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Indicators of Social Sustainability in The Airport Terminal Infrastructure

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ABSTRACT

Infrastructure development, including airport terminals, is increasing in Indonesia. This development is carried out to support the needs of the Indonesian people and facilitate connectivity between regions. The application of sustainable development principles in the construction sector has become an urgent need, along with the increasing awareness of the long-term impact of public infrastructure on society. Social sustainability is crucial to consider in construction, especially airport terminal infrastructure, because public infrastructure directly interacts with the needs and satisfaction of the community as end users. This study was conducted to identify and define social sustainability criteria applied to airport terminal infrastructure. This study uses primary data obtained from a questionnaire survey containing social sustainability criteria for airport terminal infrastructure. This study focuses on the operational and maintenance phase of the construction project. Data were collected by distributing questionnaires to airport operators, construction service providers, and international airport users. The method used in this study began with variable synthesis, a preliminary survey, a pilot test, and continued with the main survey. These variables were analyzed using mean and standard deviation tests. This research identified 21 relevant indicators to measure the social sustainability of airport terminal buildings. The most important social sustainability indicator is the indicator that the airport terminal provides a sense of security for users against threats and dangers. Further research can be conducted by developing a framework for assessing the social sustainability aspects of airport terminals.

INTRODUCTION

Airport construction in Indonesia has increased significantly over the last two periods, where during the 2014-2024 era, there was an addition of 28 new airports and the rehabilitation of 64 terminals (Kementerian Perhubungan, 2024). The rapid development on Java Island aims to support regional connectivity as an economic center contributing more than 58% of the national GDP, with a population density reaching 55.93% of Indonesia's total population (Badan Pusat Statistik, 2025). Although it drives economic growth, the development of airport terminal infrastructure has the potential to cause social inequality, the marginalization of local communities, and the loss of cultural identity (Makmuri, 2017). As public infrastructure, airport terminals are required to implement sustainable building concepts that integrate economic, environmental, and social aspects (Hussain & Ramdan, 2020).

Suryan et al (2024) stated that airport terminals also function as public spaces that encourage social interaction between users. Airport terminals possess unique characteristics as national and international gateways that demand inclusivity, accessibility, and fair service (Bezerra & Gomes, 2015), where critical travel flows emphasize the importance of comfort and perceptions of justice (Pivac et al., 2025). Adopting sustainability principles ensures that infrastructure benefits current generations without harming future ones (Chen et al., 2024), particularly during the operational and maintenance stages, which represent the longest phases of a construction project (Hidayat et al., 2020). However, attention to social sustainability has not yet received a balanced proportion compared to economic and environmental aspects (Rivai et al., 2023). Empirical issues indicate that poor access to public transportation is a major contributor to mobility injustice (Hosseini et al., 2023), and facilities that do not meet user needs can diminish the social well-being of users (Bashir et al., 2024).

Previous research regarding social sustainability in construction management has been conducted on objects such as schools, housing, and toll roads (Rohman et al., 2017). Nevertheless, a clear and consistent definition of social criteria in construction is still lacking because of its dynamic and context-dependent nature (Kristoffersen et al., 2024; Weingaertner & Moberg, 2011). The scientific novelty of this research lies in the identification of social sustainability indicators specifically for international airport terminal infrastructure, which has thus far been more focused on economic and environmental impacts alone. This study fills that gap by examining social indicators during the operational and maintenance stages at major airports on Java Island.

Based on this background, the core problem in this research is to identify relevant social sustainability indicators for airport terminals. The objective of this study is to analyze relevant social sustainability indicators for

airport terminal infrastructure in Indonesia. By identifying these indicators, it is expected that airport stakeholders can better integrate social values into the long-term management of transportation hubs.

METODE

This research was conducted at three airport locations, namely Juanda Airport Terminal, Soekarno-Hatta Airport Terminal, and Yogyakarta International Airport Terminal. The rapid development on Java Island aims to support regional connectivity as an economic center contributing more than 58% of the national GDP, with a population density reaching 55.93% of Indonesia's total population (Badan Pusat Statistik, 2025). The data source used in this research is a primary resource. Primary data refers to data obtained through direct observation conducted by the researcher to acquire information, Yusuf (2017). According to Sugiyono (2013), a primary source is a data source that directly provides data to the data collector. In this study, the researcher will personally conduct observations to obtain the data, which will subsequently be processed to complete the research.

This research employs a quantitative approach using statistical methods based on respondent perceptions. Data were obtained through a series of collection steps, including a preliminary survey, a pilot test, and the main survey. The preliminary survey was conducted to verify the research variables within the specific context of the study. Six experts were interviewed regarding the research attributes. Following the preliminary survey, an analysis was performed to identify attributes considered relevant according to expert opinions.

Tabel 1. Social Sustainability Indicators from Literature

No	Indicator	Source
X1	The airport terminal is accessible to all groups without discrimination.	Fatourehchi dkk (2020), Bashir, dkk (2024), Kristoffersen, dkk. (2024), Durmaz, dkk. (2024), Rohman, dkk (2017), Abbasi, dkk. (2022)
X2	The airport terminal can serve as a medium for knowledge development.	Atanda, dkk (2020), Rosasco & Sdino. (2023), Kristoffersen, dkk. (2024), Rohman, dkk (2017), Rivai, dkk. (2022)
X3	The airport terminal location is close to public transportation access and various supporting facilities.	Fatourehchi dkk (2020), Kristoffersen, dkk. (2024), Rivai, dkk. (2022), Rosasco & Sdino. (2023), Rohman, dkk (2017)
X4	Airport terminal facilities are designed with accessibility in sustainable design.	Fatourehchi dkk (2020), Atanda, dkk (2020), Kristoffersen, dkk. (2024), Durmaz, dkk. (2024), Rivai, dkk. (2022), Orkomy & Sharbat. (2021), Abbasi, dkk. (2022), Rohman, dkk (2017)
X5	The airport terminal provides a sense of security for users from threats and hazards.	Fatourehchi dkk (2020), Bashir, dkk (2024), Kristoffersen, dkk. (2024), Rohman, dkk (2017), Rivai, dkk. (2022), Orkomy & Sharbat. (2021), Li & Loo. (2016), Abbasi, dkk. (2022)
X6	Public participation in airport terminal operations.	Atanda, dkk (2020), Bashir, dkk (2024), Kristoffersen, dkk. (2024), Rivai, dkk. (2022), Rosasco & Sdino. (2023), Abbasi, dkk. (2022), Rohman, dkk (2017)
X7	The airport terminal creates new employment opportunities.	Atanda, dkk (2020), Bashir, dkk (2024), Kristoffersen, dkk. (2024), Durmaz, dkk. (2024), Rohman, dkk (2017), Li & Loo. (2016), Rivai, dkk. (2022)
X8	The airport terminal facilitates social interaction between individuals and groups.	Rivai, dkk. (2022), Rosasco & Sdino. (2023), Kristoffersen, dkk. (2024), Abbasi, dkk. (2022), Rohman, dkk (2017)
X9	Airport terminal operations do not cause conflicts between individuals and groups.	Durmaz, dkk. (2024), Rivai, dkk. (2022), Rohman, dkk (2017), Kristoffersen, dkk. (2024)
X10	A sense of ownership and pride among users toward airport terminal operations.	Atanda, dkk (2020), Durmaz, dkk. (2024), Rivai, dkk. (2022), Rosasco & Sdino. (2023), Rohman, dkk (2017), Kristoffersen, dkk. (2024), Hussain & Ramdan (2020)
X11	Proper management of noise, water, air pollution, and waste.	Ferreira dkk (2024), Kristoffersen, dkk. (2024), Dulinski (2025), Rosasco & Sdino. (2023), Orkomy & Sharbat. (2021)
No	**Indicator**	**Source**
X12	The aesthetic quality of the airport terminal design as perceived by users.	Atanda, dkk (2020), Rosasco & Sdino. (2023), Abbasi, dkk. (2022), Kristoffersen, dkk. (2024)
X13	The airport terminal provides a sense of comfort for the user community.	Fatourehchi dkk (2020), Li & Loo. (2016), Atanda, dkk (2020), Kristoffersen, dkk. (2024), Rivai, dkk. (2022), Orkomy & Sharbat. (2021), Abbasi, dkk. (2022), Rohman, dkk (2017)
X14	Management commitment to meeting the needs of airport terminal users.	Atanda, dkk (2020), Kristoffersen, dkk. (2024), Orkomy & Sharbat. (2021), Li & Loo. (2016)
X15	The airport terminal provides privacy area facilities.	Hussain & Ramdan (2020), Rivai dkk (2022)
X16	The airport terminal is designed with cultural and ethnic identity.	Fatourehchi dkk (2020), Abbasi, dkk. (2022), Atanda, dkk (2020), Rivai, dkk. (2022), Rosasco & Sdino. (2023), Rohman, dkk (2017), Kristoffersen, dkk. (2024), Orkomy & Sharbat. (2021)
X17	Disabled-friendly access at the airport terminal.	Hussain & Ramdan (2020), Rivai dkk (2022), Kristoffersen, dkk. (2024), Durmaz, dkk. (2024), Rivai, dkk. (2022), Orkomy & Sharbat. (2021)
X18	The airport terminal has a multilingual information system (not limited to Indonesian).	Hussain & Ramdan (2020), Abbasi dkk (2022), Kristoffersen dkk. (2024), Rivai dkk (2022), Rosasco & Sdino (2023)
X19	Providing sufficient parking areas for airport users.	Mahpour dkk (2023), Rivai dkk (2022)
X20	Easy access to emergency facilities (availability of evacuation routes and assembly points).	Bateman & Majundar (2020), Rivai dkk (2022)

Source : Researcher's work, tahun

Before conducting the main survey, a pilot test was carried out by distributing questionnaires to ensure that the prepared instrument could be clearly understood by the respondents. The respondents in this study are stakeholders involved in airport terminal infrastructure. Respondents are divided into three categories, consisting of:

1. Airport operators: personnel working within the airport terminal management who understand airport operations necessary to achieve social sustainability.
2. Construction service providers (contractors and consultants): parties possessing technical knowledge and project experience, providing an understanding of design standards, accessibility regulations, and functional aspects of the airport designed to meet user needs.
3. Airport terminal users (end-users): individuals who frequently use or visit the facility, serving as the primary stakeholders and end-users of the airport terminal project, aged over 20 years.

According to Roscoe (1975), an adequate sample size for quantitative research ranges from 30 to 500 respondents, depending on the complexity and objectives of the analysis. However, this study endeavors to obtain a large sample size because, according to statistical principles, a larger dataset better represents the population. The data were analyzed using the mean as an appropriate statistical technique to identify the attributes considered significant for terminal buildings.

RESULT

The preliminary survey was conducted involving assessments and opinions from experts and practitioners (expert judgment) through questionnaires. Expert judgment in this study involved six experts. This number is in accordance with the recommendation by Lynn (1986), which states that content validation of an instrument should be performed by at least five or six experts to obtain representative results. This expert judgment was provided by six lecturers and practitioners who possess theoretical expertise and practical experience in the fields of sustainable development, airport terminal management, and airport terminal construction.

The results of the preliminary survey based on expert opinions can be represented in the form of mean values and standard deviations (SD) for each attribute.

Tabel 2. Preliminary Survey Results

No	Indicators	Mean	Standard Deviation	Result
X1	The airport terminal is accessible to all groups without discrimination.	4.3	0.816	Relevant
X2	The airport terminal can serve as a medium for knowledge development.	2.3	0.816	**Not Relevant**
X3	Location is close to public transportation access and various supporting facilities.	4.2	0.983	Relevant
X4	Airport terminal facilities are designed with accessibility in sustainable design.	4.2	0.983	Relevant
X5	The airport terminal provides a sense of security for users from threats and hazards.	4.3	0.816	Relevant
X6	Public participation in airport terminal operations.	2.5	0.548	**Not Relevant**
X7	The airport terminal creates new employment opportunities.	4.2	1.169	Relevant
X8	The airport terminal facilitates social interaction between individuals and groups.	4.2	0.983	Relevant
X9	Airport terminal operations do not cause conflicts between individuals and groups.	3.7	0.816	Relevant
X10	A sense of ownership and pride among users toward airport terminal operations.	4.2	0.983	Relevant
X11	Proper management of noise, water, air pollution, and waste.	4.3	0.816	Relevant
X12	The aesthetic quality of the airport terminal design as perceived by users.	4.5	0.548	Relevant
X13	The airport terminal provides a sense of comfort for the user community.	2.7	0.516	**Not Relevant**
X14	Management commitment to meeting the needs of airport terminal users.	4.0	1.265	Relevant
X15	The airport terminal provides privacy area facilities.	4.5	0.548	Relevant
X16	The airport terminal is designed with cultural and ethnic identity.	4.0	0.894	Relevant
X17	Disabled-friendly access at the airport terminal.	4.5	0.548	Relevant
X18	The airport terminal has a multilingual information system (not limited to Indonesian).	4.5	0.548	Relevant
X19	Providing sufficient parking areas for airport users.	4.5	0.837	Relevant
X20	Easy access to emergency facilities (availability of evacuation routes and assembly points).	3.8	0.753	Relevant

Source : Researcher's work, 2026

Table 2 shows the relevance and ranking of these indicators. Variable Relevance Analysis (Preliminary Survey)The Variable Relevance Analysis was conducted using an Expert Judgment approach to validate the social sustainability indicators synthesized from the literature. The assessment involved six expert respondents, including

airport development practitioners (consultants and contractors), academics, and airport operators, to ensure the objectivity of the instrument. Indicators were declared relevant if they achieved a mean value 3.0. Based on the data processing results, 17 indicators were declared relevant, with mean values ranging from 3.7 to 4.5. Conversely, three indicators were eliminated as they were considered irrelevant by the experts, namely: Airport terminal as a mean of knowledge development (X2), Public participation in operations (X6), and Community sense of comfort (X13). In addition to the validation process, the experts contributed by adding four new variables covering aspects of technical efficiency, sustainable materials, and user cost affordability. The final result of this stage established 21 final indicators ready for use in the main survey instrument.

Table 3 Indicators of Social Sustainability

Code	Indicators
X1	The airport terminal is accessible to all groups without discrimination.
X2	The airport terminal location is close to public transportation access and various supporting facilities.
X3	Airport terminal facilities are designed with accessibility in sustainable design.
X4	The airport terminal provides a sense of security for users against threats and hazards.
X5	The airport terminal creates new employment opportunities.
X6	The airport terminal facilitates sustained social interaction between individuals and groups.
X7	Airport terminal operations do not cause conflicts between individuals and groups.
X8	A sense of ownership and pride among the user community toward airport terminal operations.
X9	Proper management of noise, water, and air pollution, as well as waste.
X10	The aesthetic quality of the airport terminal design as perceived by users.
X11	Management commitment to meeting the needs of airport terminal users.
X12	The airport terminal provides privacy area facilities.
X13	The airport terminal is designed with cultural and ethnic identity.
X14	Disabled-friendly access at the airport terminal.
X15	The airport terminal has a multilingual information system.
X16	Providing sufficient parking areas for airport users.
X17	Easy access to emergency facilities (availability of evacuation routes and assembly points).
X18	Travel time and distance from the entrance to the gate for people with disabilities and the elderly.
X19	The airport terminal supports cost affordability for all user groups.
X20	The terminal implements energy and water efficiency.
X21	Utilization of natural materials for sustainable terminal building construction.

Source : Researcher's work, 2026

Main Survey

The main survey was conducted following the completion of the preliminary survey by distributing questionnaires to the designated respondents (airport terminal end-users, operators, and construction service providers). The questionnaire distribution in this study was carried out in two stages: the pilot test and the core questionnaire distribution. The pilot test was conducted with eight potential respondents to ensure the questionnaire was easily understood. During this process, respondents were asked for feedback, and necessary revisions were made before re-testing. If the first respondent understood the questionnaire well, it was then tested on the second respondent to ensure clarity and identify any further areas for improvement. Revisions were made based on feedback from the first through the fifth respondents; however, from the fifth to the eighth respondents, no further changes were required, concluding that the questionnaire was well-understood.

The questionnaire distribution process followed the criteria established in Chapter 3, accompanied by a recommendation letter from the university. Respondents were given a specific timeframe to complete the survey, with a maximum duration of 14 working days. The collected data were processed using statistical methods, then further analyzed and interpreted to achieve the research objectives.

Prior to the main data analysis, a data screening process was performed. This involved removing unsuitable data, such as incomplete responses, inconsistent answers, and respondents who did not meet the predetermined characteristics, to ensure the quality and validity of the analyzed data. Out of the 120 responses received, 100 were selected for final analysis after the screening process.

Of the 100 respondents, 34% were airport terminal end-users, 33% were airport operators, and 33% were construction service providers (consultants/contractors). In terms of age, 1% of respondents were over 50 years old, 13% were between 41 and 50 years old, 39% were between 31 and 40 years old, and the most dominant group consisted of respondents aged 20 to 30 years, accounting for 47% of the total. Therefore, the researcher considers the age of the respondents to be adequate for providing informed opinions regarding the research object. Based on educational background, 4% of respondents had a high school education or equivalent, and 1% of the construction service user category were students. Furthermore, 9% of respondents held a diploma (D3), 19% were master's degree holders (S2), and 67% held a bachelor's degree (S1), representing the most dominant group in this study.

The instrument validity test was conducted using the Pearson Product-Moment correlation. Items are declared valid if the item-total correlation coefficient (r-calculated) is greater than the r-table value at a 5% significance level (r-table = 0.195 for n ≈ 100); thus, all items with r-calculated > 0.195 are declared valid (Arikunto, 2013). Since the R-coefficient value for each item is greater than 0.195, it can be concluded that all indicators used in this study are valid.

The Cronbach's Alpha value in this study is 0.936, which is greater than 0.60, indicating that the questionnaire items will yield consistent results when used repeatedly at different times. A Cronbach's Alpha value above 0.80 indicates good reliability.

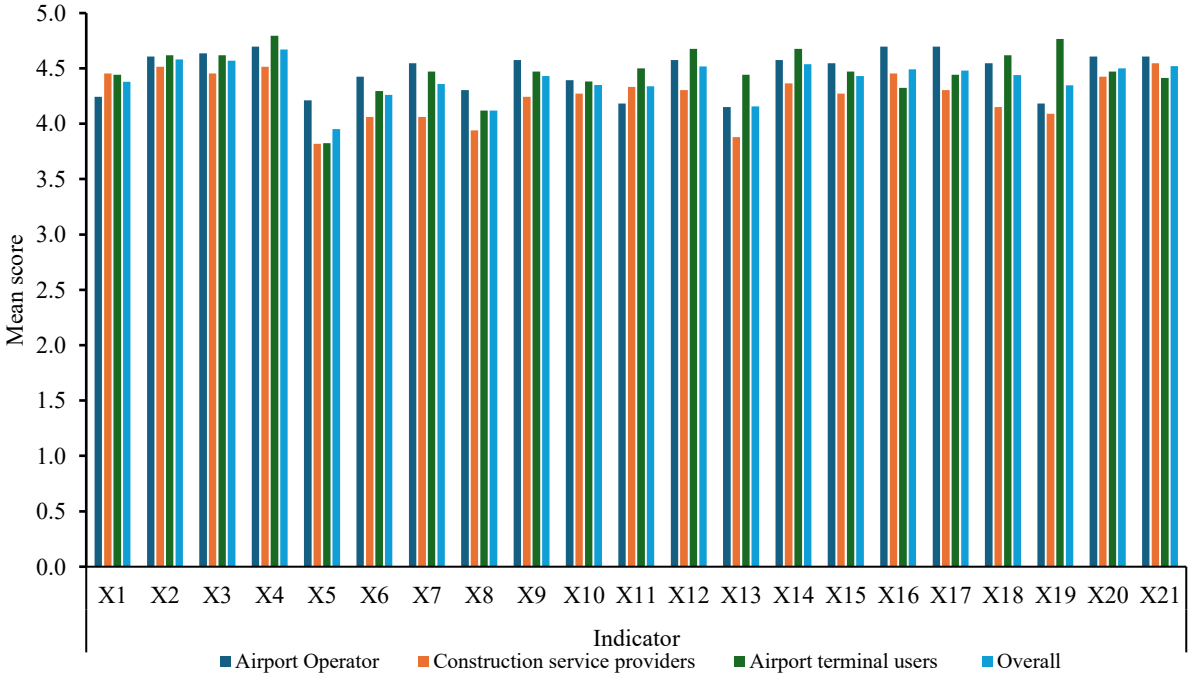

Figure 1.Mean Test Result

Source : Researcher's work, 2026

Based on the results shown in Figure above, the variable ranked as most important by all respondents is the airport terminal's ability to provide a sense of security, with a mean score of 4.67. This is further reinforced by the perception of end-users, who identify the building's ability to provide safety as a crucial variable. This attribute represents a fundamental function of any building and is naturally significant to all stakeholders; although airport operators and construction service providers do not rank it as their top priority, it remains within their top three.

Following this, the proximity of the airport terminal to public transportation and its supporting facilities ranked next, with a mean score of 4.58. This is followed by the indicator for airport terminal facilities designed with accessibility in sustainable design, with a mean score of 4.57. This finding is supported by the perceptions of service users specifically respondents closely involved in the use and management of the building who categorized it as an essential variable.

DISCUSSION

Social sustainability within airport terminals begins with the fundamental principles of accessibility and inclusivity, ensuring that facilities are accessible to all individuals without discrimination based on economic status, race, or social background (Darcy & Dickson, 2009). This is further supported by the strategic location of the terminal, which must be integrated with public transportation networks (Budd et al., 2011), and the implementation of universal design principles that accommodate the elderly, children, and other vulnerable groups (Darko et al., 2012). Specifically, the provision of physical access for people with disabilities—such as wheelchairs and clear tactile signage—reflects social equity in public services (Chang & Chen, 2012). Furthermore, the aspect of affordability across all services ensures that air transport does not exacerbate gaps in accessibility for the general public (Raimundo et al., 2023).

In terms of comfort and safety, terminals must provide a sense of security through environmental design and integrated security systems that minimize potential threats (Mapunda & Mwageni, 2025). Preparedness for emergency

conditions is also a priority, achieved through clearly marked and easily accessible evacuation routes and assembly points (Zhang et al., 2025). From a psychological perspective, the aesthetic quality of architecture and interior design plays a vital role in creating a pleasant emotional experience for passengers (Poerwadi, 2024). This is complemented by the availability of private spaces, such as nursing rooms and prayer facilities, which enhance the overall well-being of users (Yazgan, 2024).

From a socio-economic standpoint, airport operations should function as an economic driver by creating new employment opportunities and supporting local SMEs to reduce social inequality (Ratso & Sheard, 2024). The terminal also serves as a "third space"—a public realm that encourages social interaction among individuals (Losekoot, 2015). To maintain social harmony, management must mitigate potential disputes through transparent communication (Hauptvogel et al., 2024) and demonstrate a commitment to meeting user needs by being responsive to feedback (Olabi et al., 2025). A sense of community ownership is further strengthened by incorporating local cultural and ethnic identities into the building design, serving as a symbol of regional pride (Wattanacharoensil et al., 2022; Elmoghazy et al., 2025).

Operational efficiency remains a critical indicator, where multilingual information systems are essential to facilitate fair navigation for global passengers (Wattanacharoensil et al., 2022). Regarding landside access, the provision of adequate parking and organized drop-off areas is key to user satisfaction (Tam et al., 2011). Within the terminal, an efficient layout that minimizes transit time from the entrance to the boarding gate is crucial for reducing passenger stress and fatigue (Otieno, 2025). Finally, social sustainability is integrated with environmental responsibility, including strict pollution and waste management (Sreenath, 2021), the implementation of energy and water efficiency (Sreenath et al., 2021), and the use of sustainable natural building materials to support the long-term health and quality of life of the users (Olabi et al., 2025).

Five indicators achieved the highest rankings, serving as key factors for achieving long-term socially sustainable airport terminals: (1) the airport terminal provides a sense of security for users against threats and hazards. This indicator signifies that the airport terminal provides a sense of security for users through the provision of security systems, supporting facilities, and environmental designs capable of minimizing potential threats and hazards, allowing users to engage in activities comfortably and protected while within the terminal area. Research by Mapunda & Mwageni (2025) states that the implementation of integrated security systems and safety-oriented terminal designs is proven to enhance the sense of security and comfort for airport users during their time in the terminal area; (2) the location of the airport terminal is close to public transportation access and various supporting facilities. This can be interpreted as the airport terminal's position being integrated with an efficient and adequate public transportation network, as well as being surrounded by supporting facilities that facilitate users, thereby promoting ease of access for users from various locations. According to Budd et al. (2011), an airport location integrated with public transportation is essential for supporting sustainable and inclusive access.; (3) airport terminal facilities are designed with accessibility in sustainable design. This can be interpreted as all spatial elements, facilities, and terminal service systems being designed inclusively to be usable by all users, including people with disabilities, the elderly, children, and other vulnerable groups, without compromising efficiency, comfort, or the long-term sustainability of the building's function. Darko et al. (2012) revealed that physical terminal facilities utilize Universal Design principles to ensure they are easily accessible and usable by everyone, including those with limited mobility, while simultaneously implementing resource efficiency and minimal environmental impact in the long term.; (4) disabled-friendly access at the airport terminal. This indicator signifies the provision of physical facilities and specialized services (such as wheelchairs, dedicated elevators, or easy-to-read signage) to guarantee ease of navigation and terminal use for people with disabilities. The provision of access and disabled-friendly facilities at airport terminals reflects the principles of inclusivity and social justice, ensuring that all user groups have equal opportunities to access and utilize public facilities, thereby supporting the social sustainability of airport terminal operations (Chang & Chen, 2012).; and (5) the airport terminal provides privacy area facilities. This indicator signifies the availability of specialized spaces (such as nursing rooms, prayer rooms, or rest areas) that accommodate the personal and privacy needs of terminal users. The provision of privacy spaces, such as nursing rooms, prayer rooms, and comfortable rest areas in airport terminals, not only meets the diverse basic needs of users but also enhances the accessibility of facilities for all passenger groups. This creates an inclusive and equitable environment that contributes to social well-being and the overall quality of the user experience (Yazgan, 2024).

CONCLUSION

There are 21 indicators identified to measure Social Sustainability in airport terminals on Java Island. Five indicators achieved the highest rankings, serving as key factors for achieving long-term socially sustainable airport terminals: (1) the airport terminal provides a sense of security for users against threats and hazards; (2) the location of the airport terminal is close to public transportation access and various supporting facilities; (3) airport terminal

facilities are designed with accessibility in sustainable design; (4) disabled-friendly access at the airport terminal; and (5) the airport terminal provides privacy area facilities.

This research provides an understanding of social sustainability indicators for international airport terminal buildings in Indonesia. These indicators serve as essential references for delivering social benefits to stakeholders, particularly the end-users of the airport terminal. Implementing the concept of sustainability is vital to ensure a balance between the economic, environmental, and social aspects of sustainability. Consequently, this balance will ensure that maximum benefits are delivered to society, stakeholders, and lead to more successful infrastructure projects. However, this paper represents only an initial step.

This research only focuses on international airports on the island of Java and only uses descriptive methods. Further research needs to expand the research object area to other regions and needs to assess the differences in perceptions between stakeholders, as well as need to classify social sustainability factors in airport terminal infrastructure.

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