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The City Through Unseeing Eyes: A Five-Dimensional Framework for Inclusive Urban Architecture for the Visually Impaired

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Abstract

This study examines how individuals with visual impairments perceive and experience urban spaces that are predominantly designed for sighted users. Employing a phenomenological approach combined with direct observation and semi-structured interviews, the research explores the embodied experiences and sensory perceptions of blind and low-vision individuals in navigating the urban environment of a mid-sized Indonesian city. To strengthen the analysis, the RAPFISH (Rapid Appraisal for Fisheries) method was adapted to assess dimensions of urban accessibility from the perspective of visually impaired users. The findings reveal that the urban landscape does not yet provide adequate support for non-visual sensory access, particularly in the domains of information and technology (23.86), social acceptance (30.78), and safety and comfort (39.84). Among the five dimensions analyzed, information and technology fell into the “non-inclusive” category, while social acceptance and safety and comfort were classified as “less inclusive.” These results suggest that the city not only fails to provide physical accessibility but also symbolically excludes people with visual impairments from the meanings of urban space. The study underscores the importance of integrating assistive technologies, universal design, and multisensory planning into inclusive urban architecture.

1.0 INTRODUCTION

The city, as a living space for society, should be accessible to everyone, including individuals with visual impairments. However, the reality in many urban areas shows that public infrastructure and facilities remain far from fully accommodating their needs. People with visual impairments continue to face significant challenges related to mobility, accessibility, and social participation in urban environments. In several European cities, efforts to enhance accessibility for the visually impaired have been implemented more effectively. For instance, in cities such as London and Stockholm, public transportation systems have been equipped with audio and tactile information to facilitate navigation for people with visual impairments. Research by Matuska (2017) in the Czech Republic shows that the evaluation of railway systems for wheelchair users has been conducted, which also had a positive impact on accessibility for individuals with visual impairments.

In Asia, several cities have begun adopting universal design to improve accessibility. However, challenges persist, particularly regarding infrastructure that remains insufficiently accommodating for visually impaired individuals. For instance, in many large cities, uneven sidewalks and the absence of tactile indicators continue to hinder mobility. Cities produce a “social space” that implicitly assumes users with full sensory capacity, particularly vision (Parkin & Smithies, 2012). In Havik et al. (2015), study, the absence of non-visual elements such as audio guidance, tactile markers, or sensor-based navigation emerged as key barriers to independent mobility for visually impaired individuals.

In Indonesia, efforts to improve accessibility for individuals with visual impairments have been initiated, yet numerous challenges remain to be addressed. Research by Prahastuti and Setyowati (2024) highlights the importance of physical accessibility for blind and mobility-impaired persons in public buildings. Similarly, a study conducted in Pekanbaru revealed that accessibility for individuals with visual and physical disabilities still requires significant improvement, particularly in relation to public facilities and services. Local studies across Indonesia report comparable findings, underscoring the limited real-world implementation of regulations intended to support accessibility (Salsabila & Apsari, 2021; Sativa & Bactiar, 2020; Tumorang et al., 2023).

In responding to the challenges of visual bias and the need for experience-based planning, a phenomenological approach provides a framework for understanding the subjective meanings of space for individuals with visual impairments. Bodily experience, sound, temperature, texture, and spatial orientation constitute essential sources of spatial knowledge for those with limited vision (Setiawan et al., 2022; Shin, 2024; Yaptan & Teh, 2024).

This research aims to explore in depth how individuals with visual impairments experience and ascribe meaning to the urban environment, while systematically assessing the dimensions of urban accessibility based on their perspectives. By combining phenomenology with the adapted RAPFISH framework, the study seeks to contribute both theoretically and practically to the development of cities that are more inclusive and sensorily equitable.

2.0 LITERATURE REVIEW

Research on urban inclusivity for people with visual impairments has generally developed along three main approaches: phenomenological studies grounded in non-visual spatial experience, quantitative evaluations through audits and technical indicators of the built environment, and assistive-technology research focused on navigation systems and AI-based digital assistance.

2.1 Theoretical Perspectives on Visual Impairment and Spatial Experience

Theoretically, Titchkosky (2011) conceptualizes disability as a social construct—an interaction between the individual and the environment that shapes the lived experience of disability. This framework suggests that the “face of the city” encompasses not only its physical structures but also its social norms and systemic arrangements. Maftuhin (2017) identifies four key indicators of an inclusive city: the full participation of persons with disabilities, the fulfillment of their rights, physical and informational accessibility, and inclusive social attitudes among urban residents. A study in Yogyakarta illustrates that despite the presence of regulatory frameworks, actual implementation—from the provision of facilities to social acceptance—remains far from ideal (Salim et al., 2022).

Previous studies highlight that individuals with visual impairments experience the city differently, as visual limitations alter the ways in which they perceive and make sense of urban space (Kitchin, 1998; Titchkosky, 2011). The absence of non-visual navigation elements—such as tactile markers, auditory cues, or consistent textures—significantly complicates orientation and mobility (Brock & Jouffrais, 2015; FG & Picinali, 2011). In this context, bodily experience emerges as a primary source of spatial orientation, underscoring the importance of multisensory urban design (Kwon & Iedema, 2022).

2.2 Urban Accessibility and the Challenges of Inclusivity

Recent urban design scholarship emphasizes that multisensory perception—including tactile, auditory, and spatial cues—plays a critical role in shaping how visually impaired users interpret, navigate, and experience urban environments, positioning multisensory design as a core principle of inclusive urbanism (Doboš, 2025; Koesoemawati et al., 2025). The concept of the inclusive city refers to the existence of systems that support the participation of all residents, including persons with disabilities. However, many cities continue to operate under a logic of visual design that disregards other sensory needs (Imrie, 2012; UNDP, 2019). Limited access to information, unsafe pedestrian environments, and inadequate navigational infrastructure remain pressing issues: 82.4% of blind respondents reported a lack of auditory information at bus stops, 81.4% noted the absence of audible traffic signals, and 45–64% pointed to inconsistent sidewalks (holes, stairs, uneven surfaces) as hazards to safe orientation (Havik et al., 2015; Rey-Galindo et al., 2020). Local studies in Indonesia (Prahastuti & Setyowati, 2024; Rebowo et al., 2022; Umar et al., 2021) confirm that large cities have not yet fully adapted to the needs of blind users.

In a related study, Zhang et al. (2022) provided important insights into urban design from a sensory perspective. Their research involved 26 blind participants evaluating 24 soundscapes across seven types of urban spaces, including parks, sidewalks, and bus stops. Parks and shopping streets were perceived as safe and comfortable, whereas markets and bus stops triggered anxiety largely due to traffic and construction noise. Participants expressed a preference for environments with fewer vehicles, slower traffic, and moderate pedestrian density. More recently, Cohen et al. (2024) developed a geospatial accessibility index for the blind in London. From a design perspective, multisensory environments are not merely supportive features but constitute an integrated spatial language through which non-visual users construct meaning, orientation, and spatial confidence within the built environment (Levy, 2020). Using data on street network connectivity, hazardous areas, and mobility challenges, the study revealed significant inequalities: while some areas were found to be relatively friendly, many others posed substantial risks and barriers for visually impaired individuals. These findings underscore that contemporary urban design continues to neglect the non-visual orientation needs of blind users.

2.3 Universal Design and the Multisensory City

Universal design emphasizes the importance of creating public spaces that are accessible to everyone without the need for further adaptation (Gupta et al., 2025; Pujiyanti & Ikaputra, 2025; Rahim & Permana, 2024). In the context of individuals with visual impairments, this entails the provision of guiding pathways, auditory signage, braille information, and the reduction of visual barriers such as low contrast or undetectable obstacles (Cole, 2021; Costa et al., 2024; Schreiber & Carius, 2016). Boucherit et al. (2022) further highlight the role of cultural codes in shaping products and services that are more intuitively accessible at the sensory level. Recent reviews highlight rapid advancements in human-centered and AI-supported navigation systems for visually impaired pedestrians, demonstrating significant progress in assistive technologies designed to support wayfinding and mobility in complex urban settings (Real & Araujo, 2019; Soltani et al., 2025).

El-Taher et al. (2021) conducted a comprehensive review of urban navigation systems for the visually impaired between 2015 and 2020, offering a taxonomy of navigation processes ranging from positioning to route guidance, while also identifying gaps where non-visual sensory needs were frequently overlooked in system design. Their findings suggest the integration of sensory metadata and users' natural orientation strategies as crucial directions for future inclusive design. An experiment conducted in İzmir, Turkey, comparing dense urban areas with open spaces, found that blind participants relied primarily on sound and echo as orientation elements particularly effective in dense urban contexts with physical boundaries, but less useful in open park settings due to the absence of echo effects from surrounding buildings (Kan-Kilic & Dogan, 2017). Exploratory analysis further demonstrates how blind individuals construct mental representations of the city based on non-visual sensory information. They attend closely to urban elements that are almost imperceptible to sighted individuals—features that serve as orientation cues and help shape cognitive maps of the city (Tota, 2022)

However, much of this literature implicitly assumes legible and supportive physical environments, thereby underscoring the need for parallel investigations into the inclusivity of urban spatial design as a foundational condition for the effective deployment of assistive navigation technologies (Telesińska, 2023). At the policy and planning level, recent urban studies emphasize that accessibility and inclusion must be evaluated as systemic qualities of urban environments, integrating experiential dimensions with spatial and regulatory frameworks to inform inclusive urban governance (Kavee & Flanigan, 2025).

Although they make significant contributions, phenomenological approaches, technical metrics, and assistive technologies each tend to remain fragmented between experiential depth, systemic operationalization, and assumptions about environmental conditions thereby failing to fully capture the quality of urban spatial inclusivity for users with visual impairments. This study bridges this gap by integrating phenomenological analysis with a multidimensional metric approach to link non-visual sensory experiences with quantitative evaluations of urban inclusivity that are relevant to inclusive urban planning and policy.

3.0 METHODOLOGY

This study employs a mixed-methods approach, combining a qualitative phenomenological method with a quantitative RAPFISH analysis. The mixed-methods design was chosen because it enables an exploration of subjective meanings and in-depth perceptions that can subsequently be reduced into numerical or statistical representations. The integration of phenomenology and RAPFISH in this research represents an important contribution in bridging qualitative and quantitative understandings of what constitutes a truly inclusive city. Although RAPFISH (Rapid Assessment Techniques for Fisheries) was originally developed for marine studies by the Fisheries Center at the University of British Columbia, Canada (Kavanagh & Pitcher, 2004), it has since been successfully adapted to assess social and spatial dimensions within the context of urban planning (Suriandjo et al., 2023). In this study, the RAPFISH analysis is conceptually adapted by refining the selection of dimensions and attributes to better represent the spatial experiences and accessibility needs of people with visual impairments. This modification does not alter the mathematical procedures of MDS, but reorients the RAPFISH framework to evaluate urban inclusivity from a non-visual user accessibility, safety, comfort, information, and social acceptance, as the key aspects that support independent mobility and active participation in urban space for individuals with visual impairments.

Phenomenology, as a methodological approach, allows researchers to access the subjective meanings and lived experiences of persons with disabilities in their interactbATU DANaWANions with space. This study follows such an approach, which has been widely applied in disability contexts and is regarded as crucial for generating experience-based policy (Açıkgöz & Özil, 2024; Šakaja, 2020). Phenomenology is employed here to reveal how blind individuals construct an understanding of the "face of the city" through non-visual sensory experiences such as sound, surface texture, smell, temperature, and social interaction in public spaces. Accordingly, the focus of this study is on the "felt city" rather than solely the physically visible city (Basyazici & Alpturer, 2013).

3.1 Area of Study

This study was conducted in the city of Manado, with sample locations selected from areas that represent the daily activities of individuals with visual impairments, as illustrated in Figure 1.

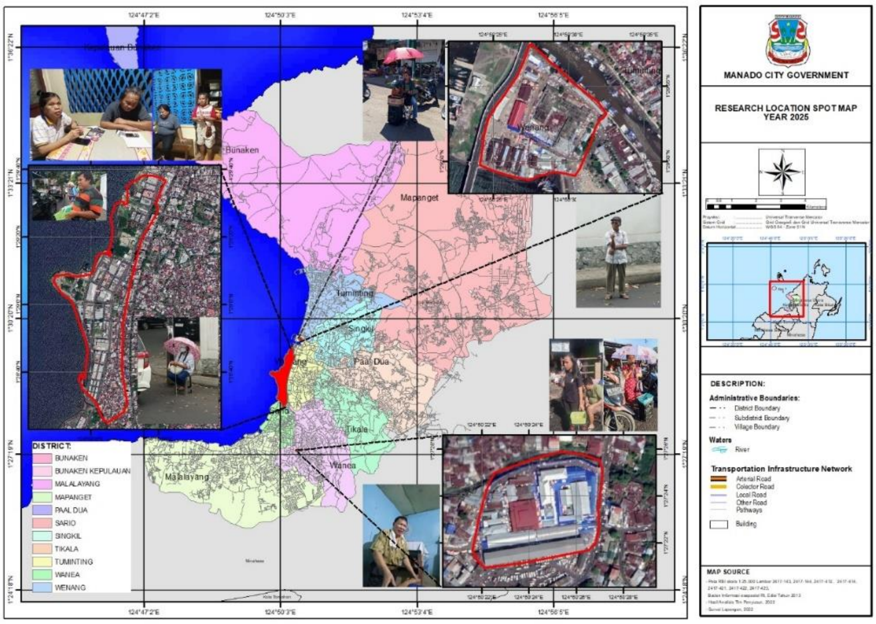

Figure 1. Area of Study (Source: Map Data Processing by the Authors, 2025)

3.2 Data Collection

3.2.1 Participant Observation

To gain a deeper understanding of the lived experiences of individuals with visual impairments in urban spaces, the researcher employed participant observation by accompanying participants in their daily routines, such as commuting from home to bus stops or university campuses. Throughout this process, the researcher carefully documented participants' physical responses to encountered barriers, observed the social reactions of people around them, and noted how participants interacted with physical elements of the city, such as tactile paving, audible traffic signals, and vehicles. This method allowed the researcher to capture spatial experiences in a direct and contextual manner.

3.2.2 In-depth Interviews

In-depth, semi-structured interviews were conducted to explore the subjective experiences of visually impaired individuals in perceiving and navigating urban spaces. The questions were designed to examine participants' perceptions of public spaces considered welcoming or unwelcoming, as well as the personal meanings they ascribe to auditory cues, textures, and urban atmospheres. The interviews also revealed the obstacles they face and the adaptive strategies they develop in their everyday activities within public spaces.

A semi-structured interview guide was developed to explore the spatial experiences and non-visual perceptions of people with visual impairments, which were then systematically interpreted and validated across researchers before being transformed into an ordinal scoring scheme of 0–2 (0 = poor, 1 = fair, 2 = good) for use as attributes in the RAPFISH analysis.

3.2.3 Research Participants

The number of participants was set at ten individuals, based on methodological literature in phenomenological research indicating that a sample of 5 to 15 participants is generally sufficient to capture key experiential patterns in focused and relatively homogeneous study contexts (J. Creswell, 2015; J. W.

Creswell & David Creswell, 2018). The ten visually impaired individuals who were purposively selected based on specific criteria: being at least 18 years old, experiencing total blindness or severe low vision, residing and actively engaging in daily activities within the city of Manado, and being willing to openly share their experiences. The participants came from diverse occupational and mobility backgrounds, including massage therapists, street vendors (such as tissue and peanut sellers), public transport users, and white cane users. This diversity provided a rich and varied representation of experiences, as identified in Table 1.

Table 1. Respondent Identification

No	Code	Age	Occupation
1	P1	62	Music Performer
2	P2	36	Tissue Vendor
3	P3	47	Massage Therapist
4	P4	53	Peanut Vendor
5	P5	32	Peanut Vendor
6	P6	50	Massage Therapist
7	P7	49	Massage Therapist
8	P8	65	Tissue Vendor
9	P9	41	Massage Therapist
10	P10	48	Music Performer

Source: Field Data

3.2.4 Research Instruments

To collect comprehensive data, this study employed several key instruments. A semi-structured interview guide was used to elicit in-depth narratives from participants, while field notes were maintained to document direct observations during participatory sessions. In addition, an audio recorder was utilized to capture verbal accounts as part of the documentation process. A camera was also employed to record the physical conditions of the urban environment relevant to the participants' experiences; however, ethical considerations were strictly observed by avoiding the direct recording of participants themselves.

3.3 Analysis Method

3.3.1 Phenomenological Analysis Method

The data in this study were analyzed using the Interpretative Phenomenological Analysis (IPA) approach, which seeks to deeply understand the subjective meanings of participants' lived experiences (Putra, 2024; Sim, 2020). The analysis began with repeated and holistic readings of the interview transcripts to grasp the overall sense of participants' accounts. Subsequently, the researcher identified initial emerging themes from the narratives and conducted thematic coding of experiential elements such as "urban noise," "confusing pathways," "market odors," or "fear of crossing the street." Following this coding stage, the meanings embedded in these experiences were interpreted, taking into account the participants' social context and sensory limitations. Finally, triangulation with data obtained from participatory observation was performed to strengthen the validity of the findings and to enrich the contextual understanding of the narratives. Phenomenological analysis is not used to determine index categories; rather, it serves as an exploratory stage to identify experiential themes and to formulate the dimensions and attributes of inclusivity.

3.3.2 Validity and Research Ethics in Phenomenology

To ensure the credibility of the data, this study employed method triangulation (interviews and observations), member checking (confirming findings with participants), and systematic documentation throughout the research process. Ethical considerations were addressed by obtaining written informed consent, ensuring the confidentiality of participants' identities, and granting participants the right to withdraw at any stage of the study.

3.3.3 Analysis Method: Multidimensional Scaling (MDS)

A rapid appraisal method was applied to assess the sustainability status of urban inclusivity using MDS. The analysis followed several stages: 1) identification of attributes across five dimensions: pedestrian infrastructure, information and technology, accessibility and mobility, social acceptance, and safety and comfort, and 2) ordination process to assess the sustainability status using the Rapid Sustainability Index, adapted in this study as the Rapid Urban Inclusivity (Rap-UI) framework. Scoring was performed on a scale of 0 (poor) to 2 (good) for each attribute. The scores were then processed using the MDS approach through the Rap-UI application, which produced an index value representing the level of urban inclusivity for persons with visual disabilities.

The analysis results are presented through MDS indices (0–100) for each dimension, radar charts Radar charts are used as a visualization tool to display the distribution of Inclusivity Index values across dimensions simultaneously on a 0–100 scale, thereby facilitating the interpretation of differences in inclusivity performance among dimensions, leverage analysis to identify the most influential attributes, and validity tables (Stress, R^2, and Monte Carlo) to ensure model reliability. Attribute influence is evaluated through leverage analysis within the RAPFISH framework, calculated based on changes in the Root Mean Square (RMS) of MDS ordination positions when an attribute is removed or modified while others remain constant, with the entire process automated using Microsoft Excel. The magnitude of RMS change reflects the system's sensitivity to each attribute, where higher RMS values indicate a stronger influence on ordination positions and the Inclusivity Index. The unit of analysis is the dimensions and attributes of urban inclusion, not individual respondents, with respondents' perceptions aggregated into scores across five main dimensions. All analyses are conducted using Rap-UI, an Excel-based adaptation of RAPFISH, conceptually and operationally tailored to the context of inclusion for people with visual impairments without altering the underlying statistical procedures.

3.3.4 Categories of Inclusivity Status

The Inclusivity Index is calculated using the MDS procedure as applied in the RAPFISH method. Attribute scores (0–2) are first transformed into a distance matrix and then processed through ordinal MDS to map the positions of each inclusivity dimension. The resulting ordination values are subsequently normalized to a 0–100 scale to produce the Inclusivity Index. As RAPFISH is non-parametric in nature, the reliability of the analysis is assessed through Stress and R^2 values rather than through closed-form mathematical formulas.

The inclusivity score in this study was adapted from the sustainability scoring framework proposed by Suriandjo (Suriandjo, 2023), and subsequently modified to fit the context of urban inclusivity for persons with visual disabilities. Based on the score range, the level of inclusivity is classified into four categories, as presented in Table 2 below.

Table 2. Inclusivity Status

Index Values	Category
0 - <25	Not Inclusive
25 ≥ Index Values <50	Less Inclusive
50 ≥ Index Values <75	Moderately Inclusive
75 ≥ Index Values ≤ 100	Inclusive

Source: Modified from Suriandjo et al. (2023)

3.3.5 Validity of MDS Analysis

The validity of the MDS analysis was tested using the Monte Carlo procedure. This approach ensures the robustness and reliability of the results by comparing the ordination stability across repeated random simulations.

3.3.6 Dimensions, Variables, and Scores

The identification of dimensions and variables related to urban inclusivity was derived from the categories and subcategories obtained through the phenomenological analysis. These dimensions were then operationalized into measurable variables and assessed using scoring criteria (0 = poor, 1 = fair, 2 = good).

The operationalization of dimensions and variables of urban inclusivity was derived from phenomenological findings and further structured into five key domains: (a) pedestrian physical environment, (b) information and technology, (c) accessibility and mobility, (d) social acceptance, and (e) safety and comfort. These dimensions are presented in Table 3.

Table 3. Dimensions and Variables

No	Dimensions		Variable
a	**Physical Pedestrian**	1	Sidewalk surfaces are flat and free of holes
		2	Guiding blocks are available and follow standardized patterns
		3	Ramps are available and non-slippery
		4	Stairways are equipped with railings and step-edge markings
		5	Pathways are free from obstacles (e.g., poles, flower pots, illegal parking)
		6	Surface differences can be detected with a white cane
		7	Tactile paving is correctly installed (alignment and position according to function)
b	**Information and Technology**	1	Audio information systems are available at intersections and along pathways
		2	Braille signage is provided at key locations
		3	Navigation systems via smartphone applications are available
		4	Directional signage (e.g., toilets, bus stops) includes auditory cues
		5	General information is available in tactile map format
		6	Location information is positioned at touch-accessible heights
		7	Public facilities provide audio notifications (e.g., elevators, train platforms)
		8	Natural sound markers are used (e.g., fountains, bells)
c	**Accessibility and Mobility**	1	Pathways from bus stops to sidewalks are accessible without gaps
		2	Key points are easily recognizable through tactile features
		3	Mobility guidance for persons with visual disabilities is available
		4	Public facilities are connected through guiding blocks
		5	Waiting areas at bus stops or public facilities are easily identifiable
		6	Transitions between surface types are detectable with a white cane
		7	Safe and convenient pedestrian crossings are available
d	**Social Acceptance**	1	Citizens respect guiding blocks (not stepping over or blocking them)
		2	Public officers are trained to assist persons with visual disabilities
		3	Volunteers or assistants are available at key points (e.g., bus stops, intersections)
		4	Public education campaigns raise awareness among non-disabled users about guiding blocks
		5	No negative stigma exists against white cane users
		6	Persons with visual disabilities participate in pedestrian planning
		7	Rights of persons with visual disabilities to access urban spaces are respected
		8	Active communities or advocacy groups support inclusion
e	**Safety and Comfort**	1	Guiding blocks are intact and continuous
		2	No disturbing odors interfere with spatial orientation
		3	Excessive noise does not mask environmental sounds
		4	Intersections are equipped with audible crossing signals
		5	Street lighting is sufficient and evenly distributed at night
		6	Supervision or assistance is available in crowded or high-risk areas
		7	No hidden hazards exist on sidewalks (e.g., open holes, concealed puddles)

Source: Field Data

4.0 RESULTS AND DISCUSSIONS

4.1 City from the Perspective of Persons with Visual Disabilities

Most participants reported significant difficulties in achieving independent mobility within the urban environment. Their navigation largely relied on memory of routes, assistance from others, and embodied experiences—such as the tactile sensation of feet against pavement surfaces or auditory cues from traffic. The absence of continuous guiding blocks, consistent tactile markings, and adequate auditory information emerged as primary obstacles to safe and independent navigation.

4.1.1 Physical Pedestrian

Two participants emphasized that the physical condition of pedestrian pathways in Manado remains inadequate for the needs of persons with visual impairments. Sidewalks are often discontinuous, uneven, and cluttered with obstructions such as poles, flower pots, or parked vehicles. One participant noted:

> *"I once bumped into a flower pot on the sidewalk—it hurt, and even damaged my cane. This is not just once or twice, but something that happens almost every day on that street."* (P2, 36 years old, tissue vendor)

Another participant highlighted the absence of essential tactile and physical support in public facilities:

> *"At the sub-district office, there are stairs without handrails. We have to hold onto the wall, and it feels unsafe—we are afraid of falling."* (P3, 47 years old, massage therapist)

This finding underscores that both vertical and horizontal circulation elements in the city remain largely designed from a visual perspective, without integrating non-visual sensory needs crucial for safe navigation by persons with visual impairments.

4.1.2 Information and Technology

Two participants emphasized the scarcity of non-visual information systems in public spaces in Manado. The absence of audio wayfinding cues, tactile maps, and Braille signage forces them to rely almost entirely on other people for orientation and decision-making. As one participant explained:

> *"When I need to find the restroom in a mall, I can only ask someone. There are no audio announcements or Braille signs to guide me."* (P4, 53 years old, peanut vendor)

This highlights a critical gap in the application of assistive information technologies. While international accessibility standards encourage multimodal communication—visual, auditory, and tactile—the local urban environment remains predominantly sight-centered. Such exclusionary design limits independent mobility and erodes the dignity of visually impaired individuals who must continually depend on social assistance for basic navigation.

Although some participants occasionally use smartphone-based navigation applications, technical barriers such as unstable internet connectivity and limited contextual information reduce their effectiveness. One participant noted:

> *"The phone application is good, but the signal often drops, and we need to know the name of the place first. At the bus stop there is no audio guidance, so we often wait at the wrong spot." (P10, 48 years old, music performer)*

These findings indicate that the potential of assistive technology has not been matched by adequate infrastructure support. The urban environment remains primarily designed for sighted users, neglecting multimodal accessibility that could enhance independence and confidence for persons with visual impairments.

4.1.3 Accessibility and Mobility

The interconnection between facilities emerged as a major challenge for the mobility of visually impaired participants. Two participants reported that the available guiding blocks were often discontinuous and poorly integrated with public facilities such as bus stops, parks, or university campuses. As one participant, who works as a tissue vendor, explained:

> *"From the bus stop to the campus, I have to make a long detour because the sidewalks are not connected. There is a guiding block, but it stops in the middle of the road."* (P8, 65 years old, tissue vendor).

In addition, unsafe physical conditions such as uncovered drainage channels further increase the risk of accidents. One participant described:

> *"We often walk by feeling along the walls, because on the way to the post office there are many open drains. Sometimes we feel scared, worried about making a wrong step."* (P6, 50 years old, massage therapist).

These findings highlight the critical need for continuous and connected pedestrian pathways to support independent mobility. The absence of safe and integrated pedestrian infrastructure not only restricts physical access but also undermines the sense of security and confidence among visually impaired users in navigating urban spaces.

4.1.4 Social Acceptance

Two participants reflected on the ambivalent social dynamics faced by visually impaired individuals in the city. While some residents expressed willingness to assist, the majority of the public appeared unfamiliar with the function of guiding blocks or the appropriate way to accompany persons with visual disabilities. As one participant shared:

> *"We walk on the sidewalk, but people put their vending tables right on top of the yellow tactile path. They said, 'Oh, those lines are just for decoration.'"* (P1, 62 years old, music performer).

Another participant recounted:

> *"There are also people who try to help, but sometimes they suddenly grab our hands without saying anything first. That makes us startled, even frightened."* (P5, 32 years old, peanut vendor).

These narratives demonstrate that the participation of visually impaired individuals in urban spaces depends not only on physical design but also on broader social acceptance and understanding. Inclusive cities therefore require cultural sensitivity and awareness-raising among the general public to complement infrastructural interventions.

4.1.5 Safety and Comfort

Safety and comfort emerged as a critical dimension highlighted by the last two participants. They noted that the absence of auditory signals at intersections, hidden holes along pedestrian pathways, and poor night-time conditions marked by darkness and noise significantly increased both the risk of accidents and sensory stress. One participant explained:

> *"I almost fell on the bridge near the market, because there was no auditory signal, and many motorcycles were passing by at high speed."* (P7, 49 years old, massage therapist).

Another added:

> *"Along Samrat Street at night it is very dark, hard to hear vehicles because of the noise, and there is also a strong smell of garbage that makes us dizzy."* (P9, 41 years old, massage therapist)

These accounts underscore the urgent need for safe and controlled sensory environments to support independent mobility and well-being for the visually impaired in urban settings.

4.2 Five-Dimensional Inclusivity Scores

Perceptual assessments of the five inclusivity dimensions were analyzed using RAP-UI. The MDS results display the scores of each dimension of inclusivity, derived through RAPFISH analysis, from the perspective of the visually impaired.

4.2.1 Physical Pedestrian Dimension

Figure 2 shows that out of eight accessibility attributes, three have the greatest impact on urban inclusivity for the visually impaired. The most influential is “Stairs with railings and edge markings” (score 8.41), followed by “Obstacle-free pathways” (6.88), and “Flat, hole-free pedestrian surfaces” (3.36). These strongly affect safety, comfort, and navigation.

Other attributes have lower influence, such as “Proper tactile paving” (2.81), “Standard guiding blocks” (1.59), “Slip-resistant ramps” (1.37), and “Detectable surface differences” (1.00). Overall, vertical navigation, obstacle-free paths, and surface quality should be top priorities in inclusive urban design.

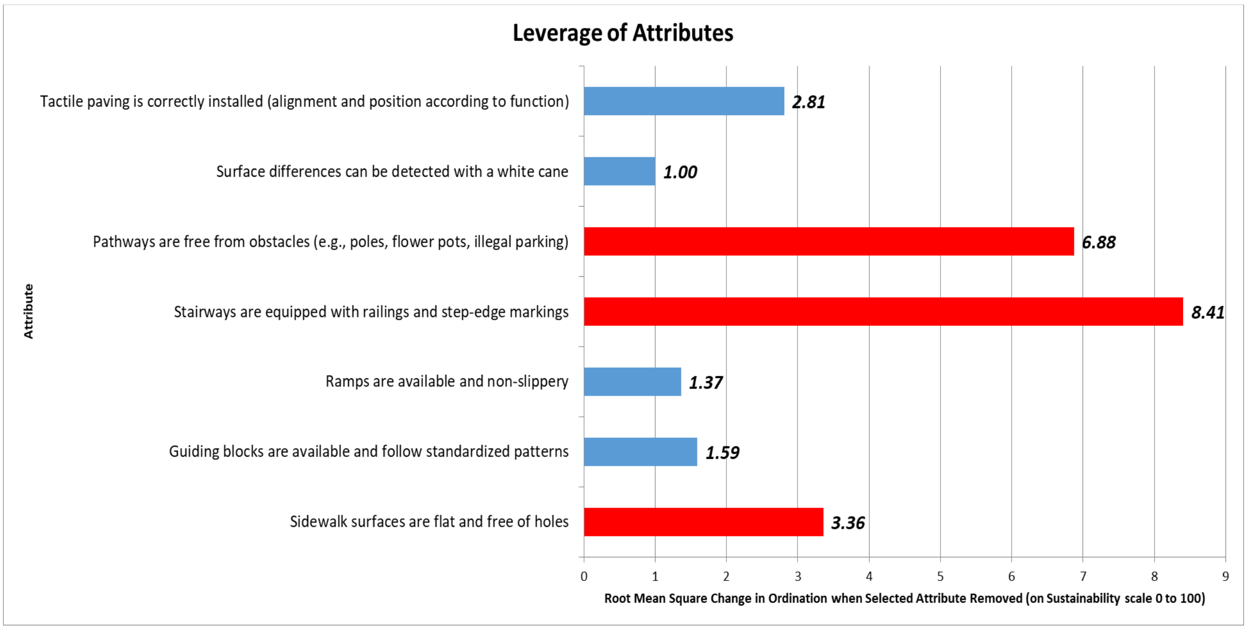

Figure 2. Physical Pedestrian

4.2.2 Information and Technology Dimension

The analysis in Figure 3 identifies the “Availability of location information at a touchable height” (7.17) as the most influential factor in ensuring information inclusivity for visually impaired individuals, emphasizing the necessity of accessible physical orientation cues. The second-highest factor, “Navigation systems based on mobile applications/smartphones” (5.89), reflects the growing reliance on digital technologies in supporting independent mobility. Other significant attributes include “Audible directional signage” (4.67) and “Tactile maps” (4.66), both of which reinforce the importance of auditory and tactile modalities in spatial understanding. “Natural auditory cues” (4.28) also provide intuitive, environment-based orientation, while “Braille information” (3.64) and “Audio information at intersections” (3.05) play a secondary role. The least influential attribute is “Audible notifications in public facilities” (1.87). Overall, the findings suggest that tactile and auditory systems, whether physical or digital, should be prioritized in designing inclusive urban infrastructure.

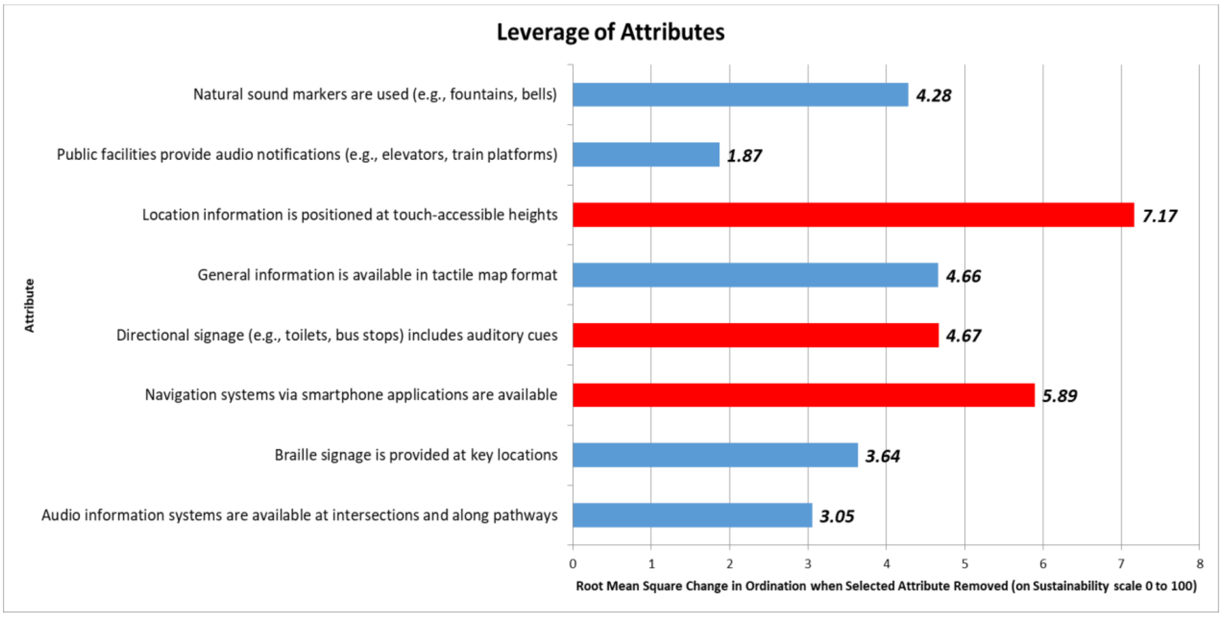

Figure 3. Information and Technology

4.2.3 Accessibility and Mobility Dimension

The analysis in Figure 4 shows that the most influential attribute for sustainable public transport accessibility among visually impaired individuals is the "Availability of mobility guidance for the blind" (4.14), emphasizing the importance of structured guidance in supporting orientation and independence. The next significant attributes are "Recognizable waiting areas at bus stops or public facilities" (1.61), and "Connectivity of public facilities with guiding blocks" (1.28), reflecting the role of spatial clarity and connected access points in shaping inclusivity. Additional factors, such as "Tactile recognition of key points" (1.12) and "Blind-friendly pathways from bus stops to sidewalks" (0.91), stress the need for continuous, safe pedestrian links. The least influential attributes are "Perceptible transitions for white cane detection" (0.40) and "Safe and comfortable pedestrian crossing facilities" (0.21). Overall, these results highlight that mobility guidance and spatial recognition mechanisms should be prioritized in designing inclusive public transportation systems.

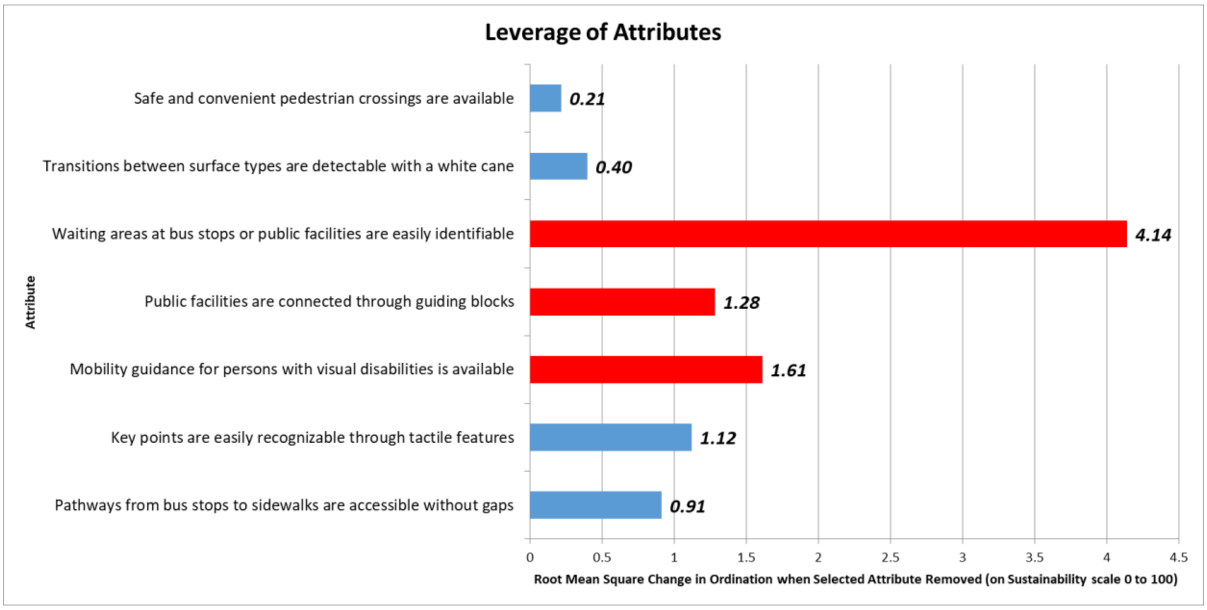

Figure 4. Accessibility and Mobility

4.2.4 Social Acceptance Dimension

The analysis in Figure 5 identifies "Participation of visually impaired individuals in pedestrian planning" (6.87) as the most influential social factor in sustaining urban inclusivity, underscoring the importance of involving disabled groups directly in design processes. The second strongest attribute is "Absence of negative stigma towards white cane users" (6.32), reflecting that social acceptance is critical for fostering inclusive environments. Other notable attributes include "Availability of volunteers or assistants at key points" (5.35) and "Trained public facility staff" (5.02), both highlighting the role of direct human support. Additionally, "Awareness campaigns for non-disabled users" (4.98) and "Community sensitivity to guiding blocks" (4.69) stress the significance of public education in maintaining accessibility. Lower-ranked factors, such as "Active advocacy groups" (3.94) and "Respect for access rights" (2.03), remain relevant but less influential. Overall, the findings show that inclusive cities require not only infrastructure but also social acceptance, awareness, and community-based support systems.

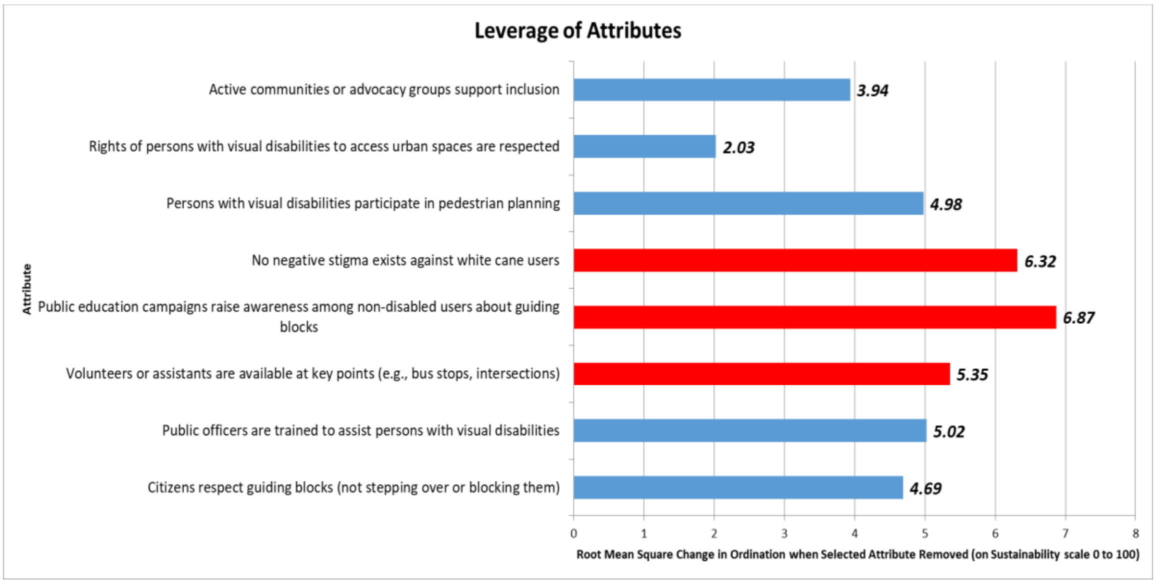

Figure 5. Social Acceptance

4.2.5 Safety and Comfort Dimension

The analysis in Figure 6 indicates that "Intersections equipped with audible crossing signals" (5.90) is the most influential attribute in sustaining inclusivity related to safety and comfort for the visually impaired, underscoring the importance of auditory navigation aids at high-risk points. The second key factor, "Absence of sidewalk hazards" (4.15), highlights the role of physical safety in ensuring secure and comfortable mobility. Other attributes, such as "Supervision or assistance in crowded areas" (3.11), "Absence of disruptive odors" (2.92), and "Adequate nighttime lighting" (2.57), demonstrate how environmental quality and human support systems enhance inclusivity. In contrast, "Guiding blocks that are intact and continuous" (1.88) and "Absence of excessive noise" (0.11) were ranked lower, suggesting a comparatively minor influence on perceived safety. Overall, these findings stress the need to prioritize audible signals and hazard-free sidewalks in urban planning to strengthen both safety and comfort for visually impaired individuals.

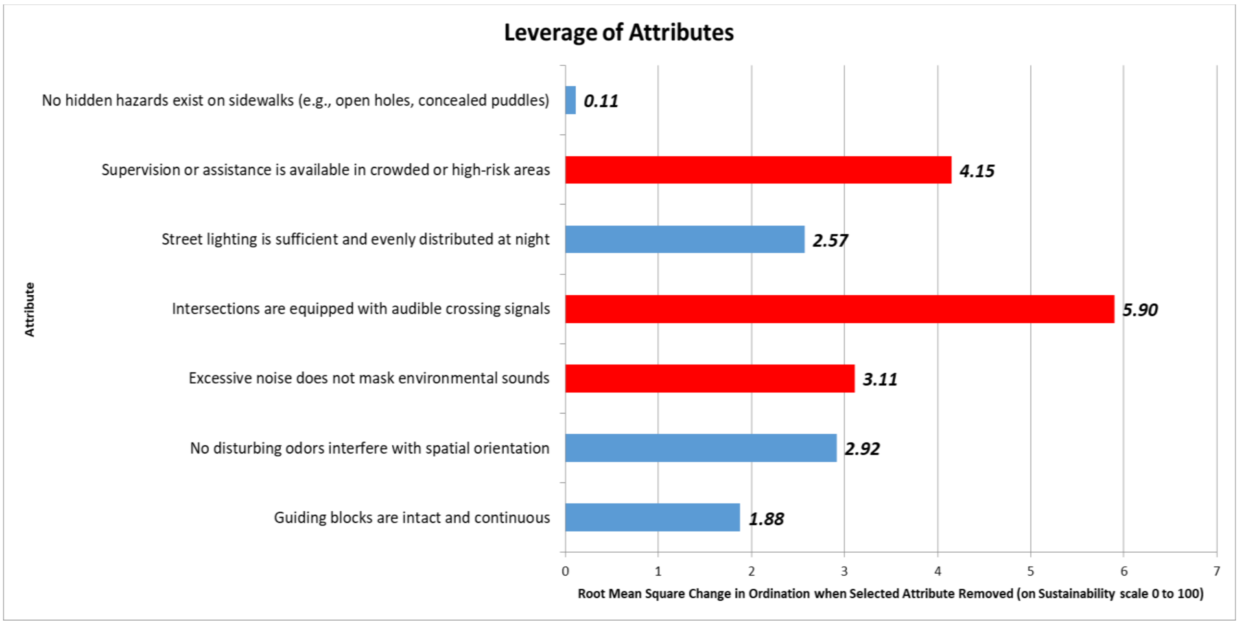

Figure 6. Safety and Comfort

4.3 Inclusivity Status of the Visually Impaired

The RAPFISH analysis presented in Table 4 and Figure 7 identified five dimensions of urban inclusivity: (1) Physical Pedestrian, (2) Information and Technology, (3) Accessibility and Mobility, (4) Social Acceptance, and (5) Safety and Comfort. The summary in Table 3 indicates that the overall level of inclusivity for visually impaired individuals remains less inclusive, with an average score of 39.93. Among the five dimensions, Accessibility and Mobility achieved the highest score of 54.23, followed by Physical Pedestrian at 50.94; both fall within the Fairly Inclusive category, suggesting that basic infrastructure partially supports independent movement for visually impaired users.

Conversely, significant gaps were identified in other dimensions. Information and Technology scored only 23.86 (Not Inclusive), reflecting limited access to tactile cues, auditory signals, and digital navigation systems. Additionally, Social Acceptance (30.78) and Safety and Comfort (39.84) fall under the Less Inclusive category, indicating insufficient social support, public awareness, and environmental protection in urban spaces. These findings highlight the urgent need for improvements, particularly in information accessibility, social engagement, and sensory-friendly environments, to achieve truly inclusive and safe cities for visually impaired individuals.

Table 4. Status of Urban Inclusivity for The Visually Impaired

Dimension	Score	Inclusivity Status
Physical Pedestrian	50.94	Moderately Inclusive
Information and Technology	23.86	Not Inclusive
Accessibility and Mobility	54.23	Moderately Inclusive
Social Acceptance	30.78	Less Inclusive
Safety and Comfort	39.84	Less Inclusive
Average	**39.93**	**Less Inclusive**

Source: Analysis Results, 2025

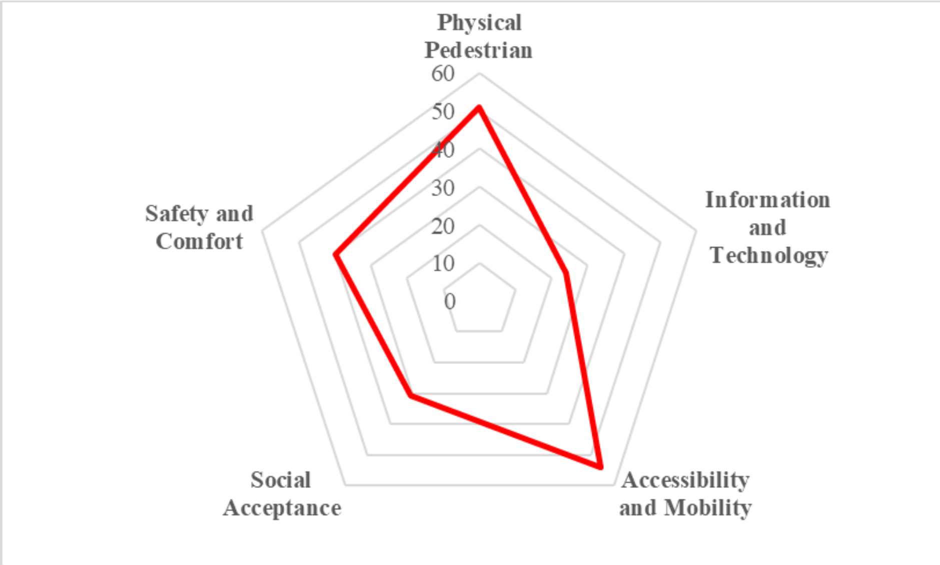

Figure 7. Status of Urban Inclusivity for The Visually Impaired

Based on the radar chart visualization, it is evident that the sustainability of urban accessibility for visually impaired individuals varies across dimensions, displaying a notable pattern of disparity. The Physical Pedestrian dimension (50.94) and Accessibility and Mobility (54.23) fall within the fairly sustainable range, forming the widest axes on the chart, reflecting the presence of basic infrastructure efforts such as guiding blocks, pedestrian pathways, and connectivity of public areas.

In contrast, the Information and Technology dimension scores only 23.86, representing the shortest axis on the radar chart, highlighting critical weaknesses in the provision of tactile cues, auditory signals, digital navigation systems, and accessibility of assistive technologies. Meanwhile, Social Acceptance (30.78) and Safety and Comfort (39.84) remain below optimal thresholds, indicating insufficient public awareness, limited support from personnel, and physical environmental conditions that are not yet fully accommodating.

The asymmetrical shape of the radar chart illustrates that, although physical infrastructure is gradually developing, the city is not yet fully inclusive socially, sensorily, or digitally. This underscores the need for cross-dimensional strategies to create truly inclusive urban spaces for visually impaired users.

4.3.1 Validation

The validity of the MDS analysis was assessed using the Monte Carlo method. Detailed calculations of the inclusivity index and its validation are presented in Table 5 below.

Tabel 5. Validation of The Inclusivity Index

Dimension	Score	Montecarlo	Delta	RSq	Stress
Physical Pedestrian	50.94	50.68	0.26	0.95	0.14
Information and Technology	23.86	26.16	2.30	0.95	0.13
Accessibility and Mobility	54.23	53.48	0.75	0.94	0.16
Social Acceptance	30.78	32.101	1.32	0.95	0.13
Safety and Comfort	39.84	40.501	0.66	0.95	0.15

Source: Analysis Results, 2025

The quantitative evaluation of the five inclusivity dimensions in Table 5 shows strong consistency between actual scores and Monte Carlo simulations, confirming the reliability of the model. The Physical Pedestrian dimension records the smallest delta (0.26) between actual (50.94) and simulated (50.68) values, reflecting high stability (R^2 = 0.95, Stress = 0.14). Similarly, Accessibility and Mobility shows close agreement (Delta =

0.75; R^2 = 0.94), indicating reliable predictive accuracy. In contrast, the Information and Technology dimension demonstrates the largest deviation (Delta = 2.30), suggesting higher variability, though still supported by robust statistics (R^2 = 0.95, Stress = 0.13). Social Acceptance (Delta = 1.32) and Safety and Comfort (Delta = 0.66) also exhibit good alignment. Overall, high R^2 values (0.94–0.95) and low Stress (<0.2) confirm that the sustainability mapping model is accurate and defensible.

Dimensions that demonstrate good Monte Carlo performance are characterized by small differences between the MDS index values and Monte Carlo results, consistently low Stress values, and stable R^2 values. Based on these criteria, the dimensions of **mobility and accessibility**, **pedestrian physical conditions**, and **safety and comfort** are the most stable and reliable in this analysis. (see Table 5). However, improvement efforts should prioritize the Information and Technology dimension due to its lower performance and higher variability.

4.3.2 Leveraging Factors for Netra Disability Inclusivity

The Rap-UI analysis of the five inclusivity dimensions (Table 6) highlights three dominant variables in each dimension, showing that perceived inclusivity for visually impaired users is shaped by specific key factors. In the Physical Pedestrian dimension, critical attributes include staircases with railings and markings, unobstructed circulation paths, and safe pedestrian surfaces, reflecting the need for structural safety and smooth mobility. The Information and Technology dimension is driven by accessible location information, digital navigation systems, and audible directional indicators, underscoring multimodal information access. For Accessibility and Mobility, mobility guidance, recognizable waiting areas, and guiding block connectivity are central to independent navigation. Social Acceptance depends on the participation of visually impaired individuals in planning, the removal of stigma, and the availability of volunteers, stressing social support. Lastly, Safety and Comfort relies on audible crossing signals, absence of hazards, and supervision in high-risk areas. Overall, inclusive cities demand integrated interventions across infrastructure, information, social engagement, and safety.

Table 6. Leveraging Factors for Netra Disability Inclusivity

Dimensions	Leverage Attributes
Physical Pedestrian	• Stairways are equipped with railings and step-edge markings • Pathways are free from obstacles (e.g., poles, flower pots, illegal parking) • Sidewalk surfaces are flat and free of holes
Information and Technology	• Location information is positioned at touch-accessible heights • Navigation systems via smartphone applications are available • Public facilities provide audio notifications (e.g., elevators, train platforms)
Accessibility and Mobility	• Mobility guidance for persons with visual disabilities is available • Waiting areas at bus stops or public facilities are easily identifiable • Public facilities are connected through guiding blocks
Social Acceptance	• Persons with visual disabilities participate in pedestrian planning • No negative stigma exists against white cane users • Volunteers or assistants are available at key points (e.g., bus stops, intersections)
Safety and Comfort	• Intersections are equipped with audible crossing signals • No hidden hazards exist on sidewalks (e.g., open holes, concealed puddles) • Supervision or assistance is available in crowded or high-risk areas

Source: Analysis Results, 2025

5.0 DISCUSSIONS

This finding reinforces previous studies indicating that the physical conditions of pedestrian infrastructure in major Indonesian cities remain insufficiently adaptive to the needs of persons with visual impairments. Direct statements from participants regarding sidewalk holes, poles placed in the middle of pathways, and the absence of railings affirm the reports of (2021) and Nugroho et al. (2017), in which pathway discontinuities demonstrate that the design is still predominantly visual, without considering the consistency of tactile access that is essential for white cane users.

Participants' acknowledgment that they were unable to access directional information, auditory cues, and maps in public spaces indicates that the city of Manado has not yet developed an adequate non-visual navigation system. This aligns with the findings of El-Taher et al. (2021) and Zhang et al. (2022), which highlight the absence of multisensory information systems in Southeast Asian cities. Moreover, the fact that participants did not utilize navigation technologies further underscores the digital divide and the lack of supporting local infrastructure.

Field findings from two participants are consistent with the studies of Susanto and Sudiro (2018) and Sativa and Bactiar (2020), which reported that inter-facility accessibility remains very low and does not support independent mobility. Disconnected guiding blocks, gaps between sidewalks and bus stops, and the scarcity of tactile markers illustrate that the mere presence of infrastructure does not guarantee its functionality. This finding also reinforces the phenomenological perspective that orientation relies on bodily experience rather than solely on the physical presence of accessibility elements.

Statements regarding the community's lack of concern for guiding blocks, as well as the limited scope of public education, support Maftuhin (2017) argument on the importance of cultural aspects and social acceptance in building inclusive cities. This finding challenges the assumption that constructing inclusive infrastructure alone is sufficient to solve the problem since without social awareness, guiding blocks continue to be stepped over or even damaged. The presence of volunteers or officers is also uneven, and not all citizens are informed about how to provide assistance.

Direct experiences concerning open drainage channels, the absence of auditory signals, and the presence of unpleasant odors reveal that urban spaces still pose high risks for persons with visual impairments. This supports the findings of Kan-Kilic and Dogan (2017) and Tota (2022), which emphasize that sensory orientation is strongly influenced by environmental qualities such as lighting, sound, and smell. Even the presence of guiding blocks does not guarantee safety unless integrated with comprehensive safety systems. These findings indicate that comfort for visually impaired persons cannot rely solely on visual elements.

6.0 CONCLUSIONS

The phenomenological findings indicate that mobility guidance for people with visual impairments relies on non-visual features such as continuous tactile guiding paths, crack-free surface textures detectable with a white cane, stair handrails with edge markings, audible signals at intersections, and waiting areas that are easily recognizable when marked by tactile paving connected to guiding paths, changes in floor texture, and locations that are consistent and free of obstacles. This study also reveals that the experiences of persons with visual impairments in urban spaces are shaped by a complex interaction of physical, sensory, and social factors. Through a phenomenological approach, it was found that the city is perceived as inconsistent, confusing, and largely exclusive to non-visual navigation needs. Barriers such as discontinuous guiding blocks, the absence of auditory information systems, and ambiguous social responses emerged as significant sources of discomfort.

Quantitative analysis using the MDS-RAPFISH method reinforces these qualitative findings, showing that the city's inclusivity level toward persons with visual impairments only reached a score of 39.93, which falls into the "less inclusive" category. The dimensions of information and technology scored the lowest (23.86, non-inclusive), social acceptance was also categorized as less inclusive (30.78), and safety and comfort were similarly low (39.84). Meanwhile, accessibility and mobility (54.23) and physical pedestrian conditions (50.94) indicated moderate inclusivity, suggesting potential areas of support that could be strengthened. These results emphasize the urgency of mainstreaming inclusivity in spatial planning and urban design, positioning persons with disabilities as central subjects rather than mere recipients of facilities.

This study also acknowledges several limitations. First, the limited number of participants (ten persons with visual impairments) and the inherently subjective nature of the phenomenological approach mean that the findings cannot be widely generalized. Second, the RAPFISH scoring used as a complementary analysis relied primarily on individual perceptions without technical verification against accessibility standards, thus serving only as an initial diagnostic tool. Third, the study's focus solely on user experiences did not incorporate perspectives from urban planners or policymakers, who play a crucial role in shaping urban environments. Fourth, a limitation of this study is that it does not include specific design features related to mobility guidance for the visually impaired.

These limitations provide opportunities for future research, such as conducting comparative studies across multiple cities, integrating technical infrastructure audits with user perceptions, exploring institutional actors' perspectives on inclusive city implementation, and to further develop studies on models of specific design features related to mobility guidance for people with visual impairments. Furthermore, sensory ethnography could be advanced to investigate non-visual sensory experiences in greater depth, while interdisciplinary research may also be directed toward the development of assistive technologies and urban navigation systems that are more responsive to the needs of persons with visual impairments.

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