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SYSTEMIC APPROACH TO TRAFFIC EVALUATION OF MOSTAR AIRPORT

ABSTRACT

The attempt of this work is to systematically find solutions for Mostar Airport development through technical and technological harmonization of traffic processes undertaken in two separate organizations - airport and air traffic control and coordination between other traffic branches. The work uses the indicators of traffic flows and tourist trends in the region, and together with the mentioned simulations it attempts to evaluate the traffic potentials in the region by affecting the change in the current negative traffic flows at Mostar Airport.

KEY WORDS

Mostar Airport, airport traffic capacity, harmonization of traffic processes, traffic capacity simulation

1. INTRODUCTION

The region of Herzegovina is located in the south-eastern part of Bosnia and Herzegovina. It is an economically well integrated region with a population estimated at about 450,000. The town of Mostar is the capital economic, cultural and political centre of the region, located at the foothills of the mountains Velež, Hum and Čabulje, in the valley of the river Neretva.

According to the International Civil Aviation Organization – ICAO – the airport which is located in the close vicinity of the town of Mostar has the reference code 4C and the capability of serving the whole catchment area of the Herzegovina region, which covers an area of about 12,276 square kilometres.

The extremely favourable location of the airport in relation to the town of Mostar, the main road and railway routes that pass in the close vicinity, and the

planned construction of the corridor Vc which would pass close to the airport, and the closeness of the world-known Virgin Mary's shrine of the apparition of the Blessed Virgin Mary, have been some of the motives for writing this scientific paper.

The present traffic volume in Mostar Airport does not satisfy the capacities of the airport and is not sufficient for its normal operation. The analysis of traffic data has shown that the number of passengers is at the level of 8% of the pre-war status, and the number of operations is at the level of 30%.

In Bosnia and Herzegovina there are four international airports: Sarajevo, Mostar, Tuzla and Banja Luka. However, they do not represent the actual demands for air traffic services required by the domicile population, of relatively large number of emigrants, as well as of a large number of foreigners living in Bosnia and Herzegovina on various bases, but had been developed in the former state rather for the military requirements. Thus, for instance, airports in Tuzla and Banja Luka, had no civil aviation operations until the nineties of the last century.

Mostar Airport, which before the war in the region of ex-Yugoslavia used to be a combined civil-military airbase, is located in the South of Bosnia and Herzegovina, in the Herzegovina region with a relatively large serving area covering 12,276 square kilometres, populated by about 450,000 inhabitants. In the North it borders with Bosnia, in the East with Serbia and Montenegro, in the South and the West with the Republic of Croatia (Dalmatia). On the coastal part of the border with the Republic of Croatia it has access to the Adriatic Sea in the Neum-Klek bay, in the length of 23.5 km of well-indented coast.

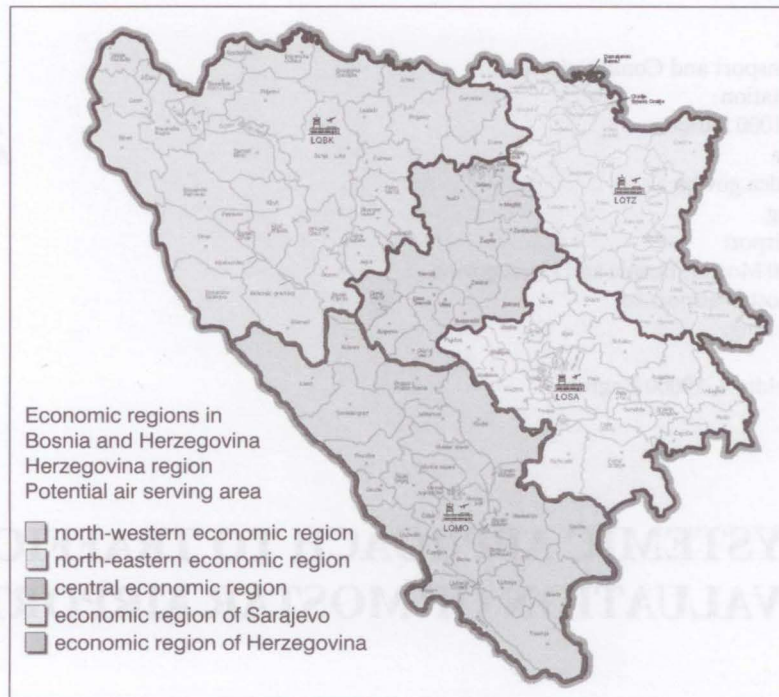


Figure 1 – Map of Bosnia and Herzegovina

The economical, cultural and political centre of this region is the town of Mostar, located in the middle, 130 km from Sarajevo, and regarding Croatian regional centres, 180 km from Dubrovnik, 160 km from Split and 430 km from Zagreb. It is at a distance of 530 km from Belgrade.

Due to severe devastation during the war, the airport has been restructured in phases, and completely renewed in 2002. The regular air traffic with Vienna and Zagreb, established immediately after having been opened, has not been maintained. In spite of good occupancy on the flights to Vienna, the flights were cancelled for no known reasons. The flights to Zagreb had a lower occupancy level, first of all due to the very high fares as well as unfavourable flight schedule that did not provide possibilities of continuing the journey from Zagreb. Currently, the airport operates only charter flights that are mainly related to the Virgin Mary's shrine in the nearby Medjugorje.

2. GENERAL CHARACTERISTICS OF THE SERVED AREA

Climate

Herzegovina is a region with diverse climate. In lowland Herzegovina where Mostar Airport is located, the climate is modified Mediterranean-Adriatic, with mean annual air temperature above 10°C. It is characterized by a large number of sunny days, low relative humidity and cloudiness, increased airstreams, rains in winter half of the year and warm, long

summers. Snow and frost are of rare occurrence in Herzegovina.

The climate in the vicinity of Mostar Airport is characterized by short winter, free of heavier frost and snow but with abundant rains and long and warm summer [1]. There are most precipitations in the months of November and December. Clouds prevail in the period from November to February. During this period, on the average, every other day is cloudy. Fog occurs in November on the average 1-2 days and in December 3, in February 1 day. In one month there was a maximum of 5 to 7 days with fog. In other months fog is very rare. In the Mostar Airport zone the winds "bora" (north-eastern wind) and "jugo" (warm moist southern wind) prevail. "Bora" occurs most often in January and February, on the average 6-7 days and for a maximum of 15-18 days monthly. It blows at a speed of over 12 m/s and reaches the speed of as much as 30 – 40 m/s. It very often changes the direction (by 30° - 180°) and speed (up to 30 m/s). Due to the terrain configuration there are also characteristic sudden occurrences of the north-eastern wind of high speeds, especially on the northern part of the airport. When "bora" is blowing, there is strong and very strong turbulence up to the altitude of 3000 m. The highest daily temperature (over 40°C) occurs in the summer season. The lowest daily temperature in the winter period was recorded at -16°C. The temperature below -10°C is very rare, whereas the temperatures of over 30°C are very frequent in the period from June to September (56 days on the average).

Diagram 2 shows the data regarding the wind at the Airport.

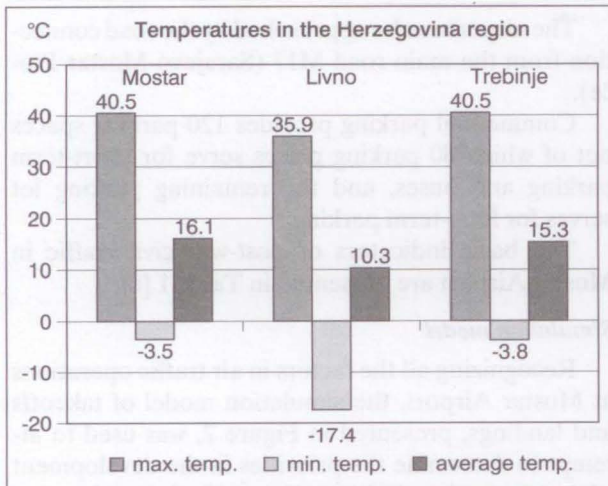


Diagram 1 – Temperatures in the region recorded in 2003

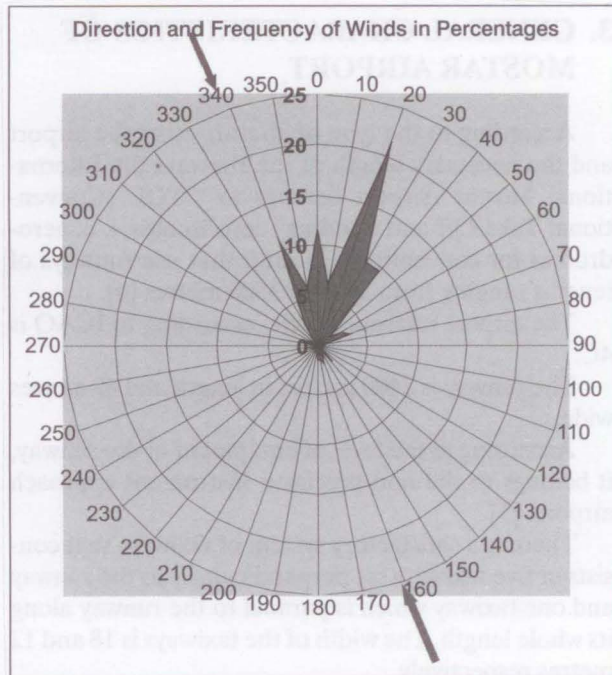


Diagram 2 – Wind rose measured in the period 1996-2004

Demography

The Mostar Airport serving area features highly expressed migration movements of population, mainly towards major city centres [2].

The main centre of the region, Mostar, has about 105,000 inhabitants, whereas other cities are much smaller (diagram 3) [3].

As consequence of war in this region, there is still a great number of displaced persons and refugees.

Industry

The Herzegovina region is historically, industrially underdeveloped part of Bosnia and Herzegovina, with

a population mainly living of agriculture and cattle raising.

There is also a high level of unemployment.

During the last decade, there has been a noticeable increase in the industrial production, especially in West Herzegovina.

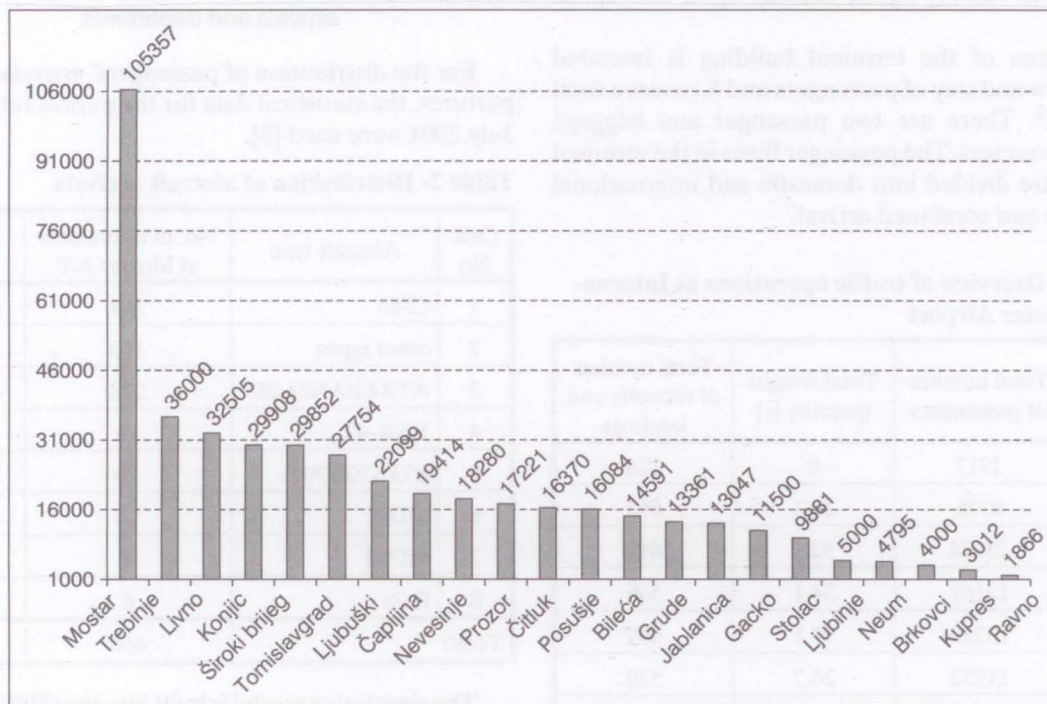


Diagram 3 – Comparison indicators of the number of population in the districts of the Herzegovina region

3. GENERAL CHARACTERISTICS OF MOSTAR AIRPORT

According to the type of aircraft using the airport and the necessary length of the runways the International Mostar Airport belongs to CTOL (Conventional Take-Off and Landing) aerodromes, i. e. aerodromes for conventional aircraft that use runways of lengths ranging from 2000 to 3500 metres [4].

The airport reference code, according to ICAO is 4C.

The runway is 2400 metres in length and 49 metres wide.

According to the level of equipment of the runway, it belongs to the non-precision instrument approach airports [5].

There is a satisfactory system of taxiways that consists of five taxiways set perpendicularly to the runway and one taxiway which is parallel to the runway along its whole length. The width of the taxiways is 18 and 12 metres respectively.

The airport has 2 aprons for aircraft handling and parking. The apron dimensions are: 100 x 60 m (2 parking positions for reference aircraft A319), and 216 x 74 m (4 parking positions for aircraft B737).

The parking on aprons is the turning one, using the power of aircraft engines, nose away from the terminal building.

The airport is equipped also by night-operation instruments. The approach lights are CAT I – ALPAATA, and apart from the approach lights there are also the runway lights, taxiway lights and apron lights.

The area of the terminal building is intended for the flow and stay of passengers and it covers a total of 1163m². There are two passenger and baggage check-in counters. The passenger flows in the terminal building are divided into domestic and international departure and combined arrival.

Table 1 – Overview of traffic operations at International Mostar Airport

Year	Total number of passengers	Total freight quantity [t]	Total number of takeoffs and landings
1998	1717	0	128
1999	9776	16.2	665
2000	13024	32.1	617
2001	12167	34.1	536
2002	13210	97.1	609
2003	11952	26.7	520
2004	6804	135.7	424

The airport can be approached by the road connection from the main road M17 (Sarajevo-Mostar-Ploče).

Commercial parking provides 120 parking spaces out of which 80 parking places serve for short-term parking and buses, and the remaining parking lot serves for long-term parking.

The basic indicators of post-war civil traffic in Mostar Airport are presented in Table 1 [6].

Simulation model

Recognizing all the factors in air traffic operations at Mostar Airport, the simulation model of takeoffs and landings, presented in Figure 2, was used to attempt to determine the priorities in the development of the airport in relation to the traffic demand.

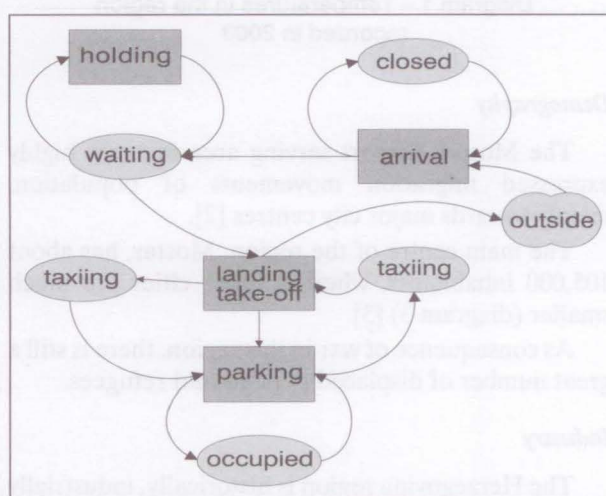


Figure 2 – Simulation model of aircraft arrivals and departures

For the distribution of passengers' arrivals and departures, the statistical data for the period July 2002 – July 2004 were used [5].

Table 2- Distribution of aircraft arrivals

Ord. No	Aircraft type	No. of operations at Mostar A/P	%
1	C560	164	24.625
2	other types	110	16.517
3	ATR42/AN24-26	278	41.742
4	YAK-42	18	2.703
5	B737-300/700	70	10.511
6	MD81	14	2.102
7	MD83	4	0.601
8	IL76	8	1.201
Total:		666	100

The simulation model is built into the GPSS/H program, with the simulation of eight-hour daily work [7].

The simulation results have yielded the following basic indicators:

1. 10 aircraft with traffic load of 47% were handled at the commercial apron;
2. 5 aircraft with traffic load of 43% were handled at the GAT apron;
3. a total of 28 operations were performed.

Taking into consideration the conditions of separating the arriving and departing aircraft [2], and the traffic capacities of the terminal building, it may be concluded that the infrastructure regarding taxiways, apron, and runway, the airport can meet the traffic demand over the next short-term period.

4. POTENTIALS IN PASSENGER AND GOODS TRAFFIC

Potential number of passengers in scheduled traffic

According to the available data, there are about 450,000 inhabitants living in the Herzegovina region. Let us assume that out of this number, 70 percent gravitate to Mostar Airport. The total number of potential users, therefore, amounts to 315,000. Out of this number, 5 to 9 percent of the population will use the services of regular air traffic. This results in an approximate number of potential passengers in scheduled traffic, 15,750 to 28,350. It can be assumed that 75% of the passengers will use air traffic for the return journey as well, so that there is a total number of Mostar Airport service users of 23,625 to 42,525 [8].

If we add to this number the redirected flights from Sarajevo during the winter months when Sarajevo Airport is temporarily closed down due to adverse weather conditions, there may be an increase of 3000 to 5000.

Thus, the total number is 26,625 to 47,525 passengers in scheduled traffic.

Assuming that airlines have a strategic business approach of high-quality services with low fare prices, good choice of destinations and favourable schedule allowing connections, good occupancy of flights may be expected.

Potential number of passengers in non-scheduled traffic

In non-scheduled traffic the potential number of passengers is much higher. This primarily refers to the vicinity of the world-known shrine of Medjugorje which attracts from year to year an increasing number of tourists from all over the world. The number of visitors is estimated to over a million a year. The tourist offer includes also the reconstructed Old Bridge which also attracts an increasing number of foreign tourists, and also other tourist potentials offered by this region to great extent.

Medjugorje is located at a distance of only 30 km from the Airport, and, as known, it belongs to one of the most visited pilgrimage centres in the world, visited annually by over a million visitors, including a majority of foreigners, coming by organized chartered transport, buses and aircraft. Therefore, the number of passengers at Mostar Airport could be much greater.

For the sake of easier forecasting, let us assume that Medjugorje is visited annually by a million pilgrims. Let there be a minimum of 80% foreigners (800,000), and out of this number let there be at least 20% passengers who use aircraft on arrival (160,000). If 50% of this number of passengers who arrived by air, choose to land at Mostar Airport, the number of passengers in non-scheduled transport by aircraft should be about 80,000 on arrival. These passengers should also return by plane so that for Mostar Airport this would mean $80,000 \times 2 = 160,000$ passengers a year, only in the segment of religious tourism.

Thus, when all potential passengers who could be using Mostar Airport for their travel origin and departure to further connections are summed up, this would result in somewhat more than 214,200 passengers annually.

If Mostar Airport managed to take over the majority of flights carrying passengers who visit Medjugorje, and in cooperation with airlines that operate in this region organized a good flight schedule with several at-

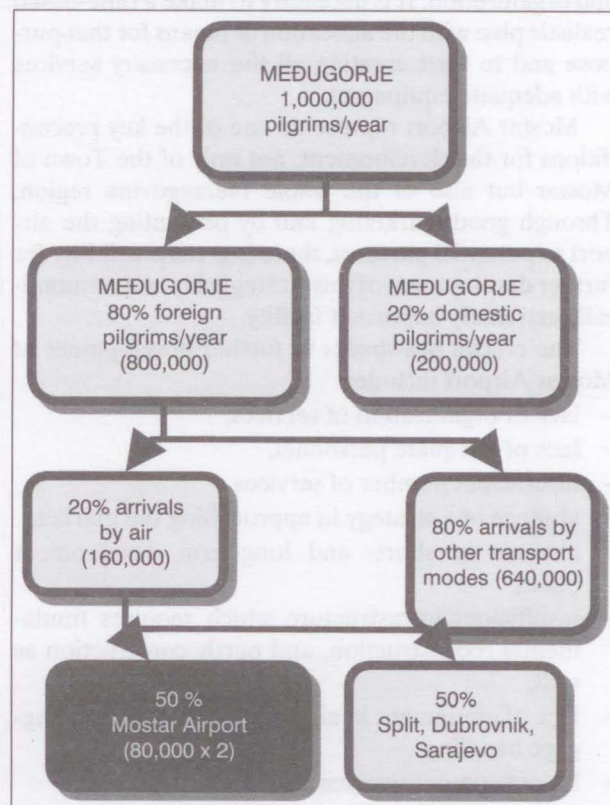


Figure 3 - Algorithm of pilgrims' arrivals

tractive international destinations so that passengers could have the possibility of continuing their journey (by coordinating the flight schedule in relation to other world airlines), and takes over a part of passengers from Sarajevo Airport (during winter – due to bad weather conditions), the potentials of Mostar Airport could be even higher.

Potentials in transportation of goods

Table 1 shows a constant annual increase in goods traffic, in spite of the fact that there is no conventional cargo terminal at the airport.

The extremely favourable geo-traffic position which is determined by the close vicinity of the main railway and road route in B&H, opens up great possibilities for integral transport. The railway line that starts from the Port of Ploče, passes along the very northern threshold of the runway, and the railway cargo station Mostar is only 1.5 km away from the airport.

5. NECESSARY IMPROVEMENTS IN INFRASTRUCTURE AND ORGANIZATION

The Mostar Airport management, i. e. complete functioning is an extremely complex and long process that requires exceptional means, persons, equipment and organization. It is necessary to make a time-based realistic plan with the allocation of means for that purpose and to start creating all the necessary services with adequate equipment.

Mostar Airport represents one of the key preconditions for the development, not only of the Town of Mostar but also of the whole Herzegovina region. Through good marketing and by presenting the airport to potential partners, there is great possibility for further development of this strategically and economically extremely important facility.

The crucial drawbacks in further development of Mostar Airport include:

- lack of organization of services,
- lack of adequate personnel,
- insufficient number of services,
- absence of a strategy in approaching the market,
- absence of short- and long-term development plans,
- insufficient infrastructure which requires fundamental reconstruction, and partly construction as well,
- lack of equipment in aircraft, passengers and baggage handling,
- lack of competitiveness of prices,
- lack of understanding and insufficient support by the owners.

For the airport – aerodrome to be able to function seamlessly, and to provide services in the field of air traffic, it is necessary to insure certain technical and technological preconditions. These preconditions have a basis in the international standards and recommended practices.

Mostar Airport should tend towards the objective of regional international airport and to the fulfilment of the pre-condition of being used as the alternative airport for Sarajevo. At the same time, apart from technical equipment, the raising of the security level and the airport infrastructure construction, the following is also necessary:

- to create preconditions for investment through analysis of the potentials of the region regarding scheduled and non-scheduled traffic, tourist and other offers, as well as interior design and organizational restructuring of the airport and employing of competent staff members;
- to determine the main objectives in relation to market potentials;
- to construct/take over/repair the lacking facilities:
 - technical objects;
 - objects for warehousing and fuelling aircraft;
 - cargo terminal;
- to expand the apron by one position for the reference type of aircraft;
- to insure the lacking equipment for aircraft, passengers and baggage handling;
- airport computerization and automation;
- restructuring of the terminal building according to the required peak traffic loads.

6. CONCLUSION

It is obvious that Mostar Airport has traffic potentials to be able to operate on commercial bases, without any major usage of the town budget.

This claim is based on the knowledge about the number of tourists, i. e. primarily pilgrims who arrive to visit Medjugorje.

The estimate of 80,000 pilgrims, which means 160,000 passengers passing through the airport, has been taken as the bottom short-term realizable threshold in the number of passengers, which can be significantly increased by systemic planning of traffic development, and could reach the level that is currently unreachable even to the busiest airport in Bosnia and Herzegovina, Sarajevo.

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SAŽETAK

SUSTAVNI PRISTUP PROMETNOJ EVALUACIJI ZRAČNE LUKE MOSTAR

Ovaj rad pokušava da na sustavan način pronađe osnovne smjernice razvoja Zračne luke Mostar, kroz tehničko-tehnološko usklađivanje prometnih procesa koji se odvijaju u organizacijski odvojenim prometnim cjelinama kontrole letenja i aerodromskog poduzeća, kao i usklađivanja ostalih prometnih grana (cestovni, željeznički) sa zračnim prometom. Rad se koristi i pokazateljima prometnih tokova i turističkih trendova u regiji, kojima se zajedno sa navedenim simulacijama pokušava evaluirati prometne potencijale u regiji, kroz utjecaj na promjenu postojećih negativnih prometnih tokova po Zračnu luku Mostar.

KLJUČNE RIJEČI

Zračna luka Mostar, prometni kapaciteti zračne luke, usklađivanje prometnih procesa, simulacije prometnih kapaciteta

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