

Barriers to the Development of Intermodal Transport: The Situation in Bosnia and Herzegovina

SNEŽANA R. TADIĆ, University of Belgrade,

Faculty of Transport and Traffic Engineering, Belgrade

ORCID: 0000-0003-4651-3699

BILJANA B. MIČIĆ, University of East Sarajevo,

Faculty of Traffic Engineering, Dobož, Bosnia and Herzegovina

ORCID: 0009-0003-7469-6119

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Intermodal transport (IT), involving the integration of multiple modes of transport to create a sustainable, efficient, and competitive system, faces significant challenges in transition countries. Under conditions of limited infrastructure capacity, institutional and market barriers, and regulatory challenges, the development of IT in Bosnia and Herzegovina (B&H) remains constrained. This paper aims to identify and structure the key barriers that hinder the development of IT in B&H, by means of a comprehensive analysis and comparison with the region and the European Union (EU). The specific nature of B&H lies in its fragmented institutional framework, resulting from a complex political structure and a lack of coordination between entities, which hinders the institutionalization of the sector and the adoption of a unified IT development strategy. Infrastructure barriers include the lack of modern intermodal terminals, inadequate rail and inland waterway infrastructure, and limited connectivity between transport modes. In addition, market barriers include low service competitiveness and limited attractiveness of IT for private investors due to the uncertainty of the legal and regulatory framework. Regulations are often misaligned, and harmonization and standardization processes are slowed by administrative barriers and the lack of effective policy implementation. These barriers contribute to the marginalization of IT within the overall transport system of B&H.

Key Words: *intermodal transport, barriers, Bosnia and Herzegovina, region*

1. INTRODUCTION

In modern logistics and transport systems, intermodal transport (IT) is increasingly recognized as a sustainable, efficient, and competitive solution that enables the integration of transport modes: road, rail, and inland waterways, with the aim of cost optimization and reduction of negative environmental impacts. In the European Union (EU), IT holds a central position in transport policy, particularly in the context of achieving the goals of the Green Agenda and the decarbonization of the mobility sector [1]. While the

green transition represents a significant development opportunity for Western Balkan countries, it is hampered by limited institutional and regulatory capacities [2]. In transition countries such as Bosnia and Herzegovina (B&H), the development of IT faces numerous constraints, ranging from infrastructural and institutional to regulatory and market-related challenges. Although IT is widely implemented in advanced transport systems across Europe and the world, its full integration in transitional and infrastructure-deficient countries like B&H remains a challenge [3].

Despite B&H's favorable geostrategic position along Pan-European corridors and its potential for the development of intermodal capacities, this form of transport remains marginalized in practice. Insufficient investment in transport infrastructure, underdeveloped intermodal terminals, a fragmented and inefficient institutional framework, poor interoperability between transport modes, and the absence of targeted and

Autor's address: Snežana Tadić, University of Belgrade, Faculty of Transport and Traffic Engineering, Belgrade, Vojvode Stepe 305

e-mail: snezatadic74@gmail.com

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incentivizing policies are among the key reasons for its limited application. In this context, identifying and understanding the key barriers to the development of IT in B&H is fundamental to designing effective strategies and adopting relevant policies. Previous research has largely focused on technical or sector-specific aspects of transport, while a comprehensive analysis of IT development barriers tailored to the specific context of B&H is virtually absent in the literature. This paper aims to fill that gap by identifying, structuring, and analyzing the most significant barriers that limit the development and broader implementation of IT in B&H, while also providing a comparative analysis with Western Balkan countries and the EU. The findings, which represent the key contribution of this study, may serve as a foundation for the development of targeted policies, strategic plans, investment programs, and further research in the field of integrated and sustainable transport in B&H and the Western Balkans region.

2. LITERATURE REVIEW

Intermodal transport, defined as the integration of at least two modes of transport within a single logistics chain, with minimal handling of goods during modal transfer, represents a key component of modern sustainable transport systems [4]. Its implementation contributes to increased energy efficiency and cost optimization, particularly over long distances where a significant portion of transport is carried out by rail and inland waterways [5]. In EU countries, IT has been institutionalized, with clearly defined financing models and strategic support through instruments such as the TEN-T network and policies for the internalization of external costs [6, 1]. The main barriers to the development of IT have been identified as the shortage of suitable terminals, limited multimodal infrastructure, and coordination issues between different modes of transport [7]. In contrast, transition countries-especially those in the Western Balkans-face a broader range of challenges in the development and implementation of IT. In addition to inadequate infrastructure and logistics networks, other barriers identified in the region include the lack of institutional coordination and interoperability, incomplete and unaligned regulatory frameworks, and limited adoption of modern technologies [8, 9]. Significant progress has been made in addressing one of the major early-21st-century barriers- the lack of qualified personnel [10]. However, concerns remain regarding the balance of power and expertise across the transport sectors in individual countries of the region. Similar issues are reported in Eastern European countries, where inadequate transport networks and insufficient public investment continue to limit IT development, as evi-

denced by research findings in Romania [11]. Investment in rail infrastructure and IT significantly lags behind road transport in the Western Balkans, particularly in B&H, where rail freight transport continues to decline and connectivity with the EU network remains limited [12]. High handling costs, limited infrastructure availability, and insufficient coordination between modes represent the main barriers to shifting freight from road to intermodal transport (IT) [13]. The lack of handling equipment for transshipment and low digital integration among transport modes further hinder IT development [14]. In addition to efficient terminals, Rodrigue and Notteboom [15] emphasize technical interoperability as a primary requirement for successful IT system development. Several authors highlight that the limited share of IT in European transport is the result of weak integration between rail and inland waterway transport, which significantly reduces its potential as a sustainable alternative to road transport [16, 17, 18].

Spatial and physical characteristics, such as topographical conditions and infrastructure limitations (e.g., tunnels, bridges), further complicate the integration of transport modes [19]. Additional challenges include the absence of regulatory frameworks, lack of effective institutions, weak international harmonization, and insufficient cooperation among relevant stakeholders [20, 8], particularly between the public and private sectors in terms of investment, operations, and management of intermodal systems. Furthermore, EU reports emphasize that data on the location and capacity of intermodal terminals are not readily accessible, which complicates the planning of efficient transport routes [21]. In addition, the separation of responsibilities for different transport modes at the national level often leads to misaligned policies [22]. The development of IT systems in the Western Balkans region-particularly in B&H and Serbia-is characterized by a fragmented institutional framework, the absence of national strategies, and inefficient coordination [6, 8, 10]. The financial sustainability of the intermodal terminal project in Belgrade demonstrates that investments can be profitable when accompanied by tariff reforms and public support [23]. However, effective public-private partnership (PPP) models are lacking [24], both in the investment phase and in the operational and management stages. Given that a regional approach and interregional cooperation-along with knowledge exchange and the strengthening of local capacities-are key factors for the development of IT and sustainable logistics planning in less developed areas of the Western Balkans [25], it is essential to identify all local barriers. Although numerous studies address IT in the region, a comprehensive identification, analysis, and structuring of

barriers specific to B&H has yet to be undertaken. Previous approaches have mostly focused on general analyses of transport policies without clearly identifying and classifying barriers or evaluating them based on their priority for resolution. This gap underscores the need for a more detailed analysis of barriers, which should serve as a foundation for defining strategies to overcome them and for the development of IT in B&H and the Western Balkans region.

3. BARRIERS TO THE DEVELOPMENT OF INTERMODAL TRANSPORT IN B&H

This chapter identifies and describes the key barriers that are impeding the development of intermodal transport (IT) in B&H.

The barriers are grouped into several core categories: infrastructural, technical-technological, institutional-legal, economic-financial, organizational, market and operational, as well as planning barriers. Each of these categories is addressed separately to provide a comprehensive view of the factors that negatively affect the efficient implementation of IT systems in the country.

3.1 Infrastructural Barriers

The development of IT relies on the existence of high-quality and technically compatible physical infrastructure that enables efficient transitions between different transport modes. In B&H, this infrastructure is underdeveloped, technically outdated, or entirely lacking. Limited capacities, physical disconnection, and the absence of key infrastructural facilities represent serious obstacles to establishing a functional and competitive intermodal system.

Lack of Intermodal Terminals

B&H does not have a developed logistics network with intermodal terminals that would enable efficient transshipment between transport modes, nor does it have logistics centers that support storage, consolidation, and distribution of goods. There is no functional terminal in the country that meets European technical and operational standards for IT. The absence of such terminals limits the establishment of intermodal routes, increases costs, and prolongs delivery times.

Poor Connection to Intermodal Corridors

Despite its geostrategic position, B&H is poorly connected to key European intermodal corridors, such as Corridor VII (Danube) and Corridor X (Balkans–Central Europe). The lack of functional links to major EU terminals and the absence of regular international intermodal routes (e.g., shuttle trains) undermine the

competitiveness of the export and import sectors. Instead of integrating into major freight flows, B&H remains on the periphery of the European logistics network. Identifying routes that offer greater flexibility, better environmental sustainability, and integration into broader European logistics flows forms the basis for defining concrete measures to modernize and enhance the competitiveness of the transport system (Tadić et al., 2025).

Limited Connection with the TEN-T Network

The TEN-T network forms the backbone of European transport integration. In the case of B&H, the only corridor formally part of the TEN-T core network is Corridor Vc, which is still under construction and modernization. Other routes, including those toward neighboring countries (Serbia, Croatia, Montenegro), are not technically or administratively aligned with EU standards. This limited inclusion in the TEN-T network poses a serious challenge to the long-term development of IT.

Poor Integration of Rail and Road Networks

In many locations, rail and road infrastructure are neither spatially nor functionally connected. Access roads to railway stations are often inadequate, misaligned with logistical needs, and lack sufficient capacity for higher volumes of freight flows. This complicates the synchronization between transport modes, prevents the „door-to-door“ concept, and increases the complexity of logistics processes.

Inadequate Link to Maritime Transport

The Port of Ploče, the closest maritime gateway for B&H to international IT networks, is not sufficiently developed or technically adapted for intermodal functionality. Its capacity, infrastructure for intermodal operations, and connection to B&H's railway network are limited, further reducing its strategic potential. Moreover, modern intermodal systems require the presence of dry port terminals (inland intermodal terminals) that alleviate congestion in port areas, enable consolidation, customs clearance, and distribution of goods outside port zones, and expand the catchment area of maritime and river ports [25, 26]. B&H does not currently have any dry port terminals, despite their potential to significantly improve the functionality of Corridor Vc and enhance regional trade. Such terminals could support the Port of Ploče and other maritime and/or river ports [27].

Outdated Railway Infrastructure

A large portion of the railway network in B&H is technically outdated, with limited speeds and insufficient axle-load capacity. Additionally, the railway sector faces a shortage of locomotives and freight

wagons, further complicating the planning and implementation of IT. The lack of investment in track modernization, signaling and safety systems, and traction stock directly limits the use of railways in modern logistics operations. An added problem is the fact that a significant portion of the network is not electrified (22.3% of tracks) [28], which increases operational costs and dependence on diesel traction. This barrier particularly affects the development of IT, where speed, reliability, and interoperability are key factors for competitiveness compared to road alternatives.

Underdeveloped Inland Waterway Infrastructure

Inland waterways, particularly the Sava River, have significant potential for integration into IT. However, river infrastructure in B&H is neglected, poorly maintained, and often inaccessible for high-volume transport. The lack of ports, modern river terminals, and navigational conditions limits the integration of water transport into IT. The Port of Šamac is non-operational, while the Port of Brčko has limited capacity.

Shortage of Logistics Capacities

Logistics capacities and consolidation centers in B&H are underdeveloped in terms of infrastructure, equipment, and functionality to support modern IT chains—especially regarding equipment for handling intermodal transport units (cranes, reach stackers, and ramps). A particular challenge is the absence of integrated logistics centers that enable consolidation, storage, customs clearance, and redistribution of different freight flows—critical for achieving economies of scale and a prerequisite for efficient IT application. Without such centers, IT in B&H remains limited to isolated cases, as the lack of consolidation makes IT economically unfeasible.

3.2 Technical and Technological Barriers

Efficient functioning of the intermodal system requires the use of various intermodal units, transshipment technologies, and advanced information systems that enable the management of freight and data flows. In B&H, the low level of technological equipment and digitalization presents a significant limiting factor.

Shortage of Equipment for IT Technologies

In addition to the general lack of capacity and container-handling equipment, Bosnia and Herzegovina has minimal infrastructure for IT technologies that involve the transport of complete vehicles or trailers. There are no RoLa (Rollende Landstraße) or Hucklepack terminals, nor systems that allow entire road vehicles or trailers to be loaded onto railway

platforms without conventional vertical or horizontal transshipment (such as Modalohr or CargoBeamer systems). This directly limits the possibility of integrating road and rail transport efficiently, especially for intercontinental freight flows. Without this infrastructure, carriers are unable to include in IT the segment of cargo transported in trailers or specialized vehicles, which significantly reduces rail competitiveness in combined transport.

Limited Use of Telematic Systems

Most logistics and transport operators in B&H lack adoption of basic ICT tools such as Electronic Data Interchange (EDI), Warehouse Management Systems (WMS), Transport Management Systems (TMS), or Supply Chain Management (SCM). Many are also unfamiliar with more advanced systems like DFM, CRM, PDM, or SCEM. These limitations prevent automation and supply chain visibility—i.e., the planning, management, optimization, and control of IT in real time. This further reduces system efficiency, generates additional costs, and lengthens supply chain execution times. Moreover, data exchange among various actors is slow, often manual and paper-based, and prone to errors.

Low Interoperability

Low interoperability refers to the technical and operational misalignment between transport modes, most commonly between rail and road transport. Differences in technical standards, types of loading units, and handling procedures are prevalent. In B&H, this results in freight units being challenging to transfer from one mode to another without additional handling, which directly undermines the core principle of intermodality—continuity and integration of transport across multiple modes without interruption or extra handling.

Insufficient Digitalization of Processes

The digitalization of logistics and transport processes in B&H is still at an early stage. Many operators and institutions rely on analog methods for planning, documentation, and communication. The shortage of e-platforms, digital services for capacity booking, electronic customs declarations, and integrated databases disrupts synchronization among stakeholders and slows freight movement. Without systemic digitalization, IT cannot meet the demands of modern supply chains, which are based on speed, flexibility, and transparency.

3.3 Institutional and Legal Barriers

Institutional and legal barriers pose substantial obstacles to the development of IT in B&H. A lack of alignment with European regulations hinders the integration of the domestic transport system into broader

European flows and standards. The process of adopting laws and by-laws is often slow and inefficient, further delaying the implementation of necessary reforms. An additional issue is the insufficient institutionalization of IT and logistics. These areas fall under the jurisdiction of the railway transport departments within the competent ministries, without dedicated sectors or organizational units responsible for the systematic development, coordination, and promotion of IT and logistics. This institutional structure limits strategic planning and an integrated approach, both of which are essential for developing multimodal and intermodal infrastructure in line with European trends. Weak cooperation and coordination across different levels of government-state, entity, and local-impair the ability to act in a unified manner and develop joint policies. In addition, complex and inconsistent customs procedures create further barriers in cross-border transport. All of this, combined with a lack of public policy support for IT, forms the key institutional and legal obstacles.

Lack of Harmonization with EU Regulations

Given B&H's strategic objective of integrating into the European transport network, one of the essential prerequisites is aligning domestic legislation with EU standards. The legal framework in the transport sector in B&H is still not harmonized with that of the EU, particularly in areas related to IT, infrastructure management, terminal standardization, and safety and technical requirements [29]. This misalignment prevents B&H from integrating into the TEN-T network and limits access to EU financial instruments, which are contingent on regulatory compatibility. As a result, B&H is only marginally included in international intermodal flows and ranks lower in competitiveness compared to neighboring countries.

Slow Legislative Processes

Due to the complex political-administrative system in B&H, the adoption of laws and accompanying regulations proceeds very slowly. This leads to legal uncertainty and a low degree of predictability in the business environment. The lack of up-to-date and harmonized regulations hinders the introduction of new intermodal technologies, complicates the development of public-private partnerships, and reduces the scope for strategic planning. This issue is particularly problematic for foreign investors, who require legal stability and clear regulatory frameworks.

Weak Cooperation Between Levels of Government

Transport sector responsibilities in B&H are divided among various levels of government-state, entity, cantonal, and local-without a clear hierarchy or coordination mechanisms. This fragmentation makes it

difficult to establish common goals, develop integrated strategies, and implement infrastructure projects. The lack of institutional cooperation and communication results in overlapping responsibilities, administrative barriers, and low policy implementation efficiency.

Complex Customs Procedures

Customs and border procedures in B&H are frequently complex, inconsistent, and largely misaligned with the practices of neighboring countries and the EU. Electronic processing of customs documents is still underdeveloped, and various levels of government apply different protocols. This results in delays and additional costs for logistics operators. These barriers are particularly relevant in cross-border IT, where efficient and rapid data exchange is essential.

Insufficient Support for IT in Public Policy

In B&H's strategic documents, IT is typically mentioned mainly in a declarative manner, without concrete objectives, budgets, or implementation measures. There are no dedicated support programs for the development of intermodal terminals, no incentives for transport mode integration, no proactive measures to promote IT use, and no clearly defined institutional responsibilities in this area. In the absence of political commitment and proactive public support, IT development is left to market forces, which under current conditions favor road transport.

Administrative Barriers in Cross-Border Transport

In addition to physical and time-related barriers, IT in B&H also faces significant administrative constraints. Misaligned customs systems, differing technical standards (such as rail gauge, signaling, and rolling stock), and duplicated inspection and sanitary controls further complicate the execution of logistics chains. Moreover, the lack of electronic document exchange delays procedures and increases the administrative burden. This combination of factors leads to additional costs, delays, and reduced reliability in the supply chain, ultimately diminishing B&H's attractiveness as a transit and logistics hub on the international market.

3.4 Economic and Financial Barriers

The development of IT in B&H faces numerous economic and financial barriers that directly affect its sustainability and attractiveness for end users. These barriers stem from structural market weaknesses, limited public and private financing sources, and a lack of effective economic mechanisms and incentives that would support the shift from a monomodal, predominantly road-based transport system to sustainable intermodal solutions. A particular problem is the lack of competitiveness of rail transport compared to road transport, which diminishes the potential of IT.

Insufficient investment in infrastructure modernization, as well as complex and slow procedures for establishing PPP, significantly hamper investments in terminals and the transport and logistics network.

Lack of Financial Incentives

There is no developed system of incentives in B&H to motivate carriers and logistics operators to use IT. Unlike EU countries, which promote IT through subsidies, tax relief, and investment grants, in B&H all transport modes are essentially treated equally on the market, without differentiation based on environmental and social benefits. The absence of such mechanisms maintains the dominant role of road transport and discourages investment in IT.

Non-competitive Rail Transport Prices

Although rail transport has the potential to be more cost-effective over medium and long distances, in practice its price in B&H is often uncompetitive compared to road transport. This is particularly evident for smaller shipments and shorter routes. Contributing factors include high handling costs, low levels of digitalization and automation, and complex tariff models. In addition, the inflexibility of the rail system in terms of frequency and user adaptation further reduces its market appeal. On the other hand, the actual costs of road transport are not fully reflected in its market price. The lack of internalization of external costs further undermines the competitiveness of rail transport, which faces higher operational costs and complex tariff structures.

Limited Sources of Financing

B&H has limited budgetary capacity for investments in the modernization of transport infrastructure, and access to international funds (e.g., WBIF, CEF, IPA) faces delays due to administrative and institutional barriers. Private investors are often hesitant to invest in intermodal terminals or logistics facilities due to high risks and a lack of market security. The result is an investment deficit in key components of the intermodal network: terminals, access roads, warehouses, and specialized equipment.

Absence of Internalization of External Costs

One of the main reasons for the market dominance of road transport in B&H is that its market price does not include externalities-negative effects such as pollution, noise, infrastructure wear and tear, traffic accidents, and CO₂ emissions.

In the EU, a system for the internalization of external costs transfers these effects to the user through fees and permits, facilitating the development of more sustainable options such as IT. In B&H, such mechanisms have not been developed, resulting in

unrealistically low costs of road transport and thus distorting market balance in favor of less sustainable solutions.

Complicated Procedure for Establishing PPPs

Although PPPs could represent an effective model for financing the construction and management of IT, the procedure for their establishment in B&H is complex, slow, and legally inconsistent. The lack of a clear legislative framework and administrative support discourages private investors, while the public sector lacks sufficient capacity and experience to initiate complex infrastructure projects in the form of partnerships. As a result, the potential of the PPP model in the intermodal sector remains largely untapped.

3.5 Organizational Barriers

Organizational barriers represent a significant challenge for efficient intermodal transport (IT) in Bosnia and Herzegovina (B&H). The lack of integrated logistics operators, such as Third Party Logistics (3PL) and Fourth Party Logistics (4PL) providers, reduces the ability to offer comprehensive logistics services. Poor coordination among supply chain actors further diminishes the efficiency of logistics and transport processes and hampers timely service delivery. A limited range of flexible logistics solutions and weak information exchange between participants in the chain further complicate the management of the overall logistics and transport system and hinder the development of a competitive intermodal market.

Lack of Integrated Logistics Operators

Integrated 3PL and 4PL providers, as well as intermodal operators capable of planning, coordinating, and executing complex intermodal logistics chains, are virtually absent in B&H.

Most companies in the logistics sector provide only basic transport and warehousing services, without advanced offerings such as consolidated distribution, route optimization, IT support, and full supply chain management. The absence of such players means there are no intermediaries to connect all chain participants and enable users to access integrated intermodal services.

Poor Coordination Among Supply Chain Participants

Logistics activities and processes in B&H are characterized by poor coordination between shipping companies, railway operators, road carriers, terminal operators, freight forwarders, logistics providers, warehouses, and end users.

The lack of joint planning, standardized procedures, and operational alignment leads to delays,

duplication of processes, and increased costs. In an intermodal system, where continuity is crucial, such fragmentation severely undermines efficiency.

Limited Availability of Logistics Services

The logistics services market in B&H remains limited and does not offer a broad range of services adapted to IT. Services such as just-in-time deliveries, small shipment consolidation, reverse logistics management, and rapid response options to changes in the supply chain are largely unavailable. This rigidity further discourages users from opting for IT.

Weak Information Exchange Within the Chain

One of the key organizational challenges for IT in B&H is the absence of effective information exchange mechanisms between different actors. Communication is most often conducted via telephone, e-mail, or in person, lacking integrated digital communication platforms.

This hampers shipment tracking, prevents joint planning and response to transport disruptions, and increases operational risks. In modern intermodal systems, information is as important as the physical flow of goods, making this barrier particularly significant.

Delays at Border Crossings

Border crossings between B&H and neighboring countries—especially Croatia and Serbia—are often plagued by delays caused by lengthy procedures, lack of capacity, poor technical equipment, and insufficiently trained personnel.

These delays significantly impact the efficiency of IT, which relies on precision and continuity in the flow of goods. Even when physical connections are established, the system's functionality is limited due to long layovers and administrative inefficiencies at the borders.

3.6 Market and Operational Barriers

Market and operational barriers significantly impact the development of IT in B&H. Low market demand for intermodal solutions is often due to limited awareness and understanding of the advantages of this transport mode among potential users. Smaller volumes, higher frequency, and shorter distances, which characterize domestic transport flows, make road transport a more convenient and cost-effective choice.

Companies operating over longer distances often lack the volume to justify the adoption of IT technologies, and capacities to achieve economies of scale are either nonexistent or inadequate. Additionally, the limited number of users with sufficient cargo volumes

to fully utilize ITUs further reduces the efficiency and economic viability of intermodal solutions.

Low Demand for Intermodal Solutions

One of the primary issues is the insufficient demand for IT among businesses. Most companies rely solely on road transport due to its simplicity, flexibility, and availability. The lack of continuity and volume in freight flows prevents the establishment of regular intermodal lines, further reducing the attractiveness of such solutions. This creates a vicious cycle: there are no intermodal services because there is no demand, and there is no demand because there is no supply.

Lack of Awareness of IT Benefits Among Users

A significant number of logistics users in B&H are not sufficiently informed about the benefits of IT, such as faster transshipment, shorter supply chain times, reduced external costs, better cargo security, and greater capacity. The lack of education and promotional activities leads to low awareness of alternative transport options. In this context, IT is perceived as complex, expensive, and unreliable, although this is generally not the case.

Short Transport Distances for Domestic Flows

The geographical characteristics and distribution of industrial zones in B&H result in relatively short average transport distances, which favor the dominant use of road transport. IT is most cost-effective and efficient over medium to long distances (over 300 km), where rail and other modes become more viable. For shorter routes, the time and operational complexity of intermodal operations often outweigh the benefits, further limiting its application.

Insufficient Flow Volumes

IT relies on the efficient use of loading units (containers, trailers), which requires users to have sufficient cargo volumes to fill them. In B&H, many small and medium-sized enterprises lack the cargo volume needed to independently utilize intermodal capacities. There is also a lack of a consolidation system for smaller shipments (e.g., LCL – Less than Container Load) that would enable shared transport for multiple users, further reducing the practicality and cost-effectiveness of IT.

3.7 Planning Barriers

The lack of relevant planning documents and clear strategies for the development of intermodal transport (IT) hampers coordinated and long-term planning. Additionally, the absence of national and regional logistics network plans that include intermodal ter-

minals leads to inefficient resource use and hinders the integration of transport modes.

Lack of Strategic Planning Documents

B&H has not adopted or operationalized strategic documents that explicitly and thoroughly address the development of IT. While certain sectors (such as transport, infrastructure, and environmental management) have seen some strategic planning initiatives, intermodality is largely marginalized or only superficially addressed. The absence of a national strategy for IT prevents systematic planning, resource allocation, and integration into international investment flows.

Absence of Specific Strategies for IT

Although B&H formally participates in regional initiatives (e.g., the South-East Europe Transport Observatory – SEETO, and the Transport Community – TC), it lacks a clearly defined strategy for IT development, as well as documents that address the development of terminals, transshipment points, associated logistics zones, and digital integration. Without strategic priorities, the planning of intermodal infrastructure remains unsystematic and reliant on ad hoc initiatives, most often driven by foreign investors or international loans.

Absence of Logistics Network Plan

Efficient development of an intermodal system requires planning of the logistics network—both spatially and functionally. In B&H, there is no harmonized national logistics network plan identifying the locations of various categories of terminals and logistics centers.

Intermodal terminals are especially critical components of this network. The network should also define the connections between centers and terminals, as well as their links to industrial zones, major users, and international corridors. This planning gap results in overlap, investment uncertainty, and under-utilization of existing resources.

4. COMPARISON OF IT DEVELOPMENT BARRIERS IN B&H WITH THE REGION AND THE EU

The following section (Table 1) presents an analysis and comparison of barriers affecting the development of IT in B&H, with those faced by Western Balkan countries and in a broader international context. B&H and the region face similar challenges, but B&H lags somewhat further behind European standards. The analysis highlights multiple differences, particularly in terms of institutional, infrastructural, and technological development. Western Balkan

countries generally demonstrate faster progress in reform processes than B&H, while the EU has significantly advanced all key aspects of IT development.

Countries in the region—especially Serbia and North Macedonia—are actively modernizing their transport infrastructure and strengthening their connections to European corridors, gradually reducing the infrastructure gap with the EU. In parallel, the EU operates a highly developed TEN-T network and modernized terminals, enabling efficient integration of various transport modes.

From a technical and technological standpoint, the region is showing early signs of progress through the digitalization and standardization of transport processes, while the EU is highly advanced in this area. The EU applies cutting-edge logistics technologies and systems, ensuring a high level of interoperability and efficiency, whereas B&H has made little progress in this regard.

Institutional and legal coordination in the region has significantly improved compared to B&H, as several countries have already aligned a substantial portion of their legislation with EU regulations and established more efficient institutional mechanisms. On the other hand, the EU has implemented a fully harmonized regulatory framework and strong institutional support for IT development.

Financial mechanisms and incentives for IT development are more present in the region than in B&H, though still insufficient—particularly in terms of effective PPP models and access to EU funds. Unlike the region, the EU further promotes sustainable transport through environmental taxes, subsidies, and specialized funds, enhancing the competitiveness of intermodal solutions. Organizational capacity and market dynamics are also more developed in most regional countries than in B&H. In Western Balkan countries, there is evident growth in the sector of integrated logistics operators and the development of digital coordination platforms, while the EU is significantly ahead in this area thanks to its established logistics networks and advanced telematics systems.

The region is achieving better results in connecting to the TEN-T network and in standardizing cross-border procedures, while the EU operates within a highly integrated and digitalized transport network. B&H, however, continues to lag behind in this process, further slowing down cross-border transport flows. Strategic planning and institutional coordination are considerably better developed in the region and especially in the EU, while B&H still lacks clearly defined sectoral strategies or adequate plans for developing an intermodal system.

Table 1. Comparison of Barriers to IT Development in B&H and the Region

Barrier	B&H	Western Balkans	EU
Infrastructure Barriers			
Lack of intermodal terminals	Absence of terminals, slow development	Insufficient terminals but greater development	Developed network with different categories of IT terminals
Poor connectivity with intermodal corridors	Very weak integration	Partial integration	Full integration
Weak connection to the TEN-T network	Corridor Vc, weak network	Multiple corridors, projects underway	Complex TEN-T network
Poor integration of rail and road networks	Very low level of integration	Significant problems remain	High integration
Inadequate connection with maritime transport	Extremely poor port connections	In planning and partial development phase	Strong links, planning and development of dry ports
Outdated rail infrastructure	Low electrification level	Common regional problem	Electrification and modernization are priorities
Underdeveloped inland waterway infrastructure	Poor navigability and capacity	Similar problems with slightly better development	Developed river network
Lack of logistics capacity	Absence of modern facilities and equipment	Limited capacities	Automated systems
Technical and Technological Barriers			
Lack of equipment for IT technologies	Outdated, inadequate equipment, lack of new technologies	Minimal implementation in the region	Introduction of Modalohr, CargoBeamer
Limited use of telematics systems	Very low adoption and usage	Increasing implementation	High digitalization and use of smart solutions
Low interoperability	Technical and procedural obstacles	Standardization in progress	EU standard harmonization
Insufficient process digitalization	Dominated by analog processes	Digital projects under development	Digital customs systems, e-documents, etc.
Institutional and Legal Barriers			
Lack of harmonization with EU regulations	Slow alignment	Similar challenges	Full harmonization
Slow legislative processes	Political fragmentation	Similar challenges	Efficient processes
Weak coordination across levels of government	Poor coordination	Coordination in progress	Centralization
Complicated customs procedures	Lengthy processes	Similar challenges	Digitalized customs
Insufficient IT support in public policy	Lack of strategies	Weak political priorities	Strong incentive policies
Administrative barriers in cross-border transport	Uncoordinated procedures	Slow implementation of agreements	Harmonization and interoperability
Economic and Financial Barriers			
Lack of financial incentives	No subsidies	Similar challenges but higher development level	EU funds and grants
Non-competitive rail transport prices	High costs	Similar challenges	Environmental taxes in the EU
Limited funding sources	Few investments	Investment issues	EU funds, PPP models
Lack of external cost internalization	Costs not included	Similar challenges	Green taxes
Complicated PPP procedures	Administrative obstacles	Similar challenges	Facilitated regulations and incentives

Organizational Barriers			
Lack of integrated logistics operators	Low level	Sector growth	High levels of integration
Poor coordination among supply chain actors	Insufficient collaboration	Similar challenges	Mature collaboration networks
Limited logistics service offerings	Mainly basic logistic services	Broader range of services	Wide spectrum of services
Weak information exchange within the chain	Incomplete exchange	Present challenges	Integrated systems
Border crossing delays	Long waiting times	Frequent issues	Digitalized procedures
Market and Operational Barriers			
Low demand for intermodal solutions	Low awareness	Similar trend	Mature IT market
Lack of user awareness of IT benefits	Inadequate treatment and promotion	Similar trend	Balanced modal mix
Short domestic transport distances	Rigid schedules	Regional challenge	Flexible services
Insufficient transport volumes	Fragmented market, lack of consolidation and aggregation	Similar situation	Support for consolidation and aggregation
Planning Barriers			
Lack of strategic planning documents	Complete absence of plans	Planning in progress	Numerous strategies and planning documents
No specific strategies for IT	Absence of sector-specific strategies	Partial documents	Clear strategies
No logistics network plan	No research or planning activities	Plans under development	Detailed network plans

5. CONCLUSION

The analysis of IT development barriers in B&H, compared with Western Balkan countries and European standards, points to significant challenges and setbacks. The key issues relate to an underdeveloped awareness of the importance and benefits of intermodal transport, inadequate treatment of the sector within national administration, and a lack of planning activities. The consequences include an under-developed infrastructure, technical and technological shortcomings, institutional fragmentation, legal and regulatory obstacles, and limited financial support. Although similar challenges exist in other countries of the region, most have made notable progress through strategic initiatives, modernization, and institutional coordination. Therefore, it is recommended that B&H prioritize efforts toward proper institutionalization and promotion of the IT sector, along with the development of strategic and action plans and IT system development programs. Key actions should focus on building and modernizing infrastructure and terminals, accelerating digitalization, aligning the legal framework with EU standards, and strengthening institutional cooperation and financial support through PPPs. An integrated approach and the application of best practices from the region and the EU are essential for

improving the efficiency and sustainability of IT in B&H. The aim of this research was to systematically identify and structure the key barriers to IT development in B&H, in comparison with countries in the region and the EU. The contribution of the study lies in the detailed analysis of specific IT challenges in B&H, highlighting its lag behind the region, and providing guidance for future actions to support not only transport development but also the broader economic development of the country and the region. By identifying and analyzing these barriers, a foundation has been laid for future policies, strategies, investments, and further research focused on developing an efficient and sustainable transport system in B&H.

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REZIME

BARIJERE RAZVOJA INTERMODALNOG TRANSPORTA: STANJE U BOSNI I HERCEGOVINI

Intermodalni transport (IT), koji podrazumijeva integraciju više vidova transporta radi postizanja održivog, efikasnog i konkurentnog transportnog sistema, predstavlja ključni izazov u zemljama u tranziciji. U uslovima ograničenih infrastrukturnih kapaciteta, institucionalnih i tržišnih barijera i regulatornih izazova, razvoj IT u Bosni i Hercegovini (BiH) ostaje ograničen. Ovaj rad ima za cilj da identifikuje i strukturira ključne barijere koje usporavaju razvoj IT u BiH, kroz sveobuhvatnu analizu i poređenje sa regionom i Evropskom unijom (EU). Specifičnost BiH ogleda se u fragmentiranom institucionalnom okviru usljed složene političke strukture i nedostatka koordinacije između entiteta, što otežava institucionalizaciju oblasti i usvajanje jedinstvene strategije razvoja IT. Infrastrukturne barijere obuhvataju nedostatak savremenih intermodalnih terminala, neadekvatnu željezničku i vodnu infrastrukturu, kao i ograničenu povezanost između vidova transporta. Pored toga, tržišne barijere uključuju nisku konkurentnost usluga i nedovoljnu privlačnost IT za privatne investitore zbog nesigurnosti pravnog i regulatornog okvira. Regulatorna je često neusklađena, a procesi harmonizacije i standardizacije usporeni su administrativnim barijerama i nedostatkom efikasne implementacije politika. Ove barijere doprinose marginalizaciji IT u ukupnom transportnom sistemu BiH.

Ključne riječi: intermodalni transport, barijere, Bosna i Hercegovina, region