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Transportation Mode Choice and Sustainability: A Study of Tourist Transportation in The National Tourism Strategic Area Ciwidey

Umar Fariz[1*], Nahry[2], Gloriani Novita Christine[3]
Universitas Indonesia[1,2], PTDI-STTD[3]

Abstract

This study conducted in Bandung Regency delves into the factors influencing the choice of transportation modes for tourists and provides practical insights. Specifically, the research examines the influence of park-and-ride security, travel time savings, and travel costs on the selection of private vehicles and shuttle buses. The findings emphasize the importance of sustainable transportation facilities and efficient public transport services, offering a practical roadmap for addressing transportation needs for tourists in Bandung Regency. With a focus on the park-and-ride concept, this research identifies and analyzes the factors influencing mode choice between private vehicles and public transportation. The study was conducted in Ciwidey, a natural tourism area in Bandung Regency, which offers diverse attractions such as nature-based tourism, ancient sites, culinary experiences, and water tourism. The findings of this research aim to contribute to the improvement of sustainable transportation and mobility choices for tourists while alleviating traffic congestion and environmental impact in Bandung Regency's tourism areas.

Keywords: Mode Choice, Park and Ride, Likert scale, Analytical Hierarchy Process

A. INTRODUCTION

Transportation is not just a means of getting from generating region to destination in tourism activities, it is a strategic element. It serves as a medium for transporting tourists from the origin area to tourist destinations (Cooper, 2005). The tourism system is divided into two sides, namely supply and demand (Var & Gunn, 2020). Demand concerns someone with the will and ability to travel, while supply is related to four components: attractions, transportation, services, and information (promotion). Transportation, as a key component of the supply side, plays a crucial role in the overall tourism system.

According to Middleton and Clarke, (2012), several things that can support tourism include tourist attractions, managers of tourist attractions, lodging services and facilities offered, and transportation or travel organizers. The transportation sector strongly influences tourism activities. Undeniably, transportation's primary function is very closely related to accessibility (Moeis & Ali, 2012). The development of transportation, therefore, plays a pivotal role in enhancing tourism supply, ensuring that tourists have the necessary means to access and explore various destinations. This is an essential concern of the government in providing the best service for tourists.

The expansion of tourism activities is closely related to transportation demand and congestion, which are sources of damage to nature and the image of destinations (Jo et al., 2016). Increased travel intensity, which needs to be balanced with excellent road infrastructure, will affect the decline in the level of services on a road section and impact congestion. This is directly proportional to the number of private vehicle owners in Indonesia in 2021, which increased by 6.99% from the previous year (Badan Pusat Statistik., 2022). The high growth of private vehicle ownership spurs congestion problems, extends travel time, increases energy consumption, worsens environmental pollution and results in traffic accidents (Ye, 2012). The congestion problem can occur continuously and can only be solved if residents, especially tourists, have viable mobility alternatives to consider (Gonzales et al., 2019).

* Corresponding author: Umar Fariz; email: umar.fariz@ui.ac.id
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Indonesia is an archipelagic country that has extraordinary natural tourism potential. One of Indonesia's regions with popular natural attractions is Bandung Regency. It was noted that in 2021, the number of visitors to tourist attractions in Bandung Regency reached 1,836,675 visitors, or an average per day of 5,032 visitors, and was ranked fifth (five) with the highest number of tourists in West Java Province (BPS, 2022). In the National Tourism Development Master Plan for 2010 - 2025, a comprehensive strategy was outlined to develop Indonesia's tourism sector, including the identification of National Tourism Strategic Areas. Ciwidey, where this study was conducted, is one of these strategic areas. The problems experienced in going to the natural tourism area are the narrow and uphill road geometry and the location of congestion on weekends or holiday seasons. Congestion occurs not only on the main route but also on alternative routes. Geometric conditions in the area make it challenging to intervene to widen or add roads because the surrounding land is used as a residence, and other land designations are difficult to change.

Therefore, efforts are needed to limit traffic through Travel Demand Management and transfer the movement of people who initially used private vehicles to public transportation. One of the efforts to improve mobility choices (pull factor) and optimize the role of mass transportation can be implemented with the park-and-ride concept. Park and ride schemes can be used as a promotional event for public transportation, reducing traffic congestion levels and reducing carbon pollution (Pickett et al., 1999 in Asapa, 2014). This study identifies and analyses the factors influencing mode choice between private vehicles and public transportation available on park and ride services.

B. RESEARCH METHOD

Research Location

The research was conducted in Ciwidey, a natural tourism located in Bandung Regency and one of the National Tourism Strategic Areas in West Java. Ciwidey offers various types of tourism, such as nature-based tourism, ancient sites, culinary, and water tourism. Even more interestingly, there are inns in the middle of nature so visitors can enjoy their holidays more quietly without any noise. Ciwidey's natural tourism contribution is relatively high, in 2021, the number of visitors who came to this tour reached 1,836,675. Ciwidey is located ±25 kilometres from Bandung Regency and Soreang Toll Exit. There are two routes to get to Ciwidey: the main route via the Soreang – Ciwidey National Road or via the alternative route Pangalengan. These two roads are often very congested due to parking lots and the high volume of tourist vehicles, especially on weekends and national holidays.

Research Method

The first step in this study is to conduct a literature review to identify common factors that influence mode choice in park-and-ride service plans. The literature review results obtained several factors that can be seen in Table 1. From the results of identifying the factors that influence the use of park-and-ride services, in the next step, a survey is carried out to determine the factors that have a higher influence on someone using park-and-ride services. The target of this study is tourists visiting Ciwidey both from Bandung and outside Bandung.

This research uses two stages, namely an influence factor survey with a Likert scale and continued with the Analytical Hierarchy Process (AHP) method. The first step uses the Likert scale, a study of mode choice factors, to rank affect mode selection so that five weights of the most critical factors are obtained (See table 2). The survey was conducted by distributing questionnaires directly to tourists visiting Ciwidey with private vehicles. The location of the study was in the Rengganis Crater and Curugtilu Ecopark tourist area, which are two of the most popular tourist destinations in Ciwidey. These areas were chosen for the study due to their high visitor numbers and the variety of activities they offer. The study was conducted

on weekends for 98 samples. At this stage, respondents were asked to give weight to each factor of influence on mode choice on park and ride services, which had a weight value of one to four levels.

The second stage uses the Analytical Hierarchy Process (AHP) method. This stage aims to rank the five most influential factors carried out with the Likert scale into three main factors. The survey was conducted by distributing questionnaires directly to tourists visiting Ciwidey. Bos et al., 2004 explained that the number of respondents using the AHP method does not have a particular formulation. However, there is only a minimum limit of two respondents. For this reason, researchers refer to Sugiono (2013) that the study size is at least 30 respondents. The survey location is in the tourist area of Emte Highland Resort and Koboy Tjipelah Café on weekends In this study, data processing was carried out by expert choice 11. This software can process the results of paired comparisons of all respondents obtained from the geometric average of each respondent, as well as determine the consistency ratio of the comparison.

Table 1. Factors Affecting Mode Choice on Park and Ride Services Plan

Nu.	Factors Affecting the Use of Park and Ride Services	References
1	Travel aims	Habib, et al. (2012).
2	Travel time information	Huang, et al. (2022); Nazala & Erli(2017).
3	Travel route information	Malkhamah, et al (2018); Nazala & Erli (2017).
4	Parking availability	Habib, et al. (2012).
5	Luggage	Bos, et al. (2004)
6	Parking duration	Nazala & Erli (2017).
7	Park and ride cleanliness	Bos, et al. (2004); Malkhamah, et al (2018);
8	Park and ride comfort	Nazala & Erli (2017).
9	Park and Ride security	Bos, et al. (2004); Malkhamah, et al (2018); Nazala & Erli (2017).
10	Travel distance	Bos, et al. (2004); Chalermpong, et al. (2018); Malkhamah, et al (2018); Habib, et al. (2012).
11	Traffic condition	Bos, et al. (2004).
12	Public transport frequency	Bos, et al. (2004); Huang, et al. (2022).
13	Features of public transport	Curtale, et al. (2021).
14	Probability of getting a seat	Bos, et al. (2004); Malkhamah, et al (2018); Huang., et al. (2022).
15	Travel time savings	Curtale, et al. (2021); Malkhamah, et al (2018); Habib, et al. (2012); Dale, et al. (2019).
16	Travel cost savings	Curtale, et al. (2021); Chalermpong, et al. (2018); Malkhamah, et al (2018); Huang, et al. (2022); Habib, et al. (2012); Dale, et al. (2019).
17	Bicycle rental	Bos, et al. (2004).
18	Flexibility	Arentze, et al. (2013)

Table 2. Likert Scale Score

Score	Information
1	No Effect
2	Little Effect
3	Influential
4	Very Influential

Park and Ride Location Plan

In order to improve the performance of road sections and anticipate congestion, the Bandung Regency Government plans to build sustainable mobility services in the form of park-and-ride facilities integrated with the Ciwidey tourism area with shuttle buses as a mode of transportation to access tourist areas. The location park and ride services plan are in the Sabilulungan Cultural Building (GBS) area (see Figure 1), which is close to the Soreang toll exit, with consideration of accessibility and availability of land use. The distance between the park and the ride to Ciwidey tourist sites is ±25 kilometres. The mode offered is a shuttle bus that only stops at city tourist destinations. On the way, it allows savings in travel time compared to using private vehicles or other public transportation.

Figure 1. Layout Park and Ride Location Plan
Source: Google Earth and Author own documentation, 2023

C. RESULTS AND DISCUSSIONS

The results of this research analysis are divided into two parts: the results of scoring influence factors using the Likert scale and the analysis using the Analytical Hierarchy Process (AHP) method.

Scoring with Likert Scale

Based on the survey results, 110 questionnaire filling data were obtained, which were then sorted against invalid questionnaires to get 98 valid answers. The data obtained include respondent characteristics, respondent travel characteristics, and the intensity of influence on the choice of modes that serve tourist areas. Table 3 presents an overview of respondents. The presence of male respondents was 60%, and female respondents were 40%. Most respondents of productive age are in the age group of 17-35 years, and 31.63% work as civil servants/police/army. 11.22% of the sample travelled using institutional/ company funds, while the remaining 88.78% with personal funds (See table 3).

All respondents are tourists, which has a negative impact on the performance of the section for residents who will travel because the road is dominated by tourist vehicles. Influence factor scoring aims to determine the intensity of influence of eighteen influence factors on the choice of mode between private vehicles or switching to using shuttle buses available at park and ride services. The greater the average value of the total summation of weights, the more significant the influence factor in the mode choice. The results of rating the influence factor using the four-level Likert scale are presented in Table 4.

Based on Table 4, the conclusion is five factors for modes choice on park and ride services that have the highest score in sequence: the probability of getting a seat, travel time savings, park and ride security, traffic conditions and travel costs. However, the difference in weights on the Likert scale shows quite very close differences in values. Therefore, the weighting results will be further analyzed by the Analytical

Hierarchy Process (AHP) method of the five highest factors to re-measure the accuracy of these factors in the choice of transportation mode.

Table 3. Characteristics of respondents

Indicators	Classification	Percentage	Total
Gender	Male	60.20 %	100%
	Female	39.80 %	
Age	< 17	0 %	100%
	17 – 25	35.71 %	
	26 – 35	22.45 %	
	36 – 45	25.51 %	
	46 – 55	12.24 %	
	56 – 65	4.08 %	
	> 65 tahun	0 %	
Education level	Secondary school	42.86 %	100%
	Diploma	14.29 %	
	D4/S1	33.67 %	
	S2/S3	9.18 %	
Employment	Student	21.43 %	100%
	Civil Servant/Army/Police	31.63 %	
	Self-employee	12.24 %	
	Employee	13.27 %	
	Honorary employee	9.18 %	
	Housewives	9.18 %	
	Retired	3.06 %	
Income	< Rp. 1.000.000	30.61 %	100%
	Rp.1.000.000 - Rp.3.000.000	18.37 %	
	Rp.3.000.001 - Rp.5.000.000	8.16 %	
	Rp.5.000.001 - Rp.10.000.000	23.47 %	
	Rp.10.000.000 - Rp.15.000.000	17.35 %	
	> Rp. 15.000.000	2.04 %	
Source of Funds	Personal Funds	88.78 %	100%
	Institutional/Corporate Funds	11.22 %	
Travel aims	Business	3.06 %	100%
	Holiday	75.51 %	
	Education/Research	10.20 %	
	Other	11.22 %	
Visit status	Tourist	100%	100%
	Local People	0%	

Table 4. Factor rating of mode selection influence Likert scale

Factors	Score	Rank
Probability of getting a seat	**3,480**	**1**
Travel time savings	**3,378**	**2**
Park and ride security	**3,357**	**3**
Traffic condition	**3,347**	**4**
Travel cost savings	**3,347**	**5**
Features of public transport	3,306	6

Factors	Score	Rank
Flexibility	3,224	7
Public transport frequency	3,214	8
Park and ride comfort	2,929	9
Travel route information	2,908	10
Parking availability	2,888	11
Luggage	2,827	12
Park and ride cleanliness	2,704	13
Travel time information	2,622	14
Parking duration	2,582	15
Travel distance	2,582	16
Travel aims	2,551	17
Bicycle rental	2,194	18

Scoring with the Analytical Hierarchy Process (AHP) method

The hierarchical structure in the AHP method is by setting goals and then determining criteria and sub-criteria. In this study, the hierarchical structure is only made at one level; there are only goals and criteria (Figure 2). This study aims to determine the influence of mode choice on park and ride services, while the criteria use the results of weighting that was done with the Likert scale. The criteria are the probability of a seat, travel time savings, park and ride safety, traffic conditions and travel costs.

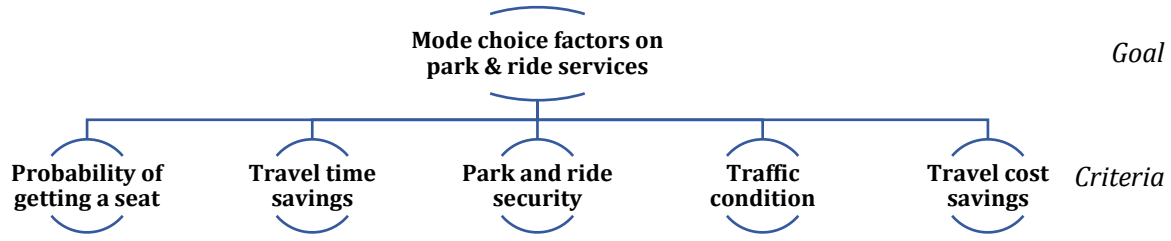

Figure 2. Hierarchy structure of mode choice factors in park and ride services

The conclusion should answer the objectives of the research and the research discoveries. The concluding remark should not only repeat the results and discussions or abstract. Also, suggest future research and point out those that are underway. Factor ranking with the AHP method is a follow-up to the results of the Likert scale weighting. The assessment is carried out by comparing each influence factor with other factors to determine the level of importance in mode choice between public transportation available on park and ride services and private vehicles. After surveying 30 samples, weights were obtained from ten combinations of pairwise comparisons from each influence factor criterion that had been prepared. Table 4 shows the weights of paired comparison assessments in this study.

Table 5. Results of factor assessment with AHP method on 30 samples

Criteria A	Weights (respondents)									Criteria B
	5	4	3	2	1	2	3	4	5	
Prob. of getting a seat	1	0	2	2	7	0	9	5	4	Travel time savings
Prob. of getting a seat	1	0	0	0	3	5	15	2	4	Park and ride security
Prob. of getting a seat	2	1	7	4	8	3	1	4	0	Traffic condition

Criteria A	Weights (respondents)									Criteria B
	5	4	3	2	1	2	3	4	5	
Prob. of getting a seat	1	2	0	2	6	3	9	5	2	Travel cost
Travel time savings	1	2	3	2	11	4	4	2	1	Park and ride security
Travel time savings	3	5	5	6	9	1	0	1	0	Traffic condition
Travel time savings	1	2	4	5	15	3	0	0	0	Travel cost
Park and ride security	2	3	9	9	6	0	0	1	0	Traffic condition
Park and ride security	1	2	4	6	10	4	3	0	0	Travel cost
Traffic condition	1	1	4	0	4	7	10	2	1	Travel cost

The percentage of respondents from Bandung Raya ((Bandung City, Bandung Regency, West Bandung Regency, Cimahi City) was 53.33%, while from outside Bandung, such JABODETABEK, Central Java, West Java, and Yogyakarta, was 46.67% (Figure 3).

No	Grouping Origin of Respondents	Freq.	Percentages
1	JABODETABEK	8	26,67 %
2	Central Java	2	6,67 %
3	West Jawa	3	10 %
4	Yogyakarta	1	3,33 %
5	Bandung Regency	4	13,33 %
6	Bandung City	9	30 %
7	Cimahi City	3	10 %
	Total	**30**	**100 %**

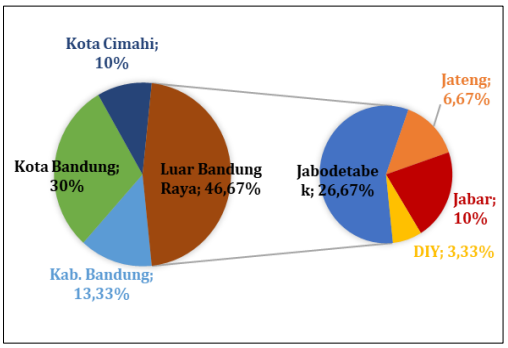

Figure 3. Frequency of grouping from which respondents travel

Data processing of survey results was carried out using the Expert Choice 11 application. The tool in the AHP method is an application program that can assist decision-makers in making decisions (Handayani, 2015). The simulation will be divided into two groups: the first group is respondents from Bandung Raya (Bandung City, Bandung Regency, West Bandung Regency, Cimahi City) and the second group is from outside Bandung. Thus, the characteristics of the factor of mode choice from both groups of respondents can be known.

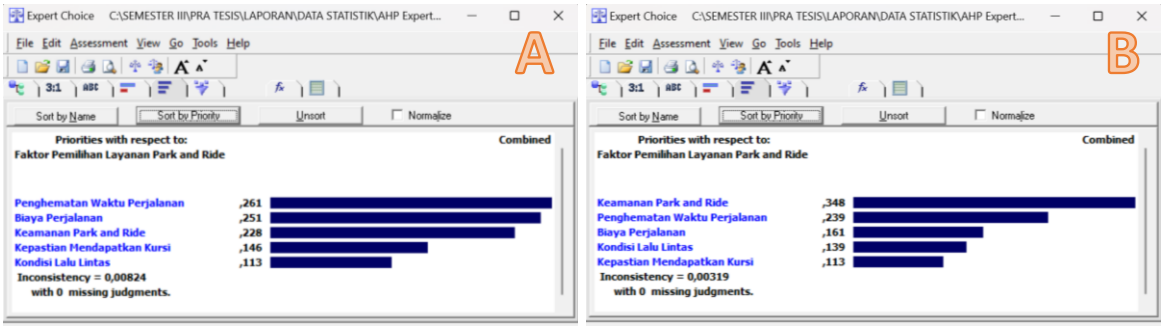

Figure 4. Score of criteria based on respondents from (A) Bandung Raya (B) Outside Bandung

From the two running results using the expert choice 11, the Consistency Ratio (CR) value showed a figure of 0.00824 for respondents from Bandung Raya and 0.00319 outside Bandung. Thus, the data was

consistent. However, there are differences in characteristics between respondents from Bandung Raya and outside Bandung (Figure 4). Respondents from Bandung Raya are more concerned about saving travel time and travel costs, with the highest criteria weighting of 26.1% and 25.1%, respectively. This phenomenon occurs because tourists living close to the Ciwidey tourist area travel in the morning, and the average respondent only stays for a shortening travel time, which is very important.

In contrast to respondents' answers from outside Bandung, the security factor of the park and ride is more important than any other factor, which is 34.8%. Interviews with tourists from Jabodetabek, Central Java, West Java, and DIY assume that if the organizer can guarantee the security of parked vehicles on park-and-ride services, then most of them are willing to leave their vehicles and use shuttle buses to continue the journey to Ciwidey. After the characteristics of the two groups were known, this study also weighed all respondents to determine the highest to lowest ranks in the influence factor of park and ride service selection.

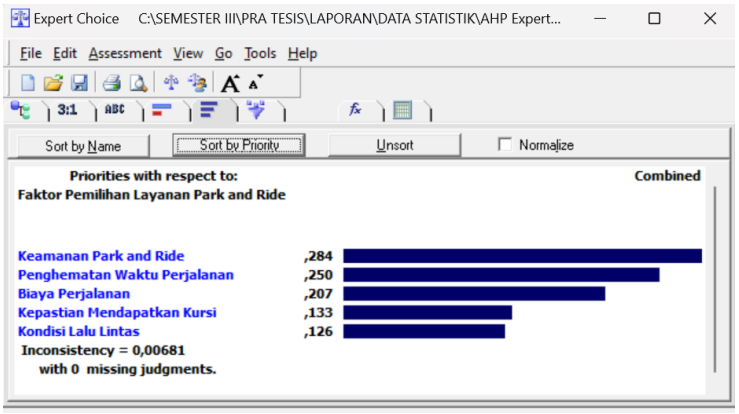

Figure 5. Score of all respondents' criteria

The results of running on all respondents showed the highest criterion weight was park and ride security, which was 0.284 or 28.4%. Furthermore, travel time savings weight of 0.250 or 25%, followed by travel cost criteria of 0.207 or 20.7%, certainty criteria of getting seats of 0.133 or 13.3%, and the lowest weight is traffic conditions, which is only 0.126% or 12.6%. The Consistency Ratio (CR) value shows several 0.00681, so the data was consistent.

Table 7. Order of ranking of factors by criteria weight

Rank	Criteria	Score
1	Park and ride security	0,284
2	Travel time savings	0,250
3	Travel cost	0,207
4	Probability of getting a seat	0,133
5	Traffic condition	0,126

The results of the ranking of criteria or influence factors, three main factors that influence tourists to change modes of transportation on park and ride services, (1) park and ride security, (2) travel time savings, and (3) travel costs (Table 7). Security is the most influential factor in the mode of transportation's choice. Guaranteed security at the parking location is prioritized. A security that needs to be developed includes the availability of security officers for 24 hours, the installation of CCTV cameras that highlight directly to the parking lot, and good lighting. If this service is already implemented, and public interest in using park-and-ride services is high, it is expected to reduce tourist travel time to Ciwidey. The reduced volume of private vehicles by tourists who come is expected to reduce the congestion that often occurs on

the Ciwidey national road so that traffic flow becomes smooth and travel time is shorter. Moreover, respondents' perceptions also expect the shuttle buses provided to avoid picking up and dropping off passengers on the road carelessly. If that happens, it can disrupt the smooth flow of traffic and will increase travel time.

Travel costs incurred when using private vehicles will be higher than public transportation. In addition, the amount of parking fees in tourist areas is a factor that influences tourists in switching modes. Many tourists will visit several tourist destinations in Ciwidey, while the application for parking tickets is available for every tourist destination visited. The park-and-ride service will likely minimize the initial enormous travel costs.

Based on the ranking results based on the Likert scale, the results of five main factors that are most influential in mode choice between private vehicles and shuttle buses available on park and ride services in Bandung Regency include the probability of getting a seat, travel time savings, park and ride security, traffic conditions and travel costs. Furthermore, based on the results of ranking using the Analytical Hierarchy Process (AHP) method, three main factors in mode choice between private vehicles and shuttle buses available on park and ride services in Bandung Regency include park and ride security, travel time savings, and travel costs.

D. CONCLUSION

As the study concludes, it provides valuable insights into the factors impacting transportation mode choices for tourists in Bandung Regency. The research emphasizes the critical role of sustainable transportation infrastructure and efficient public transport services in meeting the needs of tourists in the region. The findings affirm that transportation is a strategic element in tourism activities and plays a significant role in the tourism system. It highlights the challenges posed by increased transportation demand, including congestion and environmental damage, driven by the rise in private vehicle ownership in Indonesia.

The study advocates for the implementation of strategies to manage travel demand and promote modal shifts from private vehicles to public transportation. It underscores the potential of park-and-ride schemes to optimize mass transportation, reduce congestion, and minimize carbon pollution. Furthermore, by focusing on Ciwidey, a prominent natural tourism destination in Bandung Regency, the study offers practical implications for addressing transportation challenges specific to this area. The varied tourism offerings in Ciwidey necessitate tailored transportation solutions to cater to diverse visitor needs. The final results of ranking using the AHP method can be developed for further research in forming a model of mode choice between private vehicles and shuttle buses available on park and ride services in Bandung Regency.

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