Original Article

Optimising Space Utilisation in Public Bus Terminals: Exploring the Link Between Space Management and User Satisfaction

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Abstract

Public transportation hubs, especially for terminal buses, operate in many cities worldwide. The efficient utilisation of space in public utilities and facilities for transportation hubs, especially in terminal buses, is crucial. However, poor space management in bus terminals can lead to congestion, overcrowding, a lack of waiting places, inefficient space allocation, underutilization of certain areas, and many more issues that negatively impact operational inefficiencies and user experience. To settle these issues, efficient space management is crucial for enhancing user satisfaction. Therefore, to optimise space utilisation in Public Bus Terminals, this paper explores the direct relationship between space management and user satisfaction. The study highlights the theoretical framework that links the relationship between space management and user satisfaction. These findings also highlight the key factors of space management and space utilisation elements affecting user satisfaction, including waiting area availability, seating comfort, and passenger flow management. These factors will be incorporated as key variables in the questionnaire to assess their impact on user satisfaction in public transportation terminals. The findings emphasise the need for strategic space management to encourage several passengers and offer a positive experience, thereby reducing the cost of wasted space and optimising its use.

1. Introduction

The efficient utilisation of space in public utilities and facilities for transportation hubs, especially in terminal buses, is crucial. Public transport provides an accessible introductory text to the field of public transport systems, covering bus, coach, rail, metro, domestic air, and taxi modes [1]. However, poor space management often results in overcrowding, inefficient space allocation, imperfect spaces in the waiting area, and underutilization of certain regions, leading to operational inefficiencies and reducing passenger comfort. To address these issues, this paper explores the link between space management and

user satisfaction by focusing on what factors influence user satisfaction in public bus terminals. Grounded in Environmental Psychology Theory by Mehrabian and Russell [2], this study explains how spatial configurations impact overall experience in public transportation facilities. Mehrabian and Russell [2] posited that environmental stimuli influence an individual's emotional state and user satisfaction. This assumes that the consumer's emotional state mediates the effect of atmosphere (the stimulus) on consumer behaviour. For instance, a well-designed terminal with clear signage and ample space can enhance comfort and user satisfaction. Conversely, poorly designed spaces in a terminal may affect consumers' emotional state and user satisfaction.

According to Currie et al. [3], enhancing the quality of service and facilities of public transport is often considered a strategy to encourage passengers to use bus transit. Moreover, according to Cartenì et al. [4], transport quality has long been recognised as an important factor in influencing travellers' behaviour, and transport terminal quality undoubtedly plays no small part. Most passengers are more likely and willing to pay for a high-quality bus terminal. Public utilities and facilities for transportation hubs, especially terminal buses, operate in many cities worldwide. As Lindau et al. [5] mentioned, it provides affordable connectivity and rapid and reliable services for a range of requirements. According to Currie et al. [3], transport quality has long been recognised as an important factor in influencing travellers' behaviour, and transport terminal quality undoubtedly plays no small part.

Efficient space utilisation is one of the critical components of facility management, especially in high-traffic transportation hubs, such as bus terminals. Space utilisation enables organisations to assess how employees interact and use different areas, such as workspaces and conference rooms. These insights can then be leveraged to optimise space usage and reduce costs. This has subsequently led to challenges in providing suitable bus terminals. In addition, Archibus [6] stated that the goal of space management is to effectively manage the space, thereby reducing the cost of wasted space and optimising its use. Space management plays an important role in ensuring that the related organisation achieves its business goals. Optimising space management contributes to the efficiency and success of most organisations [7]. In addition, space management is one component of facility management. Space management is one of the most important components in facilities management [7].

A space audit is a systematic assessment of a space's current and future use, as well as its strengths and weaknesses. It can help identify and address security risks by evaluating the existing and potential threats, vulnerabilities, and countermeasures. A space audit can be conducted to review the current performance or the existing position of the available space within the building. The information and data obtained from a space audit are used to update an existing place. As Wan Hamdan et al. [8] indicated, space audits offer data for evaluating space use, planning future adjustments to meet evolving needs, and realigning program priorities. Consequently, this paper investigates the direct link between space management and user satisfaction to enhance space utilisation at public bus terminals.

2. Literature Review

2.1. Terminal Bus and Public Transportation

Cities worldwide have grown rapidly in recent decades and are expected to keep growing significantly in the future. Public utilities and facilities for transportation hubs, especially terminal buses, operate in many cities worldwide. It provides affordable connectivity and fast and reliable services for various requirements [5]. A transport hub is crucial to sustainable urban transport policies [9]. It is a more complex transport facility than a conventional station, allowing travellers to transfer from one mode to another [10]. According to Hörcher et al. [11], public transport, defined as high-capacity vehicle sharing with fixed routes and schedules, is the backbone of urban transport systems in global cities, especially

in densely populated metropolitan areas. The study by Saif et al. [12] highlighted accessibility as a crucial outcome of the transportation system. Public utilities and facilities, especially in bus terminals, are vital in supporting transportation hubs by connecting cities with diverse destinations nationally and internationally. Effective public transit is central to development [13]. In addition, as with all public services, public transport should meet the needs and expectations of its users [14]. Therefore, as the number of users increases, there is a pressing need to optimise available space to enhance operational efficiency and improve the overall passenger experience.

2.2. Space Management

According to Archibus [6], space management involves effectively managing the space to reduce the cost of wasted space and optimise its use. Space management ensures that the related organisation achieves its business goals. Optimising space management contributes to the efficiency and success of most organisations [7]. Space management is the most important aspect of public management of physical resources, not only in terms of optimisation, but also related to the cost of maintenance operations [15]. Additionally, space management is important in effectively managing space without wasting space, indirectly impacting the price [7]. According to the study by Lawrence et al. [16], using space directly impacts the costs associated with other operations. Increased space usage correlates with higher energy expenses, as well as greater requirements for cleaning and maintenance. Without systematic management, inefficient use of space may lead to unnecessary waste.

2.3. Space Audit

An efficient space audit is used as designed, is occupied, and assesses the quality and physical conditions of each space in the existing building. The information and data that are obtained from a space audit are used to update an existing place. As Wan Hamdan et al. [8] stated, space audits provide information for assessing space allocations, prospective planning to accommodate changing situations and realigning program priorities. The audit process typically includes evaluating factors such as space capacity, occupancy, frequency of use, and the condition of the space [17].

2.4. Space Utilisation

Optimisation of space utilisation can be interpreted as an effort to compile, organise, and integrate building elements to maximise space effectiveness and efficiency [18]. It involves assessing how space is allocated and used, aiming to improve efficiency and effectiveness. Efficient space usage enhances the aesthetics and flow of an environment, leading to improved morale and workplace satisfaction. Comfort, attractiveness, excellent quality, and accessibility serve as measuring constructs for the efficient use of public space [19]. Utilising space effectively is important because it maximises the functionality of an area, enhances productivity, and can significantly reduce costs by minimising wasted space. Abdul Rahman et al. [17] mentioned that the space utilisation analysis has been used to evaluate the existing assets to accommodate current and future needs of the space within the organisation.

2.5. User Satisfaction

User satisfaction is a key indicator of the effectiveness of any facility. It reflects whether the passenger's expectations have been met or exceeded, positively evaluating their interaction. User satisfaction is influenced by various factors, such as usability, functionality, reliability, customer support, and overall user experience. Thus, user satisfaction is considered an important metric in assessing the service quality [20]. According to Wong et al. [21], passengers are more likely to be satisfied with well-maintained and clean terminals and offer adequate seating, lighting, and signage. In conclusion, various

operational, service-related, and physical aspects affect how satisfied users are at bus terminals. Users are more likely to have an enjoyable journey and be more satisfied when a terminal performs well in areas including space quality, service delivery, safety, accessibility, and passenger flow management.

3.   Methodology

This paper adopts the research method of literature review. It collects academic papers, conference papers, books, journals, and authoritative industry reports in related fields from relevant platforms such as ScienceDirect, Scopus, Google Scholar and SpringerLink databases. The time limit is set between 2015 and 2024. It uses keywords such as " Space Utilisation", "Space Efficiency", "User Satisfaction", "Bus Terminal", and "Public Transportation Facilities" to ensure a comprehensive and relevant literature search.

In conducting the literature review, the study focuses on analysing cases and implementations in public bus terminals to understand how space management influences user satisfaction. The research aims are to explore the key factors affecting passenger experience, such as waiting area availability, seating arrangement, crowd management, accessibility, and others. Carefully read and analyse the references that can be retrieved, explore their research methods, research objectives, research results, research cases, etc., and extract helpful literature as the basis for this study.

The extracted data is then organised and synthesised to identify factors and challenges in optimising space utilisation in public bus terminals. It also highlights how space management influences user satisfaction. The literature review approach provides a comprehensive analysis of space management, focusing on strategies that enhance efficiency, passenger comfort, and overall terminal functionality.

This paper combines the analysis of academic papers, conference papers, and industry reports to provide a comprehensive overview of the topic and valuable insights into the field. In addition, it seeks to provide insights into effective space utilization strategies that enhance passenger comfort, operational efficiency, and overall service quality in public transportation hubs.

4.   Results

4.1. A Guiding Framework for Linking Space Management, Space Utilisation and User Satisfaction

According to Archibus [6], space management involves effectively managing the space to reduce the cost of wasted space and optimise its use. In public bus terminals, efficient space management is crucial in enhancing the user experience and satisfaction. This relationship can be further explained using Environmental Psychology Theory by Mehrabian and Russell [2], which suggests that the built environment will influence human behaviour, emotions, overall satisfaction, and others.

The Environmental Psychology Theory, developed by Albert Mehrabian and James A. Russell in 1974, offers a comprehensive framework for understanding how spatial configurations impact overall experience in public transportation facilities. When applied to public bus terminals, this theory consists of the Stimulus-Organism-Response (S-O-R) model, which assumes that environmental factors (Stimulus) will affect an individual's internal emotional state (Organism), subsequently leading to specific behavioural reactions (Response) [22].

Figure 1 is a guiding framework linking space management, space utilisation and user satisfaction based on the Environmental Psychology Theory by Mehrabian and Russell [2]. The pictures show the guiding framework that links space management, space utilisation and user satisfaction through the Stimulus-Organism-Response (S-O-R) model. Space management, as the (Stimulus-S), involves

strategic planning to enhance efficiency and functionality for effective spatial use. This will influence the efficiency of space utilisation as the (Organism-O) determines the available space is used effectively to serve its intended purpose. When space is well optimised, users experience reduced stress, greater ease, and improved comfort. As a result, user satisfaction as the (Response-R) increases, reflecting how comfortable and satisfied individuals feel with the environment and services provided. Lastly, positive user experiences foster public trust in transportation services and enhance the reputation of the terminal. This framework emphasizes the importance of effective space management in creating user-friendly and efficient environments.
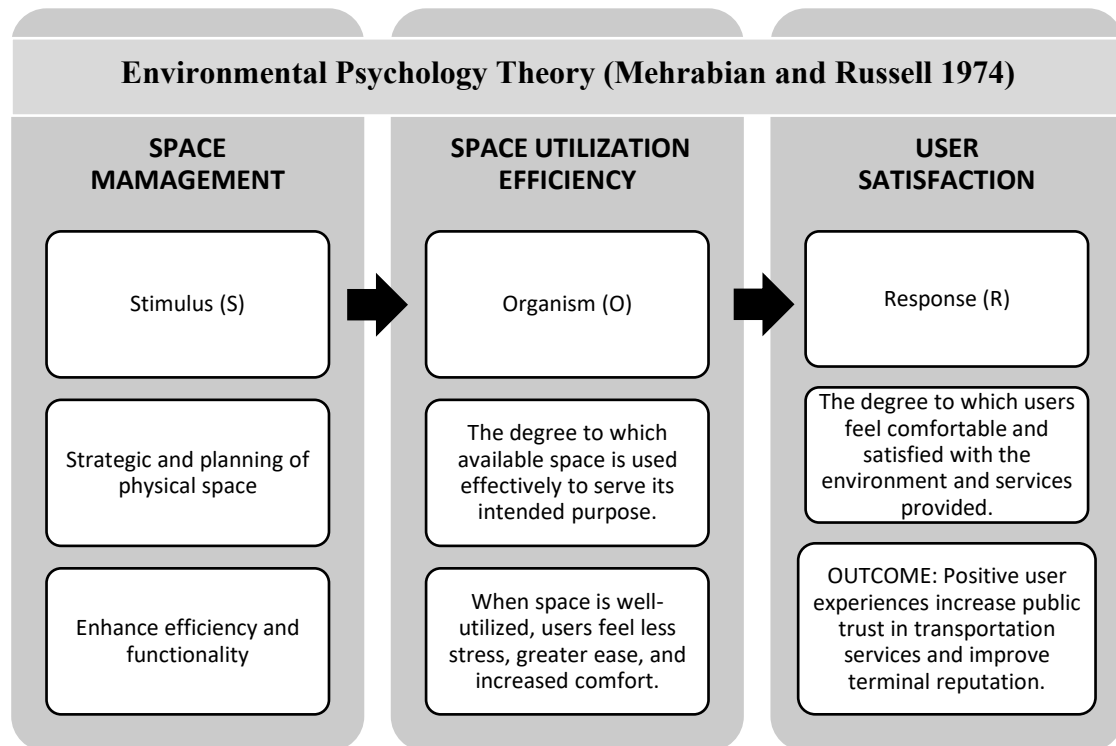

Figure 1: A guiding framework for linking space management, space utilisation and user satisfaction based on the Environmental Psychology Theory by Mehrabian and Russell [2].

4.2. Key Factors of Space Management and Space Utilisation Elements

Firstly, the questionnaire survey collected feedback from Bus Users on their satisfaction with space efficiency, comfort, and service quality. This survey will be administered to bus users/passengers to gather feedback on various aspects of the facilities and services. Based on respondents ' feedback, it is rated on a five-point linear scale (1-Very Dissatisfied, 2-Dissatisfied, 3-Less Satisfied, 4-Satisfied, 5-Very Satisfied). The collected data will be analysed and evaluated using Microsoft Excel, and a chart will be generated. The questionnaire consists of three sections:

- Section A: Respondent Information
- Section B: Level of Satisfaction
- Section C: User Suggestion (Open-Ended Question)

Based on the reviewed studies and findings, several key elements will be incorporated to measure user satisfaction effectively. These elements will be used as key metrics to assess user experience in bus terminals. It ensures that space is managed and utilised effectively to enhance passenger comfort, efficiency, and accessibility.

- Space Allocation: This includes evaluating the adequacy of waiting areas, seating arrangements, and ticketing or service counters. A well-designed waiting area with sufficient space and comfortable seating will enhance the user experience.
- Passenger Flow Efficiency: It will be assessed through accessibility of entrances/exits, wayfinding signage, and crowd management strategies to minimise congestion and enhance passenger flow management.
- Space Efficiency: It consists of multi-purpose space use, facility utilisation rate, and vacant space management. Efficient space usage can enhance users' experience, decrease overcrowding, and ensure optimal functionality in terminal areas.
- User Satisfaction & Comfort: Elements such as cleanliness of seating areas and restrooms will be considered to evaluate overall comfort and satisfaction.

Table 1 shows the Key Constructs for Space Management & Utilisation. It is categorised into four main aspects: Space Allocation, Passenger Flow Efficiency, Space Efficiency, and User Satisfaction & Comfort. Each construct is associated with specific items that influence the effectiveness of space utilisation. Firstly, Space Allocation focuses on the adequacy of waiting areas, seating arrangements, and ticketing services and highlights studies on passengers' willingness to pay for better facilities. Next, Passenger Flow Efficiency emphasises accessibility and crowd management strategies, focusing on managing movement and passenger flow in transportation hubs. Followed by Space Efficiency, which consists of optimising space usage, facility utilisation, and vacant space management, and is supported by studies on campus and bus terminal layouts. Lastly, User Satisfaction & Comfort explores cleanliness, maintenance, and overall user experience, focusing on the research on public transport satisfaction factors and many more. A table consisting of each construct and references can provide a framework for evaluating and improving space management in transportation facilities to enhance the passenger experience and operational efficiency.

Table 1: Key Constructs for Space Management & Utilisation.

No.	Constructs	Items	References
1.	Space Allocation	Adequacy of waiting area Seating arrangements Ticketing and service counters	Cartenì et al. [4] Eboli and Mazzulla [23] Mehta et al. [24]
2.	Passenger Flow Efficiency	Accessibility of entrances/exits Crowd management strategies	Best et al. [25] Brown et al. [26] Chua et al. [27]
3.	Space Efficiency	Multi-purpose space usage Utilization rate of facilities Utilization of Vacant Spaces	Hasan et al. [28] Li [29] Zhang and Li [30]
4.	User Satisfaction & Comfort	Cleanliness and maintenance Overall user experience	Chauhan et al. [31] Chen and Lee [32] Arip et al. [33]

5. Conclusion

In conclusion, effective space utilisation in public transportation, especially in bus terminals, is crucial in enhancing user experience, improving operational efficiency, and many other aspects. This conceptual paper highlights the importance of optimising space utilisation in bus terminals to enhance space efficiency and improve user satisfaction. By addressing these critical elements, transportation hubs can create more sustainable, efficient, and user-oriented spaces. By implementing this research,

this study will successfully evaluate the existing space allocation and identify areas for improvement. The findings contribute to developing strategies that enhance space efficiency, improve passenger comfort, and optimise the overall functionality of bus terminals.

Declaration of Conflict of Interest

The authors declared no conflict of interest with any other party on the publication of the current work.

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