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Original Article

Improving the Aerodrome Category in the Vicinity of Sibenik through the Ana Lazarovska`s Codex on the Sustainable Aerodrome Development

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Abstract: *Given that the commercialization of airports is carried out according to the principle of arbitrariness, the birth of a new airport is a very intriguing topic that imposes the dilemma of the correct airport category with the adequate location that allows for that level of development. This research is based on providing answers to three questions: which location, which category, and sustainable development of the airport in accordance with optimization practices as a recast model in accordance with the theory of equilibrium and benchmarking. The decision model for the necessary category for the construction of the airport near the city of Sibenik consists of intertwined elements that, when taken together, create and deliver significant value in academic research in the holy trinity of airport operations, air traffic control, and airlines through the prism of airspace economics. The first contribution of this paper is to establish a location for the construction of an airport that meets the necessary dimensions for expansion. The second goal is to determine the necessary category for constructing an airport using an optimization model and equilibrium theory for its adequate implementation within the airspace. With the example of the construction of a sports school airport infrastructure, by comparing the data and the given research, the expected results for the imposed dilemma regarding the need for airport infrastructure were provided.*

Keywords: *Aerodrom Location Selection in the Vincinity of Sibenik, Optimization Process, Equilibrium Theory, Aerodrome Design; "Codex On The Sustainable Aerodrome Development",Category Sustainable Development.*

I. INTRODUCTION

The Republic of Croatia has nine airports, eleven sports airports, and two military ones. Due to the need for the development of airspace, airport coverage is needed on the Adriatic near the city of Sibenik. Recommendation from expert authorities that the airport in the first phase be intended for sports-school flying, training of aeronautical personnel, panoramic flying, and medical purposes, and later in further development for commercial flights. This academic elaboration of the given topic presents the process for optimal location selection and determination of the required airport category at the given location.

The concept of equilibrium, according to the emergence of new technologies and the emergence of new technologies intended for the development of airport infrastructure, occupies an important place in the field of optimized aviation networks as a key criterion for the purposes of this article. In this decision-making process, there is a special need to improve optimization processes as one of the necessary solutions for an equal system. The implementation of the optimization model is a potential condition for increasing the capacity of planned airports, especially where there is a decision rule. After working during the third cycle of study, the author, with the help of co-authors, came to the conclusion that the optimization model can be reworked as a decision factor. The facts from the White Paper in the section on aviation, where it is presented as a Study on Air Traffic Management in the Single European Sky, have built a project methodology that teaches how the new airport infrastructure can be born. Our design for the airport in the vicinity of the city of Sibenik has a large number of desirable locations and is decisive for one that generalizes many decision factors.

A decisive role in the proposed locations is played by the position between supply and demand in accordance with sustainable development and benchmarking to explain them by trying to prove that the interaction in the overall general equilibrium for the development of the airport, while its other factors are held constant. Bearing in mind the navigational, topographic, and meteorological conditions that are considered uneconomic, they are left behind in the elaboration of this article, since they are a result outside the natural scope of economic analysis. The prevailing prices are those that coordinate the demands of different consumers for the development of the airport category, from the sustainability of the airport, which leads to the question of the stability of the equilibrium. For each of the given potential locations for airport infrastructure, it is valid that they will be unstable if an unsustainable development of this category is caused. In the case of an unstable equilibrium, the process regresses with a process of returning to the same outcome. The sustainable development of the airport depends directly on the uniqueness of the location layout. The unstable equilibrium as a result of multiple random situations leads the economy to end up with a different set of allocations and prices. In the process of adjustment that guarantees the stability of the system with a guarantee of prices and allocations, supply, demand, and elasticity are represented based on the theory of equilibrium. In our case, when one potential location for airport infrastructure has more than one stable existing equilibrium, it causes the beginning of another. The selected location must satisfy the possibilities for the development of the runway category and the expansion of the airport due to the evaluation of sustainable development, and the location is leading in the benchmarking process. The main goal of the author is to establish a way and also find an adequate solution for the construction of a general aviation airport in the vicinity of the city of Sibenik, Croatia, through the Handbook on Sustainable Development of Airports.

The increase in air traffic and the need for more industries are increasing the need for several new public airport infrastructures in the Republic of Croatia. Another concern is the safety of the airport's manoeuvring areas from incidents and accidents, with consequent environmental and pollution consequences. The risk assessment process takes into account the reliability, location, and consequences of the risk of accidents. The methodology allows engineers and aviation personnel to have a permissible use for use with risk and environmental aspects. The main focus is on the decision-making process, the context, and the environmental impact of ICAO regulations to be used for airport planning and the construction of airport infrastructure. The global increase in air traffic for better coverage of airports in the Republic of Croatia creates a need for the necessary sustainable growth of the airport in the vicinity of the city of Sibenik. The paper presents sustainable development according to Ana Lazarovska's notebook and in parallel with Leonardo da Vinci's notebook. The "Code for Sustainable Airport Development" is written in parallel with the "Code for Bird Flight" and is intended for all engineers working with airport infrastructure. The proposed notebook works with a "step-by-step" process showing the required level of category development and improvement of the current airport infrastructure in this article for the category of airports in the vicinity of the city of Šienik. The main focus is on the theory of equilibrium as a basic solution to the problems related to the possibilities of runway extension, including further necessary development within the Annex 14 boundary.

Objectives for proving the birth of a new airport near the city of Sibenik:

1. Transport economics and sustainable development
2. Important features of transport economics
3. Basic determinations of sustainable development
4. Causes and consequences for the environment
5. Valuation of the environment
6. Sustainable development of airport infrastructure
7. Sustainable development of the economy in national and international branches
8. Degree of development and success of air traffic in the Republic of Croatia.
9. Project development
10. Benchmarking model for development
11. Development and success of international exchange
12. Opportunities for the development of air traffic at the selected location for airport infrastructure
13. Airport infrastructure in international frameworks
14. The relationship between transport economics and sustainable development in international exchange
15. Compatibility and complementarity of transport economics at the international level
16. Compatibility and complementarity of sustainable development at the international level
17. Economic aspects of the sustainable development of air traffic
18. Defining the universal optimization model of transport economics in interaction with sustainable development
19. Valuation of the universal equilibrium model of transport economics in the function of sustainable development
20. Setting up an adequate cost-benefit analysis for the action of adjusting air traffic in the Republic of Croatia in international frameworks.

The overall objective of this research is to provide an economic, safe, rapid, and regular analysis for a given project, with services proportionate and adaptable to all user requirements in the field of European air transport. The services that will have to meet national security requirements should be globally harmonized, environmentally sustainable, and functional according to unified principles and meet demand.

When researching and formulating the results of scientific and development research on a complex topic presented in the post-doctoral dissertation "Code of Sustainable Airport Development", twenty-two scientific methods were used in appropriate combinations:

1. "Mosaic" method
2. Mathematical models
3. Statistical methods
4. Description methods
5. Compilation methods
6. Modeling methods
7. Analysis and synthesis methods
8. Deductive and inductive methods
9. Methods of abstraction and concretization
10. Methods of generalization and specialization
11. Methods of proof
12. Classification methods
13. Theoretical systems as methods
14. Comparative methods
15. Historical methods
16. Empirical methods
17. Axiomatic methods
18. Case study methods
19. Ideal type methods
20. Programming methods
21. Observation methods
22. Forecasting methods.

II. AERODROME LOCATION SELECTION IN THE VINCINITY OF SIBENIK CITY

There is no infrastructure for air traffic in the area of the city of Sibenik and the Sibenik-Knin County. Currently, air traffic is carried out via the Split Airport in Kaštela (45 km) and the Zemunik Airport near Zadar (50 km) from Sibenik. According to public sources, there is no organized connection with public transport, and transfers are carried out exclusively by travel agencies or taxis. With the construction of the planned airport near the city of Sibenik, it is possible to influence the increase in the number of passenger arrivals. According to data on the population of this area and the development of industries, as well as for the purposes of operating various types of aircraft, an organized airport is necessary in the area of the city of Sibenik between the former barracks of the princes of Bribir in Sibenik and the island of Zlarin in the Polje area.

According to the principle of sustainable development, the environmental protection objectives in the transport sector for the city of Sibenik are as follows: urban transport to be covered by the concept of sustainable development, reducing the scope of road personal transport and developing public transport, incorporating the principles of sustainable development into development plans and sector strategies, reducing the impacts of traffic activity and traffic infrastructure on the environment, protecting sensitive areas, increasing the safety of the transport of hazardous materials and the reception of hazardous materials in ports, as well as realizing sustainable mobility in the city.

Measures to achieve the objectives: Optimizing road traffic in the area, improving the quality and accessibility of public transport, replacing oil-fueled vehicles with natural gas and biodiesel or hybrid vehicles, creating a master plan for urban revitalization and mobility of the city of Sibenik, creating a strategy for the development of intelligent transport systems and revising and supplementing the traffic study of the city of Sibenik, green belts along the roads, implementing the measures envisaged by the innovative public transport program of the city of Sibenik, construction and arrangement of a network of bicycle and pedestrian paths, moving transit traffic on state, district and local roads outside the settlement with traffic planning and/or construction of bypasses.

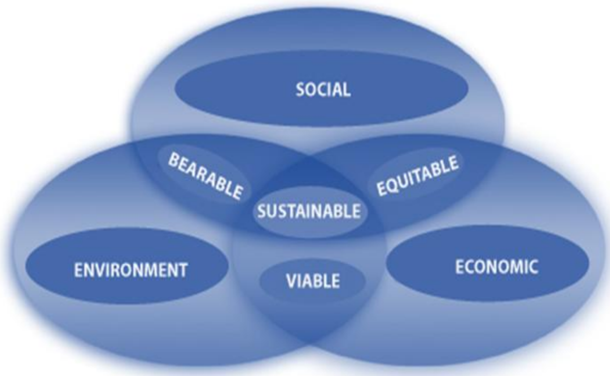


Figure 1. Three dimensions of sustainable development
Source: ODRAZ, 2015

The city of Sibenik does not have a general aviation airport. Using the acquired knowledge of multidisciplinary analysis and theoretical testing in the process of selecting and testing several possible locations leads to the selection of the best location for the airport.

The process of identifying possible locations takes into account geological, vehicular traffic, urban, and environmental factors, as well as the long-term development of the airport in compliance with the Republic of Croatia's Strategy and Program for Spatial Planning and the Municipality of Sibenik's regional planning based on meteorological, topographic, and navigational parameters. Considering urban and regional spatial planning, the most promising location would have the best development circumstances.

The Sibenik aerodrome would be classified up to 1200m length of runway of the finally selected location as an instrumental, which allows runway extension up to 1,800m length (AUTHOR CALCULATION). The Sustainable Development Strategy of the Republic of Croatia (NN 30/09) lists goals and measures for the development of sustainable transport, stating that the development of transport infrastructure should be a function of the sustainable and balanced development of the country as a whole.

A) Aerodrome Location Selection in the Vincinity of Sibenik

The selection of the most favorable location for airport infrastructure must be elaborated based on the topographical, meteorological, and navigational conditions, and of course, taking into account urban planning, construction, geology, traffic, and other conditions, and other industries that may affect the smooth running of airport operations.

a. Topography in the vicinity of Sibenik city- 360°

To select the most favorable location for the construction of an airport, three potential locations were taken into account in terms of settlements, construction status, and free state land in the vicinity of Sibenik, as Location 1, Location 2, and Location 3; hereinafter referred to in the paper as L1, L2, and L3.

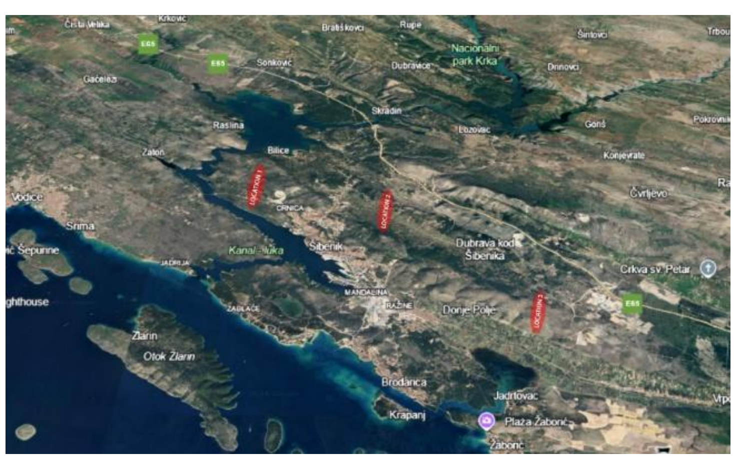


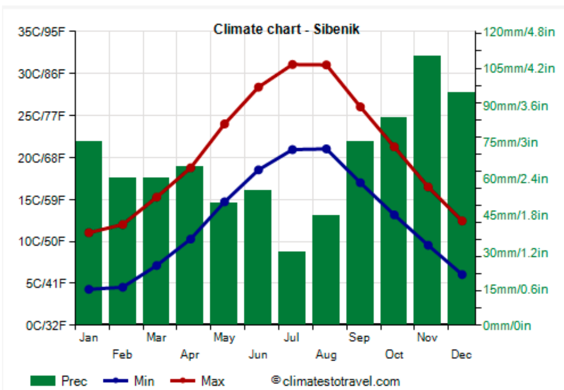
Figure 2. Possible location for aerodrome in the vincinity of Sibenik city

Source: *Google Maps*

The dynamic topography of Sibenik and the even more dynamic historical circumstances define the development of the airport, with a series of hills crowned with fortresses and a city that organically develops at their foot. The fortresses that dominate the peaks, surrounded by greenery just above the city and with the fortresses contribute to the quality and diversity of life in Sibenik. The city and the hill form a unique urban interaction. The Smričnjak hill is the most prominent of the hills in the city, where its unusual pyramidal contour forms a backdrop to the western part of Sibenik. The construction of the airport should create a new focal point, the location of which can trigger development. The starting points of our thinking when designing airport infrastructure start with a 360° view in all directions of the selected locations. It is very important to take the dimensions into account in the contours of the hill itself, that is, its very peak, which is not treated only as a point, a viewpoint, or an installation.

Into consideration for location selection will be taken the state border and proximity to the sea, the surrounding settlements, as well as the Sibenik area amenities.

Sibenik is a city on the Adriatic coast of Croatia, located in the central part of Dalmatia on the coast of Croatia on the sea and very close to the Croatian border, and connected to the open sea through the so-called Sant'Antonio's canal. The climate of Sibenik is Mediterranean, with mild, rainy winters and hot, sunny summers.



Sibenik - Average temperatures (1996-2020)						
Month	**Min (°C)**	**Max (°C)**	**Mean (°C)**	**Min (°F)**	**Max (°F)**	**Mean (°F)**
January	4.3	11	7.7	40	52	45.9
February	4.6	12	8.3	40	54	46.9
March	7.1	15.3	11.2	45	60	52.2
April	10.3	18.8	14.5	51	66	58.1
May	14.7	24	19.4	58	75	66.9
June	18.5	28.4	23.5	65	83	74.3
July	20.9	31.1	26	70	88	78.8
August	21	31	26	70	88	78.8
September	17	26	21.5	63	79	70.7
October	13.2	21.3	17.2	56	70	63
November	9.6	16.5	13	49	62	55.4
December	6.1	12.4	9.3	43	54	48.7
Year	12.3	20.7	16.5	54.1	69.3	61.7

Sibenik - Average precipitation			
Month	**Millimeters**	**Inches**	**Days**
January	75	3	10
February	60	2.4	9
March	60	2.4	9
April	65	2.6	10
May	50	2	9
June	55	2.2	8
July	30	1.2	5
August	45	1.8	5
September	75	3	7
October	85	3.3	9
November	110	4.3	12
December	95	3.7	12
Year	800	31.5	105

Sibenik - Sunshine hours		
Month	**Average**	**Total**
January	4	130
February	5.5	150
March	6.5	195
April	7.5	220
May	9	285
June	10.5	310
July	11.5	360
August	10.5	325
September	8.5	255
October	6.5	200
November	4.5	130
December	3.5	115
Year	7.3	2680

Figure 3: Climatic characteristics in the Sibenik city coordinates are 43°44′N 15°55′E.

Sibenik-Knin County is located between Zadar and Split-Dalmatia counties and covers a land area of 2,984 km2 of Croatian territory and a sea area of 2,686 km2 of the Croatian coastal sea, which is a total of 5,670 km2 (land and sea part), of which 52.62% falls on the land part, and 47.37% on the sea part.

According to the precipitation, the amount is up to 800 millimetres (31.5 inches) per year, so it is at an intermediate level. It ranges from 30 mm (1.2 in) in the driest month (July) to 110 mm (4.3 in) in the wettest (November). During the winter, the temperature can drop to -6 -7 °C (19/21 °F) at night, and stay around freezing or a little below during the day. The coldest record is -11 °C (12 °F), recorded in February 1956. In December 1996, the temperature dropped to -8.5 °C (16.5 °F), and sometimes even longer, with highs of 34/35 °C (93/95 °F) and more. The record is 38.7 °C (103 °F) during the summer. On average, there are around 2,680 sunshine hours per year.

b. Meteorology around the Sibenik area

Based on the data of the Sibenik meteorologist and the wind speed, a pie chart was created that shows the wind directions and their strength. Determining the strength and direction of the winds has an inherent importance in determining the direction of the takeoff and landing runway.

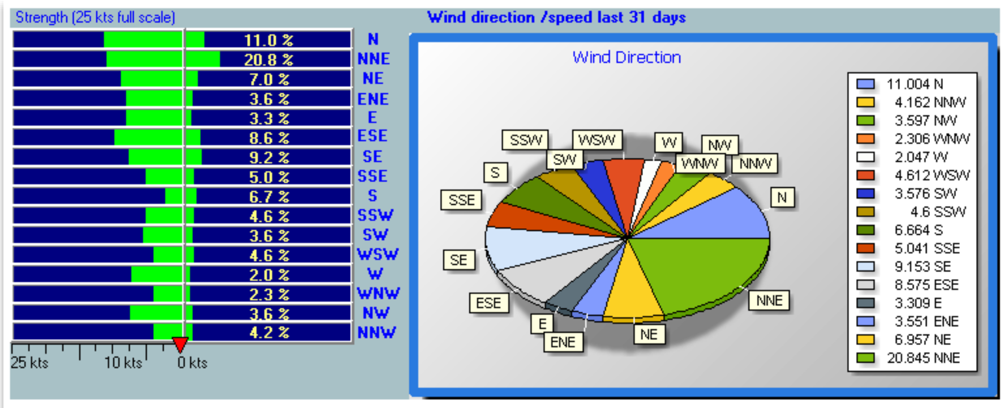


Figure 4: Wind speed and velocity in Sibenik city

Northern and southern breezes predominate, according to the wind rose. Other winds are less frequent and less powerful. In general, winds are significantly more intense in the winter, late fall, and early spring than they are in the summer. Although extremely uncommon, storms can nevertheless occur. The greatest wind speed is 6.7% from the south and 11.0% from the north.

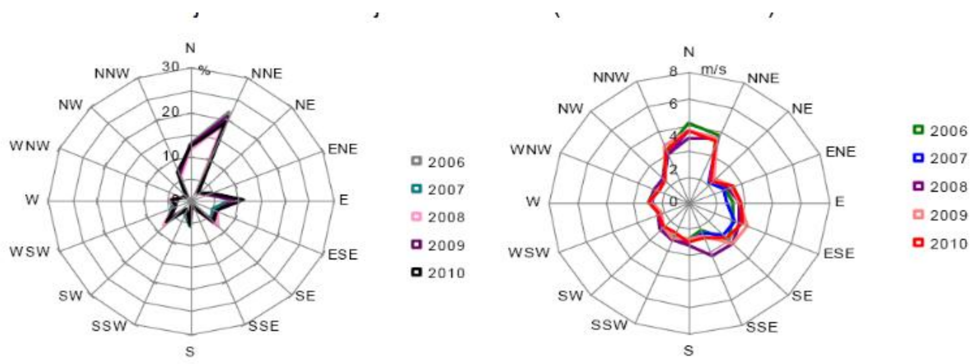


Figure 5. Characteristic wind rose for the Sibenik area

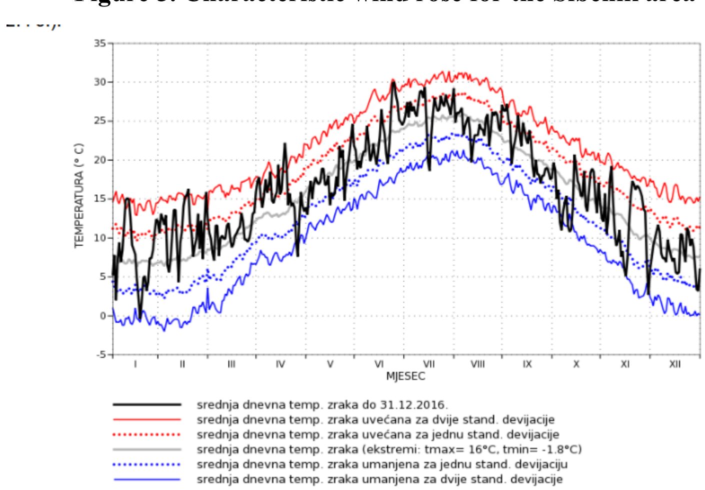


Figure 6. Average daily air temperature of the Sibenik area

According to the illustrated data, it can be concluded that the recommended direction of the runway should be in the direction NNE and SSW. For implementation, all this information published publicly should be verified by meteorological calculations and measurements on site.

c. Navigation around the planned aerodrome

According to the navigation conditions, the locations are free of significant obstacles, and thus the risk factor is considerably low. The safety of air navigation in the vicinity of the aerodrome in the area of the imaginary surfaces depends on the obstacle limitations. According to the location of the surrounding uninhabited areas, which are sufficiently remote and not below the approach and surface, and the same obstacle limitations, will be marked and illuminated, if necessary, in accordance with Annex 14, Volume 1, Chapter 6, 6.2. or 6.3.

The limits of the aerodrome include the airspace height up to 4,000 feet AMSL (above mean sea level), defined by the approach and departure routes to the runway heading. All activities that would exceed the MSL (mean sea level) of 1,500 m must require the approval of the competent air traffic control. The relative height of the school circle must be 300 m or 250 m, according to the permitted limits based on geological measurements above the selected location for the construction of the airport. The traffic pattern of the Sibenik airport for gliders can take place on the eastern and western sides according to the direction of the take-off and landing runway. The border points of departure and arrival from the airport must be outside the airport zone at 850 m MSL.

Mandatory reporting points before entering the airport traffic and maintaining contact with the already established frequency are mandatory for pilots with airport control for conducting airport operations over the controlled zone. The performance of navigation in the airport zone would be realized using visual navigation and instrument approaches. The announcement of the flight approval would be carried out by the competent airport control after the flight is taken over by the approach control. Pilots will be required to prepare themselves for the start and end of the flight operation as well as demonstrate their abilities in sport and commercial flying.

d. Optimal location selection

The final selection of the aerodrome infrastructure is carried out according to the international air traffic and common reference system. The geographical coordinates will be expressed in the World Geodetic System-84 as the Positional Geodetic System and the MSL system at sea level.

According to the topographic, metrological, and navigational conditions, and taking into account the urban-spatial conditions, civil engineering-geological and traffic conditions, the most suitable location L1 is determined.

The selected location for the airport near the city of Sibenik will be intended for general aviation flights as well as commercial flights, ultralight aircraft, helicopters, and other flight activities, according to the approvals of the air traffic control. The selected location of the airport is an uneven state surface and is located in the northern part of the city of Sibenik, taking into account the neighbouring settlements, near the highway. In the immediate vicinity of the Adriatic Sea on the western side, the selected location is located on an uneven surface with sufficient bearing capacity of the airport surface. The most suitable meteorological, topographic, and navigational conditions were taken as the final choice for the construction of this infrastructure. The location of the airport ensures the safe conduct of operations.

The design and operation of the airport, as determined by Annex 14 to the Convention on International Civil Aviation, Volume 1, defines the planned runway threshold, centre lines, and coordinates of the reference points.

Figure 7, Sibenik aerodrome location movement area

Source: *Google Maps*

According to the wind rose, the direction of the runway should be 020°-200°, ensuring that the airport will be open more than 95% of the time due to winds. The conditions for the airport reference code C3 and the commercial further development correspond to the selected L1. The most favourable location choice allows for extensions and auxiliary facilities outside the imaginary areas around the airport.

III. STAGES OF AERODROME SUSTAINABLE CATEGORY EVALUATION IN THE VICINITY OF SIBENIK CITY THROUGH NASH`S THEORIES OF EQUILIBRIUM

The size of the airport is a fundamental problem that is solved through the concepts of sustainable development, optimization models, and equilibrium theory. One of the ways to select the most favorable solution is a comparison of different systems. The sophisticated system will represent the equilibrium of the entire economic system, known as general equilibrium, and the equilibrium system will consist of numerous interdependent elements inside the economic framework. The notion of equilibrium is a fundamental organisational principle that integrates a multitude of intricate interdependent and functional interactions into a cohesive entity, wherein this relationship is distinctly illustrated in the framework of an economic society as a deterministic system. The notion that a social system with diverse objectives might align with a final cohesive state of equilibrium is a significant advancement in economic philosophy, enhancing the overall comprehension of social processes. The general interdependence, represented by their horizontal and vertical connections within the established social division, serves as the foundation for the content part of the equilibrium problem in both qualitative and quantitative terms. Horizontal linkage refers to the dependency between production and personal consumption, whereas vertical linkage indicates that the production volume within one sector serves as a prerequisite for the operation of another. The fundamental requirement for an ongoing process of social reproduction, which constitutes the core of the content aspect of general economic equilibrium, encounters challenges in organising exchange and coordinating the individual decisions of economic agents in production and consumption.

Phenomenological theories depict economic equilibrium as a singular phenomenon that may be generalised to the extent that it may be examined independently of a specific socio-economic system, so detaching it from the institutional setting. The depiction of cause-and-effect linkages is supplanted by the representation of functional links aligned with phenomenological ideas, which largely address macroeconomic, aggregate economic variables such as savings, investment, national income, consumption, and output. These numbers are regarded as empirically established, and for them, specific equilibrium relations and general equilibrium assumptions are articulated to facilitate the analysis of individual interactions. The fundamental elements of the general equilibrium model are straightforward: utility-maximizing agents constrained by budgets, profit-maximizing enterprises, and markets that clear, constituting the key components of the model.

Utilising game theory for strategic decision-making can elucidate how to effectively align supply and demand at an airport by enhancing the analysis of such decisions. A game is defined as a scenario in which participants make strategic decisions, considering the actions and responses of competing counterparts, resulting in an outcome that yields rewards or benefits. The primary objective of game theory is to ascertain the optimal strategy for each participant, where a strategy constitutes a set of rules or an action plan for gameplay. This approach aims to maintain prices at a level comparable to competitors, but if a competitor reduces their price, it will respond by lowering its price even further.

Bidders occasionally employ a method where the initial bid is x euros, but they withdraw if subsequent bids exceed 4x euros. The ideal approach for each location is to optimise the anticipated payout as either cooperative or non-cooperative, with the primary distinction being the capacity for negotiation. In cooperative games, players engage in binding agreements over shared strategies, but in non-cooperative games, negotiation or enforcement of binding agreements is unfeasible, assuming that opponents are rational and anticipate potential responses to relevant acts. The opponent's ratio and rational response are frequently overlooked or miscalculated when competitors make specific judgments. A dominating strategy is optimal irrespective of the opponent's actions, whereas an equilibrium occurs when each player possesses a dominant strategy. A Nash equilibrium occurs when each participant adopts an optimal strategy, considering the strategies of their opponents, resulting in stability since no player has an incentive to depart from their chosen approach. Nash Equilibrium is attained through advertising at the three locations, where each airport maximises its profit without any inducements to alter its strategy.

The parameters supply the necessary data to determine an equilibrium solution for prices and quantities, ensuring that there is no unmet demand from production and consumption. The examination of the equilibrium between supply and demand for flights necessitates a delineation of the conduct of resource proprietors in their capacities, such that the aggregate demand for each commodity is contingent upon consumer preferences, pricing variables, and the commodity itself, in addition to a predetermined distribution of resources among consumers. General equilibrium necessitates that the prices of factors and flights are set so that the total demand for each flight does not surpass its total supply, establishing a condition whereby the ratio of relative prices does not exceed opportunity costs. Equilibrium allocates resources based on the concurrent resolution of various relations: resource limitations, pricing constraints, and equilibrium conditions in the supply and demand for the analysed items.

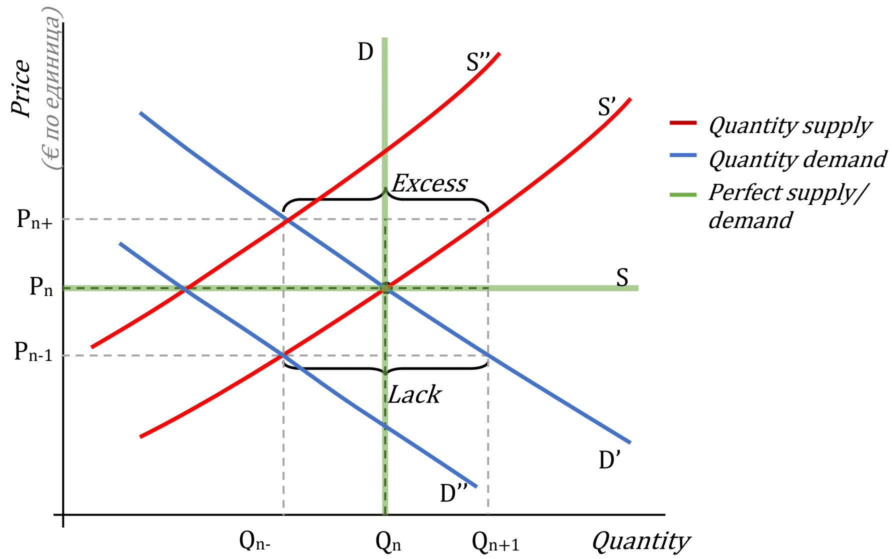


Figure 8, Supply and demand curve, Equilibrium system

Source: *Ana Lazarovska's „Codex of the sustainable aerodrome development*

A) Nash Equilibrium

A strategy profile is a set of strategies, one for each player, if and only if no player can do better by changing their strategies in the game. This means that if the question is: "Knowing the strategies of the other players, is it possible to earn money by changing your strategy?", and if any player responds positively, then this is not a Nash equilibrium.

Formally, let S_i be the set of all possible strategies for player i, where i=1,\ ...\ N. Let s^\ast=(s_I^\ast,s_{-i}^\ast)be a strategic profile, a set consisting of one strategy for each player, where s_{-i}^\ast denotes N-1, the strategy of all players other than i. Let u_i=(s_i,s_{-i}^\ast)\ be the payout of player I as a function of strategies. The strategic profile s^\ast is a Nash Equilibrium if

$$u_i(S_i^*, S_{-i}^*) \geq u_i(s_i, s_{-i}^*) \ for\ all\ s_i \ \epsilon\ S_i$$

If the balance is unique, it may be weak; a very unique Nash Equilibrium is if the inequality is severe, so the only strategically best answer is:

$$u_i(S_i^*, S_{-i}^*) > u_i(s_i, s_{-i}^*) \ for\ all\ s_i \ \epsilon\ S_i$$

The strategic set S_i can be different, and its elements can be different for mathematical objects where $S_i = \{Yes, No\}$, in other words $S_i = \{Yes|p\ = Low, No|p\ = High\}$ which can be an infinite set of $S_i = \{price\}$. as $Price$ is a positive real number.

B) Strict- Weak Equilibrium

If the question is "Knowing the strategies of the other players, should they change their strategy?" the answer follows "Yes" for a strict Nash equilibrium or no if there is a perfect equilibrium or a weak Nash equilibrium, which in turn can be a pure strategy or a mixed strategy.

C) Nash`S Existence Theorem

Nash proved that in mixed strategies, a game with a finite number of locations where one chooses strategies has a single Nash equilibrium, as a pure strategy for each location, with the probability of each strategy being distributed equally among the locations. A Nash equilibrium does not exist if the set of location choices is infinite and non-compact, but it does exist if the set of choices is compact at each location, which is the case for our choice. When two players name a number at the same time, then the winner is the one who names the larger number, or when both players each choose a real number strictly less than 3, the winner is the one who chooses the larger number.

D) Game Theory Representation of the Location Selection for Sustainable Development

In the project management process, game theory is used to model the decision-making process of players, in our case, potential locations, which are critical to the success of the projects, and to create scenarios adapted for modeling with game

theory. The project investor usually has several options given as L1, L2, and L3, offering different benefits, and must decide which are the main factors that could threaten the entire project. The main decision must be made at the best time and strategy for the development of the category, so that it can gain maximum attractiveness in terms of benchmarking during the implementation process. In considering the potential of each of these locations being more or less favorable, the decisions depend on supply and demand, with the interests of the decision maker ideally modeled by game theory. To allocate a specific location that maximizes profit, the category development index can be expressed by the equation:
CDI=(Percentage of total product category: Percentage of total project estimate)*100

Figure 9. Steps for aerodrome category development
Source: *Ana Lazarovska's „Codex of the sustainable aerodrome development*

The site selection for Sibenik airport has challenges due to impediments at elevated heights, presenting the constructor with a difficult yet realistic undertaking that necessitates meteorological, geodetic, and civil engineering duties. The chosen area is L1, which is optimal for such facilities due to its geomorphological characteristics, the availability of state land, the land composition, and the closeness to adjacent settlements. The prevailing political and socioeconomic circumstances, along with the evolution of air traffic, substantiate this decision by affirming the necessity for service in the forthcoming years without alterations. Considering the accurately evaluated topographic characteristics, the advantageous meteorological conditions, and the proximity to nearby airports, facilities, and resources, it can be concluded that the selection is viable, anticipated, and accommodating regarding the subsequent structural, institutional, and financial implications in the Sibenik region.

Game theory, as a study of a mathematical model intended for strategic selection among rational decision makers, in this case, is used to represent location decisions for a final decision. The choice of three locations, L1, L2, and L3, will be considered through the example of a simultaneous game with three locations where each location has two options, L1 has two moves, L2 has B1 and B2, and L3 has C1 and C2. The results of L1 are presented in the first entry of the upper left cells in both matrices is 0.1; the highest first entry of the upper right cells is 1.1; and we get 1, respectively 0.1 for the lower left cells, i.e., the lower right cells. The highest second entry in the first column is 0, in the second column is 1.1, in the third column 1, and in the fourth column 0.1. For L3, the third highest entry in the first row of the first matrix is 2.1, and in the second row of the first matrix is 1. In the second matrix, the third entry in the first row is 1.1, and in the second row is 2.

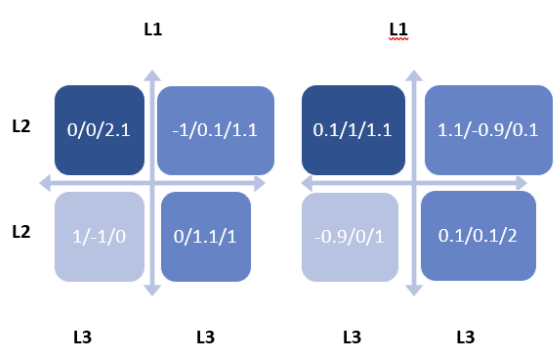


Figure 10: Game theory matrices for location selection
Source: *Ana Lazarovska's, Codex of the sustainable aerodrome development*

IV. IMPROVING THE SIBENIK AERODROME CATEGORY THROUGH ANA LAZAROVSKA`S „Codex on the sustainable aerodrome development“ PARALLELS LEONARDO DA VINCI`S „Codex on the flight of birds. “

A) Determination Of Aerodrome Areas and Physical Characteristics

Planning for the development of the airport category for use in commercial general aviation includes the construction of manoeuvring areas in order to carry out operations of aircraft whose performance does not exceed the recommended ones. The subject of the analysis is to precisely conceptualize the Movement Area, which is divided into (parking) and maneuvering area (maneuvering area), further divided into runway (runway for take-off and landing) and Taxiway (taxiway). The focus is on the RWY, which is also the most important area of the airport, as it is a commercial airport that will be used primarily for take-off and landing of aircraft and secondarily for maintenance and storage of aircraft.

Figure 11: Aerodrome round in the area of L1

Source: *author and Google Maps*

B) Aerodrome TWY

The prepared area for safe take-off and landing of the aircraft, which is rectangular and has connecting surfaces, occupies a large part of the airport complex according to Annex 14 of the Convention on International Civil Aviation, Part One, Design and Operation of the Airport defines the coordinates of the planned RWY threshold, as well as the coordinates of the center of the center and the reference point. Consequently, in accordance with the taking of the airport area under lease from the state land, the coordinates of the take-off and landing runway and the reference point will be positioned after the takeover of the area and obtaining approval from the competent authorities.

C) Number and orientation of RWY

Due to the circumstances (spatial, meteorological, economic, and navigational), the airport will have only one runway that can be used from both ends, with 95% wind direction and allowed crosswind components taking into account the wind rose for the area around Sibenik. The orientation of the runway (HDG) should be in the direction of the most common wind, with the determination of crosswind components to determine the degree of utilization, of course, taking into account the limitations for individual aircraft types and crosswinds. The slope maneuvering area (RWY) extends in the direction North North East and East East West, i.e., in the direction of 020 ° -200 °, i.e., 02-20.

D) Sibenik runway length and width of the necessary category development

To comply with ICAO regulations for the length and width of the RWY, the following topographic characteristics of the take-off and landing surface, slopes, elevation, temperature, and humidity, as well as geodetic characteristics, are taken into account in the following calculation:

KNV = 7 X HNV : 300= 7 X 594 : 300 = 13,86
TSA = HNV X 0,0065 °C = 594 X 0,0065 °C = 3,861
KT = TREF – TSA = 15° – 3,861° = 11,139
KN = N X 10% = 2% X 10% = 20
D_0 = 1200M
D = D_0 (1 + KNV : 100) (1 + KT : 100) (1 + KN : 100)
D = D_0 (1 + 13,86 : 100) (1 + 11,139: 100) (1 + 20 : 100)
D = 1200 X (1 + 0,1386) (1 + 0,11139) (1 + 0.2)
D = 1200 X 1, 1386 X 1, 11139 X 1,2 = 1 822,21 ≈ 1 800M, SOURCE: AUTHOR'S CALCULATION

The results obtained correspond to the airport category C3, which meets the current needs and requirements of all industries in the vicinity of the city of Sibenik.

The reference length is 1200m, and the width is 18 m, corresponding to the reference code C3, with a mandatory correction of the USS length due to temperature, altitude, and slope of the land. Due to the introduction of all necessary conditions from the beginning of the construction of the airport with a runway for take-off and landing on a structural pavement, no further corrections are required.

According to the determined dimensions of length and width, the runway is intended for use in visual and instrumental metrological conditions and for further use with a control tower or instrument control conditions. The specifications of the airport, such as longitudinal and transverse sections, dimensions for the basic flight path with transverse and transverse sections, facilities in the airport area, taxiways, and parking areas, should be regulated by the dimensions according to Annex 14 ICAO. As an airport surface with the highest level of safety system, from a large number of imaginary surfaces rising and falling from the baseline USS, the boundaries of the airport barriers are defined, and the occurrence of closure of the airport due to dangerous obstacles in the approach area, departure area, transition area, inner horizontal surface, and conical surface is prevented. By analyzing the barriers of the surface of the required category according to ICAO Annex 14, we determine the possibility of constructing an instrument airport in accordance with the standards.

E) USS capacity and area of the most favorable location for the Sibenik aerodrome

The carrying capacity of the structural runway, taking into account the topography of the land as determined by geological surveys, is sufficient to support continuous aircraft traffic along the length of the landing and the increase in length and the entire length of the USS. Normal airport operations, such as take-off and landing, should not have any impact on the landing surface, taking into account the increased pressure caused by an exceptional landing or a bad landing that may occur in exceptional situations.

Excessive surface irregularities that would cause vibration, increased friction coefficient, or other difficulties in the operation of the aircraft should be avoided in order to avoid adverse effects on the performance of the aircraft during aircraft maneuvers, where a rough composition for increased friction coefficient should be used. The aquaplaning analysis should satisfy the design of the grooves and must meet the conditions and criteria prescribed by ICAO. According to the surrounding towns and villages, in terms of ICAO requirements, there is no danger of environmental damage.

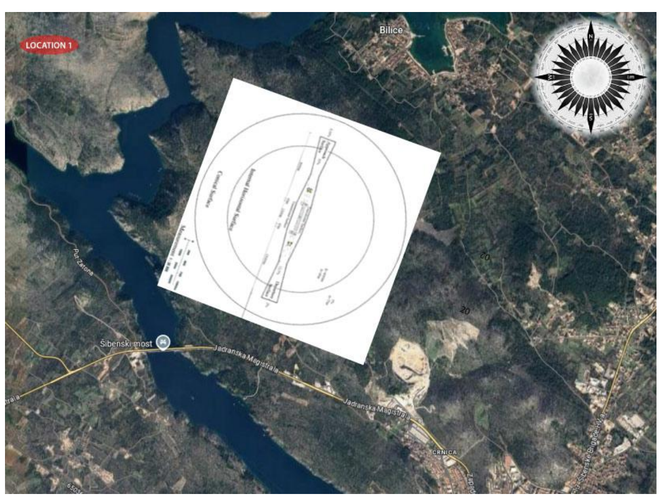


Figure 12: Micro aspect interpretation of aerodrome surfaces

Source: *Author`s Picture*

F) Physical characteristics and planned possible development

Due to the complex socio-economic factors as well as the urbanization of the surrounding settlements, it is necessary to determine the construction phases in the development of the airport location. In the process of developing the airport and determining the required category as well as the required time period for construction, the established and planned routes and economic profitability will be taken into account. A huge role in determining the airport is also played by the proximity of the Split and Zadar airports, the year-round openness, and the favorable weather conditions that lead to the conclusion for the construction of the C3 category. The open approach will also enable the development of aviation, sports, and school purposes that are of particular interest in the development of tourism on the Adriatic. The potential L1 location, in addition to meeting all the conditions for the construction of the C3 airport reference code, also meets the conditions that satisfy the need for further development, including modern control towers and instrument flights. Confirming the established parameters in practice, despite the fact that the airport category is the most favorable, it provides an opportunity for further development without unnecessary additional financial costs, such as instrument flights on the maneuvering areas of an asphalt runway, associated facilities, and areas.

In order to achieve airport conditions throughout the year and in poorer visual conditions, the establishment of an instrument runway will not allow the violation of the safety framework for the operation of air traffic. Due to the limitation of flight activities that will be carried out according to visual flight rules only in the visible part of the day, it is recommended to fulfill the conditions for night flying. The openness of the airport 24 hours a day implies that equipment and night marking should be increased in order to maintain maneuvering and other areas at a higher level. Of course, here, as at other airports, there is a test of the abilities of the pilots themselves as well as their knowledge in all phases of flight maneuvering.

These financial investments will contribute to the further development of air traffic in Croatia, especially for the Adriatic, and the development of the region around the city of Sibenik as a center in the heart of the Adriatic.

G) Optimization for the planned aerodrome near the city of Sibenik

Using the knowledge gained from the field of equilibrium theory, the flow of airport traffic traveling from A to D will be illustrated.

Figure 13: Locations of existing aerodromes, Baessov paradox, author's picture.

Source: *Google Maps*

"The situation is modeled as a 'game' where each airport has strategies, where each strategy is a path from A to D (one of ABD, ABCD, or ACD), where an aircraft traveling along ABD takes (1 + x / 100) +2 travel times, and x is the number of aircraft along edge AB in order to minimize travel time. Equilibrium occurs when the times on all paths are the same and when no pilot has an incentive to change lanes, as this increases travel time. If 100 aircraft travel from A to D, each passenger now has a total travel time of 3.25, leading to the conclusion that this allocation is optimal." When 25 planes choose the route ABD, the flight length will be 1 + 0.25 + 2 = 3.25, 50 planes on the route ABCD will fly 1 + 0.5 + 0.25 + 1 + 0.5 = 3.25 and on the route ACD 25 planes will fly 2 + 1 + 0.25 = 3.25 then it would be an equilibrium in another possible way reducing the efficiency of the system known as Braes' paradox".

The equilibrium quadrant shows the correlation between the four constraints and how changing one causes the quadrant to be unbalanced. Increasing the scope of a project affects the time, cost, and quality of the project, with every project decision that can affect these four aspects of the project. Cost is a function of scope, time, and quality, and defining or changing any of these variables can potentially affect the projected cost, or budget(cost, quality, scope, and time).

The time aspect through which the project is observed and presented in function of the project triangle, according to research and practice, the obtained quality is always a function of time, budget, and cost. Constraints defined by time, coverage, and cost have long defined the criteria for project success for an organization. Completing a project on time and within budget raises the question of whether the coverage defined by the contract always guarantees satisfaction with the outcome. A project that is aligned with the business strategy, a fully developed business case, and a well-defined coverage are often underestimated key elements that guarantee success, replaced by the complete completion of the project. The standard triple constraints, time, cost, and coverage, do not guarantee delivery if the basic assumptions and analysis of the project are not consistent with the business strategy. The probability of project success increases when success criteria are defined that more accurately reflect projects as business investments. Business strategy and the realization of expected business objectives are achieved by successful deliverables that are carefully planned, apply the required methodologies, and are managed and controlled. Project management, first of all, relies on the fact that it is really important that the project is based on real needs with a legitimate business goal to achieve, while implementing the project in the right way means proper planning and execution. In 2015, the CHAOS report defined the success of a project as if it is implemented within a defined time and budget, but with a satisfactory result. Organizations should focus on project portfolio, value to increase profitability, innovation, stakeholder satisfaction, reducing project costs, and improving project management.

Figure 14, A Venn diagram for aerodrome category development,
Source: *author`s, Codex on the sustainable aerodrome development.*

Each category of airport infrastructure can be developed or built according to the author's representation. It is necessary to recognize the need for the construction of airport infrastructure and the ability to apply the knowledge from the Codex of Sustainable Development of Airports. According to this Venn diagram, the category of the required level for the airport in the vicinity of Sibenik is given. The entire development of airport construction should follow the same path of improvement. Alternative methods of elaboration may result in the inefficient use of time and resources, and, more critically, yield suboptimal outcomes. Best wishes to all prospective engineers engaged in airport infrastructure, a crucial element for the existence and advancement of the aviation sector.

To improve spatial planning in the Republic of Croatia in the aviation sector, the following measures are needed:

1. Creating and strengthening capacities and institutions for spatial planning and regulation at the state level,
2. If required, modify legislation to guarantee more consistent and prompt preparation of spatial planning documentation across all levels.

3. Simplifying the criteria for urban institutions that excessively restrict the pool of organisations eligible to create and revise spatial planning documentation.
4. Implementing professional licensing protocols to enhance the quality of spatial and urban planning;
5. Establishing or better defining existing standards through regulations and legislation for: implementing zoning planning, measures to support European principles for spatial development, establishing spatial databases, exchanging and distributing spatial data, reorganizing the way the services and institutions responsible for spatial planning work at all levels,
6. Enhancing institutional capabilities through the implementation of spatial information systems and the digitisation of spatial planning data to monitor land use in accordance with spatial planning objectives;
7. Establishing control mechanisms for the execution of designated spatial development goals.
8. The traffic system planning in the Republic of Croatia is inadequate for addressing current spatial planning challenges, necessitating strategic local-level measures and operations to resolve priority cooperation issues within the system.

An analysis of the circumstances in the Republic of Croatia, alongside the experiences of neighbouring countries and the EU, necessitates the establishment of a strategic planning process for fostering cooperation at the local level, exemplified by the proposed airport near the city of Šibenik. This initiative will involve local governments, agencies, national institutions, and international organisations, as well as donor programs engaged in transport and communications.

Strategic documents concerning the growth of international air transport underscore the necessity of integration with spatial planning and economic development plans, indicating that objectives are pragmatically matched, accompanied by guidelines indicating no further requirements. Investments in cooperative development must align with investments in economic growth and the proper functioning of the populace. Local development policies align with the principles of sustainable development. The collaborative essence of strategic documents facilitates a forum for the exchange of perspectives and information essential for the formulation of all strategic documents.

V. CONCLUSION, REMARKS, AND CONTRIBUTION TO AVIATION

A prerequisite for the growth of the remaining elements of transport economics is the creation of a new, more adequate, more efficient, more regulatory, more organized, and more institutional framework for the countries that, together with the Republic of Croatia, belong to the region of Southeastern Europe. The progressive implementation of reforms and the development of a modern air transport system are a prerequisite for the development of transport economy projects in the Balkan region.

The proposed guidelines for the development of transport economics should be taken as a framework for planning and making investment decisions within the framework of air transport connections that will define the strategic network for the inclusion of the Republic of Croatia in the European Union network.

The conducted research and analysis of costs and benefits with the theory of equilibrium for optimized sustainable development have proven the importance of transport economics in the inclusion of the Republic of Croatia in European traffic flows.

Joining the European Union and actively participating in the integration process are strategic goals for cooperation in the transport economy, the aim of which is to use all opportunities for the fastest and most successful approximation to the European Union and thus directly implement all international reforms in aviation that will contribute to national development.

According to the intensity of the development of air traffic with other industries, one of the main shortcomings is the lack of airport infrastructure, in our case, in the southeastern part of Croatia for a general aviation airport in the vicinity of the city of Sibenik. The selection process is based on the conditions: topography, meteorology, and navigation, as well as geology, traffic, urbanism, and ecology are also taken into account. According to the mentioned conditions, the most favorable selected location satisfies the further expansion and construction of an asphalt runway.

Considering that air traffic is well organized and structured, it is thus an effective factor for the inclusion of transport in the European Union. A high-quality, technically and scientifically established air traffic system is a prerequisite for the rebirth of airport infrastructure, from which the following conclusions emerge:

- The evaluation of airport investments in the aviation sector should include the financial and economic aspects of airlines and air traffic control, with the risk factor.
- When evaluating from a social aspect of monetarily measurable components, the presentation of the real investment effects of such a new infrastructure is enabled.

- External factors can have a significant impact on the valuation of investments as well as individual specific industries whose development depends on this construction.
- Measures in developed countries internalize external factors as an important activity for certain types of transport, taking into account that this new airport infrastructure must successfully fit into the already existing infrastructure and traffic system.
- The observed levels of participation of certain types of external factors that, as part of the EU, deserve to be taken more into account in the environment and in the system of sustainable development.
- Monitoring the impact of external factors is necessary to establish appropriate instruments, such as the collection and processing of necessary data, appropriate legislation in the transport sector as a whole, and the system of implementing measures to protect against the negative impact of transport on the environment.

From the project analysis side, whether it is "good" or "bad", i.e., whether it requires an upgrade or no additional investment, increases the importance of the project for construction. The research project clearly presents the rules generally accepted by the aviation industry, as well as their application in the cost-benefit analysis for the final implementation decisions. Profit and cost analysis plays an important role in the limited time, research budget, available information, and in making quick decisions that, regardless of their position in the local and regional market, face problems. The interrupted flow of information leads to inappropriate and untimely decisions that are in line with sustainable development and goals in line with the vision and mission of the airport. Airport infrastructure project management requires cost control in line with the challenges and development of technology. Good education of aviation professionals, directly or indirectly related to their emotional intelligence, social culture, and information technology, leads to success. In conclusion, the project in its structure represents a complex feasible entity with the need for refinement during its implementation and upgrading for improvement and control.

The development of air traffic and the lack of airport infrastructure led to the issue of planning the development of the category of general aviation airport in the vicinity of the city of Sibenik. The most favorable airport of the category for the needs of the city of Sibenik satisfies the construction of an asphalt runway and further expansion with a control tower and instrument equipment.

One of the first steps of transport economics in managing the airport infrastructure system is the precise definition of both the transport economics in aviation and the elements for sustainable development of which it is composed.

The proven methodology for sustainable development of airport infrastructure for construction with a commercial purpose can be seen in the previous research and monitoring of the procedure for defining transport economics, such as:

- Air traffic is the lifeblood of every country.
- Air traffic is in continuous development, with a tendency for even greater growth in the future due to speed, efficiency, and effectiveness.
- The main problems in aviation are related to the lack of airport infrastructure caused by the imbalance of sustainable development, which are increasingly pronounced, and for their solution, the theory of equilibrium for optimization is needed.
- The transport economics of aviation is only a branch of the tree of transport economics, which, although it is the most developed, unlike other types of traffic, still needs many improvements.
- Air traffic is an activity that is related to all activities, so the transport economics of aviation should be defined as follows:

The transport economics of aviation, as an applied, interdisciplinary, and multidisciplinary science as part of the general transport economics at the national and international level, through its measures and instruments, as well as according to the principles of sustainable development, enables the achievement of the main goal, a more efficient and effective implementation of uniform reforms.

With the 2020 Aviation Law, the responsibilities from the central level have been transferred to the local level, so it is necessary to affirm the transport economics at this level as well, represented through the projected sustainable development of new airport infrastructure.

As part of the recommendations for further research by the author, the following are:

- Further research after using this dissertation, the elements of transport economics, as well as a deeper entry into the sea of knowledge, for their improvement and parallel development with other sciences.
- Modeling of all elements of air traffic in models for achieving the specific goals set by international reforms for implementation.
- Research into the significance of the actual elements of airport infrastructure in transport economics, their ranking, etc.

Conflicts of Interest

The authors declare no conflict of interest.

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