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Enhancing Passenger Navigation: A Visibility Index Analysis of Wayfinding Quality in SHIAM Airport Terminal

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ABSTRACT
Complex airport environments pose significant wayfinding challenges for passengers, particularly within large international hubs like Sultan Hasanuddin International Airport (SHIAM) in Makassar, Indonesia. This study examines the quality of wayfinding at SHIAM, aiming to identify areas for improvement and inform future design decisions. Employing a quantitative approach, the study combines objective spatial data from a visibility index (VI) analysis of 23 key terminal facilities with subjective wayfinding experiences gleaned from existing case studies. The VI analysis assessed visual access, layout complexity, and facility importance, revealing an overall VI score: 0,599, indicating moderate wayfinding difficulties. These findings highlight the need for targeted interventions to address visibility and accessibility issues, particularly in critical facilities. By optimizing wayfinding within the terminal, the airport can enhance passenger experience and operational efficiency.
Keywords: wayfinding; spatial-navigation; visibility index; airport; sultan hasanuddin airport;

INTRODUCTION

Performing wayfinding in a complex architectural setting often proves to be a tedious and frustrating task. Previous research has shown that people frequently need help navigating unfamiliar architectural settings with complex multi-level geometries or in mixed-use structures such as transit hubs, hospitals, shopping malls and museums (Dogu et al., 2000; Hölscher et al., 2006; Kuliga et al., 2019; Li et al., 2016; Mandel, 2017). The implications of being lost range from confusion, stress, and frustration to unnecessary costs and delays (Hölscher et al., 2012; Jamshidi et al., 2025; Kuliga et al., 2019). Airport terminals exemplify this challenge, where intricate multi-level layouts and strict passenger schedules make the ease of wayfinding essential for operational efficiency (Arthur & Passini, 1992; Churchill et al., 2007; Farr et al., 2014). This issue is particularly acute in regions experiencing rapid aviation growth, such as Indonesia (IATA, 2025), where suboptimal passenger flow can lead to bottlenecks and missed flights (Farr et al., 2014). As a critical and expanding aviation hub for eastern Indonesia, Sultan Hasanuddin International Airport (SHIAM) serves as a pertinent case study for examining these wayfinding challenges.

Despite the importance of this topic, existing methodologies for assessing wayfinding quality have significant limitations. Qualitative approaches provide valuable subjective insights but are dependent on individual user profiles (Anuar et al., 2016). Widely used quantitative methods like Visibility Graph Analysis (VGA) offer spatial insights but struggle to model vertical circulation in multi-level structures and overlook dynamic factors such as signage or facility importance (Brösamle et al., 2007; Hölscher & Brösamle, 2007; Fan et al., 2024).

The Dada & Wirasinghe visibility index (VI) model offers a significant advancement in quantifying wayfinding quality, specifically for assessing airport terminals, incorporating level changes, decision points, and facility importance into a comprehensive visibility metric. Its algorithm systematically evaluates visual access from every decision node to all key destinations, producing a quantifiable score of wayfinding quality. This targeted approach enables designers and operators to identify precise areas for design enhancement and adjustments. This research applies advanced visibility index (VI) analysis to assess wayfinding quality at SHIAM airports' terminals as a basis for future developments of the airport.

METHODS

Wayfinding quality analysis on the existing SHIAM airport terminal is conducted through the *visibility index* (VI) calculation model developed by Dada and Wirasinghe in 1999. The scientific basis on choosing this method is primarily based on its significant advantage in quantifying the VI values at airports with multi-level terminals, as extensively validated by Churchill et al. (2008). Unlike earlier VI methods, such as Braaksma & Cook model (1980) and Tosic & Babic model (1984), which both failed to consider physical impediments that affect passenger navigation by relying solely on sight lines quantification, Dada's approach is more comprehensive because it specifically addresses the critical factor of level changes between departure and destination points. These issues were addressed by adding k_{ij} variable, which accounts for both decision points and level changes encountered during the wayfinding process. Through the quantification of k_{ij}, the index of visual access reduction experienced by passengers can be measured and assessed. The lower the k_{ij} index, the higher the tendency for the passenger to experience wayfinding difficulties, making the metrics particularly valuable for identifying problematic areas within multi-level airport terminals. The following formula is the VI model proposed by Dada:

$$\mathrm{VI(new)} = \frac{\sum_{i,j} c_{ij} k_{ij} w_j}{N \sum_{i,j}^{N} w_j}$$

$$\mathrm{VI}_i\mathrm{(new)} = \frac{\sum_{i=1}^{N} c_{ij} ki_{ij} w_j + \sum_{j=1}^{N} c_{ij} k_{ij} w_j}{2N} \quad \text{(activity centre)} \tag{1}$$

c_{ij} : Visual connectivity
k_{ij} : Visual access factor
w_j : Weighted index
N : Amount of *nodes*

Layout complexities(k_{ij}) is determined by,

$$k_{ij} = \mathrm{e}^{-(0.01n+0.1Lc)} \quad (0 < k_{ij} < 1) \tag{2}$$

n: The amount of decision points that is needed to reach destination *j* from *i*
Lc: The amount of level changes that is needed to reach destination *j* from *i*

From the wayfinding calculation formula above, the four variables that influence the quality of wayfinding in the VI Dada method can be determined, namely visual connectivity (c_{ij}), layout complexity (k_{ij}), weighted index (w_j), and number of nodes (N). The c_{ij} variable addresses the availability of visual connections between facilities being measured, where a connection is obtained through the availability of viewing space or signage. If a visual connection is obtained through signage, then measurements are made on the k_{ij} variable. Measurement of the said variable is influenced by the number of intersection points (n) and the amount of level differences (Lc). The weighted index (w_j) is the weight or level of importance of a certain facility, meanwhile, the N variable represents the number of nodes or facilities measured in this research.

The data collection process conducted in this research consists of a structured two-stage process designed to ensure comprehensive and reliable results. The first step is the initial data collection, gathered primarily to establish baseline conditions, context, and relevant entry points

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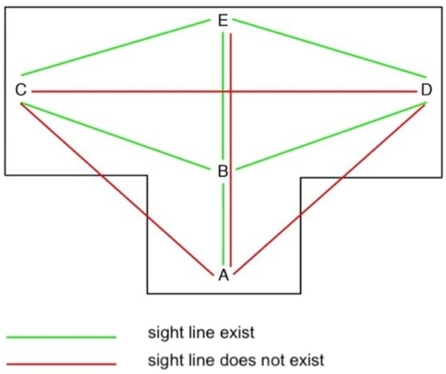
for the study. And then continued by collecting the core data, which focuses on the variables directly related to the visibility index (VI) analysis.

RESULTS AND DISCUSSION

A. Visual Connectivity (c_{ij})

The viewpoint or sight line variable (c_{ij}) represents a critical component in VI analysis, which quantifies the availability of visual connectivity between any originating point and the destination point within the terminal environment. Visual connectivity is established through either direct line-of-sight access to the destination point or through the presence of available signage systems that provide directional guidance. If a destination point is clearly seen from originating points without any obstruction, it receives an indicator value of 1. Conversely, if there is not any available sight lines between the two points, then the c_{ij} is assigned a value of 0.



j/i	A	B	C	D	E	Σ
A		1	0	0	0	1
B	1		1	1	1	4
C	0	1		1	0	2
D	0	1	1		1	3
E	0	1	0	1		2
Σ	1	4	2	3	2	24

Figure 1. Illustration of measuring and recording visual connectivity data
Source: Churcill et al. (2008)

As seen from the illustration above, not all points are visually connected or have visual connectivity. For instance, Point A may establish clear sightlines only to Point B, while visual access to Points C and D becomes obstructed by existing architectural layouts, and visual connection to Point E is compromised by excessive spatial separation that eliminates meaningful sight lines between these locations. Therefore, the value of A to B is considered 1, while the c_{ij} from A to C, D, and E is valued at 0 due to the lack of clear sightlines.

Visual connectivity (c_{ij}) data at the SHIAM airport terminal were collected through a field survey that aimed to assess direct sightlines and signage-guided visibility between terminal facilities empirically. A systematic observation of passenger circulation paths and on-site inspection were conducted to map the visual connection between the originating and destination points. Before conducting the on-site observation, detailed floor plans of the SHIAM airport terminal were obtained first to identify all key facilities or nodes to be assessed for visual connectivity. The floor plans were then used as a field instrument in coding and mapping the circulation routes of passengers, verifying sightlines, and mapping the sign systems that provide directional guidance between nodes. The observation procedure was conducted in accordance with the passenger's boarding procedure, starting from the entrance, check-in, security check, and boarding.

Table 1. Visual connectivity matrix (c_{ij})

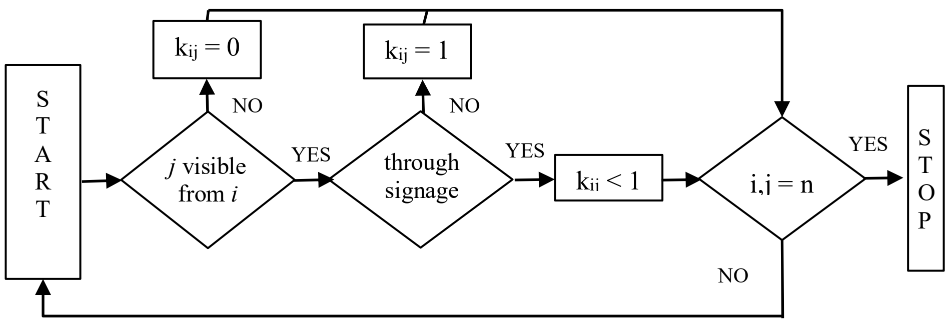
Nodes	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Σcj
Weight of facilities (wj)	*1,00*	*1,00*	*1,00*	*1,00*	*1,00*	*1,00*	*1,00*	*1,00*	*1,00*	*0,95*	*0,95*	*0,80*	*0,86*	*0,87*	*0,87*	*0,89*	*0,59*	*0,70*	*0,63*	*0,94*	*0,88*	*0,82*	*0,76*	
Primary facilities																								
Entrance		1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	10
Check-in Hall	1		1	1	1	1	1	1	1	1	0	0	0	0	0	1	0	0	0	1	0	1	0	12
Boarding Gate 1	0	0		1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1	0	1	17
Boarding Gate 2	0	0	1		1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	18
Boarding Gate 3	0	0	1	1		0	0	0	0	0	0	0	1	1	0	0	1	0	0	1	0	0	0	6
Boarding Gate 4	0	0	0	0	0		1	1	1	0	0	0	1	0	1	0	1	0	0	1	0	0	0	7
Boarding Gate 5	0	0	1	1	1	1		1	1	1	0	1	1	0	1	1	0	0	1	1	1	0	1	15
Boarding Gate 6	0	0	1	1	1	1	1		1	1	0	1	1	1	1	1	0	0	0	1	1	0	0	14
Boarding Gate 7	0	0	1	1	1	1	1	1		1	1	1	1	1	1	0	1	0	1	1	1	0	0	16
secondary facilities																								
Toilet	0	1	1	1	1	1	1	1	1		1	1	1	1	1	1	0	0	1	0	0	0	0	15
Prayer room	0	0	1	1	1	1	1	1	1	1		1	0	0	0	0	0	0	0	0	0	0	0	9
Nursery room	0	0	1	1	1	1	1	1	1	1	1		0	0	0	0	0	0	0	0	0	0	0	9
ATM Gallery	0	0	1	1	1	1	1	1	1	1	1	0		1	1	1	1	0	1	1	0	0	0	15
Elevator A	0	1	1	1	1	1	1	1	1	1	1	1	1		0	1	1	0	1	1	1	0	0	17
Elevator B	0	0	1	1	1	1	1	1	1	1	0	1	1	0		1	1	0	1	1	1	0	0	15
Information Counter	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1		1	0	0	1	0	0	0	15
Phone booth	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	0	0	0	17
Smoking area	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1		0	1	0	0	0	12
Shower room	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0		0	0	0	0	8
Flight information board	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	22
Charging Station	0	0	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	1		0	1	13
Airlines office	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	0		0	11
Airport Lounge	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	0		17
Σci	3	6	21	21	21	21	21	21	21	19	11	14	15	12	13	11	11	4	9	18	9	3	5	620

Source: Field Study Results

B. Visual access factor (k_{ij})

A factor for visual access, or in the original dissertation named as reduced visibility access (k_{ij}) is a variable developed by Dada to assess how the number of signs and floor level affected the ease of wayfinding (Churcill, 2008). If a direct sight line exists between facility *i* and *j,* then the value of k_{ij} recorded on the matrix has a value of 1. However, if the connection between facility *i* and *j* is obtained from a signage, then the calculation through the decision point and level change data is made.

Chart 1. Systematic Measurement of k_{ij} variable



Source: Dada in Churcill (2008)

The k_{ij} variable is affected by the number of decision points (n) and the difference in floor level (Lc) between facilities in the terminal (Dada, 1999). Decision points are identified by mapping the passenger circulation flow on the airport floor plan, where the flow paths between

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nodes or facilities are traced to locate all instances where travellers must make directional decisions. Following the establishment of these circulation paths, the number of such decision points along the route between any two facilities is quantified. This quantification, combined with vertical level differences, enables the k_{ij} variable to effectively capture the complexity and navigational challenges posed by multi-level terminals. After the circulation flow between nodes or facilities is done, the decision points can be identified through the decision points circulated, and the point is plotted on the terminal's floor plan.

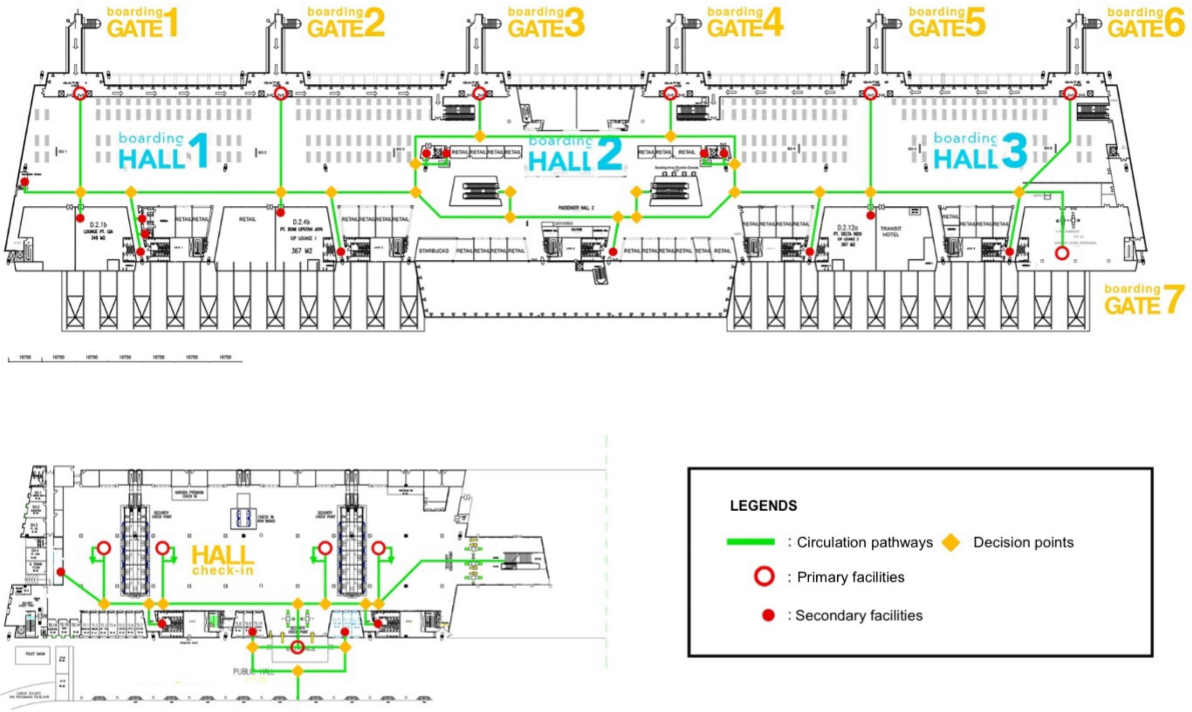

Figure 2. Circulation flow of passengers and decision points (*n*) in the SHIAM airport terminal
Source: field survey

The decision point data is collected by calculating the total number of decision points that need to be passed from originating nodes to destination nodes. Afterwards, level change or floor level difference (*Lc*) is gathered by assessing the location between facilities. If there is a difference in floor level between the assessed nodes or points, the *Lc* value is recorded as 1, and if there is none, then the value is 0. After collecting all the data required for visual access factor (k_{ij}) the final step is calculating the values using the mathematical model.

$$k_{ij} = e^{-(0.01n+0.1Lc)} \quad (0<k_{ij}<1) \tag{3}$$

n: The amount of decision points that is needed to reach destination *j* from *i*
Lc: The amount of level changes that is needed to reach destination *j* from

Table 2. Visual access factor analysis (k_{ij})

Nodes	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Weight of facilities (wj)	*1,00*	*1,00*	*1,00*	*1,00*	*1,00*	*1,00*	*1,00*	*1,00*	*1,00*	*0,95*	*0,95*	*0,80*	*0,86*	*0,87*	*0,87*	*0,89*	*0,59*	*0,70*	*0,63*	*0,94*	*0,88*	*0,82*	*0,76*
Primary facilities																							
Entrance	1	1	0,79	0,81	0,81	0,8	0,8	0,79	0,79	0	0	0	0	0	0	0	0	0	0	1	0	1	0
Check-in Hall	1	1	0,83	0,84	0,84	0,84	0,84	0,83	0,82	0,98	0	0	0	1	0	1	0	0	0	1	0	1	0
Boarding Gate 1	0	0	1	1	0,96	0,9	0,9	0,9	0,89	0,97	0,97	0,97	0,94	0,94	0,91	0	1	1	0	1	1	0	1
Boarding Gate 2	0	0	1	1	0,95	0,92	0,92	0,91	0,9	0,97	0,97	0,97	0,96	1	0,93	0,96	1	0	0,97	1	1	0	1
Boarding Gate 3	0	0	0,96	0,97	1	0	0	0	0	0	0	0	1	1	0	0	1	0	0	1	0	0	0
Boarding Gate 4	0	0	0	0	0	1	0,97	0,96	0,93	0	0	0	1	0	1	0	1	0	0	1	0	0	0
Boarding Gate 5	0	0	0,9	0,91	0,9	0,98	1	1	0,97	0,97	0	0,9	1	0	1	0,94	0	0	0,97	1	1	0	1
Boarding Gate 6	0	0	0,89	0,9	0,9	0,97	1	1	0,98	0,98	0	0,89	0,95	0,92	0,95	0,93	0	0	0	1	1	0	0
Boarding Gate 7	0	0	0,88	0,9	0,89	0,93	0,97	0,98	1	0,99	1	0,88	0,94	0,92	0,94	0	1	0	0	1	1	0	0
secondary facilities																							
Toilet	0	1	0,97	0,97	0,94	0,95	0,97	0,98	1	1	1	1	0,97	0,98	0,97	0,97	0	0	1	0	0	0	1
Prayer room	0	0	0,97	0,97	0,92	0,9	0,9	0,9	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1
Nursery room	0	0	0,97	0,97	0,92	0,9	0,9	0,9	0,89	1	1	1	0	0	0	0	0	0	0	0	0	0	0
ATM Gallery	0	0	0,97	0,98	1	1	0,98	0,97	0,96	0,96	0,94	0	1	1	1	1	1	0	0,96	1	0	0	0
Elevator A	0	1	0,97	0,98	1	0,92	0,93	0,92	0,91	0,96	0,94	0	1	1	0	0,97	1	0	0,96	1	1	0	0
Elevator B	0	0	0,91	0,93	0,92	1	1	0,97	0,96	0,97	0	0	1	0	1	0,95	1	0	0,96	0,98	1	0	0
Information Counter	0	1	0,94	0,96	0,95	0,93	0,94	0,93	0,92	0,97	0	0	0,97	1	1	1	1	0	0	1	0	0	0
Phone booth	0	0	0,97	1	1	1	1	0,92	1	0,96	0,94	0	0,99	1	1	1	1	1	0,96	1	0	0	0
Smoking area	0	0	1	0,97	0,92	0,9	0,9	0,9	0,89	0,97	0,97	0,97	0	0	0	0	1	1	0	1	0	0	1
Shower room	0	0	0,95	0,97	0,94	0,94	0,97	0,96	0,95	1	0	0	0	0	0	0	0	0	1	0	0	0	0
Flight information board	1	1	1	1	1	1	1	1	1	0,98	0,97	0,97	1	1	1	1	1	1	0,97	1	1	1	1
Charging Station	0	0	1	1	0,97	0,97	1	1	1	0,97	0,96	0,96	0,95	1	1	0	0	0	0,96	1	1	0	1
Airlines office	1	1	0,82	0,84	0,83	0,83	0,84	0,84	0,83	0,98	0	0	0	0	0	0	0	0	0	1	0	1	0
Airport Lounge	0	0	1	1	0,94	0,94	1	1	0,97	1	1	0,97	0,96	0,96	0,96	0,96	0	1	0	1	1	0	1

Source: Field Study Results

C. Weighted Index (w_j)

This variable is used to calculate the priority index of the airport secondary facility/nodes based on passenger perception. The w_j values were gathered through questionnaires asking the degree of importance of nodes using 1-5 scales, where 1 represented 'not necessary', and 5 represented 'very important'. The total score of each node then averaged out and converted into a 0-1 scale. The results show that the highest weighted value was for restroom facilities with a weighting of 0,95, followed by the flight information board and prayer room with weightings of 0,94 and 0,93, respectively. With these weighted values, these three facilities are considered to have an essential role in the SHIAM terminal.

Table 3. Tabulation of Facility Weighting Measurements (w_j)

Nodes	Respond					Total score	*(wj)*
	1	2	3	4	5		
Toilet	1	0	5	40	193	1141	0,95
Prayer room	1	3	13	42	180	1114	0,93
ATM Gallery	1	7	33	72	126	1032	0,86
Elevator	2	6	39	73	119	1018	0,85
Smoking room	37	28	63	49	62	788	0,66
Shower room	24	53	84	42	36	730	0,61
Nursery room	9	27	44	83	76	907	0,76
Phone Booth	47	52	62	43	35	684	0,57
Airport lounge	8	23	64	90	54	876	0,73
Flight Display Information	3	0	10	42	184	1121	0,94
Charging booth	2	6	26	68	137	1049	0,88
Information counter	2	12	20	91	114	1020	0,85

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Nodes	Respond					Total score	*(wj)*
	1	2	3	4	5		
Airline's office	12	29	53	78	67	876	0,73
n = 239							

Source: Field Study Results

D. Visibility Index for the Terminal (VI) and Facilities (VI_i)

Following the collection and analysis of all required variables, the visibility index (VI) calculation was systematically executed using Dada's enhanced model to quantitatively assess the wayfinding quality within the SHIAM airport terminal. This calculation process incorporate the visual connectivity data (c_{ij}), visual access factor (k_{ij}), which is calculated from level change (Lc) and decision points (n), and weighted index (w_j) into Dada's mathematical framework, which accounts for both direct sight-lines and architectural complexity that influence passenger navigation.

The computational analysis yielded an overall visibility index value of 0.599 for the SHIAM terminal, indicating a moderate level of wayfinding clarity and spatial legibility within the facility. This VI score provides a quantitative benchmark for evaluating the terminal's current wayfinding performance and serves as a baseline for identifying areas requiring improvement interventions. Subsequently, individual facility-specific VI calculations were performed using Dada's methodology to provide detailed insights into the spatial distribution of wayfinding challenges throughout the terminal, enabling targeted analysis of specific zones where enhanced visual connectivity or signage modifications may be most beneficial for optimizing passenger circulation and reducing navigation difficulties.

Table 4. Visibility Index (VI) results per facility

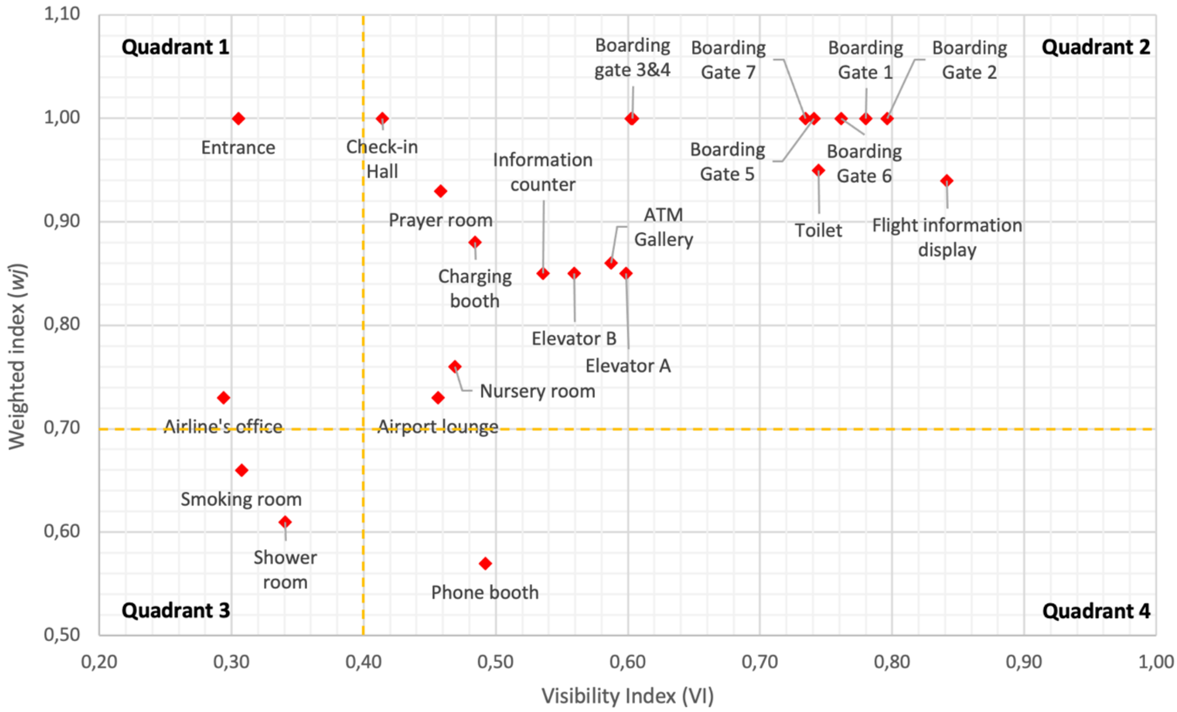
Nodes	VI value	Nodes	VI value
Entrance	0,305	ATM Gallery	0,587
Check-in Hall	0,414	Elevetor A	0,598
Boarding Gate 1	0,780	Elevator B	0,559
Boarding Gate 2	0,796	Information counter	0,536
Boarding Gate 3	0,604	Phone Booth	0,492
Boarding Gate 4	0,603	Smoking room	0,308
Boarding Gate 5	0,741	Shower room	0,341
Boarding Gate 6	0,762	Flight information display	0,841
Boarding Gate 7	0,735	Charging boot	0,484
Toilet	0,744	Airline's office	0,294
Prayer room	0,458	Airport lounge	0,456
Nursery room	0,469		

Source: Field Study Results

E. Importance – Performance Analysis (IPA)

After each VI value of every facility is identified, IPA analysis is conducted. This analysis is used for identifying facilities that need evaluation or optimization based on wayfinding quality (VI) and weighted index (w_j). This analytical method combines two critical variables: the wayfinding quality represented by the VI value, and the weighted index w_j, which reflects the importance or priority of each facility. These variables are plotted on a Cartesian plane, with the VI value positioned on the x-axis and the weighted index on the y-axis.

Chart 2. Importance – Performance Analysis (IPA) of SHIAM Airport terminal facilities.



Source: Field Study Results

Based on the diagram of the results of the IPA analysis, it can be interpreted that:

(i) **Quadrant 1** shows facilities that have a high weighted index, but a low visibility index (VI). These facilities have important roles but have low wayfinding quality. Some of the facilities that are in this quadrant are the entrance, check-in hall, airline office, and nursing room.

(ii) **Quadrant 2** shows facilities that have a high weighted index and visibility index (VI), which means these facilities are important and have ideal wayfinding qualities. Most of the airport facilities are in this quadrant.

(iii) **Quadrant 3** shows facilities that have a low weighted index and visibility index (VI). The facilities in this quadrant aren't optimal in terms of wayfinding quality, but are considered not important from the passenger perspective. Facilities that are in this quadrant are the smoking room and the shower room.

(iv) **Quadrant 4** shows facilities that have a low weighted index, which means it is not considered important from a passenger perspective, but has a high visibility index (VI), so evaluation of the wayfinding attribute of the facility in this quadrant isn't necessary. The only facility identified in this quadrant is the public telephone.

F. Analysis, Evaluation, and Discussion

Based on the results obtained through Visibility Index (VI) measurements and Importance–Performance Analysis (IPA) conducted on terminal facilities, the researcher proceeded with interpretation and evaluation grounded in the findings. The IPA revealed five facilities requiring improvement in wayfinding quality: the terminal entrance, check-in hall, airline office, prayer room, and nursing room. These facilities are categorised in **Quadrant 1**.

Beyond these five facilities, several facilities in **Quadrant 2** are also considered in need of enhancement to improve wayfinding quality. These include the charging booth, lounge, and

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boarding gates 3 and 4. The charging booth and lounge have visibility index (VI) values below 0.5, placing them near the threshold of Quadrant 1. Boarding gates 3 and 4 were selected due to their significantly lower VI values compared to other gates. Both gates are classified with VI scores of 0,604 and 0,603, respectively. Those values are substantially lower than other gates, with the lowest VI recorded at 0,735.

The smoking room and the shower room, which are located in **Quadrant 3**, exhibit very low VI values. The values are 0,308 for the smoking room and 0,341 for the shower room. The absence of improvements to these facilities could negatively impact the terminal's overall VI. Therefore, evaluation of these two facilities is also necessary to enhance the terminal's overall visibility index.

Facilities in **Quadrant 1** represent those with the highest urgency for wayfinding quality improvement. These include the terminal entrance, check-in hall, airline offices, prayer room, and nursing room. From the study conducted, it was found that three of these five facilities are located on the first floor of the terminal, where they are located in different floor levels from most other facilities, which resulted in limited visual connectivity. Furthermore, observational data indicate that the current sign system is not providing optimal directional guidance. The lack of visual connectivity from the first floor to the other floors shows that these three facilities are poorly linked to others. Therefore, improving the signage system is essential, as modifying the layout would be inefficient in terms of cost and time.

Regarding the prayer room, the existing layout places it far from facilities in boarding gates 2 and 3. Additionally, the signage directing passengers to this facility lacks consistency, resulting in minimal connectivity. Providing a prayer room within boarding gate 3 could be a viable solution to enhance wayfinding quality. This would improve visual connectivity (c_{ij}) and the visual access factor (k_{ij}) value to the prayer room.

Although the nursing room at SHIAM Airport benefits from a favourable location, which is close to the boarding gate, its visibility index reveals inferior wayfinding performance compared to the other facilities, such as the prayer room. Further investigation revealed that the signage system guiding passengers to the nursing room is not fully effective in linking the nursing room with other terminal facilities. Therefore, it is advisable to augment the signage network by installing clear, strategically placed directional signs at critical junctions and decision points along primary circulation routes.

Beyond the five aforementioned facilities, boarding gates 3 and 4 also warrant urgent attention. As final destinations in passenger circulation, boarding gates should exhibit above-average wayfinding quality. The existing study found that the low VI values for gates 3 and 4 are due to commercial facilities obstructing the line of sight to these gates. Consequently, their visual connectivity is lower than that of other gates. Additionally, the circulation complexity caused by these commercial facilities further impacts the VI scores. It is recommended to relocate the commercial facilities to more strategic locations to avoid obstructing visibility and reduce decision points to the boarding gates.

CONCLUSION

The analysis of wayfinding quality conducted in the SHIAM Airport terminal has identified the quality of wayfinding at the terminal and its facilities, and the focus points for future improvements. The measurement of wayfinding quality through VI analysis found that the SHIAM airport terminal has an overall Visibility Index of 0,599. The value represents that the passengers of SHIAM are still capable of doing wayfinding, but very dependent on the available terminal attributes. Through an Importance-Performance Analysis (IPA), the research identified 11 facilities—including the entrance, check-in hall, several boarding gates, and the prayer room—as high-priority areas for intervention due to a combination of high passenger importance and low visibility or navigational clarity. The findings offer actionable insights for airport management, shifting the basis for improvements from subjective feedback to data-driven recommendations aimed at enhancing passenger experience and operational efficiency.

However, it's important to acknowledge the limitations of this study. First, as a single case study, the findings are specific to the unique architectural configuration of SHIAM and may not be directly generalizable to other airports with different layouts. Second, the VI model provides a static analysis of the physical environment and does not account for dynamic variables such as real-time passenger density, temporary obstructions, or varying light conditions, which can also influence wayfinding. Finally, the facility importance weighting (w_j) is based on aggregated passenger perceptions and may not capture the nuanced priorities of different traveler demographics (e.g., business vs. leisure, frequent vs. first-time flyers).

These limitations open several avenues for future research. A logical next step would be a longitudinal study to reassess the terminal's VI score after the proposed design interventions are implemented, thereby quantitatively measuring their effectiveness. Furthermore, applying the VI methodology in a comparative analysis across multiple airports with varying architectural typologies could help establish broader, more universal design principles for effective wayfinding.

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