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Meta-Analytical Insights into Transportation Hub Planning: Managing Uncertainty with Fuzzy Best-Worst Method

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ABSTRACT

Transportation hubs are important parts of urban and regional mobility systems because their locations directly affect how people reach and use transport networks. Since these infrastructures can work as central points within a city or even at the national level, their location selection should not be evaluated only with traditional cost-based criteria. It should also consider resilience and long-term service performance. This study reviews the existing literature to examine whether the fuzzy Best-Worst Method (BWM) has been used for transportation hub location selection. For this purpose, a metasearch was conducted in Web of Science by combining BWM with transportation hub and related terms. The reviewed literature shows that transportation hubs have been studied from different perspectives, including network design, accessibility, internal design, safety, resilience, and multi-criteria decision-making. However, the direct use of fuzzy BWM for transportation hub location selection seems to be limited. Since hub location assessment includes several uncertain and partly qualitative dimensions, fuzzy BWM can be a useful method under uncertainty.

1. Introduction

Economic activities form the backbone of human life. The continuity of the economic system can be understood as being driven by individuals' pursuit of their own interests, which collectively sustains the functioning of the overall system [1]. From basic needs such as food and shelter to more developed activities like trade and services, these activities affect how societies work and change over time. They are important not only for people's daily lives, but also for helping societies develop at different levels. Talking about the scale, from a global perspective, development can be understood as an interactive process shaped by the interplay between human needs and values, social structures, and material conditions [2].

Transportation systems are strongly connected to economic activities because they help goods, services, and people move from one place to another. To add, transportation plays a fundamental

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role in the functioning of a market economy, while the efficiency of transportation systems is closely linked to improvements in overall economic productivity [3]. Political discourse is also significant because people often say that new transportation investments support local and regional development [4]. In this sense, transportation is not only a supporting system, but also an important part of economic activities because it affects where these activities take place and how efficiently they work. However, economic systems can still face many problems, such as natural disasters, economic crises, pandemics, and political conflicts. These problems drive continuous transformations in spatial, social, economic, and environmental conditions, emerging as sudden shocks and gradual stresses, respectively [5]. For instance, as can be observed from recent experience, pandemics such as COVID-19 disrupt economic chains and slow down both economic and social development [6].

Since shocks and stresses can seriously disrupt economic chains, they can also stop production, limit workers' movement, and change supply and demand. To give an example from the UK, global financial crisis of 2007–08 have had a significant impact on economic output and inflation in recent periods [7]. As a result, economic systems must continuously adapt to maintain functionality under changing and often uncertain conditions.

Infrastructure system resilience is defined as its ability to predict, absorb, adapt to, and/or rapidly recover from disruptive events such as natural disasters [8]. Among the most affected infrastructure systems during disasters are transportation systems [9]. In this context, transportation networks are an important part of resilient infrastructure because they help economic activities remain during disruptive events. By ensuring the movement of essential goods, services, and personnel, resilient and adaptable transportation systems help mitigate the adverse impacts of shocks. Furthermore, transportation networks provide the conditions necessary to sustain economic stability and enable faster recovery in times of crisis.

In that sense, transportation hub location assessment is crucial in order to ensure the efficient, reliable, and resilient functioning of transportation networks under both normal and disrupted conditions. In multimodal transportation systems, transport hubs play a critical role in achieving optimal system efficiency [10]. Through achieving correct placement, it is possible to enhance connectivity, minimize travel times and costs, and maintain the continuity of economic activities even in the presence of shocks. Moreover, well-planned hub locations enhance the adaptability of the system by enabling alternative routing options and supporting rapid response mechanisms, thereby strengthening the overall resilience of the economic and transportation system.

Fuzzy Best Worst Method (BWM) is a relatively recent extension of the Best Worst Method, with its first studies published in 2016 [11-13]. Since then, it has been increasingly used in decision problems where expert judgments and uncertainty need to be incorporated into the weighting process. Transportation hub location selection is also a multi-dimensional decision problem because hubs are evaluated not only through operational and network-related factors, but also through economic, social, environmental, accessibility, and resilience-related considerations. Since these dimensions may involve both quantitative criteria and qualitative expert judgments, fuzzy BWM can be considered a suitable method for evaluating hub location alternatives.

Fuzzy set theory was first introduced by Zadeh [14] as an extension of classical set theory to address problems involving uncertainty and vagueness. In fuzzy set theory, elements are evaluated with membership degrees between 0 and 1 rather than only as belonging or not belonging to a set. Therefore, it is useful for representing uncertain and subjective expert judgments in multi-criteria decision-making problems.

Building on this logic, fuzzy BWM adapts the original Best-Worst Method to a fuzzy decision-making setting. In the traditional BWM, decision-makers first choose the best and worst criteria and then compare them with the other criteria using exact values. In fuzzy BWM, these comparisons can

be made with linguistic terms such as “equally important,” “weakly important,” “fairly important,” “very important,” and “absolutely important.” These terms are then converted into triangular fuzzy numbers, which helps the method represent the uncertainty in expert judgments more clearly. Guo & Zhao [15] state that fuzzy BWM can produce reasonable alternative rankings and may provide higher comparison consistency than the original BWM because it incorporates the uncertainty of decision-makers’ qualitative judgments into the weighting process.

Accordingly, fuzzy BWM can be a useful method for evaluating transportation hub locations, especially when there are many criteria and uncertain expert opinions. Although MCDM and fuzzy methods are widely used in transportation and logistics location problems, the use of fuzzy BWM for transportation hub location selection still needs further attention. This study reviews the literature to identify whether there is a research gap in the application of fuzzy BWM to transportation hub location selection.

2. Literature Review

This section first reviews studies that examine transportation hubs from a multidimensional perspective, focusing not only on their physical role as transfer points but also on their functional, operational, spatial, and urban significance. This part aims to show that transportation hub location is a multidimensional planning problem, since hubs can influence not only local travel behavior but also the efficiency and continuity of broader transportation networks.

The second part of the literature review focuses on the metasearch conducted to understand how the BWM has been used in relation to transportation hub location and similar planning problems. The metasearch was initially conducted specifically on fuzzy BWM and transportation hub-related terms, but the search scope was later broadened to include BWM-based studies on similar transportation, facility location, and metro-related problems in order not to overlook relevant studies. Instead of directly applying fuzzy BWM to a case study, this review examines whether such an application already exists in the literature and how close existing studies are to this research topic. This helps identify the potential gap regarding the use of fuzzy BWM for transportation hub location selection.

2.1 Transportation Hubs

The literature includes numerous studies examining transportation hubs from different perspectives. Firstly, the spatial positioning and distribution of transportation hubs have long been considered important factors influencing the efficiency and coverage of transportation networks. In order to decide if the location is well-selected or not, two terms should be defined: centrality and intermediacy. Centrality refers to the locational importance of a hub in relation to the size, function, and traffic-generating capacity of its surrounding area, while intermediacy refers to its strategic in-between position within transportation networks, where it can serve as a connecting hub, relay point, or gateway between important origins and destinations [16]. O’Kelly and Miller reviewed the hub network design problem and proposed a classification framework based on node–hub assignment, direct node-to-node connections, and hub interconnectivity, showing that different hub-and-spoke configurations involve trade-offs between network efficiency, design flexibility, and problem complexity [17]. As the years passed, conventional hub location assumptions were relaxed, and network design models were developed to better represent urban public transportation systems by determining hub nodes, hub edges, and passenger flow allocation [18]. In contrast to earlier cost-centered approaches, it is argued that transportation hub locations should be selected in a way that enables the network to meet the required service levels between origin–destination pairs, rather than being determined solely by cost minimization [19].

This discussion has also been extended to intermodal and large-scale transport systems. Li *et al.,* [20] examined intermodal hub location under the Belt and Road Initiative by incorporating government subsidies, local–central government co-opetition, and carrier route choice into a two-stage mixed-integer programming model, showing that intermodal transportation can reduce costs more effectively when the number of hubs is limited and modal cost differences are high. From a broader economic geography perspective, hub development is described as a process in which transportation cost advantages increase trade flows through specific locations, creating labor demand and eventually leading to population agglomeration around hub cities [21].

In addition to economy, accessibility and intermodality are key considerations in transportation hub planning. Liu *et al.,* [22] evaluated the spatial accessibility of the Shanghai Hongqiao Transportation Hub by measuring total travel time across walking, waiting, transfer, and in-vehicle travel components under different public transport scenarios. Similarly, transport hub location has also been examined through public transit accessibility, with emphasis on its relationship with social and economic activity and its potential to reduce walking transfer distance and total travel time [23]. Another study compared alternative locations for an urban transport interchange hub by considering passenger traffic, public transport routes, walking accessibility, attraction points, and capital investment, and selected the more suitable option through SWOT analysis [24].

Beyond their location, the internal design and operation of transportation hubs are also important because they affect transfer efficiency and service quality. Elshater & Ibraheem [25] approached transportation hubs from an urban design perspective by focusing on Ramses Station and concluded that sustainable hub design should include safety, passenger services, environmental quality, and economic improvement within the urban context. This perspective is also visible in Staniewska *et al.,* [26] who linked small transport hub design with SDG 11 and proposed a framework based on accessibility, ecology, functionality, and local identity. It emphasized that sustainable hubs should support transport efficiency, inclusiveness, and place-based design together. Extending this design perspective to larger and more complex hubs, Lv *et al.,* [27] examined the design and spatial organization of a large transportation hub through the idea of the "city's new sitting room." It argued that large hubs should not only provide easy transfers, but also work as urban centers that include public spaces, commercial areas, and service activities.

The operational and safety-related aspects of hub design have also received attention. Shen *et al.,* [28] consider transportation hub station design from a safety and operation management perspective. It focused on vertical pedestrian facilities, passenger flow, and fire evacuation. The study showed that stair and escalator layout, barriers, passenger guidance, and removable facilities can strongly affect crowd movement and evacuation performance. From an inclusiveness perspective, Rosa *et al.,* [29] examined the co-design of an inclusive bus stop in a tourist transportation hub. The study combined universal design, perceived accessibility, and sustainable mobility principles, and showed that hub infrastructure should meet the needs of older tourists and people with disabilities through user-informed design features.

Recent studies have focused more on the role of transportation hubs and transport networks in supporting resilient and sustainable mobility systems, both in normal conditions and during disruptions. In this regard, Qi *et al.,* [30] evaluated the resilience of Beijing's bus and subway network and showed that disruptions at important transfer stations can reduce overall network connectivity and efficiency. Building on the network resilience perspective, Li & Zhang [31] focused more specifically on transportation hub complexes by modelling internal passenger flows as a network. They showed that sudden increases in demand can reduce hub performance, while better recovery planning and load redistribution can support faster recovery. In addition to performance metrics, Wan *et al.,* [32] approached urban transportation complex hubs from a risk assessment perspective.

They identified different hazard sources and evaluated fire, flood, stampede, and abnormal crowd retention risks using fault tree analysis, Bayesian networks, DBSCAN clustering, and a cloud-based risk assessment model. At the urban economic scale, Wang *et al.,* [33] examined national comprehensive transportation hubs using a multi-period difference-in-differences model, showing that they enhance urban economic resilience through cost reduction, agglomeration, innovation and entrepreneurship, and spatial optimization, with stronger effects in large, economically agglomerated, and less sprawling cities.

Because transportation hub assessment includes many different dimensions, multi-criteria decision-making methods are often used to compare alternative hub locations and planning strategies. Broniewicz & Ogrodnik [34] reviewed the application potential of MCDM/MCDA methods in the transport sector and showed that these approaches provide useful decision-support tools for complex transport planning and infrastructure problems. In the context of hub location, Ding [35] developed an integrated fuzzy MCDM model for selecting logistics hub locations for global shipping carrier-based logistics service providers, highlighting the role of fuzzy evaluations in handling vague expert judgments and multiple logistics-related criteria. In case of public transportation, Liu *et al.,* [36] examined public transportation hub location by combining qualitative and quantitative factors within an improved MAGDM-based stochastic location model, where alternatives were evaluated according to criteria such as connection degree, commercial potential, policy environment, hydrological conditions, and passenger distribution strength, while the final model also incorporated cost, capacity, distance, and stochastic passenger flow. Zečević *et al.,* [37] further proposed a hybrid fuzzy MCDM framework for intermodal transport terminal location selection by combining fuzzy Delphi, fuzzy DANP, and fuzzy DVIKOR, allowing conflicting stakeholder preferences and uncertain evaluations to be incorporated into the assessment process. At a larger spatial scale, Zhang *et al.,* [38] examined logistics hub location under the Belt and Road Initiative by combining qualitative policy-based screening with a hybrid GARA-TOPSIS, AHP, entropy, and game-theory-based MCDM model, selecting key intermodal container hubs according to multimodal connectivity and logistics-chain performance. More recently, Eydi *et al.,* [39] addressed the public transport hub location problem through a two-stage framework in which TOPSIS was used to pre-select potential hub locations and a bi-objective optimization model with Lagrangian Relaxation was applied to minimize both system costs and maximum passenger travel time

2.2 Metasearch

To identify the relevant literature, a comprehensive meta-search was conducted in the Web of Science Core Collection (see Figure 1). Since transportation hubs may be represented in the literature through different concepts and terminology, the search strategy was intentionally designed to be inclusive. In addition to studies explicitly using terms such as “transportation hub,” “mobility hub,” “transit hub,” “intermodal hub,” and “multimodal hub,” the search also included hub-like transportation facilities such as transport interchanges, transfer centers, rail stations, metro stations, bus stations, public transport stops, park-and-ride facilities, carsharing stations, bike-sharing stations, and shared mobility stations. These terms were combined with location-related expressions including “location,” “site selection,” “facility location,” “station location,” “hub location,” “location-allocation,” “siting,” “placement,” “allocation,” “assessment,” “evaluation,” and “selection.” Accordingly, the following query was used to capture a wide range of studies related to transportation hub and hub-like facility location assessment: TS=(("transportation hub*" OR "transport hub*" OR "mobility hub*" OR "transit hub*" OR "intermodal hub*" OR "multimodal hub*" OR "transport interchange*" OR "transit center*" OR "transfer center*" OR "transfer station*" OR "transport terminal*" OR "transit terminal*" OR "rail station*" OR "metro station*" OR "bus station*"

OR "public transport station*" OR "public transport stop*" OR "transit station*" OR "park and ride" OR "park-and-ride" OR "P&R" OR "carsharing station*" OR "car-sharing station*" OR "car sharing station*" OR "bike sharing station*" OR "bike-sharing station*" OR "bikesharing station*" OR "shared mobility station*" OR "shared mobility hub*") AND ("location" OR "location selection" OR "site selection" OR "facility location" OR "station location" OR "hub location" OR "location-allocation" OR "siting" OR "placement" OR "allocation" OR "assessment" OR "evaluation" OR "selection")). This query returned 5,040 records (see Figure 2).

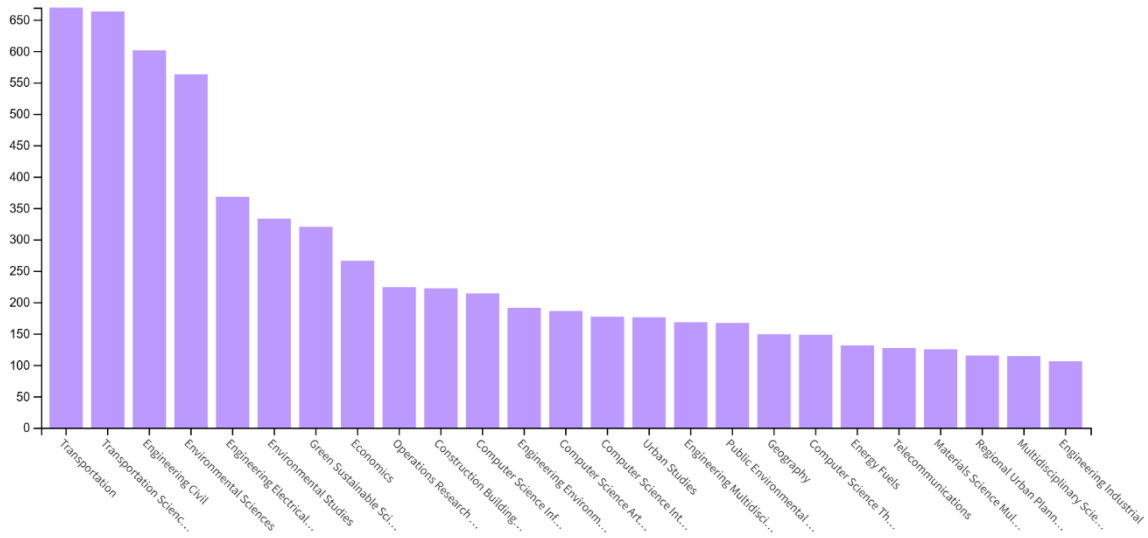

Fig. 1. Transportation-related meta-search in the Web of Science Core Collection

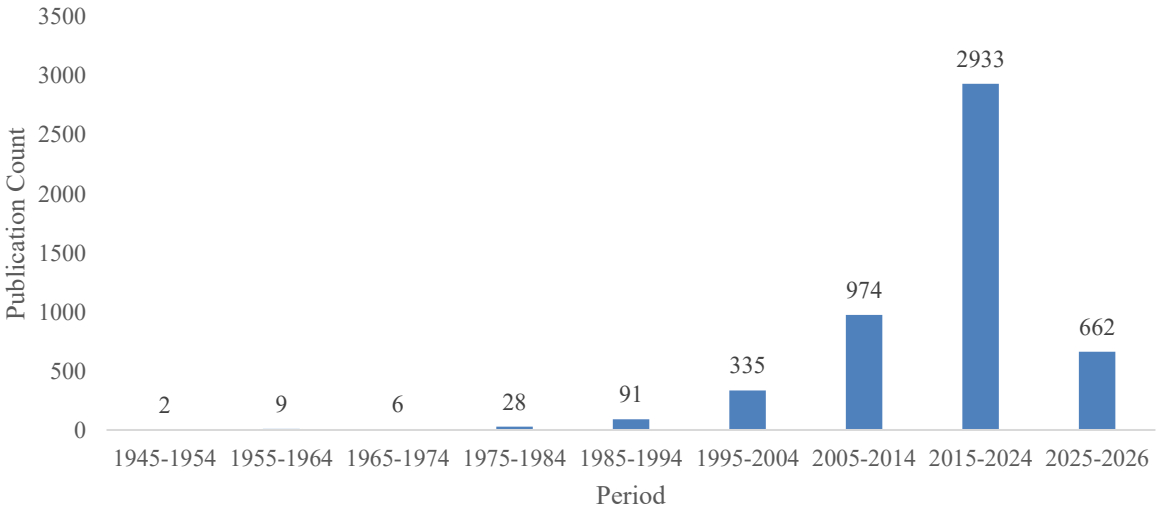

Fig. 2. Publication counts by period

The publication trend shows that studies on transportation hub and hub-like facility location have increased strongly over time. In the early years, especially between 1945 and 1984, the number of studies was very limited. After the 1990s, publications began to increase gradually, and this growth became more visible between 2005 and 2014. The strongest rise occurred after 2014, when the number of studies increased from 974 in 2005–2014 to 2,933 in 2015–2024. This shows that topics such as transportation hubs, mobility hubs, public transport stations, park-and-ride facilities, and shared mobility stations have received much more attention in the last decade. Although the 2025–

2026 period covers only about one and a half years, it already includes 662 studies, suggesting that interest in this research area is still growing rapidly.

In the second stage, the search was not limited only to fuzzy Best Worst Method studies, in order to avoid excluding relevant BWM-based studies that may not explicitly use fuzzy terminology (see Figure 3). Therefore, a broader BWM query was applied as follows: TS = ("best worst method" OR "best-worst method" OR BWM OR "best-to-worst method"). This query returned 2,983 records (see Figure 4).

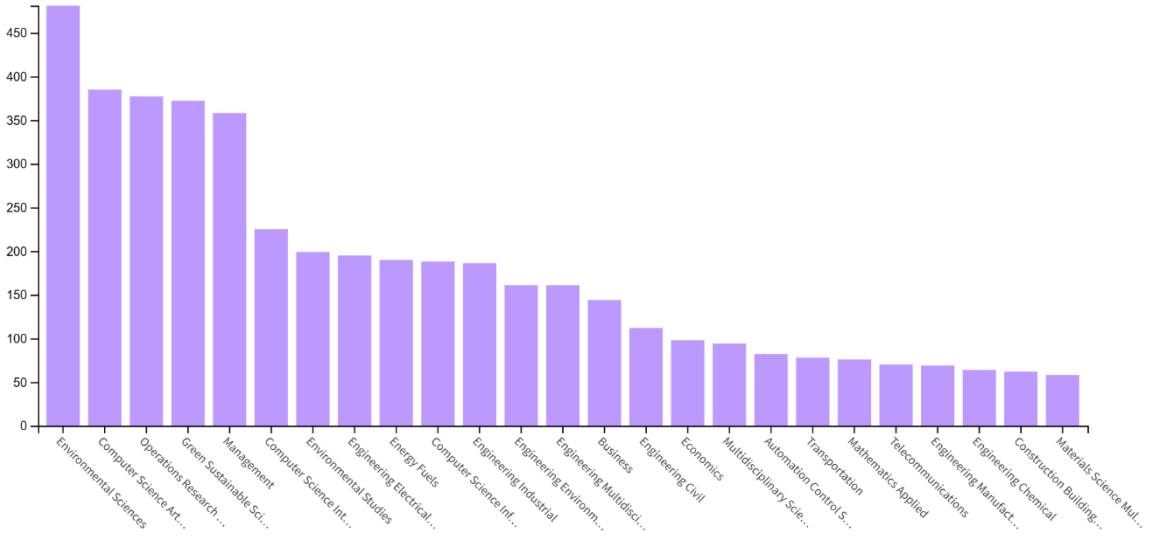

Fig. 3. Fuzzy Best Worst Method studies related meta-search in the Web of Science Core Collection

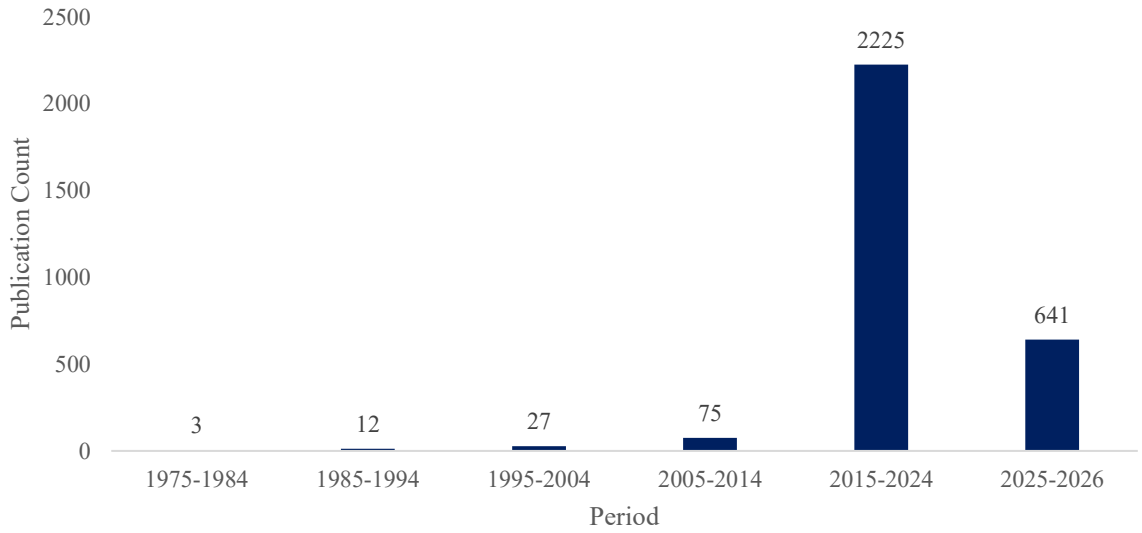

Fig. 4. Publication counts by period

The publication trend for Best Worst Method studies demonstrates an even more concentrated and rapid increase in recent years. Before 2005, the number of publications was very limited, and even in the 2005–2014 period, only 75 studies were identified. However, after 2014, the number of publications increased dramatically, reaching 2,225 in the 2015–2024 period. This sharp rise indicates an almost exponential growth pattern in the use of BWM, especially as a multi-criteria decision-

making method applied across different research fields. The 2025–2026 period is particularly notable because it already includes 641 publications despite covering only around one and a half years. Considering that this period is much shorter than the previous ten-year intervals, the high number of publications suggests that BWM-related research is gaining speed.

The intersection of these two search sets resulted in 11 publications, which were then reviewed according to their titles and relevance to the scope of the study. The resulting papers are presented in Table 1 below.

Table 1
BMW studies in literature

Author (Year)	Article	Method / Model	Case / Application Area	Relevance to Study
Ortega *et al.,* [40]	Using the Best Worst Method for Sustainable Park and Ride Facility Location	BWM	Sustainable Park-and-Ride facility location	Highly relevant; directly applies BWM to Park-and-Ride facility location, but without fuzzy logic.
Ortega *et al.,* [41]	An Integrated Multi-Criteria Decision-Making Model for Evaluating Park-and-Ride Facility Location Issue: A Case Study for Cuenca City in Ecuador	Integrated AHP-BWM	Park-and-Ride facility location in Cuenca, Ecuador	Highly relevant; evaluates Park-and-Ride facility location with AHP-BWM, but without fuzzy logic.
Ortega *et al.,* [42]	A two-phase decision-making based on the grey analytic hierarchy process for evaluating the issue of park-and-ride facility location	Grey-AHP; comparison with FAHP and BWM	Park-and-Ride facility location	Relevant; addresses Park-and-Ride location and compares results with BWM, but BWM is not the main method.
Feng *et al.,* [43]	An integrated decision framework for resilient, sustainable waste electric vehicle battery recycling transfer station site selection	BWM + Cumulative Prospect Theory	EV battery recycling transfer station site selection	Methodologically relevant due to its BWM-based facility site selection approach, but outside the transportation hub context.
Sirizi *et al.,* [44]	A Scenario-Based Multi-Criteria Decision-Making Approach for Allocation of Pistachio Processing Facilities: A Case Study of Zarand, Iran	BWM + OWA + GIS-MCDA	Pistachio processing facility allocation in Zarand, Iran	Methodologically relevant due to BWM-based GIS facility allocation, but outside the transportation hub context.
Javid *et al.,* [45]	Multi-criteria spatial assessment of urban open spaces for promoting physical activity and spatial justice: a case study of Tehran metropolitan	BWM + CRITIC + WLC + spatial statistics	Urban open space quality and spatial justice in Tehran	Partially relevant; uses BWM-based spatial assessment and public transport accessibility, but focuses on urban open spaces.
Jafari *et al.,* [46]	Using best-worst method and fuzzy logic to determine the best location for transit-oriented development: a case study of Tehran, Iran	BWM + fuzzy logic + ArcGIS-based spatial analysis	TOD location selection around metro stations in Tehran, Iran	Highly relevant; it combines BWM, fuzzy logic, GIS, and TOD-related metro station location selection.

Table 1
Continued

Author (Year)	Article	Method / Model	Case / Application Area	Relevance to Study
Mangu *et al.,* [47]	Evaluation of transit-oriented development based on 9D's approach in the developing countries context	Delphi + BWM + k-means clustering	TOD evaluation around metro stations in Hyderabad, India	Relevant; applies BWM to TOD evaluation around metro stations, but does not include fuzzy BWM or location selection.
Jiang *et al.,* [48]	Risk Assessment of Constructing Deep Foundation Pits for Metro Stations Based on Fuzzy Evidence Reasoning and Two-tuple Linguistic Analytic Network Process	Fuzzy evidential reasoning + TL-ANP + fuzzy BWM for expert weights	Metro station construction risk assessment	Partially relevant; applies fuzzy BWM in a metro station context, but focuses on construction risk.
Mei *et al.,* [49]	A Multi-Granularity 2-Tuple QFD Method and Application to Emergency Routes Evaluation	BWM + multi-granularity 2-tuple QFD	Emergency route evaluation for a metro station	Weakly relevant; uses BWM in a metro-related case, but focuses on emergency route evaluation.
Sun *et al.,* [50]	Inundation Resilience Analysis of Metro-Network from a Complex System Perspective Using the Grid Hydrodynamic Model and FBWM Approach: A Case Study of Wuhan	Grid hydrodynamic model + dynamic node breakdown + FBWM	Metro network flood resilience in Wuhan	Partially relevant; uses FBWM for metro network assessment, but focuses on flood resilience rather than location selection.

Ortega *et al.,* [40] examined Park-and-Ride facility location using the Best Worst Method and showed that public transport accessibility is one of the most important criteria in determining suitable facility locations. Ortega *et al.,* [41] extended this discussion by proposing an integrated AHP-BWM model for evaluating Park-and-Ride location factors, with particular attention to proximity to public transport stations and consistency in pairwise comparisons. Similarly, Ortega *et al.,* [42] developed a Grey-AHP-based framework for Park-and-Ride location assessment and compared its results with FAHP and BWM, again emphasizing the central role of public transport accessibility in location decisions.

Looking beyond Park-and-Ride systems, Feng *et al.,* [43] proposed a sustainability- and resilience-based decision-making framework for selecting waste electric vehicle battery recycling transfer station sites, using BWM for criteria weighting and cumulative prospect theory for ranking alternatives. Similarly, Sirizi *et al.,* [44] developed a GIS-MCDA approach with BWM and ordered weighted averaging to select suitable locations for pistachio processing facilities in Iran under different risk scenarios.

Having talked about Iran, and remaining within the same boundaries, Javid *et al.,* [45] evaluated urban open spaces in Tehran through a hybrid BWM-CRITIC framework, focusing on physical activity potential, accessibility, infrastructure, and spatial justice. In a more transportation-oriented context, Jafari *et al.,* [46] developed a fuzzy BWM and GIS-based spatial decision-making approach to identify suitable TOD locations in Tehran by considering planning regulations, expert opinions, and site selection criteria. Moving to a different geography, Mangu *et al.,* [47] assessed TOD performance around metro stations in Hyderabad using a 9D TOD framework, Delphi-based indicator selection, BWM weighting, and k-means clustering.

Now that the topic has reached metro station areas, looking at the topic from another aspect, Jiang *et al.,* [48] proposed a fuzzy risk assessment model for metro station construction by combining fuzzy evidential reasoning, linguistic ANP, and fuzzy BWM to identify key construction risk factors. In the operational dimension, Mei *et al.,* [49] developed a multi-granularity linguistic QFD method for group decision-making, using BWM to weight customer requirements in an emergency route evaluation case related to a metro station. At a larger scale, Sun *et al.,* [50] evaluated metro network inundation resilience in Wuhan by combining hydrodynamic modeling, dynamic node breakdown analysis, and fuzzy BWM-based resilience weighting.

3. Discussion

The reviewed literature shows that the location selection of transportation hubs is not only a technical planning problem, but also a strategic decision that can shape the accessibility, mobility structure, and functional centrality of an urban region. In essence, accessibility is related to how well transportation networks allow individuals to go to the places they want to go [51].

Transportation hubs may become key nodes within a city, and when considered at a larger scale, they can even function as central points for regional or national mobility systems. For example, Tokyo Station is directly connected to approximately 15 major railway lines, including 1 metro line, 8 JR conventional urban and regional lines, and 6 Shinkansen/bullet train lines. If the Hokkaido Shinkansen through-service is also considered, this number increases to 16. Moreover, if pedestrian-connected nearby stations such as Otemachi are included within the broader hub area, the total number of connected lines can reach around 20 [52-54]. This strong connectivity shows that Tokyo Station is not only an important station in Tokyo's transport network. It also connects local, city, regional, and national transport systems in one place. Therefore, the location of transportation hubs should not be evaluated only with accessibility and cost criteria, but also with their ability to continue working during shocks, disruptions, and long-term urban problems.

Although the term fail-operational is mostly used for autonomous vehicles, it can also be used for larger transportation systems. From this perspective, transportation hubs can be evaluated according to their ability to keep working during disruptions. Fail-operational systems are fault-tolerant systems designed to maintain at least emergency operation when shutting the system down could create hazardous conditions or violate safety goals [55]. In this regard, transportation hubs, especially costly and important facilities such as metro stations, should be designed as resilient and fail-operational systems. Since these facilities serve many people and support continuous mobility, their failure can affect other parts of the transport network.

Fuzzy BWM can be a useful decision-support method for this type of problem because transportation hub location selection includes many social, economic, environmental, technical, and operational uncertainties. These uncertainties cannot always be shown with exact numbers. By using expert opinions in a structured weighting process, fuzzy BWM helps decision-makers evaluate complex criteria without oversimplification.

4. Conclusions

This paper reviewed the relevance of fuzzy Best-Worst Method (BWM) for transportation hub location selection. The main idea of the study is that transportation hubs are not only transfer points. They are also critical infrastructures that affect urban, regional, and national mobility systems. Therefore, their location should be evaluated through different dimensions.

To understand whether fuzzy BWM has already been used for this topic, a metasearch was conducted in Web of Science by combining BWM with transportation hub and related search terms. The reviewed studies show that BWM and fuzzy BWM have been used in different location selection,

transportation, facility planning, and metro-related decision-making problems. However, the direct use of fuzzy BWM for transportation hub location selection is still limited.

Based on the literature, fuzzy BWM can be a suitable method for this type of problem because transportation hub location selection includes several criteria that cannot be evaluated only with exact numbers. Criteria such as accessibility, service quality, resilience, safety, social impact, environmental suitability, and operational continuity often require expert judgment and linguistic evaluation. Fuzzy BWM can support this process by organizing expert-based comparisons and representing uncertainty in real-world planning decisions. Overall, this study suggests that fuzzy BWM has strong potential for evaluating transportation hub locations, especially when resilient and fail-operational hub design is needed. Future studies can develop an empirical fuzzy BWM framework for metro station or multimodal hub location assessment and apply it to a real-world case.

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Conflicts of Interest
Authors declare no conflicts of interest.

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