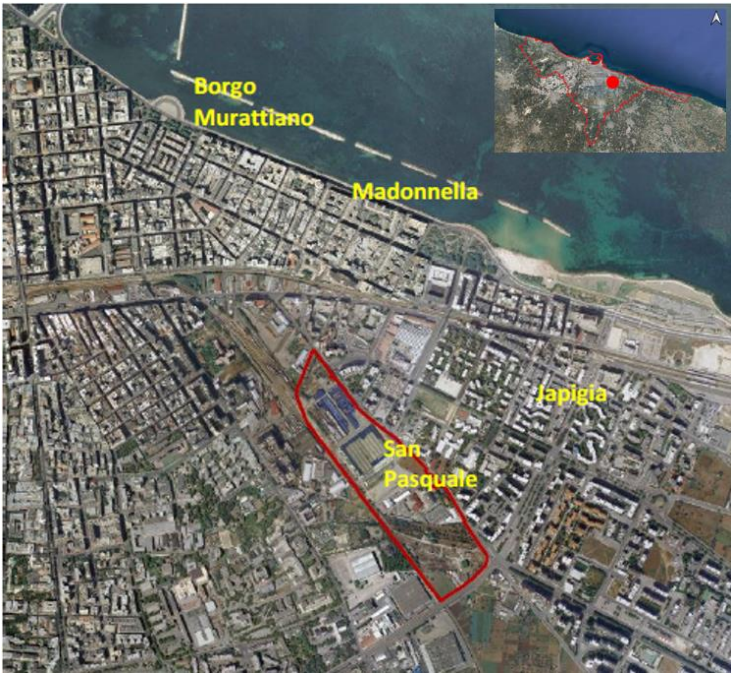

Figure 3- Case study area

Participatory process

During the drafting process of the project, the participatory process (held from March to September 2018) played a crucial role in defining the preliminary design of the park. It brought together various stakeholders, particularly the "ex Fibronit" Committee, the technical and institutional bodies of the Municipality of Bari, and the appointed designers. This process resulted in the "spatialization" of the needs and desires expressed by the active citizen groups involved.
The participatory process focused on four fundamental thematic areas:
a) symbolic value of the park;

b) environmental quality;
c) recreational activities and well-being;
d) safety and usability.

At the conclusion of the participatory process, several predominant themes emerged related to the identified thematic areas. These included the desire to preserve the civic and historical significance of the site's history, the need for park accessibility and usability, and the aspiration to create a green area that would be enjoyable and serve as a recreational and wellness oasis.
The preliminary project was subsequently developed across several domains, including the multifunctional park, urban forestry, boundaries and fencing, as well as roads and parking areas.

Results

Sample size
The sample involved 180 respondents divided into different user categories as shown in Table 1.

GENDER	
Male	63,30%
Female	34,40%
Unspecified	2,30%
AGE	
<18	1,10%
18 – 30	18,00%
31 – 50	51,70%
51- 70	24,40%
>70	4,50%
DISTRIBUTION BY NEIGHBORHOOD	
Unspecified	21,30%

Murat	14,60%
Madonnella	9,00%
Libertà	2,20%
Picone	2,20%
Picone/Poggiofranco	5,60%
San Pasquale	7,90%
Carrassi	7,90%
Japigia	21,30%
San Paolo	5,60%
Carbonara di Bari	1,10%
DIRECT EXPERIENCE OF THE EVENTS OF THE PLANT	
YES	8,90%
NO	91,10%
DIRECT EXPERIENCE OF THE EFFECTS OF THE PRESENCE OF THE PLANT	
YES	33,30%
NO	66,70%
KNOWLEDGE OF THE EVENTS OF THE PLANT	
Not at all	4,50%
Very little	8,90%
A little	33,30%
Quite a bit	41,10%
Very good	12,20%
KNOWLEDGE OF THE EFFECTS OF THE PRESENCE OF THE PLANT	
Not at all	0%
Very little	3,40%
A little	14,40%
Quite a bit	61,10%
Very good	21,10%

Table 1 – Sample size

Regarding the age of the interviewed sample, there is a predominance of individuals aged between 30 and 50 years (51.6%) and those aged between 50 and 70 years (24.2%), which means they were born between 1963 and 1993 and

may have personally experienced many of the events or, at least, have been informed about them, especially since over 70% of the respondents declare to be residents of Bari.
The majority of the questionnaire respondents are distributed among the neighbourhoods of Japigia (21.3%), Murat (14.6%), Madonnella and San Pasquale (16.9%), and Carrassi (7.9%). In relation to the knowledge of the events concerning the "ex Fibronit" plant, the majority of respondents (86.6%) state that they are aware of the issues discussed, with a level of awareness ranging from "little" (33.3%) to "very well" (12.2%), with a significant portion of respondents indicating that they know "fairly well" about the matter (41.1%).
Although a small number of respondents (8.9%) claim to be personally involved in the events of the plant, either directly or through proximity to people who have some connection to the facility, the majority state that they are aware of the effects of asbestos on human health, with a level of awareness ranging from "fairly" (61.1%) to "very well" (21.1%). This indicates a sensitivity to the issue, warranting investigation into how much influence the "ex Fibronit" matter may have had, as opposed to the informed awareness that has spread over the years among the public opinion.

Knowledge discovering text results

The KDT analysis was performed on the texts contained in the 'open response' section of the questionnaire. The graphical representation of the most frequently used words in the unstructured textual expressions, known as a 'word cloud', groups the terms based on their frequency within the text. The words at the center of the cloud therefore represent those used most frequently by respondents to the questionnaire, indicating a marked presence of terms such as “parco”, “verde”, “alberi”, “spazi”, “riqualificazione”.

Figure 4 – Word cloud

Subsequently, cluster analysis and the creation of the correlation matrix were carried out. The clustering analysis of the data, aimed at seeking emerging characteristics related to the participants' area of residence in the questionnaire, was performed by associating the variable "neighbourhood" with the responses related to "vision", analyzing the proposed macro areas individually, according to the scheme in table 2.

Clustering	Label		Attribute ("vision")
1.	neighbourhood	→	Symbolic value
2.	neighbourhood	→	Environmental quality
3.	neighbourhood	→	Area usage
4.	neighbourhood	→	Safety and Accessibility

Table 2 -Values assumed in the clustering model

For the construction of the correlation matrix, the territorial variable 'neighbourhood' was correlated with the results of the KDT analysis conducted on the responses given in the

'vision' section, looking for a statistically significant incidence of territoriality on perception (Tables 3 to 6).

	Abandonment	Degradation	Death	Health	Sadness
Carbonara		0,130	0,153		
Carrassi	0,042		0,111		
Japigia	0,015			0,237	
Madonnella		0,073			0,003
Murat		0,144		0,039	
San Pasquale					0,003
Picone	0,180	0,089		0,111	0,145
Poggiofranco	0,243	0,130		0,153	0,058

Table 3 - Heatmap of values taken from the 'correlation matrix' neighbourhoods/Symbolic value

	Aggregation	Trees	Activities	Quality	Space	Green
Carbonara					0,128	
Carrassi	0,177					
Japigia						
Madonnella			0,160		0,080	
Murat				0,100		
San Pasquale		0,108				0,377
Picone		0,124	0,177	0,177	0,245	0,177
Poggiofranco		0,167	0,235	0,225		0,225

Table 4 - Heatmap of values taken from the “correlation matrix” neighbourhoods/Environmental quality.

	Aggregation	Sharing	Culture	Park	Spaces	Sport
Carbonara				0,121		
Carrassi	0,139				0,139	0,139
Japigia	0,158		0,237	0,163		
Madonnella			0,095		0,122	
Murat				0,022		0,218
San Pasquale		0,122			0,501	
Picone	0,139	0,139	0,111		0,139	
Poggiofranco	0,183	0,183	0,153			

Table 5 - Heatmap of values taken from the "correlation matrix" neighbourhoods/Area usage.

	Accessible	Usability	Lighting	Security	Cameras	Sport
Carbonara	0,183					
Carrassi		0,408	0,139	0,062	0,371	
Japigia	0,158		0,024		0,291	0,199
Madonnella				0,049		0,108
Murat			0,065			0,051
San Pasquale		0,160	0,122	0,049	0,139	
Picone				0,062		
Poggiofranco				0,097		

Table 6 - Heatmap of values taken from the "correlation matrix" neighbourhoods/Safety and Accessibility.

Discussion

The cluster analysis highlighted a commonality of "vision" among the residents of the explored municipal area, in relation to the symbolic value of the area and the quality of the environment. The symbolic values of the area, which can be described by the terms "anguish" and "pain," but also "potential" and "opportunity," are transversal to the neighbourhood of residence of the interviewees, just as the

terms “environment,” “nature,” “aggregation,” and “community” seem to represent the shared vision for the future of the area. Overall, the four examined clusters indicate how participants converge on a common vision of the proposed topics.

Cluster 1: Neighbourhoods → VISION - Symbolic value.
The examination of the cluster related to the 'symbolic value of the area' highlights the common use of terms such as 'environment' and 'nature,' 'anguish' and 'pain,' 'potential' and 'opportunity,' suggesting that there is a more or less shared view among the questionnaire participants, regardless of their neighbourhoods of origin, regarding the symbolic value of the area.

Cluster 2: Neighbourhoods → VISION - Environmental quality.
The examination of the cluster related to 'environmental quality' also highlights the common use of terms such as 'environment' and 'nature,' 'aggregation' and 'community,' 'park,' and 'plants,' confirming the shared vision of the questionnaire participants, regardless of their neighbourhoods of origin, regarding the topic.

Cluster 3: Neighbourhoods → VISION - Area usage
The examined cluster highlights, once again, that there can be a shared idea about the enjoyment of the area, independent of the neighbourhood of residence, which seems to be focused on the common use of terms such as 'aggregation' and 'sharing', 'public', 'social', and 'sport'.

Cluster 4: Neighbourhoods → VISION - Safety and Accessibility.
The cluster related to 'safety and usability' of the area confirms the tendency of participants to share common

visions, expressed through terms such as 'accessibility' and 'usability,' 'institutions,' and 'order.'

The correlation analysis also highlighted that the perception of issues related to the presence of the abandoned area, as well as the priorities in the use of the redeveloped area, appear to be slightly divergent among respondents based on the distance of their residential neighbourhood from the area in question. In the first case, for residents in the neighbourhood almost adjacent to the area, themes related to 'health' seem to be significant, while for inhabitants of nearby neighbourhoods, even if facing each other, aspects such as 'degradation' and 'abandonment' seem to be more impactful. The interest of respondents seems to converge again regarding issues concerning the usability and safety of the future park, highlighting a lesser relevance of the aspect related to the location of residence about the area subject to intervention.

Correlation Matrix: Neighbourhoods → VISION - Symbolic value.

The correlation matrix highlights how the perception of the symbolic value of the area differs among the neighbourhoods adjacent to the study area. The analysis shows that for residents in the neighbourhood almost adjacent to the area, themes related to 'health' appear to be significant, while inhabitants of the neighbouring districts, although facing each other, seem more affected by 'degradation' and 'abandonment'. It seems plausible to hypothesize that the presence of infrastructures and areas urbanistically designated for uses other than residential may act as a sort of 'filter' to the perception and consequences of the proximity to the examined abandoned industrial area.

Correlation Matrix: Neighbourhoods → VISION - Environmental quality.

The correlation with the vision of the environmental quality of the area indicates that the responses contain the desires and perspectives of the citizens projected onto the area; this circumstance is confirmed by the significant presence of terms related to greenery, trees, and the public park, as well as the activities they imagine being able to carry out within. The approach among participants appears different between residents of neighbourhoods with larger urban spaces, private green areas, and the city park, for whom themes related to open spaces with greenery where sports and outdoor activities can be practiced are clearly relevant.

Correlation Matrix: Neighbourhoods → VISION - Area usage.

The correlation with the 'vision' of the use of the area shows fairly homogeneous responses regarding the neighbourhood of residence, highlighting the widespread desire to have shared spaces equipped with social and cultural aggregators, as well as areas where sports and outdoor activities can be practiced. In this case, territorial differences appear less pronounced, although it can be observed that residents in neighbourhoods better equipped in terms of green areas, whether private or collective, seem to express statistically more significant visions.

Correlation Matrix: Neighbourhoods → VISION - Safety and Accessibility.

The correlation with the 'vision' of safety and usability, as well as the issue of accessibility and usability, highlights that these are matters considered with widespread sensitivity among the interviewees, in line with the previous correlation analysis.

The results can be summarized into three scenarios. The proposed scenarios envision different possibilities for transforming the abandoned area and were developed to reflect the shared vision across the clusters while also integrating the differences identified through correlation analyses. The first scenario focuses on the symbolism of renewal and healing, incorporating spaces for memory and reflection. The second scenario emphasizes measures to connect the area with the urban fabric, highlighting concepts of safety, usability, and accessibility. The third scenario recognizes the site as a hub for social gathering and cultural activities.

Conclusion

The results of the KDT model confirm that using a methodology for structuring textual data can be extremely useful for identifying themes, sentiments, perceptions, and desires of those who interact daily with the territory. This approach also helps understand the influence that the area's layout has on these perceptions.

The characteristics of the sample and its uneven distribution across the city area explored may have negatively influenced the results. Therefore, these results cannot be considered absolute but provide a clear indication of how the study area is perceived and how citizens express largely consistent expectations and desires regarding it.

The ability to gain insights into perceptions and to identify desires, needs, and preferences could be particularly useful during the planning phase, guiding project decisions more accurately and enhancing their effectiveness.

In conclusion, based on the results obtained, it can be said that the online questionnaire has the advantage of collecting a large number of responses compared to data collection through traditional participation methods such as focus

groups, workshops, etc. However, this mode of questionnaire administration does not appear particularly suitable for the "vision/action" approach, as it requires users to engage in careful reflection to provide textual material of sufficient quality for the complex analyses to be conducted. It is also worth noting, as scientifically recognized, that the attention span for reading such documents, often accessed via smartphones, is approximately 2 minutes.

Adopting a participatory and structured approach in urban management decision-making processes could help ensure that decisions made by public administrations reflect the needs, preferences, and aspirations of the population regarding the creation of neighbourhoods, public spaces, and community-serving infrastructure.

Such an approach becomes essential for fostering a sense of belonging, accountability, and social cohesion, thereby improving equity and social justice. Furthermore, the participatory approach promotes collaborative decision-making, builds trust, and increases the likelihood of sustainable and effective urban development.

In synergy with the community, urban planners could create inclusive spaces that respect and preserve cultural heritage, promote social integration, and facilitate intercultural exchange. This contributes to the development of socially sustainable and resilient cities tailored to shared needs.

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Authors' Contribution

This work is the product of a collaborative effort by the authors throughout all stages of its development, including conceptualization, methodology design, results analysis, initial drafting, and the revision process.