

AIRPORT MASTER PLAN

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Content for elaboration:

When solving the variant problems of optimizing the determination of service users in air traffic in the single European airspace, an analysis of previous solutions, their effectiveness and weaknesses was first performed. It is necessary to investigate the possibilities of system development to support those parts of the system that remove bottlenecks and offer perspective.

Define a conceptual solution and implement a system for optimizing the determination of service users in the single European air traffic. On the basis of the specification of new technologies, enable recognition of efficient solutions presented in the European ATM MasterPlan.

In work it is necessary:

- investigate structuring methods and parameters of variant optimization solutions,
- propose a structure of parameters for optimizing services,
- create a database of service optimization solutions in the single European air traffic,
- set criteria of similarity of optimization solutions,
- develop an algorithm for determining similar solutions,
- develop methods for choosing suitable solutions,
- enable the adaptation of selected solutions within the existing system of the single European air traffic,
- develop methods for choosing verified solutions in the solution database at the system levelsustava.

SUMMARY

This study aims to enhance airspace structure optimization by balancing key characteristics such as expenses, time, reliability, safety, and stability, acknowledging their interdependent nature. It emphasizes the importance of advanced optimization tools and mathematical models to develop effective algorithms, particularly in the context of the Single European Sky project, and considers optimal aircraft management and air traffic control strategies. Drawing from extensive research, practical experiences, and user preferences, the study seeks to improve automated systems and develop solutions that better serve airspace users, ultimately contributing to more efficient and effective air traffic management.

Keywords: optimization, aviation, transportation, traffic, reasoning based on patterns, variant optimization, ATM strategies, parameters optimization, the single European sky

INTRODUCTIONARY

The master plan refers to the construction of a new airport as well as a significant expansion of the existing facilities of the airport infrastructure.

The most effective master plan for an airport as a whole is one that provides the necessary capacity for aircraft, passengers and baggage, cargo and mail, vehicle movement and parking with the highest capacity to accommodate passengers, freight forwarders, operators and employees with the lowest investment cost and operating costs. .

Regardless of the method used, all master plans are based on assumptions and predictions that are based on detailed and valid databases. Data collection and validation is a significant and time-consuming step in the master plan development process.

In this paper, the master plans of the airports of Sarajevo and Zagreb are presented.

1.0 DEFINITION AND OBJECTIVES (THE PURPOSE) OF THE MASTER PLAN

In conditions of continuous development of air traffic, it is necessary to have a document that will serve as a guide in planning, designing and building facilities in accordance with the development of transport. Such a plan is called a master plan according to International Civil Aviation Organization (ICAO) standards. There is no proper translation in our language, nor is such a plan recognized by our spatial and traffic planning system. The closest translation would be a master plan for the development of an airport. Materials for the master plan are processed on the basis of the ICAO - Master Planning Document. This document was issued in 1987 and is out of date in some parts, so some of the paragraphs are exempt, such as the 20-year planning horizon.

Meanwhile, the principle of finite capacity planning prevailed, and this was the case for Hong Kong's new airport for about 45 years. More specifically, the 1980s plan was defined with a maximum capacity of about 80 million passengers per year, based on the capacity of two parallel runways, for traffic and projections until approximately 2030. Meanwhile, the airport in 2010 reached a turnover of 50 million passengers and about 4.2 million tons of cargo. A master plan is developed in collaboration with aviation authorities, government and local planners, air carriers, relevant government bodies (customs, immigration, health), national and local traffic authorities, international aviation agencies and others to:

- existing airports and
- the new airports.

A master plan is a concept for planning the development of a particular airport or airfield to its ultimate capacity.

The master plan refers to the construction of a new airport, as well as the significant expansion of existing facilities. The FAA states that the purpose of the master plan is to provide guidance for future airport development that will meet airline demand in a financially feasible manner while addressing aeronautical, socioeconomic and environmental issues.

The specific objectives of the master plan include:

1. Providing an effective graphic representation of the future development of the airport and the land used near the airport;
2. The establishment of a realistic schedule for the implementation of the development proposed in the plan, especially for the short-term capital investment program,
3. Proposing a complete financial plan to support the implementation program,
4. Maintenance of the plan technically and procedurally through research of concepts and possibilities of a technical, economic or ecological nature,
5. Presenting for public review in a persuasive and honest manner the plan that adequately solves the problems and meets local and state regulations,
6. Documenting policy and future aviation demand for reference in municipal debates on consumption, borrowing and land use control,
7. Establishing a framework for a continuous planning process. Such a process should monitor key conditions and adjust the plan's recommendations if circumstances change.



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6. Documenting policy and future aviation demand for input into municipal debates on consumption, borrowing and land use control,



7. Establishing a framework for a continuous planning process. Such a process should monitor key conditions and adjust the plan's recommendations if circumstances change.

1.1 Planning philosophy and the purpose of the master plan

The most effective master plan for an airport as a whole is one that provides the necessary capacity for aircraft, passengers and baggage, cargo and mail, vehicle movement and parking with the highest possible acceptability for passengers, carriers, operators and employees with the lowest investment costs and operating costs. Flexibility, extensibility and modularity should be the basis of the plan and are fundamental in all aspects of the master plan.

Put simply, a master plan is the concept for planning the development of an airport to its ultimate capacity. The master plan is the leading instrument for:

- ✓ development of the physical contents of the airport - aeronautical and non-aeronautical purposes,
- ✓ development of the entire area around the airport,
- ✓ determination of the impact of the construction and operation of the airport on the environment,
- ✓ determining the necessary access to the airport.

A master plan is also used for:

- ✓ implementation of short-term and long-term policies / decision-making,
- ✓ identification of potential problems and opportunities,
- ✓ assistance in providing financial resources,
- ✓ basis for negotiations between the airport administration and the concessionaire,
- ✓ generating local interest and support.

Types of activities included in the Master Plan:

- ✓ goal setting and coordination,
- ✓ economic planning,
- ✓ traffic planning and design,
- ✓ environmental planning,
- ✓ financial planning.

In a Master Plan for a new airport, it usually involves an analysis of several sites being evaluated, and the selection of one of the proposed ones based on multi-disciplinary decision-making.

Recommendations when updating a master plan:

- ✓ Updating all or part or parts of the Master Plan (once a year) and,
- ✓ Evaluation and modification (every 5 years).

2.0 HIERARCHY OF PLANNING

To show the hierarchy in planning, we will use an analysis of the established structure in the USA.

In the United States, airport planning is conducted at various levels of government, where plans are formulated to address overall transportation demand in coordination with other traffic and comprehensive land use planning.

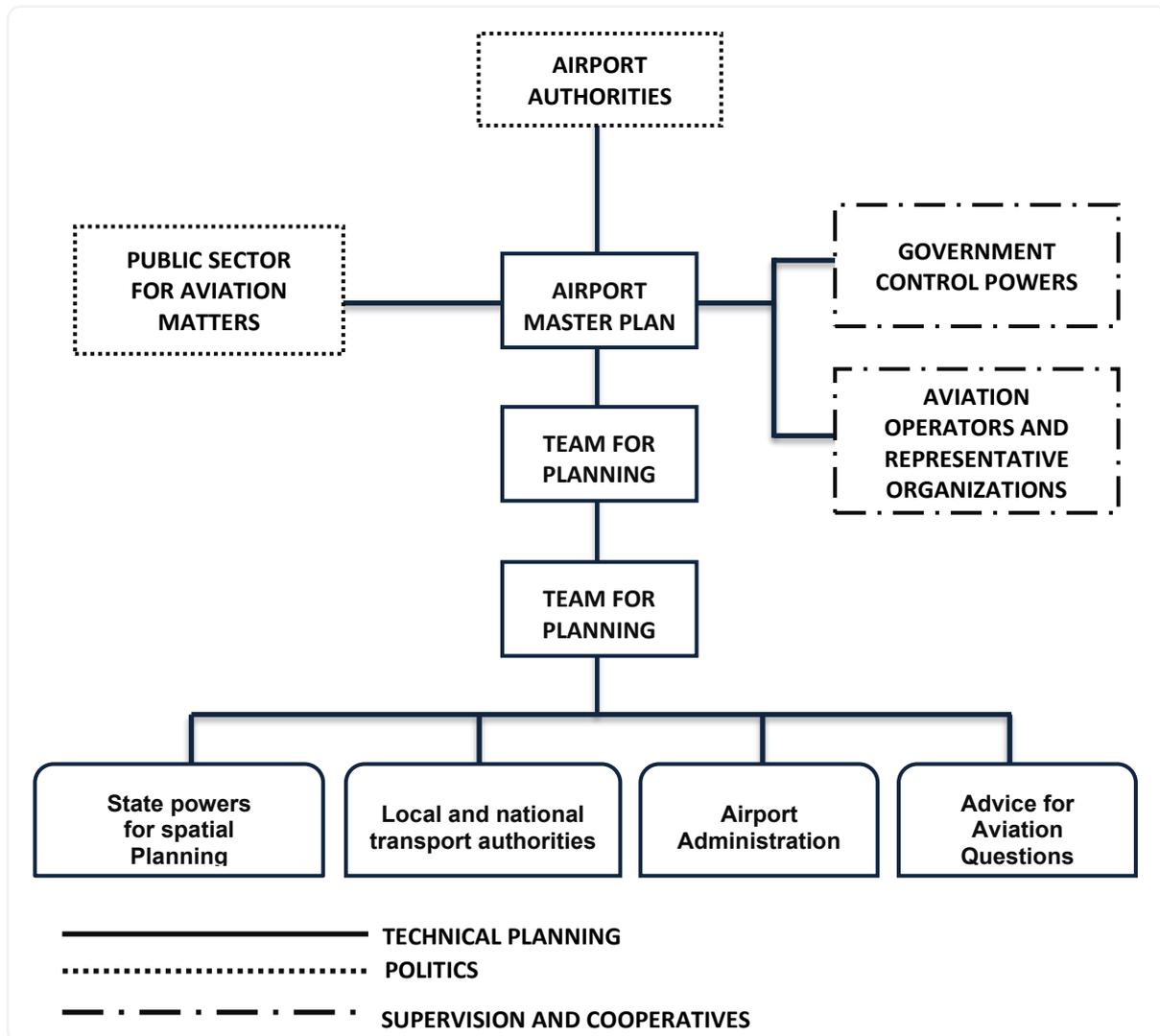
There are the following levels of planning:

1. The National Plan of Integrated Airport System (NPIAS) is a 10-year plan that is continuously updated and published every two years by the FAA. The plan sets out the public use of the airport and this plan is considered to be a description of development in the national interest, making it eligible for assistance under the Airport and Airway Improvement Act, which has been in force since 1982, as financial assistance in planning and development. at the airport.
2. Statewide Integrated Airport System Planning is carried out by state aviation planning agencies. This level of planning identifies the general location and features of the new airport as well as expanding the needs of existing airports by improving aviation objectives across the country.
3. Regional Integrated Airport System planning identifies and creates plans for large regional areas. The needs are stated in general terms in the context of the country-wide planning system.
4. Airport Master Plan is prepared for special ie. individual objects. Operators usually require the assistance of a consultant in detailed studies for many years, ie. strategic plans for the development of individual airports in the context of the country-wide planning system.

3.0 ELEMENTS OF AN AIRPORT MASTER PLAN

The Federal Aviation Administration (FAA) defines a set of elements that should in principle be included in every Master Plan, which are:

1. Organization and pre-planning (analysis of the current situation).
2. List of existing conditions and issues.
3. Aviation demand.
4. Analysis of goals and development concepts.
5. Selection of the airport location.
6. Environmental procedures and analyses.
7. Simulation.
8. Airport plans.
9. Implementation plan.



Picture 1. A typical organization for a Master Plan development

3.1 Analysis of the current situation

Analysis of the current situation involves the collection of all data on the existing state of the airport, so that aviation planners can gain insight and be able to evaluate the existing contents as well as potential locations. For all potential sites, planners need data related to the following:

- Physical and environmental characteristics of the sites,
- The existence of an airport nearby,
- Air traffic structure and status of air traffic management,
- Possibilities to install navigation aids,
- Locations of utility installations, schools, hospitals and other public infrastructure,
- Legal restrictions regarding regulations, acts,
- Existing land use and future planning,
- Zoning and building regulations and anything that may affect the nature and extent of any planned airport development.

An existing inventory should be made for the existing airport, taking into account the condition and lifespan. Furthermore, historical weather data, financial data from the financial plan are required. Historical and current data on aviation revenue and expenditure should be provided by the airport administration. It is also necessary to analyze the traffic and capacity of the maneuvering area, plants, passenger facilities, cargo terminals, road infrastructure and parking lots, ancillary facilities and areas.

3.2 Traffic forecast

Traffic forecasts are first made on an annual basis. This is not sufficient for dimensioning the contents, so peak load predictions are usually based on a specific peak hour per year, usually 30, which is used to plan and dimension the shunting area, lounges, passenger facilities, cargo terminals, roads and car parks and another. In addition to airplanes, passengers and baggage, goods and mail, vehicles, the number of officials, recipients, visitors, consumption of electricity, gas, water, etc. In addition, annual traffic and relevant peak (hour) traffic (and, if necessary, other) works for the highest expected traffic at the site or for the planned year are additionally predicted and forecasted:

→ aircraft: aircraft operations (takeoff and landing) in scheduled traffic, non-scheduled, low-cost, general aviation, aircraft size (commercial and small aircraft), touch and go, military infrastructure...

→ passengers and baggage: domestic, Schengen, international, short and long; local (arrival - departure), transit, transfer; categorization of passengers: tourists, business, private, luggage per passenger in domestic traffic, international, intercontinental.

→ cargo (goods and mail): local (arrival - departure), transit, transfer; domestic, Schengen, international short-haul and international long-haul; clear cargo planes, passengers, vans, trucks; categories of goods: general, special (dangerous); ULD, piece.

→ vehicles: arrival and departure of passengers, cargo, employees, concessionaires and others, visitors, recipients, escort. The reliability of the forecast decreases with the length of the period for which they are concerned and increases with the use of several methods or parallel forecasts. Forecasts often work as a minimum, median, and maximum, or in other words, pessimistic, realistic, and optimistic.

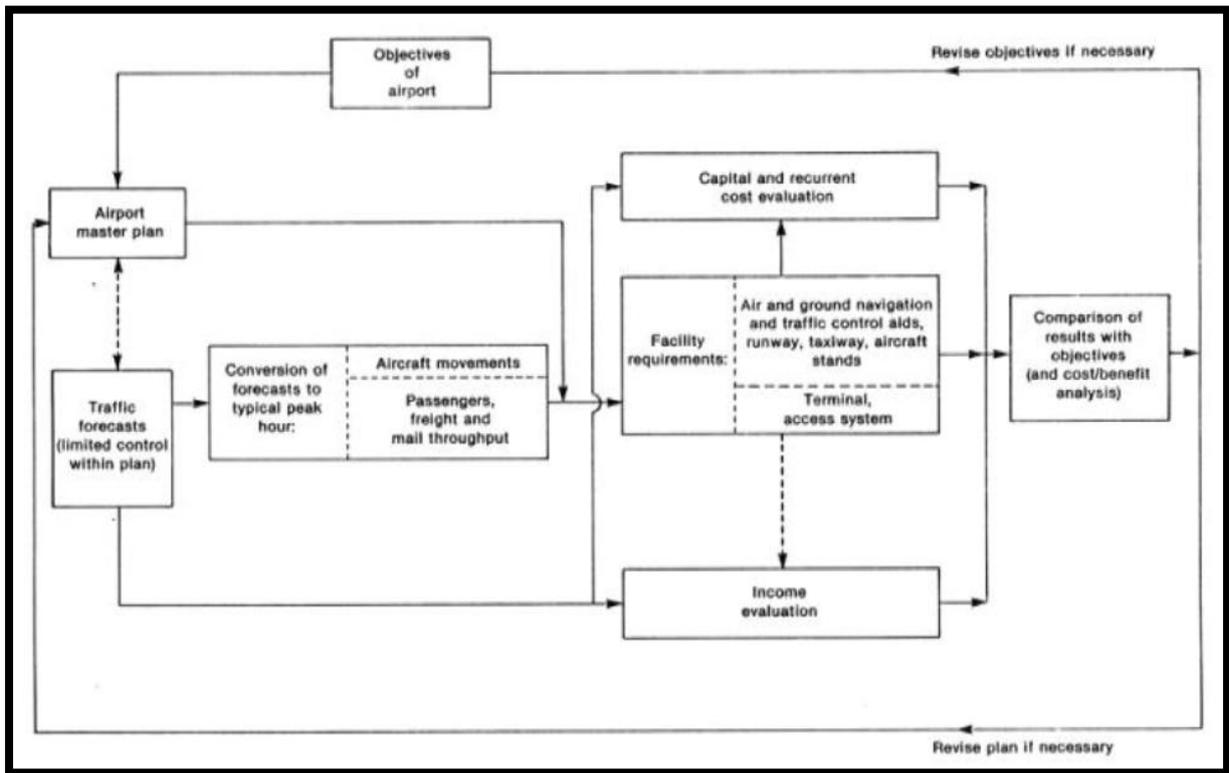


Figure 2. Forecasting, sizing, cost and revenue profiles in the process of creating an airport master plan

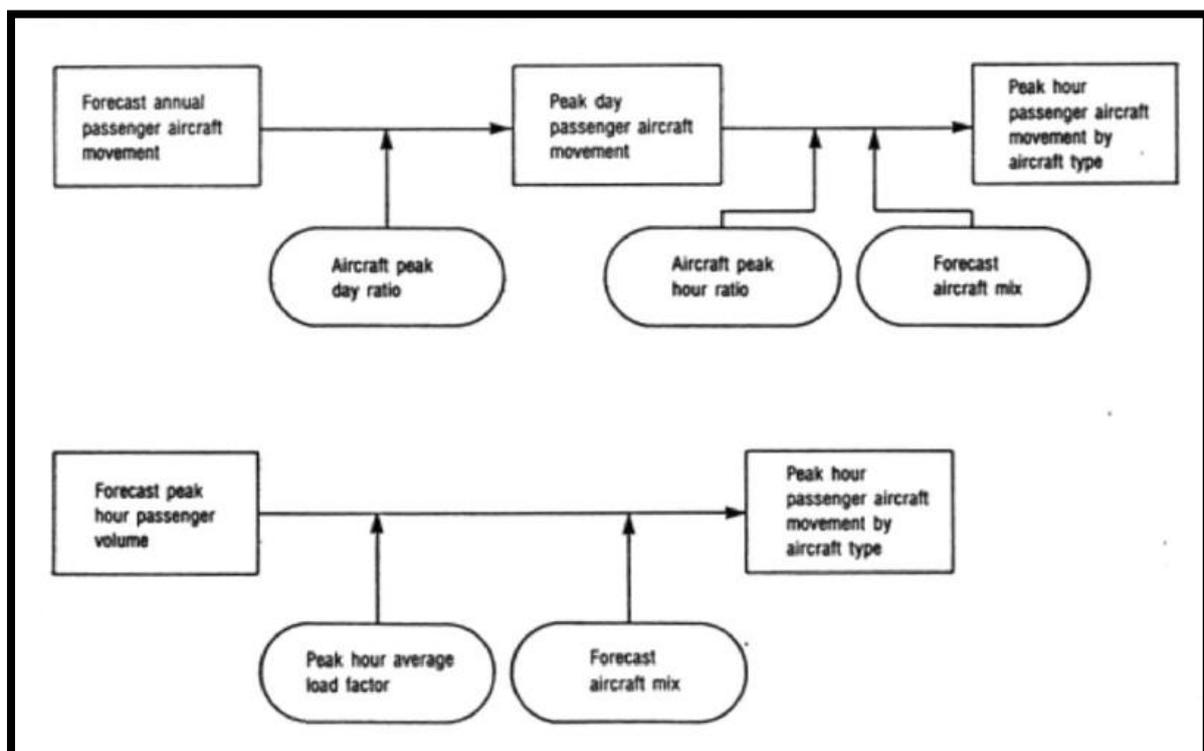


Figure 3. Possible links between airline traffic forecast and passenger peak hours

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Predictions:

- ✓ short-term (1 - 3 years in advance)
- ✓ medium term (5 years in advance)
- ✓ Long-term (more than 5 years in advance - up to 30 and more, ... to the final capacity)

Predictions:

- ✓ annual,
- ✓ seasonal traffic,
- ✓ monthly,
- ✓ weekly,
- ✓ daily,
- ✓ peak hour traffic,
- ✓ within an hour.

Forecasts are usually made for minimum, average and maximum, or in other words, pessimistic, realistic and optimistic.

Methods:

- Opinions,
- Survey of the opinion of a group of experts (method delphi).
- Projection trend
 - linear extrapolation,
 - exponential extrapolation,
 - logistic curve,
 - Gomepertz curve.
- Marketing methods - market research
 - gravity models,
 - econometric models,
 - script methods,
 - other numerous methods.

The determination of the characteristic maximum hour of the content of the planned activity depends on the policy of the airport. For the average airport in terms of traffic, without significant changes in traffic during the year (by months, days of the month, several hours a day), this is the 30th and the peak hour during the year. It is most easily obtained from statistics using a computer program.

There are also many aviation authorities of major countries for different annual turnover of aircraft and passengers gives the number of aircraft at certain hours and of the passenger traffic is given a typical peak hour, which falls with the growth of traffic. Many large airports are 40-

a (Paris Charles de Gaulle) and even 60-hour and peak (formerly London Heathrow), because their traffic during the year is quite balanced and the quality of handling will be similar to the others that you take 30th and max hour. Some airports that want high-quality acceptance and dispatch of passengers and baggage take a lower hour, e.g. 6.-i (Amsterdam). However, the peak hour should not be less than 20% of the 1st hour, which is the highest of the year. The factors that determine the growth of traffic are related to the economic needs and needs of the population. Foreign tourists traveling to Croatia make up about 60% of passenger traffic at Croatian airports.

3.3 Demand analysis and development concepts

In order to forecast demand and analyze existing airport capacity, planning continues as an investigation of the airport's ability to meet the forecast value. Where there are financial, physical or environmental constraints to expansion, the attitude of reorienting traffic to other airports must be fully tested.

Time frames used to assess demand development can be short-term (up to 5 years), medium-term (up to 10 years) and long-term (up to 20 years). Medium-term planning focuses on direct activities and involves a high level of detail that is inappropriate for a longer period of time. Long-term planning is intended for the ultimate role and development of the airport. Medium-term planning requires a level of detail somewhere between short-term and long-term considerations.

3.4 Demand - capacity analysis (capacitive demand)

With uncertain knowledge of forecasts for proposed airport locations and with varying estimates of infrastructure development set beyond existing levels, the analyst can test various development opportunities through demand analysis. The analyzes should be broad enough and should include operational monitoring in sufficient detail to approve the preliminary sizing of the installation:

- Air Operations Forecast vs. Airspace Capacity
- Forecast of air operations against air traffic control facilities
- Aviation operation forecast of airport capacity visibility
- Passenger Traffic Forecasts vs. Passenger Building Capacity (Terminal)
- Forecasting the size of the flow of goods against the capacity of the cargo terminal
- Traffic Access Forecast vs. Area Capacity for Route Deployment.

3.4.1 Requirements of airport installations

The types of required capacities, their size and their efficiency are determined as a result of the capacitive demand analysis. These elements are developed in accordance with US FAA standards and in accordance with ICAO standards or applicable national standards. Mandatory subjects and elements require consideration as follows:

- ❖ **Takeoff and landing runway.** According to the expected traffic of passengers and cargo, the size of the aircraft and the critical and most complex aircraft are planned in terms of the length of the runways. It is necessary to determine the required length of

the flight path, the orientation, the number of runways and the combination of length, number and orientation in the form of a sketch of the system of airstrips and associated surfaces of the airport (the main path of the runways, the safety surface at the end runways, track stopping, area from edge of main track to fence, possibly access lights inside set) for a rough estimate of land required.

- ❖ **Taxing stasis.** Taxiways are essential to runway capacity. It has a prescribed basic runway width of 32.5-115 meters for the largest aircraft. The parallel road to the runway along the summer runway covers about 30 hectares. It is necessary to determine the width, length, take-off clearances, derrick exit design and location, runway economy (effect), existing construction and economy.
- ❖ **Terminal surface.** The general principles for planning the location of the platforms are: the least possible distance from the runways, the movement of aircraft without unnecessary stays to and from the position, spare space for further expansion, achieving the highest possible efficiency, operational reliability and user benefits, minimizing the effects of jet engine jets, noise and air pollution.

Commercial airport services include:

- separating airline, general aviation and passenger traffic on the platform, but providing simple ground connections from the airport,
- consolidation of general aviation functional areas,
- simpler mutual passenger transfers and traffic,
- separation of special functions performed by air carriers – international charter flights, but providing a simple connection, internal traffic,
- encouraging the joint use of aviation equipment,
- reducing travel distances for passengers,
- they maintain a simple circulation of traffic on the field,
- centralized administrative administration, but with provision of adequate staff facilities (parking places, restaurants, rest areas),
- enabling cargo loading, facilitating cargo transfer and access,
- to ensure the growth of helicopter / VTOL traffic,
- ensuring efficient ground handling operations,
- locating fire and rescue services in a place where response times will be low for the entire airport area,
- car rental location in the area convenient to the terminal.

Due to the importance of the terminal in terms of cost and level of service implications, emphasis should be placed on the design of terminal areas.

1. Service and hangar area. Servicing of facility equipment, cargo installations, rescue equipment and firefighting facilities.
2. Heliports. Planning and design.
3. Obstacles. Required access standards, control surfaces and clear zones.
4. Drainage. Structure, layout and their elaboration.
5. Asphaltting. Narrow lanes, jet protection, pavement type and construction details.
6. Lighting and marking. Available lights, RWY lights, light sections, RWY and flywheel markings, helicopter landing area and obstacles.

7. Navigation equipment. Position and assessment of the claim.

In addition to the facilities at this stage, land use criteria and metrological conditions should be taken into account. The land use criterion should be adopted with:

- ❖ Adherence to standards that support the safe conduct of aviation operations, including design and construction standards prescribed by FAA "Federal aviation regulation" part 77.
- ❖ Interference with required aspects of facilities such as FAA control tower, platform control tower, navigation equipment and weather equipment.
- ❖ Using existing plants and land whenever possible.
- ❖ Flexibility to adapt to changes in demand.
- ❖ Efficiency in approach.
- ❖ Encouraging income from non-aeronautical activities.

Meteorological conditions: Data on historical visibility, wind and precipitation over the past five years allows an assessment of the site's capacity to support aviation activities.

4.0 AIRSPACE AND AIRSPACE CONTROL

In fulfilling its responsibilities in managing the air traffic control system, the FAA performs a number of tasks that are directly related to airport planning. The airport master plan and layout serves as the focal point for FAA recommendations regarding airport development and operations. Terminal flight procedures will be reviewed by the FAA, guided by the United States Terminal Instrument Procedures - TERPS for instrument operations, and the Federal Aviation Regulation - FAR for VFR procedures. A similar document "Procedures for Air Navigation Services Aircraft Operations" - (PAN-OPS), is applicable for non-US airports, which have operations according to ICAO recommendations.

Consultation with the FAA is intended to provide potential airspace restrictions. This includes:

- ❖ Permanent parts of barriers, such as high terrain, buildings and structures,
- ❖ Restrictions on the use of airspace due to proximity to another airport,
- ❖ Requests on diagonal routes, routing them through indirect control points,
- ❖ Air traffic control system overload, due to peak period or adverse weather conditions,
- ❖ Electromagnetic interference.

4.1 Selection of airport location

Before World War II, when air traffic was still relatively rare, airplanes were smaller and easier to operate, and airports in the world's largest metropolises had only a few flights a day. Airports are not considered unwelcome neighbors in the community. Site selection under these conditions was relatively simple and depended primarily on aircraft and construction requirements. The dramatic increase in air traffic, the development of larger and more powerful aircraft has occurred in the last 15 years, and airports are identified as land users, causing severe environmental degradation, generating large volumes of surface traffic and bringing economic and community development that do not is in harmony with the wishes of the population in the surrounding areas. That's why the choice of the location becomes more and more difficult. In

the Master Plan, the FAA recommends a minimum site selection analysis that includes the following factors:

- a) Operational capacity - considerations of airspace, obstacles and weather,
- b) Potential capacity - time, amount of available land, building convenience,
- c) Access to terrain - distance from demand for air services, regional highway infrastructure, public transport mode, parking availability,
- d) Development costs - terrain, land costs, soil nature, weather, land value, availability of utilities,
- e) Environmental consequences - aircraft noise, impact on flora and fauna, air quality, changes in local land use, existence of endangered species or cultural artefacts,
- f) Socio-economic factors - relocation of family and work, changes in employment patterns, changes in the tax base, requests for new public services,
- g) Compliance with wider planning - the impact of land use, the impact of comprehensive land use and transport at local and regional level.

5.0 ENVIRONMENTAL PROCEDURES AND ANALYZES

One of the requirements of the Airport and Airway Development Act of 1970 is that environmental factors must be taken into account in the site selection process as well as in the airport design itself. In addition, the "National Environmental Policy Act" in 1969. In 2010, the Council on Environmental Quality was established to develop guidelines for federal agencies. The proposed project does not relate to individual work items, but covers the wider context of the program and relates to one of the three categories:

1. Categorical exceptions;
2. Actions that require an environmental impact assessment;
3. Actions that require an environmental impact report.

Although there are relatively few airport procedures that require an environmental impact statement, all federal actions related to an airport development proposal that affect the quality of the environment must be accompanied by a statement of the following:

1. Impact of the proposed measures on the environment;
2. If the proposals have already been implemented, all harmful effects on the environment, which could not be avoided;
3. Alternatives to the proposed activities;
4. The relationship between local short-term benefits and long-term productivity improvements.
5. Proposal of irrevocable and irreversible resources.
6. It is assumed that the airport master plan should be evaluated in relation to the following possible effects:

→ **Noise** - has the most impact. Airborne noise extends beyond airport boundaries to non-airport areas, but where noise caused by aircraft operations is considered the airport's responsibility. In 1982, the Airport and Airway Improvement Act was passed, a document requiring appropriate measures, including the adoption of appropriate urban planning

regulations, to restrict the use of land near the airport, specifically relating to activities and purposes that are compatible with landing and landing of the aircraft.

→ **Socioeconomic impacts** - this includes the disruption of established communities, the need for relocation and changes in employment patterns.

→ **The impact of the artificial environment** - public parks, recreational area, animal sanctuaries, historic sites, cultural values, including architectural points of interest that must be considered in this category.

→ **Air quality** - usually a problem unrelated to airports, but if found to be a significant problem, an air quality analysis will be required.

→ **Water quality** - impacting water quality is a more common problem than air quality. Many factors depend on the current water quality and quantity. If the proposed development involves the location of an airport, the location of a PSS, or the expansion of a major PSS, the State must verify that there is sufficient assurance that the project will be located, designed, and constructed in accordance with applicable water and air quality standards. During the construction phase, soil erosion is a potentially serious source of water pollution, while during the operational phase pollution occurs as a result of fuel spills and in cold climates due to air deicing operations.

→ **Biological communities** - these communities were routinely enumerated in the past, and today the quality rather than the quantity of biological influences is considered more important. They also require consideration of rare and endangered species, wildlife and birds in wetland habitats and modification of existing habitats and wetlands..

Other causes include valleys, coastal management programs, coastal barriers, large agricultural areas, state-owned agricultural land, wild rivers, solid waste disposal.

ATM Master Plan – II

SESAR – Key Features



Essential Operational Changes			
Before-SESAR	PCP	New	Key R & D activity
<ul style="list-style-type: none"> •ATFM slot exchange •Civil/military airspace and aeronautical data coordination •Basic network operations planning •STAM 	<ul style="list-style-type: none"> •• ASM and A-FUA • Automated support for traffic complexity estimation • Collaborative NOP • CTOT to TTA for ATFCM purposes • Enhanced STAM • Free route 	<ul style="list-style-type: none"> • UDPP 	<ul style="list-style-type: none"> • Management of dynamic airspace configurations • Integrated local DCB processes • Network prediction and performance • Collaborative network management functions • Mission trajectory driven processes • AU processes for trajectory definition • AU trajectory execution from FOC perspective • AU fleet prioritisation and preferences
<ul style="list-style-type: none"> • Basic AMAN • Introduction of PRNAV • Provision of ATSA- AIRB 	<ul style="list-style-type: none"> • AMAN extended to en-route airspace • Enhanced TMA using RNP-based operations • Free route 	<ul style="list-style-type: none"> • Advanced RNP • AMAN/DMAN integration including multiple airports • Trajectory-based tools • Sector team operations 	<ul style="list-style-type: none"> • Flight- and flow-centric ATC • High productivity controller team organisation • Collaborative control • Improved performance in the provision of separation • Advanced separation management



Advanced air traffic services



High performance of Airport operations



Enabling aviation infrastructure

			<ul style="list-style-type: none"> • IFR RPAS integration • Dynamic and enhanced routes and airspace • Enhanced rotorcraft and GA operations in the TMA • Ad hoc delegation of separation to flight deck • Enhanced airborne collision avoidance for commercial air transport normal operations - ACAS Xa • Use of arrival and departure management Information for traffic optimisation within the TMA • Generic (non-geographical) controller validations
<ul style="list-style-type: none"> • Initial airport CDM • A-SMGCS L1 and L2 • Crosswind reduced separations for arrivals • Operations in LVC 	<ul style="list-style-type: none"> • TBS for final approach • Automated assistance to controller for surface movement planning and routing • Airport safety nets • DMAN synchronised with pre-departure sequencing • DMAN integrating surface management constraints • Airport operations plan 	<ul style="list-style-type: none"> • LVPs using GBAS • Collaborative airport • Integrated surface management • Integrated surface management datalink 	<ul style="list-style-type: none"> • Wake turbulence separations optimisation • Enhanced arrival procedures • Independent rotorcraft operations at the airport • Traffic optimisation on single and multiple runway airports • Traffic alerts for pilots for airport operations • Enhanced airport safety nets for controllers • Surface operations by RPAS • Enhanced collaborative airport performance management
<ul style="list-style-type: none"> • IP network • B2B services • Information reference and exchange models • A/G datalink • ADS-B, WAM • GNSS, GBAS, SBAS 	<ul style="list-style-type: none"> • Common Infrastructure Components: SWIM registry, PKI • SWIM technical infrastructure and profiles • Aeronautical information exchange • Meteorological information exchange • Cooperative network information exchange • Flight information exchange • Initial trajectory information sharing (i4D) 	<ul style="list-style-type: none"> • CNS rationalisation • Information sharing and business trajectory • Mission trajectory 	<ul style="list-style-type: none"> • Integration of trajectory management processes in planning and execution • Performance-based trajectory prediction • Enhanced mission trajectory • Management and sharing of data used in trajectory (AIM, meteo) • Workstation, service interface definition and virtual centre concept • SWIM T1 purple profile for A/G advisory information sharing • Airborne D&A systems supporting integrated RPAS operations • FCI terrestrial datalink • Future satellite communications datalink • GA/RC specific CNS systems • GBAS • Multi-constellation/multi-frequency GNSS • Alternative position, navigation and timing

Graph 1, SESAR – Key Features

6.0 GUIDELINES FOR THE STRUCTURE OF THE MASTER PLAN ACCORDING TO ICAO

Designers outside the US use ICAO procedures or national procedures based on the ICAO manual (10.11). In general, ICAO's procedure is similar to that recommended by the FAA. However, since the member countries of the organization, ranging from highly developed countries to underdeveloped countries, these procedures are specific to the design of the Master Plan, the methods of analyzing the problem of environmental impacts and the way in which economic analyzes are carried out. The ICAO manual states that the Airport Master Plan is a guide to the following:

- ❖ Development of physical objects at the airport;
- ❖ Development of land used in the area around the airport;
- ❖ Determining the effects of building an airport on the environment;
- ❖ Establishment of airport access request.

In addition, a plan can provide policy guidance and then serve to make long-term decisions, identify potential problems and opportunities, help secure financial assistance, and build local interest and support. The manual contains a number of areas that will be included in the main planned activities. This is the policy and coordination of planning, economic planning, spatial planning, environmental planning and financial planning. The master planning process consists of a set of defined steps:

1. Preparation of master plan work;
2. Documents and inventory of the current situation;
3. Forecast of the future needs of air traffic;
4. Determining the scope and time of completion of the facilities;
5. Assessment of existing and potential limitations;
6. Determining the relative importance of constraints;
7. To develop a number of alternatives to the master plan;
8. Evaluation and monitoring of all plan options;
9. Select the most acceptable option, then perform processing and replenishment in response to the evaluation process;
10. Prepare master plan documents in their final form.

The ICAO manual states that the Master Plan is more than a guide which should later be developed into a detailed implementation program.

Table 1. Outline of the master plan process according to ICAO

Planning stages	Description
Review of advance planning	Coordination, planning procedures, organizational planning, objectives and policy;
Anticipation of planning	Requirements, required forecasts, accuracy, forecasting methods and principles, factors, forecast presentation;
Financial investments and controls	Cost of capital: currency requirements, source of funds, domestic and foreign financing; Operating costs: sources of income, financial control and accounting;
Land evaluation and selection	Land Claims, Potential Sites, Factors Affecting Airport Location, Preliminary Site Studies, Inspections, Environmental Impact Studies, Plans and Cost and Revenue Estimates, Final Appraisal;
RWY and taxiway	Dimensions, payload, aircraft characteristics, performance, RWY length, configuration;
Apron	Platform layout, size of parking space, hangar area, platform capacity,
Land and air navigation equipment	Visual aids, radio navigation aids and their facilities, search and rescue services, communication;
Passenger building - Terminal	Principles of planning, air traffic and service characteristics, factors affecting the volume of services delivered, capacity and demand;

	Connecting the passenger building to access systems, passenger and baggage screening, waiting areas, state border checks, transit and transfer of passengers;
Cargo facilities	Accommodation, function and type of facility, access, parking, control;
Operations at the airport and associated facilities	Management and maintenance, medical center, vehicle fuel, generators, catering (transmission equipment), weather service, aircraft maintenance, general aviation facilities, rescue and fire service;
Refueling equipment	Safety, movement of large and heavy vehicles, storage capacity, fuel storage area, aircraft refueling systems;
Security	Port interior: roads, fences, isolated parking areas; land side: passenger building.

7.0 FLOOR PLAN OF THE AIRPORT

There are no clear and strict rules for determining grounding at the airport. The procedure refers to the design of the layout of the airport itself, in which all the elements necessary for its functionality should be respected. The design of each airport is specific. The position of some basic functional elements may coincide, while individual, specific elements will be different in layout. The schedule of the airport depends on a number of factors, the most important of which are:

- 1) Number and orientation of RWY;
- 2) Number of runways;
- 3) The size and shape of the port platform;
- 4) Size and shape of available land;
- 5) Topography and land conditions;
- 6) Air navigation obstacles;
- 7) Required area within the boundaries of the airport;
- 8) Utilization of the surrounding land;
- 9) Time and phases of airport development;
- 10) Meteorology;
- 11) Dimensions of the planned airport facilities.

When preparing the basic plan of the airport, it is necessary to consider several options in order to evaluate and choose the most favorable one. The best solution is to further optimize during plan development. The basic facilities that should be taken into account when planning the grounding of the airport are:

- RWY;
- RWY tracks;
- passenger terminals and ports;
- cargo terminals and ports;
- rescue and fire;
- control tower;
- aircraft maintenance service;

- parking lot;
- access to roads;
- airport maintenance, winter service, technical complex;
- navigation aids;
- easy maintenance;
- hospitality;
- fuel;
- the main terminal and port platform;
- waste water control;
- security fences and gates; [1]

Takeoff and landing runway

The runway has an impact on the areas outside the airport in the direction of landing and takeoff, because the planes are very low and the land must be clear of obstacles and larger capacities. According to the expected traffic of passengers and cargo, the size of the aircraft and the critical and most complex aircraft are planned in terms of the length of the runways. It is necessary to determine the required length of the landing route, orientation, number of runways and the combination of length, number and orientation in the form of a sketch of the flight plans and associated airport areas for a rough estimate of the required land.

Toll lanes

Taxiways are essential to runway capacity for take-off and landing. The parallel trail running along the summer trail covers about 30 hectares. Two tracks parallel to the main tracks cover an area of 100 hectares.

Apron

The dock platform should be planned as close as possible to the summer and tracks. It is better to use the position flexibly, as this reduces the overall area of the port platform. Positions for the largest and/or largest aircraft should be planned together with the passenger building associated with the aerobridges. The rough road to the positions between the two rows of parked aircraft, one to the building and the other to the open positions, should be double and allow one-way movements of the aircraft. There should be sufficient space on the aircraft platform for equipment for receiving and dispatching aircraft and space for removal of non-operational equipment.

The general principles of port platform site planning are:

- ✓ the smallest possible distance from the flight path,
- ✓ the movement of aircraft without undue delay to and from position,
- ✓ space for further expansion,
- ✓ achieving the highest possible efficiency, operational reliability and benefit for users,
- ✓ minimization of the effect of exiting aircraft, noise and air pollution.

Platform Gate Sizing:

- ✓ required number of positions in the current and in the future,
- ✓ types of aircraft currently and in the future,
- ✓ aircraft dimensions and maneuverability,
- ✓ parking configuration including the shape of the terminal and the environment available for development,
- ✓ minimum spaces between aircraft, aircraft and facilities and other fixed facilities,
- ✓ the way of keeping the aircraft in place,
- ✓ requirements for terrestrial acceptance and dispatch (vehicles and fixed installations) and
- ✓ driveways and service roads.

It is also necessary to plan and, if necessary, a separate platform for cargo traffic with a cargo terminal, an aircraft platform, for small aircraft, helicopters, platform service platforms and parking spaces for equipment for accepting and sending aircraft when not in use.

Passenger building

The planning of the passenger building is the result of the close cooperation of all team members, especially architects and traffic engineers who must convey the requirements to the passenger facility in the project. The basic design principles are as follows:

- ✓ For most travelers the main flows should be clearly marked stating what to do and directions to follow, travelers have individual needs, preferences and sometimes limitations.
- ✓ The planning of the location of the passenger building and associated seats depends on the configuration of the maneuvering area, the availability of space and the spatial possibilities for the development of all contents and areas to the final capacity.
- ✓ The planning of the passenger facility should be such that the flows are as short, logical and self-sufficient as possible, that there are fewer changes in direction and level and there are no intersections of the passenger flows.

Cargo terminal

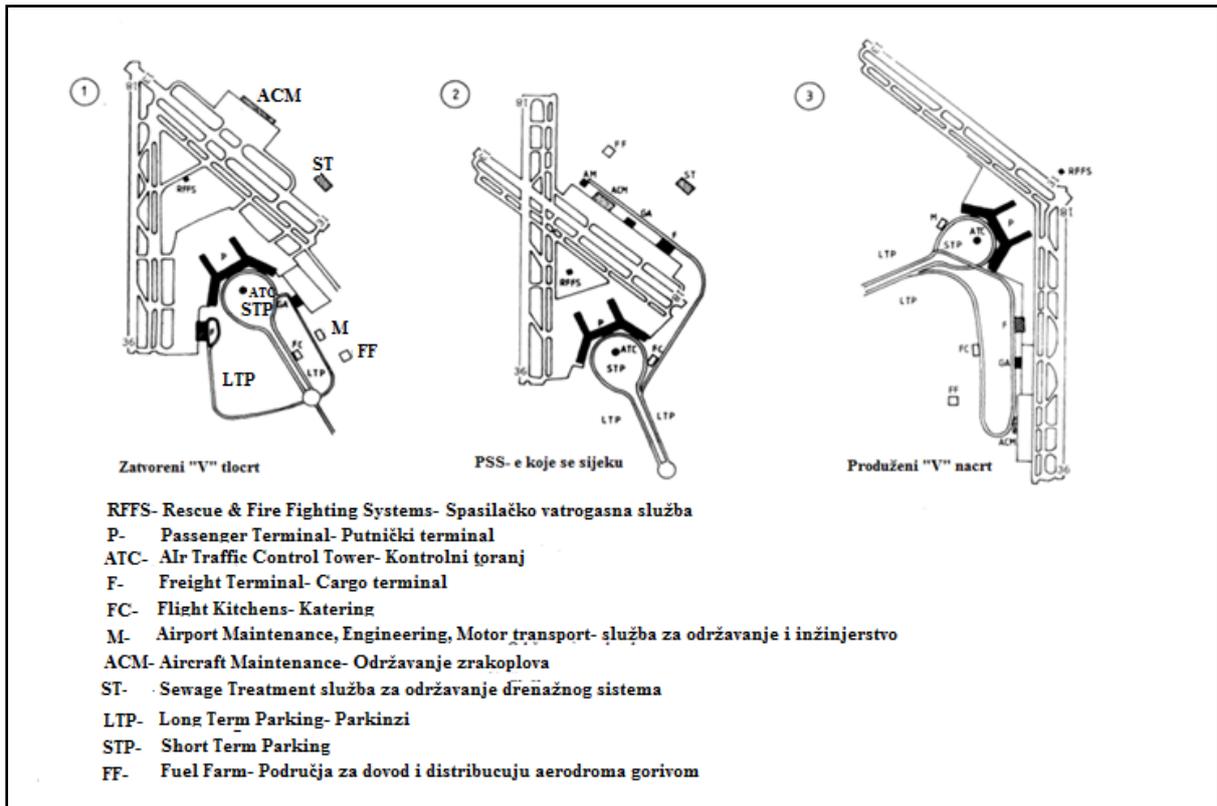
The cargo terminal should be planned near the port platform, as well as the platform near the maneuvering area and road connections, both for the initial and final capacity of cargo traffic and the airport. It is essential to understand operational acceptance and cargo dispatch technology by defining operational objectives by phases to final capacity. It provides receiving and dispatching improvements such as fixed loading/unloading equipment for boarding equipment to ensure a sufficient number of doors of sufficient width and height. [2]

Figure 2 shows three different layout schemes of the airport consisting of two PSS- on orientation 18-36 and one PSS with orientation of 13-31.

"Closed to the ground" is justified by the requirement regarding the available space, while respecting the distance to be managed, and provides enough space for the extension of the terminal zone between the two PSS.

On the other hand, the basic plan of PSS, which allows for short distances, is compact, but prevents the possibility of expanding the airport.

"Extended V land" provides sufficient flexibility in the design of the terminal area, at the expense of taking up available areas and poor operational efficiency on the air side. [1]



Picture 4. Arrangement of airport facilities for three different schedule versions [1]

8.0 DATA FOR CREATING A MASTER PLAN

Regardless of the method used, all Master Plans are based on assumptions and predictions that are based on detailed and valid databases. Data collection and validation is an important and time-consuming step in the master plan development process. When developing a master plan, you should have the following information:

1. Traffic need

- Passengers:
 - Annual flow of passengers in the last 10 years;
 - Monthly flow of passengers in the last 5 years;
- Passenger traffic for the ten busiest days of the year, for the previous 5 years.
- Aircraft:
 - Annual movement of the aircraft in the last 10 years
 - Monthly movement of aircraft in the last 5 years

- The timing of the plane for the ten busiest days of the year, for the previous 5 years..
- Estimates from ICAO and airlines for the regional increase in the number of passengers, both in domestic and international traffic;
- Fleet structure - existing for the next 15 years;
- Historical data on military movements and assessment of the growth of these movements, if the airport facilities are used for military and civilian purposes;
- Orders for operating airlines;
- General socioeconomic any support, economic database based on size and projection of growth rates in the region and airport, as well as data on population, employment, income, tourism, construction, retail sales, industrial production, etc. .Existing income distribution within the city, region and nation with expected changes in distribution;
- Costs and level of services of a competitive transport model.

2. Environmental data

- Local planning regulations;
- Plans for local development, both detailed and structural, from which the planned local and regional development can be determined;
- Existing land use, as well as potential development of the airport;
- Plans for local transport;
- Connecting local and national transport plans with investment strategies at different levels of government;
- Local and national noise regulations, in the current and planned period.

3. Physical data

- Description of the existing access to the airport;
- Meteorological data (wind roses, rain, snow, reduced visibility);
- Topographical data for the terrain within a radius of 18 miles around the airport, on maps at a scale of 1:50,000;
- Detailed topographical data within a 2-3 mile radius around the airport, on 1:2000 scale maps.
- Existing property with ownership data;
- Detailed review of the space of the existing facilities with different functions;
- Assessment of the structural correctness of existing buildings, plus an indicator of the type of construction (permanent structures, light structures and temporary structures);
- The condition and capacity of the existing drainage and sewerage systems;
- The status and level of existing PSS, runway, platform and port lighting;
- Status and level of existing airport codes;
- State, type and capacity of the existing navigation and telecommunication means;
- Data on dangers and obstacles that enter the system on imaginary surfaces;
- Details of the operation of existing services, fire protection, port platform services etc.
- Other required physical data, including environmental data on flora and fauna.

4. General

- Other transport and complex development plans around the airport;
- Commercial, tourism, industrial and government development plans.

5. Aeronautical data

- Holding positions, landing procedures, stopping landing and boarding;
- Airways.

6. Financial data

- Income and expenditure data;
- Debt structure;
- Capital investments;
- The relationship between assets and liabilities;
- Income structure by source;
- Legal restrictions on debt structure and finances.

7. Build

- Cost details, unit costs for building materials, eg. steel, concrete, construction costs, etc.;
- Final costs;
- Equipment costs;

9.0 AIRPORT PLANS AND MASTER PLAN REPORT

The presentation of the master plan is given in the form of a report describing the following content:

1. Demand

- Forecasts for passenger traffic;
- Forecasts for cargo freight transport;
- Air traffic forecasts;
- Predictions for military and civil aviation;
- Forecasts for the number of aircraft acceptance and dispatch operations at the port platform;

2. Offered capacity

- This part of the report refers to the existing capacity, as well as the need to expand the capacity in accordance with the evolution of demand.
- The capacity is calculated for:
 - Airport: PSO, miniers, port platforms, waiting positions and auxiliary facilities;
 - Terminals: passengers and cargo;
 - Land: access roads, parking, ancillary facilities.

3. Cost estimation

- RWY, bus lines, dock platforms and waiting positions;
- Cargo and passenger terminals;
- Navigational means, control tower;
- Support facilities (meteorological service, fire service, airport fuel system, canoeing, security, etc.);
- Roads, parking and other auxiliary facilities;
- Military zone;
- General aviation facilities;
- Maintenance area.

For the FAA, it is common to provide the following drawings:

Draft plan of the airport:

- 1) Site map (1: 500 000)
- 2) Surrounding map (1 : 25 000)
- 3) Floor plan map of the airport, which includes:
 - a. Designated airport facilities such as: RWY, route, apron, shoulders, apron (safety area at the end of the RWY), buildings, navigation aids, parking area, traffic lights, light signals, RWY markings, pipelines, fences, drainage, wind indicator, beacon light;
 - b. Natural and man-made structures: trees, streams, lakes, rocks, pits, railway lines, power lines, cities;
 - c. Revenue/production, non-aeronautical property
 - d. Areas foreseen for the future development of aviation and related services;
 - e. Areas intended for other purposes: industrial zones, hotels, etc.
 - f. Existing terrain contours
 - g. Aircraft refueling areas;
 - h. Objects that will deflect;
 - i. Airport boundaries
 - j. System of protected zones at the airport; height and location of control objects;
 - k. Airport reference point;
 - l. RWY end and threshold coordinates and altitude;
 - m. The true azimuth or RWY;
 - n. Point of true and magnetic north including deviation;
 - o. Relevant dimensional data: RWY and taxiway length and width, RWY, taxiway and parking lot clearances, parking lot dimensions, imaginary area dimensions. A deviation from FAA standards is required.
 - p. Depending on the size of the airport, it is necessary to use maps in a scale of 1:2500 to 1:7500.

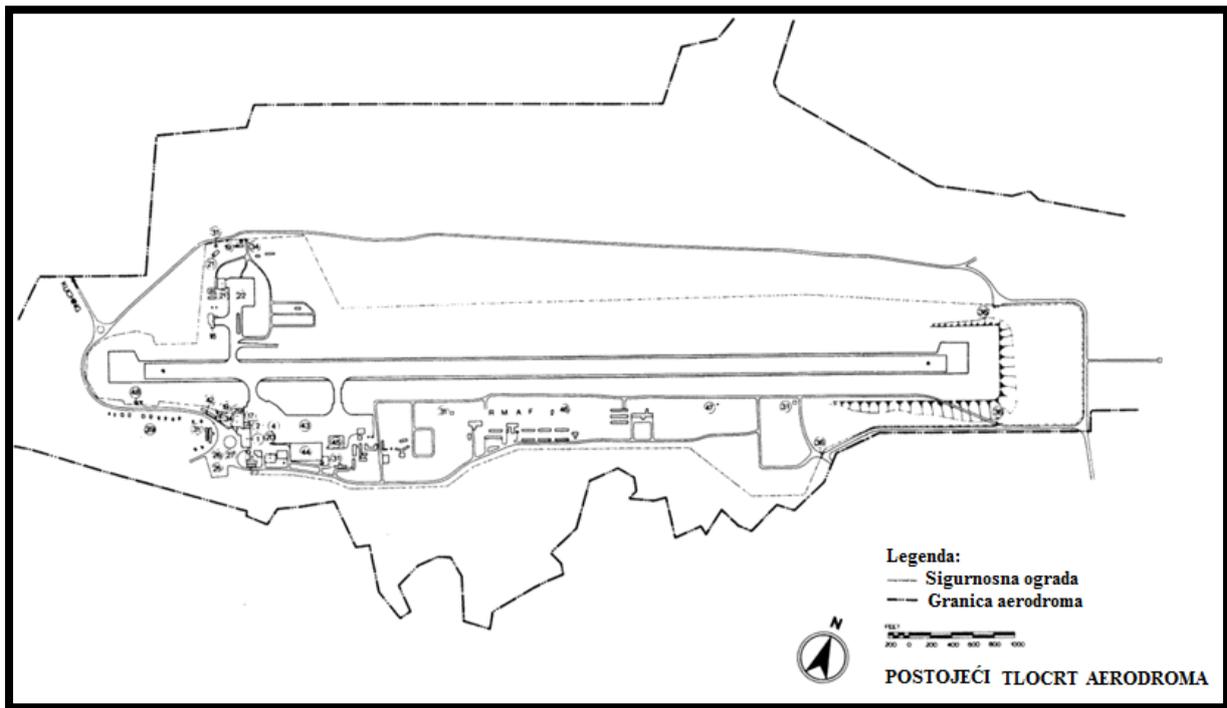
4. The basic data table shows:

- 1) Above sea level of the airport;
- 2) Airport reference point and its coordinates;
- 3) Airport magnetic variation;
- 4) Average maximum daily temperature in the hottest month of the year;

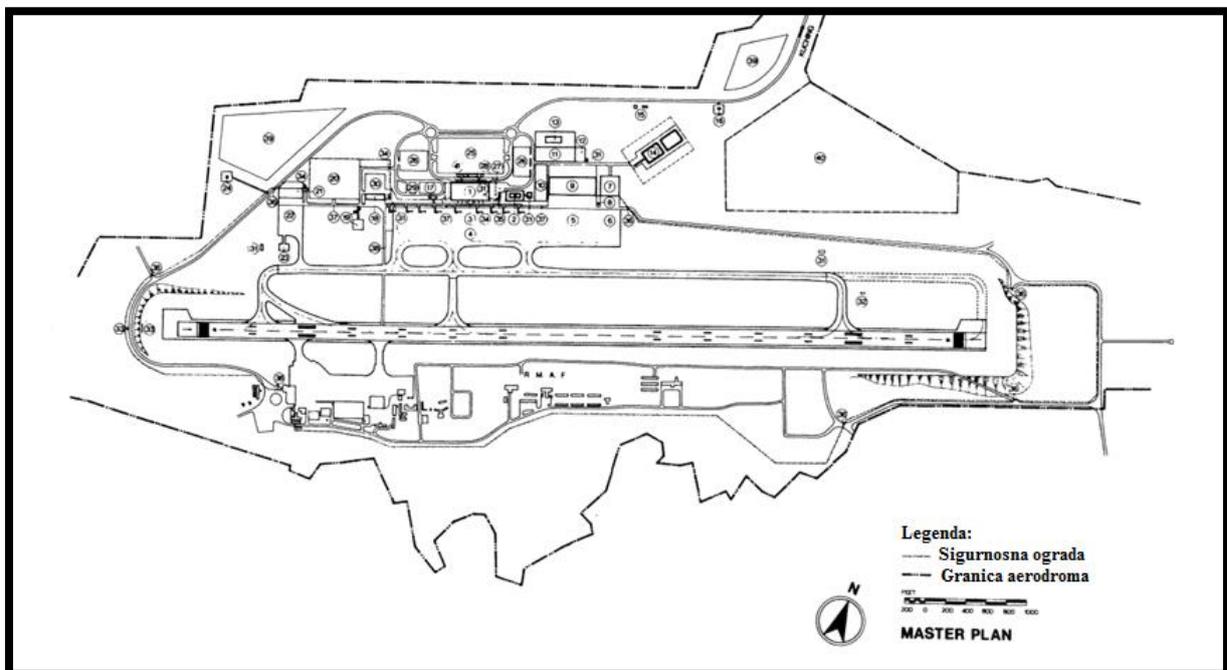
- 5) Airport and terminal navigational aids;
 - 6) Designation of the RWY according to its position relative to magnetic north e.g. 13/31;
 - 7) Percentage of effective RWY gradients for existing and planned RWYs;
 - 8) Percentage of winds present on the RWY;
 - 9) RWY category relative to instrument determination;
 - 10) Type of road construction (reinforcement (grass, etc.) reinforcement (asphalt, concrete));
 - 11) Bearing capacity of the roadway for each RWY;
 - 12) Approach areas for each RWY;
 - 13) RWY light markings;
 - 14) RWY markings;
 - 15) Means of instrumental and visual approach;
5. Wind information, wind rose, RWY orientation;
 6. Procedures for precision instrument approach;
 7. Area under imaginary surfaces, approach and departure aircraft, RWY protected zone, approach zone and controlled zone obstacles. Location and altitude;
 8. Map of facilities near the airport with data on ownership, size and utility systems;
 9. Master plan drawings showing size and direction of utility drainage;
 10. Plan phased planning whenever possible.

Figures 3 and 4 show a simple design plan for a small airport in a developing country. Figure 3 shows an advanced airport design plan of international importance, with high airport capacity.

- A. Plan of the area around the terminal (1: 5 000 to 1: 10,000) (shown where possible)
Conceptual view of the terminal, passenger and cargo;
Schematic representation for separating the flow of passengers, cargo, baggage and vehicles
Vehicle parking and empty space.
- B. Airport Approach Plan
- C. Noise Compatibility Plans outline the noise exposure contours relative to developed and developing areas. These plans should be shown whenever possible
- D. Regional land use plans [1]



Picture 5. Example of airport layout - existing facilities [1]



Picture 6. Example of airport layout - final stage of development [1]

10.0 IMPLEMENTATION OF THE MASTER PLAN

10.1 Development and Costs

The terms of the proposed development and cost estimates may be developed based on short-, medium-, and long-term aviation needs. Usually these are 5, 10, 20 year plans. Quantitative estimates are made based on previous airport layout plans and based on these preliminary development cost estimates are made. Preliminary estimates include construction and other costs shown in the Master Plan. Such costs are based on more in-depth estimates and forecasts, but for the purposes of the master planning of the airport it is necessary to present only certain costs for economic planning. [1]

10.2 Economic Feasibility

Economic justification is analyzed at every step of the airport plan development process: when determining whether to expand an existing airport and in choosing an airport-terminal-airport system conceptual design approach. In any case, when determining capital investments, the preliminary elements of costs are taken into account. In the last phase of the Master Plan, the final economic assessment must be made on the 5-10 year and 20 year plans, it must be foreseen that at each stage of the planning the development of the individual segments will be able to generate income to cover the annual capital and operating costs, taking into consideration additional revenues from the state, local subsidies and donations. In general, sources of revenue are transport user charges, rents and income from various airport operations. Evaluating the contribution allows planners to determine whether the respective areas contribute a proportional or appropriate part of the costs in accordance with the development policy.

Investments by nature can be depreciable and non-depreciable. Non-depreciable investments have an unlimited economic life to develop until they are used up. A good example of a non-reimbursable investment is the purchase of land. For fixed value items, the annual cost of capital is interest on investments. Investments that have a limited useful economic life, there are costs for interest on investment costs and depreciation. When evaluating success for airports, the following sources can be taken into account: landing revenue, apron usage fee, passenger terminal, public parking for road vehicles, fuel sales, hangars, commercial facilities, concessions and various other minor capital costs. The examination of income will show whether the project as a conceptual development is realistic, and if not it is necessary to adjust it. At the beginning of the development of civil aviation, there is a tendency to underestimate the revenue potential, therefore, development plans are too modest.

10.3 Implementation Schedule

The implementation schedule and cost estimates are developed together, for technical reasons. Technical aspects include time required for land purchase, final design, contractors, completion time, as well as time to acquire spatial and environmental permits.

Financial considerations may affect the implementation schedule due to problems with securing financial capital. [1]

11.0 DEVELOPMENT DEPARTMENT OF SARAJEVO INTERNATIONAL AIRPORT

In the organizational scheme of the airport, this sector has existed since 2005. In the previous period, from August 1994 to 1996, within the framework of JP Aerodrom BiH, the

reconstruction tasks were led by the deputy director for reconstruction, who also prepares projects and plans for reconstruction. In the initial phase of the reconstruction, a team was formed for the realization of the project from the employees of the Airport. The PIU team, as it was professionally called, is in charge of monitoring the phases of individual projects, monitoring the dynamics and quality of work on a daily basis, developing a project for an undefined state, purchasing airport equipment and organizing trainings for the quality use of the equipment. The reconstruction of the technical facilities and the passenger terminal was successfully carried out and today the airport has the most beautiful passenger terminal in the area, equipped with modern systems and devices.

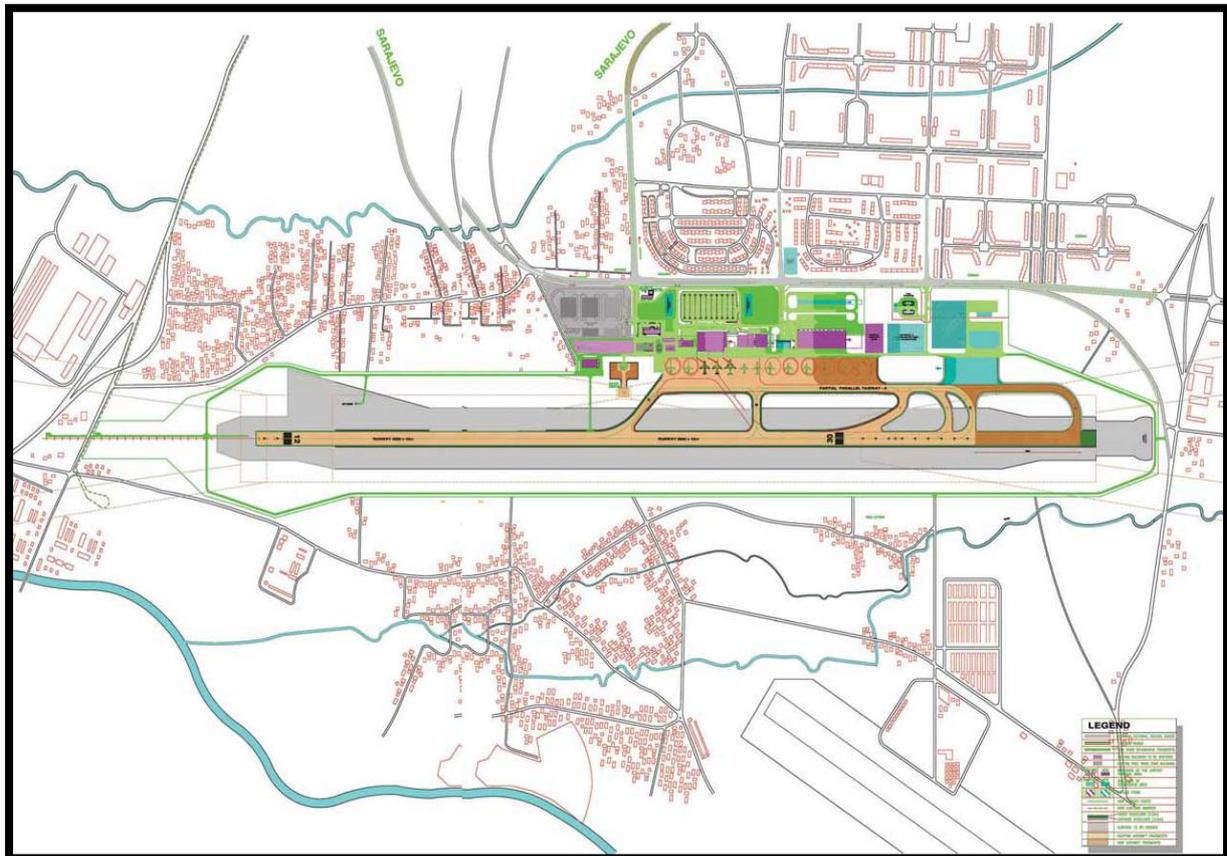
In the period 1997-2001, the reconstruction of the buildings was carried out. The necessary equipment is fully installed and according to the dynamics caused by the operation of financial resources. As a logical sequence of the activities that were carried out during the reconstruction of the Airport, the Development Department was created. The constant development of air traffic requires an appropriate response from the airport. The development department monitors all events related to new technologies, standards, regulations, airline and passenger requirements. Experienced and professional staff employed in the Department can independently prepare project solutions, technical specifications, project tasks, long-term spatial planning documents, investment programs, annual investment plans and supervise the execution of works.

As confirmation of this in the previous period, several investment projects were realized in whole or in part:

- ❖ About 90% of the land for construction was purchased;
- ❖ The construction of the new base collector has been completed, which was a prerequisite for the expansion of the maneuvering area of the airport - the construction of a fast exit node and the expansion of the platform;
- ❖ An administrative and business building was built, which provides additional space for offices and storage;
- ❖ An asylum center was built to accommodate persons who are not allowed to enter BiH;
- ❖ Reconstruction of the central heating substation was carried out;
- ❖ The reconstruction of the old hangar is in progress with the aim of providing storage for the needs of defrosting the surface and the construction of a new smaller hangar, which will provide additional storage space;
- ❖ The procedure for acquiring the repair of the asphalt surfaces under aviation, that is, the replacement of the asphalt surface in parking positions with concrete slabs, has been started. This reconstruction will contribute to reducing the risk and eliminating the risk of damage to the aircraft and service assets, and contribute to achieving an acceptable level of risk.

It is important to point out that the mentioned projects have their own dynamics, so, for example, work on the preparation of space for the expansion of the entrance door on the ground floor of Terminal B was supposed to start in 2015, the construction of a fast exit node was supposed to take place in In 2016 and 2017, the reconstruction of the summer runways and maneuvering areas was supposed to take place. In 2015, work is being done on the project

documentation for a business-administrative building, the construction of which will begin a year later. [3]



Picture 7. Ground plan (floor plan) of the airport in Sarajevo [3]

12.0 EXAMPLES OF DEVELOPMENT AND MASTER PLANS AT AIRPORTS

The city of Zagreb was included in the aviation network of an airline in 1928, with Borongaj Airport, and in 1945, with Lučko Airport, a grass maneuvering area. When in the early 1960s Yugoslavian Air Transport introduced the Convair Metropolitan aircraft into service. Lučko Airport could not accommodate this aircraft and there was a danger that Zagreb would be cut off from the airline network. The city of Zagreb bought an area of about 285 ha from the Yugoslav People's Army, from the Pleso military airport, with a land road and taxiways, and an airport services company was established.

The spatial plan from the 1960s also marked the new airport at the location of Crna Mlaka near the village of Pisarovin.

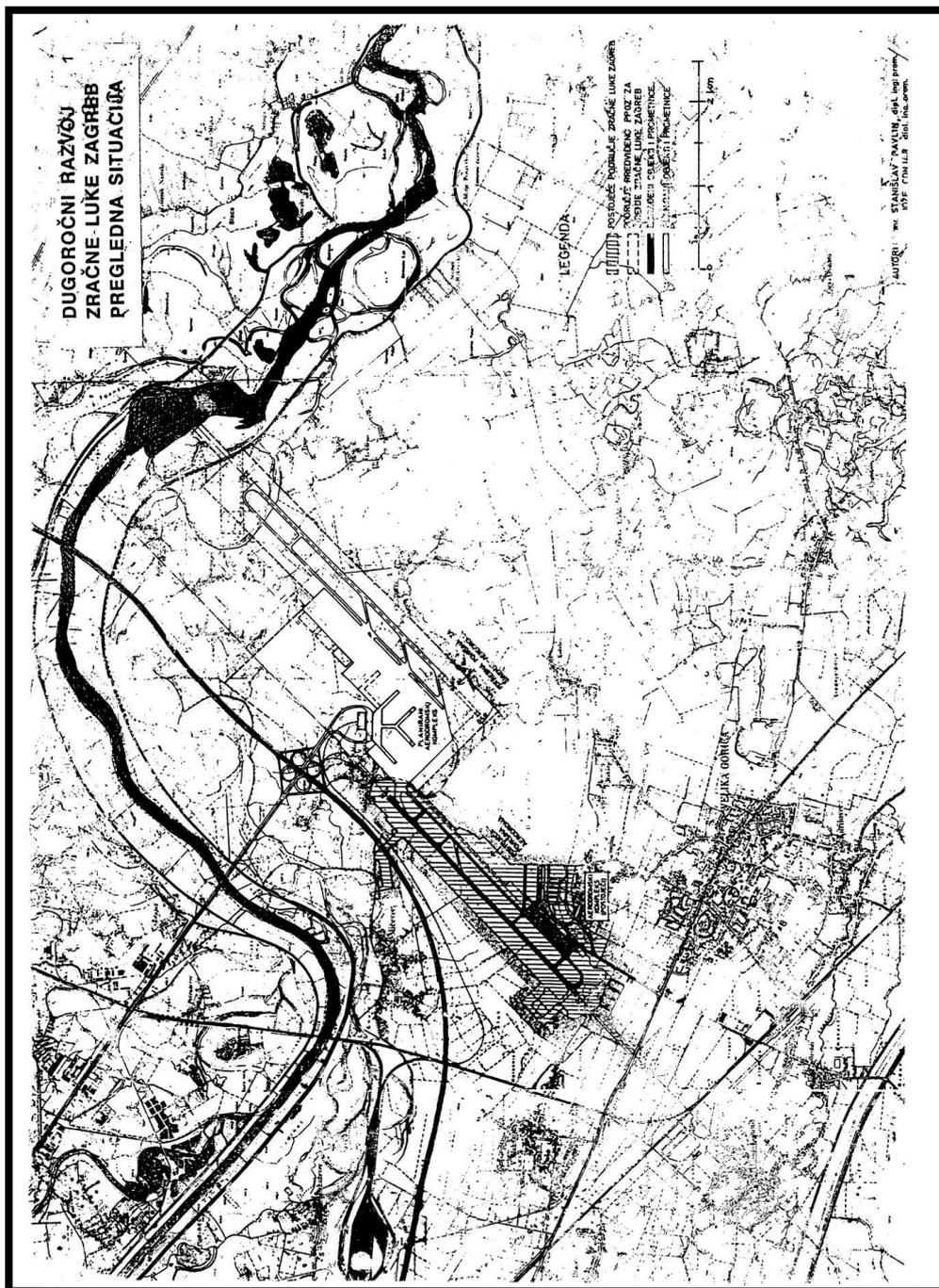
In 1981, Zagreb Airport established the organization, development and investment of the Workers' Collective with one of the tasks of defining long-term development. First, the location of Crna Mlaka was analyzed and it was noted that it is not an optimal solution from the point of view of navigation, because it is located in the continuation of the existing flight path, which

is very unfavorable from the point of view of the construction conditions of the location (watercourses, canals, lakes, groundwater ...) and an unacceptable point of view of the existing nature park on the site itself. Therefore, the location of Pesarovina was rejected for a new airport of the city of Zagreb.

Aviation, airport experts in Zagreb analyzed the necessary investments in GREENFIELD investments for the new airport (regardless of the location) as well as the expansion of the existing airport. The results showed that the construction of a new airport requires at least twice the amount of funds than the expansion of the existing one, and the management accepted the proposal to develop a long-term plan for the development of the existing site (Figure 12.1).

In the long-term plan for the development of the airport in Zagreb, which is next to the existing one, there is an expected surface expansion of up to 700 hectares, in the northeast, partly in the military area (second time) and has received approval from the Federal Committee for Transport and Communications (Ministry of Transport of Yugoslavia). Zagreb Civil-Military Airport requires the approval of the V Corps Command of the Yugoslav Air Force and Air Defense (RV and Air Defense), based in Zagreb, which covers the western part of Croatia and Slovenia. The command is operational and covers four military airfields: Cerklje (Brežice, Slovenia), Zagreb-Pleso, Bihać and Udbina, and eleven runways and airstrips that can be used in war for takeoff. The Air Force considers that, as well as for military and civilian use, it is reasonable to plan other airstrips and parallel runways for take-off at Pleso Airport. In order for the planned second runway to be operationally safe, it is necessary to move the storage of fighter aviation at the Pleso base. The RV requires the state authorities to change the spatial plan and the military warehouse was moved from the Pleso air base to the nearby forest, parallel to the airstrip, out of the radius of a potential explosion in the warehouse. After the changes and additions to the spatial plan, JRV gave consent for the development of the ZLZ.

Based on these two approvals, the spatial conditions of the long-term development plan (except for the existing 285 ha are planned and additional about 700 ha) were accepted and entered into the Spatial Plan of the City of Zagreb in 1986.

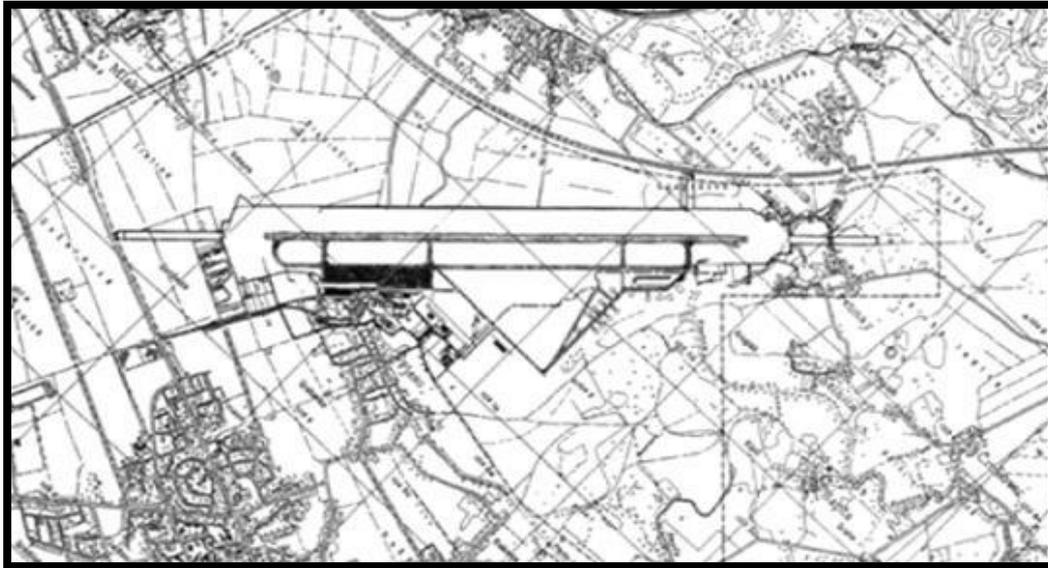


Picture 8. Long-term plan for the development of the airport in Zagreb since the 1980s

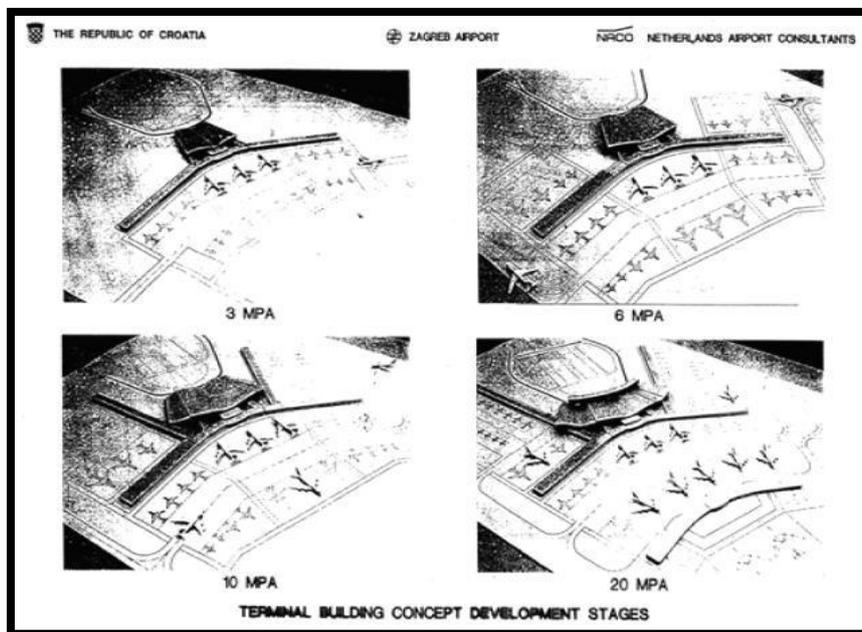
With the amendments to the Spatial Plan of the city of Zagreb from 1995, that is in independent Croatia, in an agreement between the Ministry of Transport and the Croatian Air Force (HRZ), 700 hectares planned for the development of the airport were left. Based on the views of these institutions, the Zagreb airport commissioned a Master Plan from the Dutch company NACO, and work began in 1995. The master plan of the Zagreb airport was completed in 1997.

The master plan for Zagreb Airport 1997 was made for the expected traffic in 2030 and for a maximum turnover of 20 million passengers per year.

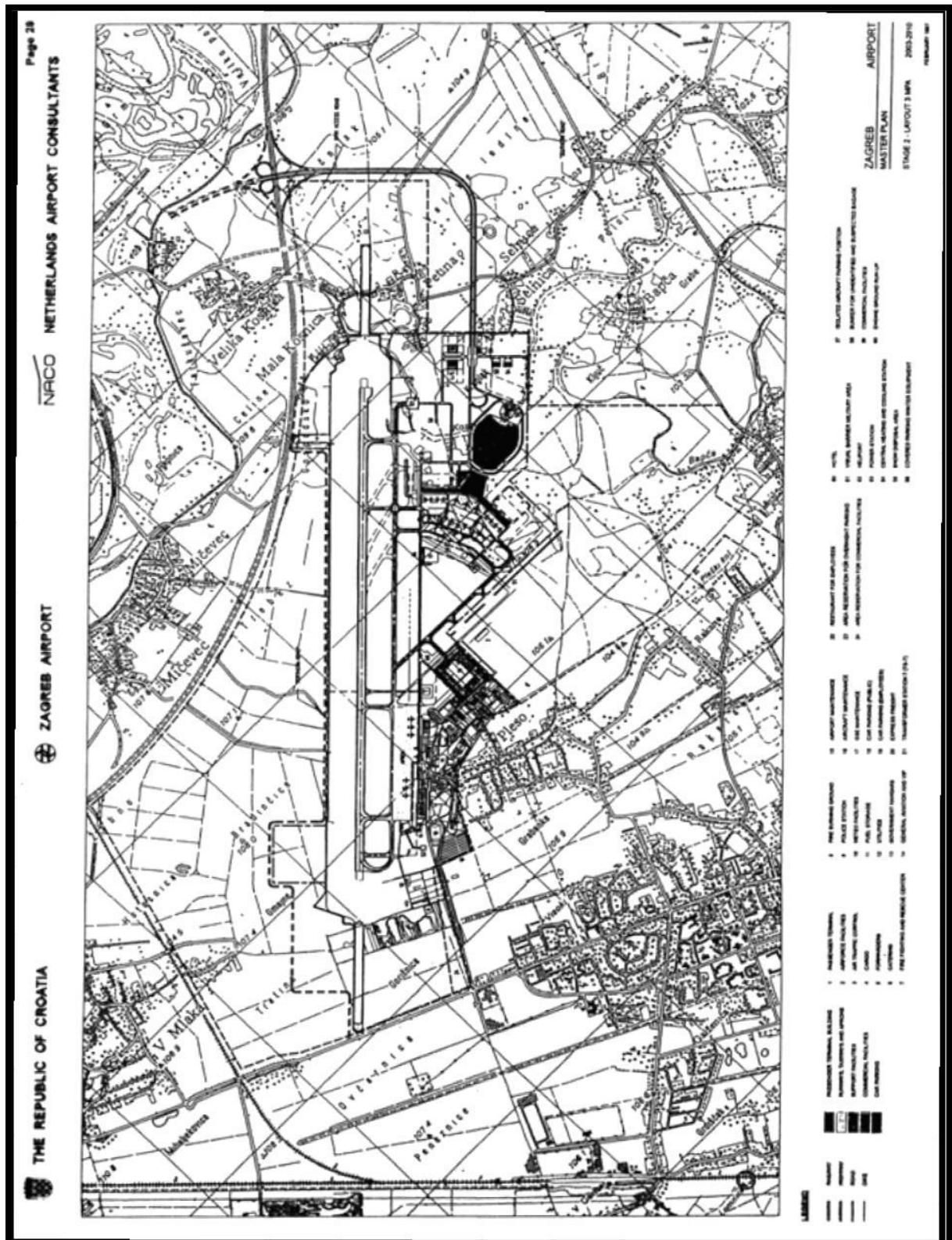
Zagreb Airport Master Plan 1997



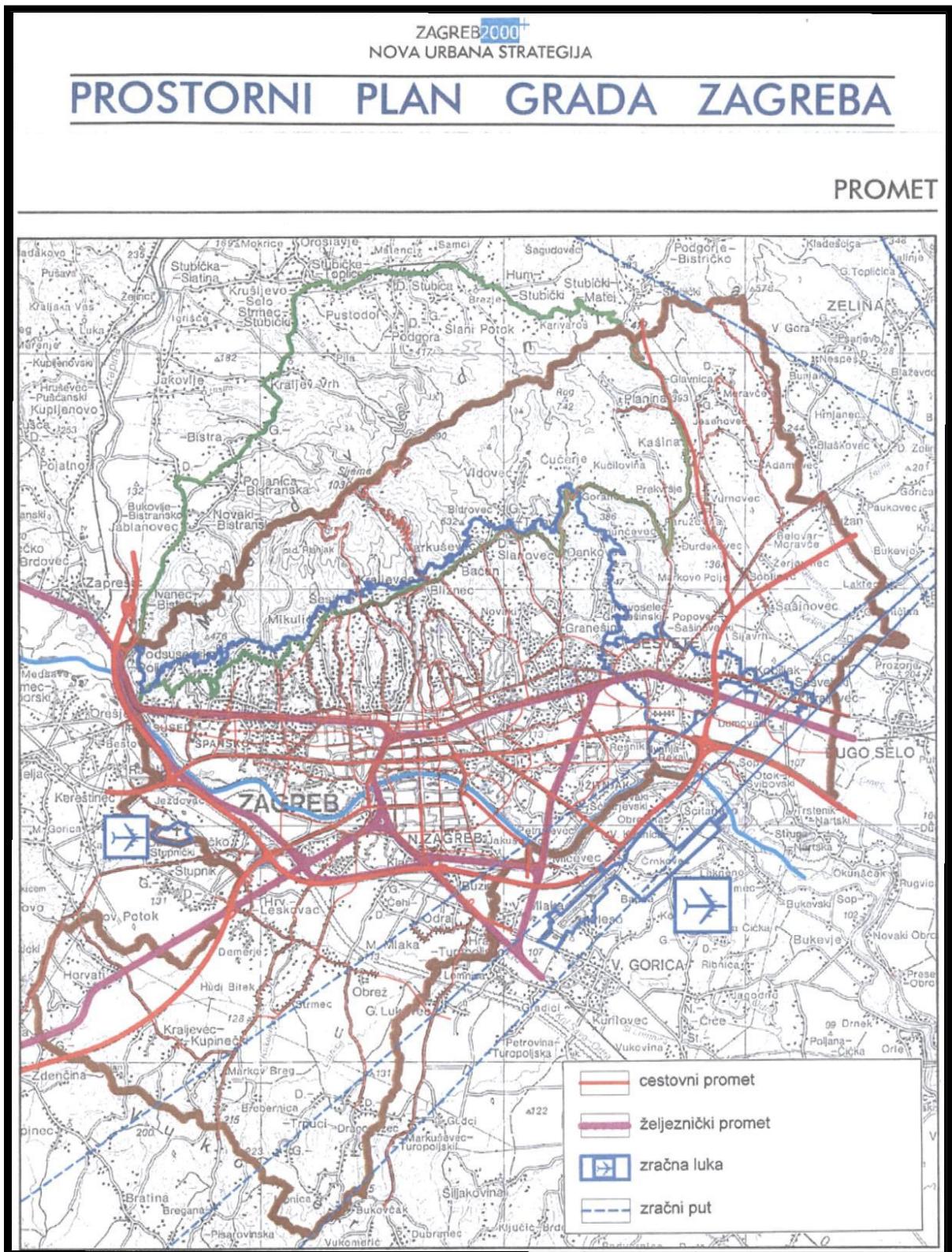
Picture 9. State of the airport in Zagreb since 1997.



Picture 10. Stages of development of the passenger building



Picture 11. Phase of development of the airport in Zagreb for 3 million passengers per year



Picture 14. Overview of the space reserved for the development of Zagreb Airport in the Spatial Plan of the City of Zagreb, New Urban Strategy, Zagreb 2000+

12.1 Zagreb Airport Master Plan 2009

The new management from the beginning of the first decade for a not so long period of time recognized the need to speed up the development of the work on the passenger building, which was already almost started in the first year. Although for some land plots needed for the development of the terminal, the Ministry of Defense has given approval for the transfer of part of the land to the Zagreb air base (in front of Pleso) and financing has been provided in the plan to purchase land from private owners, nothing concrete has been carried out. . The land was not bought, nor were plans and projects developed. Additional problems were brought by the new spatial plan, which according to the new law made as the Regional Plan for the Zagreb District in 2002 shows another RWY, or conditionally, if the need for it is proven. The management of Zagreb Airport has shown determination to return to the Spatial Plan with a second runway. Most of the planned 700 hectares for airport expansion has been repurposed, and a new bypass area has been brought in, on about 300 hectares for airport development. The space provided does not allow planning a parallel flight path at distances that allow independent instrument operations.

In the second half of the same decade, activities were started on the previous spatial documentation, but it was not yet known what the spatial coverage of the so-called last airport capacity. A sketch was prepared for possible spatial coverage with eight spatial segments, which are partly shown in the Spatial Plan, and partly not. Part of the airport development expert team, made up of airport experts and external experts, wanted to show politicians the long-term development of each option through a new Master Plan. Due to the differences in the expert team regarding the development of the airport and the decision making of non-profit persons from the airport administration resulted in a Master Plan that was not prepared according to ICAO principles.

An addition to the 2009 Master Plan was made by the German project: Stuttgart Airport for development until 2030, but also for the highest traffic for one and two runways.

The master plan did not respond to the developments in the case of all the spatial characteristics and the development of five years. The emphasis is on the maximum capacity of the site with one and two runways, with and without the HRZ air base, without giving the most important answer for the current needs - the construction of a new passenger terminal in terms of capacity optimization in the first phase in terms of further expansion. When the constructor did not provide, the airport defined the concept according to the NACO solution with some modifications.

Zagreb Airport Master Plan from 2009 under the title "General Plan for Update 2008" was intended to take into account the new data: Zagreb Airport is a new spatial structure in the Zagreb Region which was adopted in 2003 by the Mayor of the city, in which most of the 700 hectares of the Spatial Plan of the City of Zagreb for long-term development, thus eliminating the second and parallel runways. Bypass space is provided, which in a functional sense cannot replace converted land. The area that was planned for the second track was placed in the status of a space in the second track. In the new conditions, it is necessary to devise, in accordance with the new boundaries of the space and the possibilities of obtaining land from HRZ, to

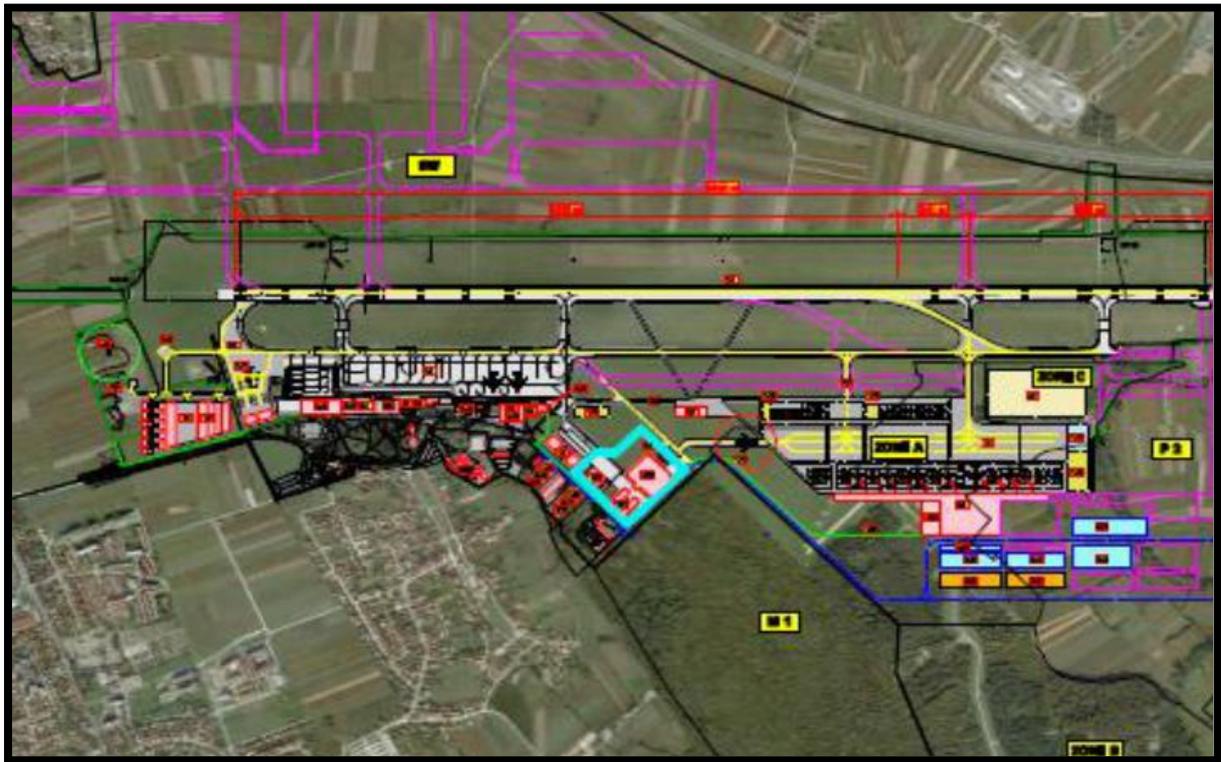
process in at least eight variants, with several alternatives, in accordance with the potential possibilities for spatial development.

Due to numerous reasons of a subjective as well as an objective nature, Zagreb Airport did not receive a Master Plan prepared according to the agreement and the principles of master planning, but received a potential, more theoretical than practical evidence, maximum capacities in a certain phase or variant of development. Even after five years there is no common development, especially in the first five years, so this document is not considered a Master Plan.

A master plan is a document for a specific airport, dimensioned measure by measure, and a development plan is obtained with theoretical values of the maximum capacity for one and two runways, with and without a military component, regardless of the limited possibilities of the site for the development of the associated surfaces and contents. Eklatanan is an example of a cargo terminal development that, in addition to the sign of the existing state, has no phase development until the migration north of the summer section, which is a long-term development before which the existing cargo terminal would have to be expanded twice.



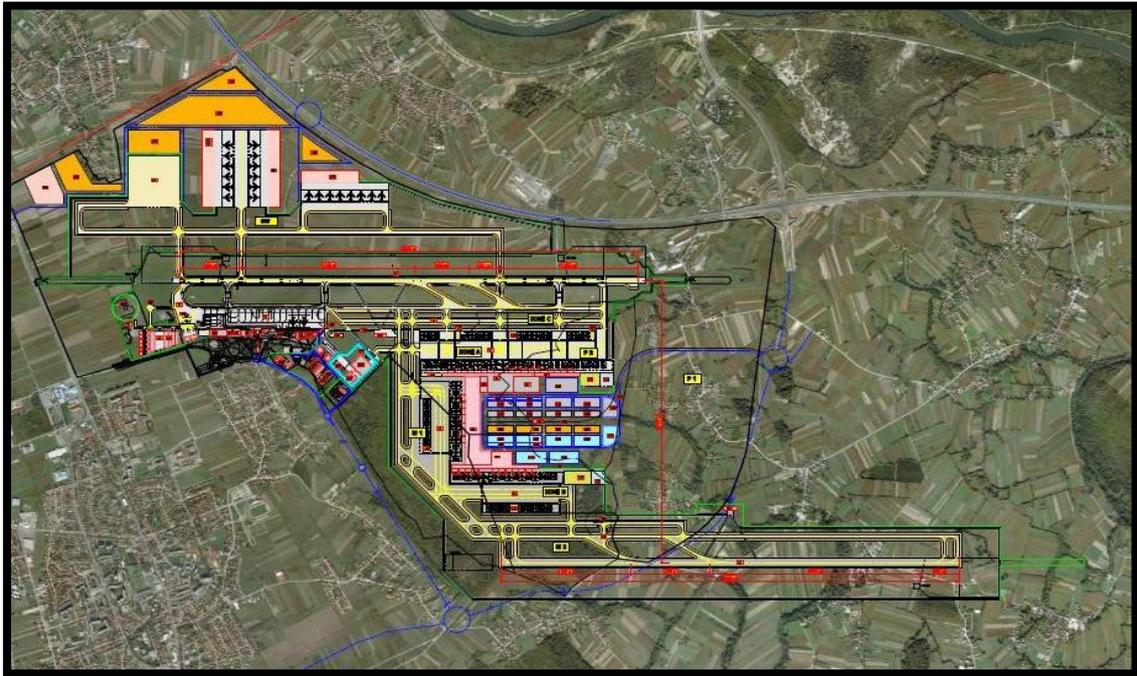
Picture 15. Current situation of the airport in Zagreb since 2009.



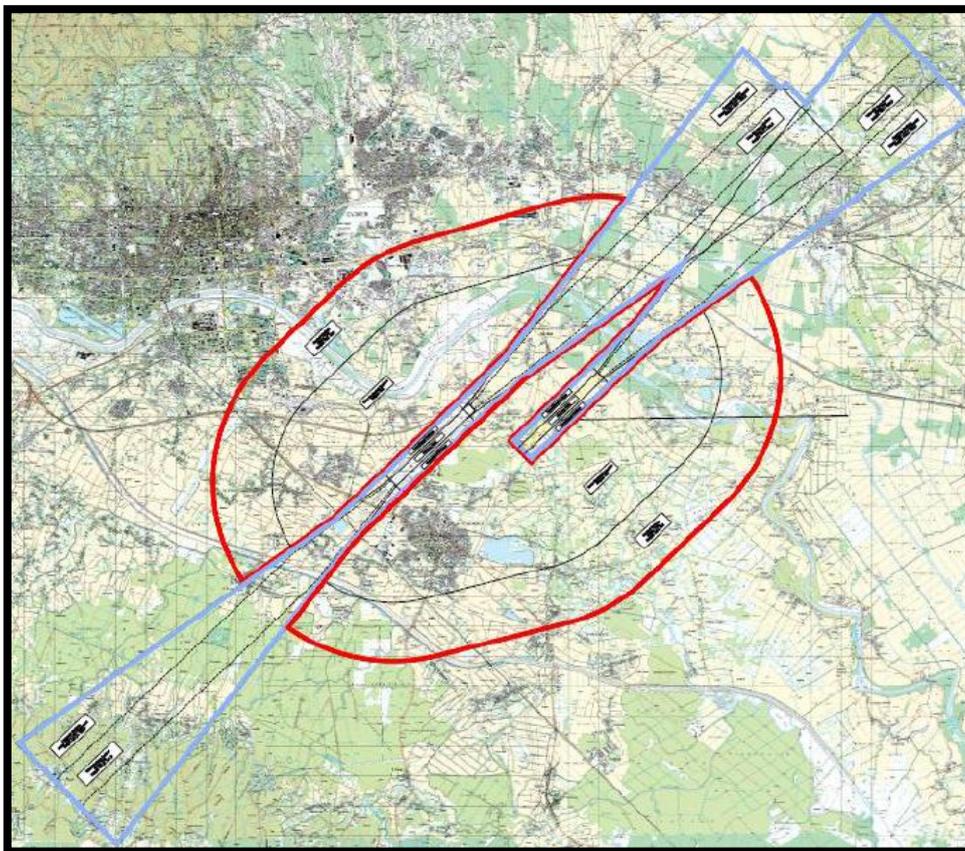
Picture 16. The initial phase of development for 5 million passengers per year



Picture 17. Development phase for 30 million passengers per year, civil and military purposes



Picture 18. Development phase for 40 million passengers per year, civilian use only



Picture 19. Terrain limitation boundaries for the existing and planned runway

12.2 Amendments to the Spatial Plan of the Zagreb Border from 2011

Based on the approval of the Croatian Civil Aviation Agency since 2010, the Zagreb airport complex has one runway and a parallel runway with elements of spare runways in case the runways are closed to traffic, the Zagreb region has adopted a solution without another runway.

After a quarter of a century since the adoption of the Spatial Plan of the City of Zagreb at a time when Zagreb Airport was neither the capital, nor the main airbase of HRZ, nor the home airport of the national air carrier Croatian Airlines, which had planned a long runway for independent operations at the airport, the Administration of Civil Aviation has decided that one runway remains for the development of the airport in the capital of the country, the main air base of HRZ and the home airport.

ICAO recommends two runways for airports in major cities in countries, regardless of the number of operations. The Zagreb case is even more complicated: landings and takeoffs of civilian and military aircraft take place on one track. In the main cities of Europe, there are a small number of airports, which are both civil and military, and those that have civil and military traffic on the same runway are extremely rare.

13.0 CONCLUSION

An airport master plan is a document that serves as a guide for planning, designing and constructing facilities in accordance with the development of air traffic.

It enables a graphic display of objects, determination of a realistic schedule, a proposal of a feasible financial plan, justification of the plan, etc. and contains an analysis of the current situation, traffic forecasts and a development concept.

An important part of the Master Plan is the presentation of the environmental impacts of the facilities. No two airports have the same development plans, even though they may contain the same available facilities.

To create a Master Plan, it is necessary to collect all available data on air traffic demand, environmental data, physical characteristics, aeronautical data, topographical data and financial data.

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ABBREVIATIONS AND FOREIGN WORDS

ACAS (Air Collision Avoidance System)

ACE (ATM Cost Effectiveness reports)

ACI (Airports Council International)

ADS-B	(Automatic dependent surveillance – broadcast)
AIRINC	(Associates for International Research, Inc.)
AIM	(Aeronautical Information Management)
AIS	(Aeronautical Information Service)
AKL	Aerodrome Flight Control
AMAN	(Arrival Management)
ANSP	(Air Navigation Service Provider)
APFD	(Auto-Pilot/Flight Director)
APM	(Approach Path Monitor)
APW	(Area Proximity Warning)
ASAS	(Airborne Separation Assistance System)
ASEP	(Airborne Separation)
ASEP-ATM	(Airborne separation In-trail merge)
ASEP-ITF	(Airborne separation In-trail follow)
ASM	(Airspace Management)
ATFCM	(Air Traffic Flow Capacity Management)
ATFM	(Air Traffic Flow Management)
ATM	(Air Traffic Management)
ATMS	(Air Traffic Management System)
ATS	(Air Traffic Service)
ATSA	(Air Traffic Situational Awareness)
CANSO	(Civil Air Navigation Services Organisation)
CAPAN	(Capacity Analyser)
CBA	(Cost/benefit analyses)
CBA	(Cross-Border Airspace)

CCO	(Continuous Climb Operations)
CDM	(Collaborative Decision Making)
CDO	(Continuous Descent Operations)
CEATS	(Central European Air Traffic Services)
CFIT	(Controlled Flight Into Terrain)
CNS	(Communication, navigation and surveillance)
CRS	(Central Reservation System)
CSPDU	Unit for strategic planning and development
CUAC	Air traffic control center in the upper airspace
DCB	(Demand Capacity Balancing)
DMAN	(Departure Management)
EATMs	(European Air Traffic Management Network system)
EASA	(European Aviation Safety Agency)
ECAC	(European Civil Aviation Conference)
ECIP	(European Convergence and Implementation Plan)
ESARR	(EUROCONTROL Safety Regulatory Requirements)
EATMN	(European Air Traffic Management Network)
EUROCONTROL	(European Organisation for the Safety of Air Navigation)
FAA	(Federal Aviation Administration)
FAB	(Functional Airspace Blocks)
FUA	(Flexible Use of Airspace)
GDS	(Global Distribution System)
GNSS	(Global Navigation Satellite System)
IATA	(International Air Transport Association)
ICAO	(International Civil Aviation Organisation)

IFF	(Identification, friend or foe)
IFR	(Instrument Flight Rules)
KPA	(Key Performance Area)
LIKS	Logical Information and Communication System
MUAC	(Maastricht Upper Area Control Centre)
MWM	(Macroscopic Workload Models Model)
Optimus	(lat) – the best, optimization
RNAV	(Area Navigation)
RNP	(Area Navigation Procedures)
RPA	(Remotely Piloted Aircraft)
SAAM	(System for traffic Assignment and Analysis)
SESAR	(Single European SKY ATM Research)
SES	(Single European Sky)
STATFOR	(Statistics and Forecast Service)
SWFAB	(South West Functional Airspace Block)
SWIM	(System Wide Information Management)
TCAP	(TCAS Alert Prevention)
TMA	(Terminal Control Area)
TSA	(Temporary Segregated Area)
UTC	(Coordinated Universal Time)
UACC	Maastricht Upper Area Control Centre (MUAC)
VFR	Visual Flight Rules
VOR	(VHF Omnidirectional Radio range)
WAM	(Wide Area Multilateration)