Evaluating Service Quality of Multimodal Transportation: A Case Study of Adi Soemarmo International Airport

Listantari[1] and Yessi Gusleni[2]
Ministry of Transportation
Jakarta, Indonesia
[1]listantari@dephub.go.id
[2]yessi_gusleni@dephub.go.id

Joewono Soemardjito
Center for Transportation and Logistics Studies
Universitas Gadjah Mada,Yogyakarta, Indonesia
Joewono_itok@ugm.ac.id

Yandra Rahadian Perdana
Department of Industrial Engineering - Faculty of Science and Technology
Universitas Islam Sunan Kalijaga
Yogyakarta, Indonesia
yandra.perdana@uin-suka.ac.id

Abstract

Adi Sumarmo International Airport, abbreviated as BIAS, played a central role in the multimodal transportation system in Central Java Province, Indonesia. On this basis, this study investigated the service quality of multimodal transportation in BIAS using the importance-performance analysis (IPA). This study measured 13 variables of multimodal services based on the level of performance and importance. The results revealed that currently, there has been an effective multimodal transportation services in supporting passenger mobility in BIAS, with an average score of 3.43. Meanwhile, respondents' assessment on the level of importance of all variables showed an average score of 4.36. From 13 variables of multimodal transportation services, the following three variables need to be prioritized to support efforts to increase service effectiveness: travel time, variety of transportation modes for other trips, and shelter facilities. This paper emphasizes the need to improve the existing multimodal transportation services in BIAS to meet user expectations.

Keywords
Airport, Multimodal, Service, Quality, Importance-Performance Analysis.

1. Introduction
Airports are one of the transportation nodes connected with the air transportation service network, road and rail as integrated transportation systems. Accordingly, airports perform a vital service as part of the transportation system, as long as they provide excellent (Prentice and Kadan 2019; Bellizzi et al. 2020; Hong et al. 2020; Pamucar et al. 2021) To deliver service excellence, airports need some support from a multimodal transportation system that is safe, highly accessible, highly certain, and environmentally friendly. Multimodal transportation aims to produce one-stop service and seamless services (Hsu 2012; Raghunathan et al. 2018; Babić et al. 2022). The implementation of a multimodal transportation system in airports is indicated by integrating various modes of transportation and infrastructure networks (Guo et al. 2021; Teodorović and Janić, 2022). From an operational aspect, multimodal transportation offers real-time information on departure and arrival schedules and an integrated payment system (Ma and Chen 2019; Paulsen et al. 2021). Thus, the keywords of the multimodal system are integrated services of various transportation modes that are interconnected and seamless.

In this context, Adi Sumarmo International Airport, popularly abbreviated as BIAS, takes a critical position in the transportation system on the island of Java, Indonesia, especially as a transportation network node in Central Java Province. From an economic point of view, BIAS is the entry point for business activities, where the movement of people using planes promotes the creation of business transactions, such as tourism and commerce. In particular, BIAS has a distinctive function as a node for Hajj departures from Central Java Province. The latest report from The Central Statistics Agency (BPS) Surakarta City showed that in 2019, the number of departures for domestic and international flights were 821,852 passengers; meanwhile, arrivals were 818,353 passengers (BPS Surakarta City, 2019). These numbers were relatively high compared to other airports in Central Java. Taking into account the integral role of BIAS, it is required to provide an excellent quality of service. Practically, the quality of transportation services at the airport requires a professional management. Considering that superior service is key to gain sustainable business, this study sought to measure the service quality in BIAS.

1.1 Objectives

This study aims to measure the quality of multimodal transportation services in BIAS.

2. Literature Review

2.1 Multimodal Transportation

Theoretically, public transportation services aim to make it easier for people to transport and to move from one location to another, both for short and long distances (Ceder 2021). Furthermore, public transportation can encourage a multiplier effect in the economy, with some consequences such as regional economic growth (Chatman and Noland 2011; Cigu et al. 2019). From the social aspect, public transportation provides opportunities for low-income people to travel within or between cities (Burguillo et al. 2017; Adnan et al. 2020; Bondemark et al. 2021). Moreover, a public transportation with a larger capacity than private vehicles can reduce congestion. Many countries encourage communities to take public transport for business or leisure travels (Bekiaris et al. 2020; Goletz et al. 2020; Liao et al. 2020; Woodcock and Tovey 2020). Therefore, the planning and implementation of public transportation-based transportation must be done effectively and efficiently (Lemonde et al. 2021). Effectiveness here requires the operation of public transportation services to ensure safety, timeliness, and reliability. Meanwhile, efficiency displays the need for public transportation services to provide customers with affordable prices and environmentally friendly services (Litman 2014; Fitzová et al. 2018). Recent studies unveiled that multimodal is a form of integrated transportation service that is proven to produce the process of mobility of people and goods effectively and efficiently (Miramontes et al. 2017).

Multimodal transportation highlights the seamless process of moving, both for people and goods, from the origin to the destination, using more than one mode of transport (Spickermann et al. 2014; Dixit et al. 2019). On this account, it is difficult to find an independent mode of transportation for public transport services since the trips from door to door require more than one mode (Alessandretti et al. 2022). For example, bus or train users must firstly take private vehicles (bike, motorcycle, car) to get to the bus shelter or train station (Song et al. 2017). Likewise, consumers may use private or public transportation connected to the airport before taking a flight. Therefore, connectivity becomes a vital requirement for multimodal transportation (Krygsman et al. 2004). For example, in the case of airports in China, the integration of air and rail transportation and their services at the Shanghai Hongqiao Integrated Transport Hub in China recommends an integrated system of services, including ticket integration, direct baggage transfer services, and train connections (Chen and Lin 2016). Hence, several criteria must be met to get excellent multimodal transportation connectivity. The first criteria is the availability of information and certainty of public transportation schedules (Sparing and Goverde 2013). The second criteria is the requirement for multimodal transportation to have supporting facilities for accessibility to transit locations (airports, shelters, train stations), such as pedestrians. Lastly, multimodal transportation system also needs integrated tickets and a payment system (Grotenhuis et al. 2007; Zografos et al. 2009; Schakenbos et al. 2016).

Previous literature (Rodriguez-Valencia et al. 2019; Chauhan et al. 2022) revealed that the success of multimodal implementation is determined by strategic decisions, namely the acquisition of consumer needs. Consumer perception is needed considering that they are users of multimodal transportation services. Furthermore, measuring existing transportation services by consumers is essential as part of the transport management cycle. Evaluation is articulated

through the measurement of various attributes of multimodal transportation services. Accordingly, this study evaluates multimodal transportation services at BIAS as a measurable step to create superior services.

3. Methods

The multimodal transportation services was analyzed using importance and performance analysis (IPA). This method measures the level of satisfaction based on the perceptions of users/customers. The measurement instrument in this method is based on two main assumptions, namely the level of performance and the level of importance (Martilla and James 1977). In this study, the level of performance was measured using a scale of 1-5, from very poor to very good. Additionally, the level of importance was measured using a scale of 1-5, from very unimportant to very important. The results of the measurements were mapped into four quadrants, as explained in the followings (Figure 1).

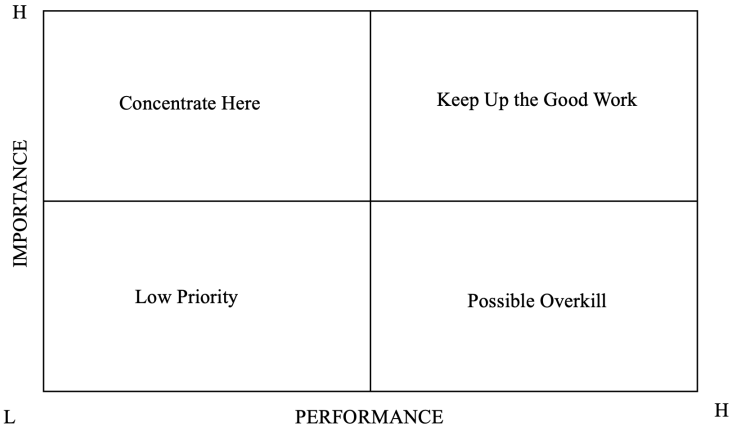

Figure 1. Quadrant of Service Performance and Importance

a. Concentrate here: this quadrant serves as improvement priority, where consumers perceive a service variable as important but poorly performed.
b. Keep up with the good work: this quadrant illustrates that consumers are satisfied with the service, which is indicated by a high level of importance followed by excellent performance.
c. Low priority: in this quadrant, the level of importance is perceived as low, so service quality improvement is not a priority for improvement even though the service performance is low.
d. Possible overkill: this quadrant indicates that consumers feel that the service variable has an excellent level of performance, even though it is perceived as unimportant.

4. Data Collection

The indicators of multimodal transportation services used as research variables are (1) the facility for changing modes from private vehicles to public transportation; (2) public transportation services to the airport (park-n-ride); (3) integrated public transport schedule; (4) integrated public transport ticketing system; (5) ticket payment system; (6) public transport capacity; (7) the travel time of public transportation; (8) the variety of connecting modes at the airport; (9) public transport travel information system; (10) shelter facilities; (11) feeder transportation; (12) supporting facilities for changing modes at the airport (corridors, waiting rooms, etc.); and (13) baggage service in public transport. The research data were collected from a primary survey involving 44 respondents who were airplane passengers at BIAS. To obtain validity, this study used face validity, where the questionnaire instrument was discussed and validated through a group discussion forum (FGD). The FGD participants came from Angkasa Pura (Airport Service), Central Java Provincial Transportation Service, and PT Kereta Api Indonesia (Train Company).

5. Results and Discussion

Before the IPA analysis, this study mapped two travel patterns of passengers in general. The first is the travel pattern of passengers departing from BIAS as the trip's starting point. The second describes the pattern of continued travel of airplane passengers arriving at BIAS. The two patterns are illustrated in Figure 2.

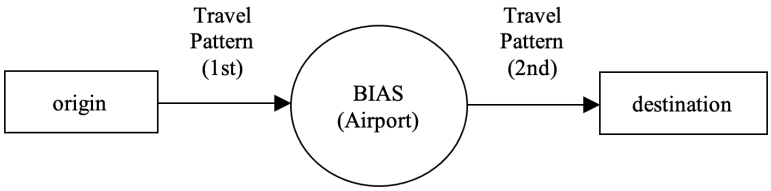

Figure 2. Travel Pattern

Referring to Figure 2, a more detailed mapping has been carried out regarding the travel patterns of airplane passengers departing from BIAS. The information acquired from survey respondents indicated the use of various modes of transportation, as presented in Table 1.

Table 1. The Travel Pattern of Airplane Passengers Departing from BIAS as The Starting Point of Their Journey

Travel Pattern	Number
Origin ➔ private vehicle (car/motorcycle)➔ airport (BIAS) ➔ airplane	20
Origin ➔ walk ➔ bus shelter ➔ public transportation (Bus)➔ airport (BIAS) ➔ airplane	1
Origin ➔ private vehicle (car/motorcycle)➔ Train Station ➔ Train ➔ airport (BIAS) ➔ airplane	1
Origin ➔ taxibike ➔ bus station ➔ public transportation (Bus) ➔ airport (BIAS) ➔ airplane	3
Origin ➔ taxibike ➔ airport (BIAS) ➔ airplane	4
Origin ➔ taxi car ➔ airport (BIAS) ➔ airplane	12
Others (renting a car from a rental company)	2
Unidentified	1
Total	44

Furthermore, for passengers who disembark at BIAS, the pattern of continued travel based on information from survey respondents is illustrated in Table 2.

Table 2. Travel Patterns of Airplane Passengers Arriving at BIAS

Travel Pattern	Number
Disembarking from the plane (BIAS) ➔ private vehicle (car/motorcycle)➔ destination	19
Disembarking from the plane (BIAS) ➔ taxibike ➔ bus station ➔ public transportation (Bus) ➔ destination	1
Disembarking from the plane (BIAS) ➔ taxibike ➔ destination	1
Disembarking from the plane (BIAS) ➔ public transportation (Bus)➔ destination	1
Disembarking from the plane (BIAS) ➔ Train Station at airport (BIAS) ➔ train ➔ Solo Balapan Train Station ➔ train ➔ destination	3
Disembarking from the plane (BIAS) ➔ Train Station at airport (BIAS) ➔ train ➔ Solo Balapan Train Station ➔ bus station ➔ public transportation (Bus) ➔ destination	1
Disembarking from the plane (BIAS) ➔ taxi car ➔ destination	16
Disembarking from the plane (BIAS) ➔ taxi car ➔ bus station ➔ public transportation (Bus) ➔ destination	1
Unidentified	1
Total	44

Moreover, the measurement of the quality services of multimodal transportation using the IPA are shown in Table 3.

Table 3. The Measurement of Level of Performance and Importance

No	Variables	Performance	Importance
1	The facility for changing modes from private vehicles to public transportation (park-n-ride)	3,53	4,16
2	Public transportation services to the airport	3,49	4,21
3	Integrated public transport schedule	3,49	4,40
4	An integrated public transport ticketing system	3,26	4,23
5	Ticket payment system	3,33	4,23
6	Public transport capacity	3,42	4,35
7	The travel time of public transportation	3,38	4,42
8	The variety of connecting modes at the airport	3,40	4,42
9	Public transport travel information system	3,51	4,58
10	Shelter facilities	3,40	4,48
11	Feeder transportation	3,47	4,40
12	Supporting facilities for changing modes at the airport (corridors, waiting rooms, etc.)	3,50	4,43
13	Baggage service in public transport	3,42	4,33
Average		3,43	4,36

Then, according to Figure 3, the results of the IPA showed that the average performance assessment of multimodal transportation services in BIAS is 3,43; it can be interpreted that the multimodal transportation service is currently seen as having a good enough condition leading to a good condition. Meanwhile, the average level of importance of all these variables is 4,36, meaning that it is deemed to have a good performance leading towards very good. Suppose the current performance appraisal is compared with the ideal level or performance condition (score 5), the current performance achievement in aggregate is 68,6%, whereas when compared with the respondents' level of interest/expectations, the recent performance achievement has reached 78,8%.

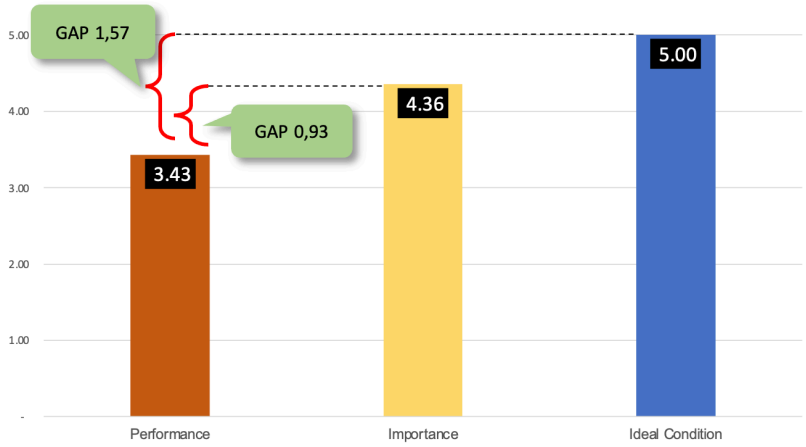

Figure 3. Gap Between Performance and Importance

Subsequently, according to Figure 4, IPA's result showed three variables considered necessary for improvement: the travel time of public transportation, the variety of connecting modes at the airport, and shelter facilities.

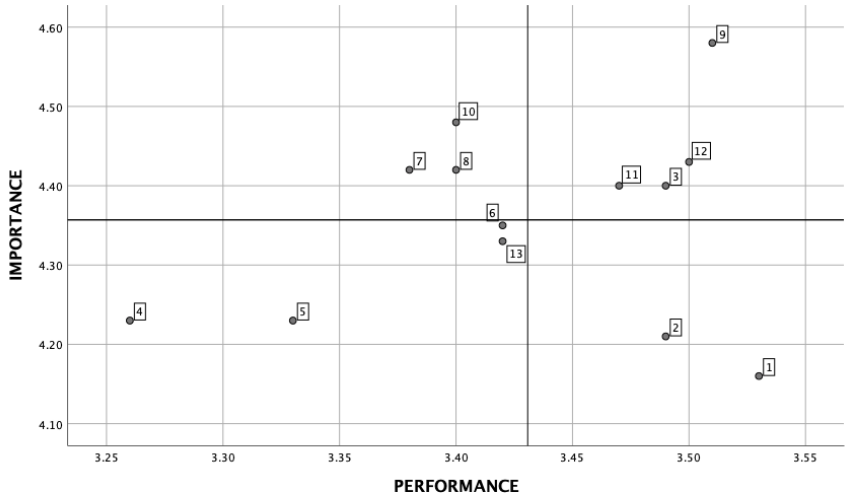

Figure 4. Matrix of Importance-Performance Analysis

Travel Time

Travel time represents the time required for mobility to finish the trip from node origin to destination. Public transport travel time from and to the airport is perceived as very important to improve. Respondents view that the current travel time of public transportation, such as Public Buses are uncertain. This uncertainty is feared to discourage consumers from using public transportation services. The certainty of travel time is undoubtedly a necessity that must be improved. The level of performance, in the sense of transportation services, is dependent on the proper schedule, both at the time of departure and arrival. Several solutions to this problem include changing routes, increasing the number of buses, using the Global positioning system for route tracking, and determining standard travel times. Moreover, the certainty of travel time performance will assist consumers in managing their trips and increase public interest in public transportation.

The Variety of Connecting Modes at The Airport

This study showed that the availability of a variety of public transportation is considered to have a low performance and is essential to be set as improvement priority. The availability of various public transportation service options to support travel to and from the airport is vital according to the passengers' perception. Airplane passengers who want speed and flexibility in their journey will choose a taxi or motorcycle taxi rather than buses or trains. The BIAS needs the availability of more choices of public transportation that airport passengers can access. Additionally, easily accessible public transportation services and transportation operational information (affordable schedules and fares) are needed to reduce dependence on private vehicles.

Shelter Facilities

The IPA results showed that consumers perceived shelter facilities' quality as underperforming. A direct observation in the shelter revealed that the facilities necessitated some improvement. For example, the setting room temperature needs to be adjusted to cooler during rush or peak hours to ensure passengers' comfort. In addition, the shelter needs to add the facility of adequate trolleys during peak hours, especially for passengers carrying a lot of luggage.

6. Conclusion

This study aims to investigate the quality of existing services at BIAS. It found the need to improve three variables. The first finding showed that the airport understudy had not shown a good performance in ensuring the travel time. Consumers felt that there had been uncertain travel time of the mode of transportation to the airport and vice versa. Moreover, this study also highlighted that passengers have limited choices of the transportation modes from the airport to their home. Finally, this study recommended that there is a need to improve the operation of shelter facilities. For further research, longitudinal and action research are needed to see changes before and after service improvement.

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Biographies

Listantari is a researcher at the Transportation Research and Development Agency, Ministry of Transportation, Indonesia. Her expertise is in multimodal transport management.

Yessi Gusleni is a researcher at the Transportation Research and Development Agency, Ministry of Transportation, Indonesia. Her research interests include multimodal transport, economics transport.

Joewono Soemardjito is a researcher at the Center for Transportation and Logistics Studies, Universitas Gadjah Mada. His research interest includes transportation and logistics policy, environmental and social issues.

Yandra Rahadian Perdana is a senior lecturer in the Department of Industrial Engineering, Faculty of Science and Technology, Universitas Islam Negeri Sunan Kalijaga. His research interests include logistics, supply chains, and lean management (corresponding author).