

RESEARCH ARTICLE

Pathways of Identity: Sustainable Campus Signage with Digital Integration

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Abstract

The growing need for dependable navigation across the National Institute of Science and Technology (ISTN) emerges as the campus environment becomes more complex. As a higher-education institution in Jakarta, the National Institute of Science and Technology continues to expand its academic and spatial functions, prompting demand for a cohesive wayfinding system that supports daily mobility and reinforces institutional branding. This study adopts a qualitative descriptive approach, grounded in site observation, movement pattern analysis, and the identification of recurring disorientation points, to examine existing navigational conditions across the campus. Based on these findings, a structured and user-focused signage framework is developed to enhance circulation clarity and visual coherence. Readability, consistency, and legibility form the basis of the design strategy, while institutional identity is expressed through controlled formal language, legible typography, and differentiated color cues that assist users in recognizing faculties, departments, and key facilities. Beyond physical signage, the system integrates QR codes to extend navigational and institutional information without disrupting the existing spatial structure. Through this integrated approach, the proposed wayfinding system improves campus legibility while subtly reflecting institutional values embodied in the institution's motto *Wedha Wiyata Wira Sakti*, resulting in a coherent, inclusive, and forward-looking campus environment that balances identity, technology, and sustainability.

Keywords: campus navigation, digital readiness, institutional identity, sustainable design, wayfinding system

INTRODUCTION

A campus, as a higher-education environment, represents a spatial system with a high degree of functional complexity, accommodating academic activities, administrative operations, and supporting facilities within a single setting. This complexity necessitates an effective environmental information system capable of supporting user orientation and navigation. Insufficient spatial information within a campus environment may lead to disorientation, increased travel time, and reduced movement efficiency, particularly for new students and visitors. Previous reviews on wayfinding systems in complex environments indicate that disorientation frequently occurs at intersections and transitional spaces where information hierarchy and directional cues are unclear [1].

Users' ability to understand and navigate an environment is strongly influenced by the clarity of the spatial information provided. Wayfinding studies indicate that logically structured and informative navigation systems play a critical role in assisting users' decision-making processes while moving through complex environments [2]. Accordingly, signage and wayfinding function as key elements in enhancing spatial legibility and shaping a more directed and comprehensible spatial experience. Recent studies further emphasize that wayfinding is not merely a physical navigation task but a cognitive process shaped by perception, memory, and the clarity of environmental information, highlighting the importance of inclusive wayfinding design in complex environments [3].

As an institution focused on science and technology education, the National Institute of Science and Technology (ISTN) occupies a campus environment characterized by a relatively dispersed distribution of academic and supporting functions. Movement patterns within the ISTN campus are dynamic and situational, with intensified activity during academic periods and institutional events. These conditions demand a signage

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and wayfinding system capable of presenting the campus spatial structure in a clear, consistent, and easily understandable manner for diverse user groups.

Recent research developments suggest that signage and wayfinding systems should no longer be understood solely as directional tools, but as integral components of user experience and environmental communication. A systematic mapping study on accessible wayfinding emphasizes that navigational effectiveness is closely related to information clarity, visual consistency, and the system's capacity to support user orientation within complex spatial settings [4]. This perspective underscores the importance of user-centered and context-responsive approaches in wayfinding design.

Inclusivity has become an essential consideration in the development of campus signage systems. Empirical research on the implementation of Braille signage in higher-education environments demonstrates that the integration of tactile elements enhances orientation clarity and independent mobility for users with visual impairments, while simultaneously expanding overall access to environmental information [5]. These findings indicate that campus wayfinding systems should address not only the needs of the majority, but also principles of equitable access within educational environments. Studies on inclusive campus planning further argue that accessibility and clarity of environmental information are fundamental components of equitable higher-education environments, particularly in large and functionally dispersed campuses [6].

Beyond navigation and accessibility, campus signage functions as a medium of environmental visual communication that represents institutional identity. Signage systems designed with consistency, clarity, and recognizability contribute to spatial legibility while reinforcing a professional and structured campus image [7]. When integrated with institutional visual identity, signage further enhances users' overall experience of the built environment [8].

Current campus wayfinding research primarily emphasizes functional navigation performance, accessibility features, or visual consistency in isolation. The integration of wayfinding with institutional identity and inclusive information delivery remains insufficiently addressed, especially within a coherent campus-wide framework [9]. In addition, digital approaches to campus wayfinding are often discussed as standalone navigation tools, rather than as integrated extensions of physical signage. As a result, the use of simple QR-based integration to connect physical wayfinding elements with inclusive information access and institutional identity remains limited in existing studies.

In response to developments in information technology, digital integration has emerged as a relevant complement to physical signage systems. Rather than relying on complex technologies, this integration may be effectively implemented through simple tools such as QR codes, providing access to digital navigation maps, campus history, and explanations of institutional philosophy and symbolism, allowing information to be updated flexibly without altering the physical signage structure [10]. This approach allows for flexible and updatable information delivery without requiring permanent physical modifications to signage elements.

Based on these considerations, this study aims to formulate an integrated, inclusive, and adaptive signage and wayfinding system for the ISTN campus by combining physical signage, accessibility features such as Braille, and QR-code-based digital integration. The proposed design is expected to support user orientation, strengthen institutional identity, and enhance the overall quality of mobility experience within the ISTN campus environment.

MATERIAL AND METHOD

This study was conducted within the campus of the National Institute of Science and Technology (ISTN) in Jakarta, Indonesia. The research focuses on evaluating movement patterns and wayfinding performance across key circulation zones and decision-making nodes within the campus environment.

Observation points were selected to represent the campus circulation structure rather than predefined problem areas. These points included primary pedestrian routes, vehicular-pedestrian intersections, building entrances, and major nodes connecting academic and support facilities [11]. The selection was based on circulation hierarchy and movement intensity, as identified through campus maps and an initial site walkthrough, ensuring that observations covered areas where navigational decisions commonly occur.

User movement was then observed across these selected circulation zones without predefining areas of navigational difficulty. Through repeated observation, certain locations consistently exhibited pauses, hesitation, or route correction, indicating challenges in spatial orientation.

A qualitative descriptive approach was employed to examine the relationship between spatial configuration, visual information systems, and user navigation behavior. This approach was selected because wayfinding is not limited to the physical placement of signage, but involves users' cognitive processes in

interpreting spatial cues and making navigational decisions. This perspective aligns with Passini’s view that wayfinding is a cognitive activity shaped by spatial structure and the clarity of environmental information.

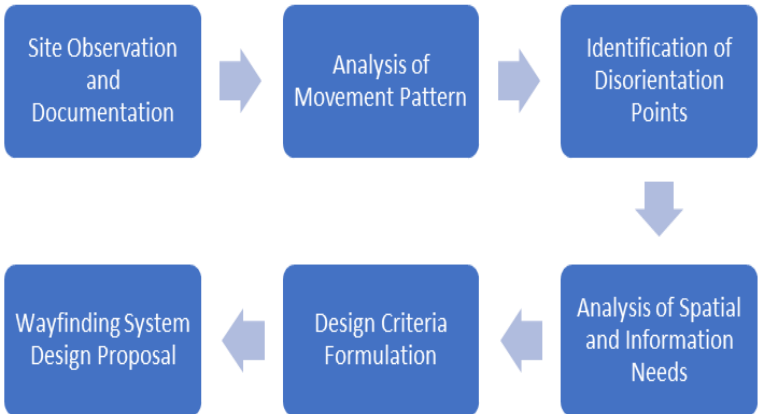


Figure 1. Research Method and Design Translation Flow

Data Collection

Data collection was conducted through three primary methods: field observation, documentation study, and literature review. Table 1 reveals a fragmented signage condition, characterized by inconsistent information hierarchy, varied typographic treatments, and uneven placement across campus zones. These inconsistencies contribute to reduced navigational clarity and informed the need for a standardized signage system with clearer hierarchy and visual coherence

Table 1. Existing Signage and Wayfinding in ISTN

No.	Category	Picture		
1	Signage			
2	Wayfinding			
3	Departments Name Sign			
4	Faculty Name Sign			

Field observations were carried out to record spatial conditions related to circulation patterns, intersections, decision-making nodes, and existing signage elements. Observations focused on identifying the overall readability of the campus environment and the presence of conditions that may challenge user orientation. Both pedestrian and vehicular movements were documented to understand how different circulation systems interact within shared campus spaces.

Movement analysis was conducted by mapping pedestrian and vehicular flows during typical campus activity periods. User movement paths were traced manually through repeated observations, focusing on entry points, route choices, pauses, and changes in direction. Particular attention was given to moments of hesitation, backtracking, or clustering, which measure potential disorientation and navigational uncertainty [12].

A documentation study was conducted to collect supporting materials, including campus maps, building layouts, photographs of existing signage conditions, and documents related to the campus visual identity system. These materials were used to understand the current information structure and to provide a baseline for developing a cohesive and integrated signage strategy.

In addition, a literature study was undertaken through a review of academic books and peer-reviewed journals addressing wayfinding theory, environmental signage, visual identity systems, accessibility, and digital information integration. This review provided a theoretical foundation for interpreting field observations and informed the design criteria applied in the development of the proposed wayfinding system.



Figure 2. Illustration of User Movement Analysis

The movement analysis illustrates recurring hesitation and route correction at circulation intersections and transitional spaces. These patterns indicate critical decision-making nodes that require enhanced wayfinding support, informing the placement of primary directional signage and orientation maps.

Data Analysis and Design Synthesis

The collected data were analyzed using a spatial logic approach that examines the relationship between spatial layout, circulation structure, and observed user movement behavior, with emphasis on how spatial configuration influences navigational decision-making. This analysis focused on circulation transitions, intersections, and decision-making nodes where users are required to interpret environmental information and select routes within the campus circulation system.

Movement observations were examined qualitatively by identifying recurring behavioral patterns rather than isolated incidents. Moments of hesitation, directional correction, and user clustering were observed across multiple circulation nodes, particularly in areas lacking orientation maps, consistent directional cues,

or clear information hierarchy. These recurring behaviors were interpreted as indicators of reduced spatial legibility and insufficient environmental information at critical decision points, often associated with destination ambiguity, dispersed building arrangements, and inconsistent placement of existing signage. These interpretations established a direct basis for determining the type, placement, and informational depth of wayfinding elements required at each identified location.

Based on this interpretation, spatial locations exhibiting higher concentrations of navigational decision-making and repeated user hesitation were identified as priority areas for wayfinding intervention. These priority locations were determined through comparative observation across the campus circulation network, focusing on relative frequency and consistency of observed navigational difficulty rather than numerical measurement, which aligns with the qualitative and interpretive nature of wayfinding design research.

The transition from analysis to design synthesis was conducted by translating identified spatial conditions into corresponding wayfinding strategies. Nodes characterized by complex route convergence informed the placement of primary orientation maps and directory signage, while linear circulation paths with observed uncertainty informed the use of sequential directional and confirmation signage to support continuous navigation.

Design synthesis was then undertaken by integrating the spatial analysis with established signage design principles. This process informed the formulation of key design parameters, including information hierarchy, typographic scale, color differentiation, symbolic representation, and the integration of tactile and digital elements. Each design parameter was derived from specific spatial configurations and recurring behavioral observations documented during the field study, ensuring that the proposed wayfinding system responds directly to empirically observed navigational challenges within the ISTN campus environment.

RESULT AND DISCUSSION

Movement Patterns and Spatial Wayfinding Response

Movement patterns across the National Institute of Science and Technology (ISTN) campus remain relatively consistent throughout the week, supporting both routine academic activities and institutional events. This continuous use intensifies the importance of spatial clarity at key decision-making points, particularly nodes that are frequently accessed by first-time users.

Several primary disorientation points were identified at intersections where circulation paths converge and destination choices increase. One critical node is located near the auditorium, which regularly accommodates graduation ceremonies and large-scale institutional events. During such occasions, the area receives a high volume of first-time visitors who are unfamiliar with the campus layout. The absence of an orientation map or directory signage at this node results in hesitation, circulation overlap, and informal wayfinding behavior. This condition indicates the need for primary orientation signage that provides an immediate overview of campus structure upon arrival [13].

Another significant disorientation point occurs at the intersection adjacent to the Faculty of Pharmacy. This node functions as a transitional junction connecting academic facilities with the campus mosque, a shared destination frequently sought by visitors and campus users. Limited directional information toward this facility causes repeated directional adjustments, highlighting the necessity for clear destination-based directional signage at this junction [14].

Disorientation is also observed along movement paths near the Faculty of Applied Science and Technology, where departmental buildings are spatially dispersed rather than centralized. Users navigating between departments encounter uncertainty due to insufficient sequential guidance along internal paths. This condition demonstrates the need for layered wayfinding support, combining directional, identification, and confirmation signage to facilitate continuous navigation [15].

Overall, disorientation within the ISTN campus primarily occurs at nodes where circulation intersects and spatial decisions must be made. These findings inform the spatial wayfinding response, which prioritizes strategic node placement, orientation maps at major arrival points, and consistent directional cues to improve spatial legibility, reduce navigational uncertainty, and support user confidence. Figure 3 highlights recurring disorientation at key nodes where multiple circulation routes intersect and visual cues are limited or competing. These locations were identified as critical decision points requiring clearer directional information and improved wayfinding hierarchy



Figure 3. Illustration of Common Disorientation at the nodes or intersection

The observed patterns of hesitation, route correction, and clustering at circulation nodes indicate that wayfinding within the ISTN campus is strongly influenced by users' need to interpret environmental information at moments of spatial decision-making. This condition reflects Passini's view of wayfinding as a cognitive process in which users rely on spatial cues to understand layout, evaluate route options, and confirm movement choices. When such information is unclear or absent, uncertainty increases and navigation becomes inefficient.

The proposed wayfinding responses were therefore developed to support this cognitive process rather than to function solely as physical markers. Orientation maps are positioned at major arrival points to provide an overall spatial framework, while directional and confirmation signage along circulation paths supports continuous understanding of movement. Through this approach, the wayfinding system operates as an environmental information structure that responds directly to observed navigational behavior and the decision-making demands encountered within the campus circulation system.

Wayfinding Design System and Spatial Expression

The wayfinding system is conceived as an integrated spatial framework that translates institutional identity into spatial clarity [16]. Rather than functioning solely as a navigational tool, the system operates as a medium through which the National Institute of Science and Technology (ISTN) communicates order, accessibility, and identity within the campus environment.

The signage form originates from a geometric abstraction of the ISTN pentagonal shield, transformed into a three-dimensional vertical pylon. Layered surfaces reinterpret the linear flow motifs of the institutional logo, producing depth and directional emphasis while maintaining formal restraint. This transformation converts a static emblem into a spatial landmark that supports orientation from multiple approach points.

Typographic consistency is achieved through the exclusive use of Arial, the typeface embedded within ISTN's official logo. Its neutral character and high legibility reinforce clarity and coherence across the signage system, ensuring that information is read efficiently in both high-traffic and transitional spaces. Visual hierarchy is established through proportion, spacing, and alignment rather than decorative variation.

The conceptual foundation of the system is aligned with ISTN's institutional motto, *Wedha Wiyata Wira Sakti*. *Wedha* (wisdom) and *Wiyata* (education and discipline) are expressed through structured information hierarchy, typographic precision, and the integration of digital navigation tools. *Wira* (heroic character) and *Sakti* (strength and capability) are articulated through the signage's vertical stance, shield-derived geometry, and assertive spatial presence. In this way, the wayfinding system functions as a spatial manifestation of institutional values rather than a purely functional object. This approach is consistent with recent studies on

sustainable campus signage, which emphasize the integration of institutional identity and cultural symbolism as part of long-term environmental communication strategies [17].

Inclusivity is embedded within this conceptual framework through the integration of tactile orientation maps and Braille information as part of the primary signage elements. Spatial features such as the lake, Rectorate, faculty buildings, and key facilities are represented through embossed map components accompanied by Braille text in Indonesian. Visual text and Braille are spatially aligned on the same signage surface, allowing tactile and visual users to access equivalent information through a unified system rather than parallel installations [18].

Digital integration complements the physical system through a QR-based portal embedded in selected primary signage. The portal provides access to an interactive campus map, institutional history, and interpretive explanations of visual symbols, extending informational depth without increasing physical signage density.



Figure 4. National Institute of Science and Technology (ISTN) Logo

Prototype Implementation, Color System, and Material Strategy

The prototype is developed at a human-centered scale, with primary information surfaces positioned at an average eye level of 165–170 cm to support natural reading posture. Digital access points are placed at an ergonomic height of 90–110 cm to enable seamless interaction without disrupting pedestrian circulation.

Material selection emphasizes durability and sustainability. Aluminum Composite Panels are applied for information surfaces due to their lightweight properties, weather resistance, and ease of maintenance. Stainless steel is used for the structural frame to ensure long-term stability and resilience under continuous outdoor exposure [19].

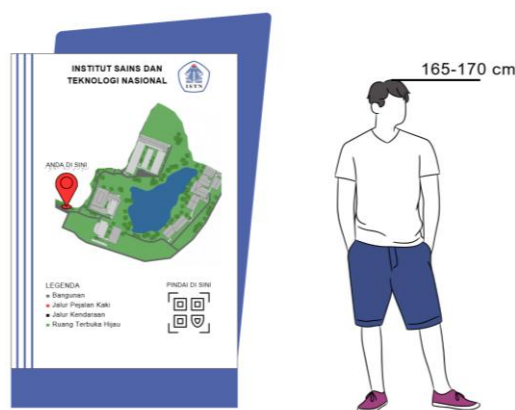


Figure 5. Prototype of National Institute of Science and Technology (ISTN) Map Sign

Color functions as a spatial coding system to support intuitive recognition. Faculty identification follows ISTN's official visual identity, with Dark Royal Blue assigned to the Faculty of Applied Science and Technology and Mulberry designated for the Faculty of Pharmacy. This color logic extends to departmental differentiation, enabling users to distinguish academic clusters and internal destinations through consistent chromatic cues across signage elements [20].



Figure 6. Prototype of National Institute of Science and Technology (ISTN) Faculties Name Sign

In addition to faculty-level identification, departmental differentiation is supported through a secondary color assignment system. Each department is associated with a distinct color variation derived from its parent faculty palette, allowing users to recognize sub-destinations without disrupting overall visual coherence. The detailed color specifications for each department are presented in a separate Table 2 to ensure clarity, consistency, and ease of application across signage elements.

Table 2. Department Color Scheme

No	Department	Color	Philosophy
1	Architecture	 Orange	Energy, creativity, and passion.
2	Landscape Architecture	 Green	Growth, balance, and serenity.
4	Mathematics	 Light Blue	Calmness, openness, and clarity of thought.
5	Information Systems	 Lavender	Gentleness, imagination, and emotional balance.
6	Electrical Engineering	 Red	Courage and strength.
7	Industrial Engineering	 Gray	Neutrality, stability, and professionalism.
8	Computer Science	 Black	Strength, assertiveness, and luxury.
9	Mechanical Engineering	 Benhur Blue	Trust, wisdom, and serenity.
10	Civil Engineering	 Yellow	Cheerfulness, optimism, and intelligence.

No	Department	Color	Philosophy
11	Pharmacy	 Brown	Depth of knowledge, stability, and reliability.

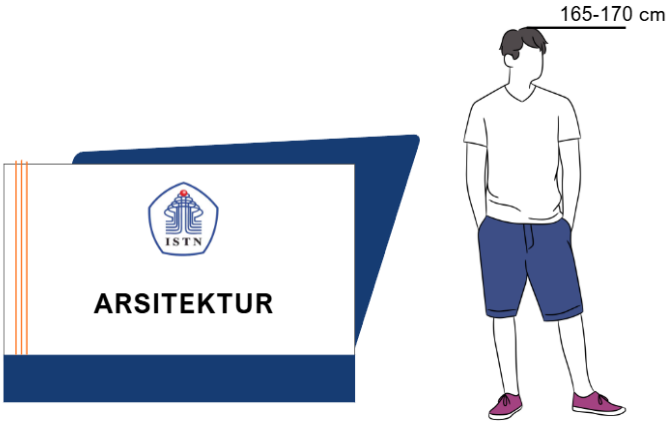


Figure 7. Prototype of National Institute of Science and Technology (ISTN) Departments Name Sign

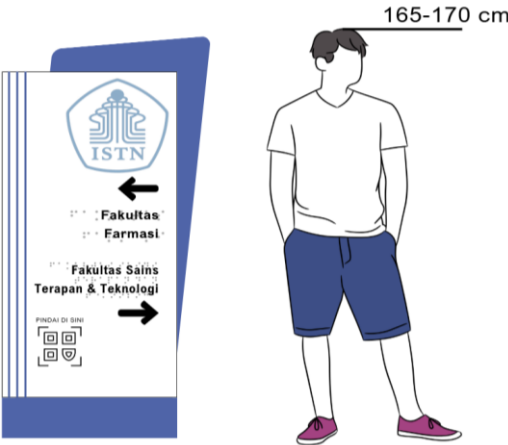


Figure 8. Prototype of National Institute of Science and Technology (ISTN) Wayfinding



Figure 9. Montage of National Institute of Science and Technology (ISTN) Map Sign



Figure 10. Montage of National Institute of Science and Technology (ISTN) Parking Sign

CONCLUSION

The development of an integrated wayfinding system at the National Institute of Science and Technology (ISTN) demonstrates how campus navigation can be addressed cohesively, enhancing legibility, accessibility, and institutional identity. By combining user-focused observations, consistent visual cues, and digital and tactile elements, the system supports diverse user needs while maintaining spatial clarity. Limitations include reliance on certain digital tools that may not be universally accessible. Future research could explore adaptive or real-time signage solutions to further improve wayfinding in evolving campus environments.

Author Contribution: Y.K contributed to site observation and documentation, analysis of movement patterns, identification of disorientation points, analysis of spatial and information needs, formulation of design criteria, development of the wayfinding system design proposal, visualization, and manuscript preparation. D. F. B contributed to site documentation, supporting data collection, color-related analysis, literature support, and manuscript refinement. P. T. P and S.S.I provided academic supervision, research direction, and critical review throughout the study. All authors have read and agreed to the final version of the manuscript.

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Conflict of Interest: There are no conflicts of interest.

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