**PERFORMANCE SCHEME IMPLEMENTATION IN FUNCTIONAL AIRSPACE BLOCK CENTRAL EUROPE**

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**Abstract**

**The Single European Sky initiative was launched in order to increase safety standards, airspace capacity and to decrease costs for air navigation service providing as well as the influence of air traffic on environment. Implementation of SES initiative has been carried out through two regulatory packages. SES I was oriented primarily on airspace restructuring and didn’t bring significant results which imposed the need for updating the legislation by second regulatory package. SES II package was performance oriented and introduced the measurement of the ATM performance through Performance scheme implementation. Measurement in ATM performance is driven by four key performance areas: safety, capacity, environment and cost-efficiency. Performance scheme itself should provide indicators and binding targets of key areas with condition of achievement and keeping the necessary safety level, allowing thereby setting targets in other key areas and it presents the basis for achieving the main efficiency related objectives. All Member States of the EU are obligated to draw and elaborate Performance Schemes for ATM, with targets for each identified key performance area in defined reference period. The Central European airspace has a significant influence on European air traffic management system and every movement in airspace design or air navigation service provisioning could contribute to better flow of European air traffic. FAB CE is still in its implementation phase but once it is implemented it will also play an essential role in reducing major delays in air traffic caused in the South East axis. For optimum usage of airspace, increase flight efficiency and safety, certain performance targets should be set within FAB CE in all key performance areas.**

**The purpose of this paper is to investigate the implementation status of Performance scheme in the first reference period**.

**Keywords**

**efficiency, performance scheme, functional airspace block**

**INTRODUCTION**

European airspace is one of the most congested airspaces in the world. The provision of air navigation services within in the same was faced with great inefficiency because of the nature of air traffic and its constant increase in the last two decades. Inefficiency was enhanced by airspace fragmentation and the fact that air navigation service providers were explicitly connected to national boundaries. For this reason, aircraft were often not able to fly direct route due to complicated procedures thus increasing the flight time (delay), fuel consumption and costs. The possibility to meet the capacity was reduced which had an impact on the air traffic safety. Airspace was not civil-military coordinated since most of the time it was occupied by military.

All of the above-mentioned facts led to the creation of the Single European Sky. Performance scheme and functional airspace block establishment impose as the two most important and cohesive elements for its full implementation. On the one hand, functional airspace blocks are established with the purpose of airspace defragmentation thereby enhancing the air traffic flow and enlarging the capacity. On the other hand, that would not be possible if there was no performance scheme. Performance scheme represents the key element for increasing the overall efficiency imposing certain targets at EU, national and functional airspace block level. Every national and FAB target has to be consistent with the EU-wide targets and contribute to efficiency improvement in an adequate manner.

Functional airspace block Central Europe consists of seven states: Austria, Bosnia and Herzegovina, Croatia, Czech Republic, Hungary, Slovakia and Slovenia. Every state had to create its own performance scheme as specified by regulation 691/2010. Bosnia and Herzegovina is a potential European Union candidate and still does not have its own performance scheme. Croatia has just entered the European Union in 2013th and at the beginning of the establishment process did not have its performance scheme but will have for the second reference period.

Thus, the following paper is based on data of remaining states with the purpose of implementation status examination for the first reference period as well as the FAB CE contribution to increasing overall efficiency.

**THE SINGLE EUROPEAN SKY INITIATIVE**

Air traffic has a variable nature and its variability greatly impacts the air navigation service providing efficiency in terms of safety, environment, capacity (delay) and costs. Therefore, the incentive for single sky of Europe was initiated. The Single European Sky initiative was launched in 2000th by the European Commission, enhanced by the inefficiency of air traffic (major delays) in 1999.

European airspace is fragmented and almost every country has its own ANSP[[1]](#footnote-1). The reason of such fragmentation lies in connecting the air traffic control with States’ sovereignty which represents the main cause for its limited operation. The purpose of the initiative is to reduce current fragmentation of entire European airspace, thus reducing delays and costs associated with service providing costs as well as increasing the safety and flight efficiency. The main SES[[2]](#footnote-2) objectives are:

* tenfold increase in safety,
* threefold increase in capacity (in terms of ability to satisfy tripled air traffic demand increase),
* reduction of air navigation service providing costs for at least 50%,
* reduction of air traffic influence on the environment by 10% .

Reform of air traffic management system is needed, to achieve aforementioned objectives, which is based on:

* developing a efficiency measuring system (refers to Performance scheme),
* rationalization of an ATM[[3]](#footnote-3) system (refers to functional airspace blocks),
* modernization of ATM system (introduction of new technologies) .

Single European Sky initiative began with the first regulatory package originated in 2004 which included four regulations aimed primarily at airspace restructuring (depending on air traffic needs – regardless national boundaries) and enhancing safety. It was constituted of following regulations:

* the framework regulation (549/2004) laying down the framework for SES creation,
* the service provision regulation (550/2004) about air navigation service provision within the SES,
* the airspace regulation (551/2004) on organization and use of airspace,
* the interoperability regulation (552/2004) regarding the interoperability of EATMN[[4]](#footnote-4).

Concept was revolutionary but it did not bring expected results in some areas. The integration process within functional airspace blocks was faced with the question of national sovereignty and as for the overall airspace design efficiency and the use of European air route network – there was very little progress. Exactly for this reason, second SES regulatory package focused on four key areas was introduced in 2009. Second regulatory package is crucial for air navigation service providing performance measuring and is composed of legislation, safety, technology, airports and human factor. Regulation 691/2010 stands as the most important regulation of second regulatory package. It applies to air navigation services as network functions and is supposed to contribute to increasing the overall air navigation service providing efficiency through key performance areas safety, environment, capacity and cost efficiency.

Air navigation service providing includes four main components:

* air traffic management,
* communication, navigation and surveillance,
* meteorology, and
* secondary services.

Almost every state in Europe has its own air navigation service provider organized in accordance with its legal framework. Since the fragmentation of European airspace, aircraft during flight and entry into each of the following states are serviced by different providers. This greatly affects the flight safety and air traffic management performance entailing costs which are, of course, settled by air traffic users. Air traffic inefficiency besides monetary terms is seen through increased fuel consumption, flight time and reduced capacity. Single European Sky first regulatory package was more oriented to reduction of airspace fragmentation rather than the aviation impact on environment and efficiency itself.

Air navigation service providers’ performance scheme is an integral part of the second Single European Sky regulatory package and represents the most important feature for sustainable development of European air traffic. Objectives which should be achieved by the end of reference period are set within the scheme in four key performance areas. Performance scheme was first mentioned in the mid 2008. Performance Review Commission on its own initiative and in collaboration with the European Commission published a draft document whose purpose was to inform about position regarding the practical implementation of performance scheme general principles. The draft was then delivered to all air traffic participants (regulators, air navigation service providers, and carriers) for further consideration. Detailed document for performance scheme draft implementation was published at the end of 2009 and it was a key input for creating the regulation. The European Commission finally adopted regulation 691/2010 laying down the performance scheme of air navigation service providers and network functions in the middle of 2010 .

EUROCONTROL has been designated as the Performance Review Body in 2010 pursuant to regulation 549/2004 whose main role is to assist the Commission in collaboration with national supervisory authorities, as well as helping them with the performance scheme implementation. It consists of Performance Review Commission (including director) which is supported by the Performance Review Unit.

European Commission designates the competent performance review body for the five year period. Tasks of the Performance Review Body include (but are not limited to) the following:

* collecting, testing, evaluating and distributing information related to efficiency,
* defining new or adapting the existing key performance areas and indicators,
* defining new or correcting the existing efficiency related targets set at EU level,
* consistency assessment of adopted performance schemes, including set targets,
* assessing the impact of revised targets or corrective measures taken by the EU member states,
* monitoring, evaluating and assessing the air navigation services’ efficiency at national/FAB[[5]](#footnote-5) or EU level,
* monitoring, evaluating and assessing networks’ functionality .

**PERFORMANCE SCHEME DEVELOPMENT, EVALUATION AND MONITORING**

Performance Review Body (i.e. European Commission) develops an initial target proposal 15 months before the beginning of the reference period. European Commission adopts the proposed EU[[6]](#footnote-6)-wide targets and sets alert threshold for every key performance indicator 12 months before the RP[[7]](#footnote-7). National supervisory authorities of every member state are obliged to draw a national performance scheme which contains efficiency targets consistent with ones set at EU level. Upon NSA[[8]](#footnote-8) proposal, member state will adopt performance scheme no later than six months after adoption of EU-wide targets. After the adoption, Commission and PRB[[9]](#footnote-9) evaluate the performance scheme and targets set within to determine their consistency as well as adequate contribution to EU-wide targets. Evaluation criteria are:

* compliance with requirements related to preparation, adoption and evaluation of performance scheme,
* analysis of relevant factors taking into account situation of each individual state,
* the interrelation between all performance targets,
* performance standards at the start of the reference period and resulting scope for further development .

In the case of performance scheme consistency and compliance with targets set at EU level, the European Commission informs the member state within four months of its acceptance. If there is any procedure inconsistency, Commission will recommend the state to change its efficiency targets. No later than two months after issuing recommendations state must adopt new changed targets which will be evaluated. In the case of further inconsistency, the European Commission may decide that states take corrective measures. At the latest two months after decision, the adopted corrective measures shall be forwarded to Commission.

Performance monitoring refers to continuous process of collecting and analyzing data in order to measure actual systems’ performance compared to predefined targets. Performance Review Body assists the European Commission in the monitoring, evaluating and reviewing of the air navigation services performance at EU level or national/FAB level. National supervisory authorities are responsible not only for performance scheme development but also for supervision and monitoring of set targets.

In the first half of the 2010th, PRB made target proposals in collaboration with air traffic stakeholders for achieving the overall efficiency at EU level. For the first reference period (between 2012 and 2014) these targets are:

* reduce the route extension by -0.75% until the end of 2014 (compared to 2009) in the key performance area environment,
* reduce delay to 0.5 min per flight for the whole 2014th in the key performance area capacity,
* determine the unit rate at 53.92€ till 2014 in the key performance area cost efficiency .

Performance measuring areas of air navigation services are defined by key factors safety, environment, capacity and cost efficiency.

In order to increase performance to satisfactory level, certain targets are set at EU level as well as national and functional airspace block level. Targets are set using performance indicators in each key performance area in accordance with the guidelines contained in the performance scheme. For the first reference period (2012 - 2014) targets are set within the key performance area environment, capacity and cost efficiency while not in safety where only key performance indicators are being observed. The first reference period is considered to be a transitional period where the overall efficiency is viewed with the respect to the targets set at EU and national level, while targets at FAB level will take place in second reference period (2015 - 2019).

Since proposal for EU wide targets is developed at least 15 months and then adopted 12 months before beginning of reference period all targets are revised. By comparison with the first reference period, targets for the second reference period are as follow:

* at least EoSM[[10]](#footnote-10) level 4 in all management objectives should be achieved by all ANSPs; by the end of RP2, all ANSPs should be reporting ATM Ground using the RAT methodology for severity classification for all reported occurrences (i.e. 100%),
* average horizontal en route flight efficiency will have to range between 4.1% - 4.4%,
* annual average en-route delays will have to amount between 0.3 – 0.6 min,
* unit rates are still in determination process .

As far as functional airspace blocks, states which still have not adopted performance scheme with targets at FAB level must forward aggregated information to European Commission in order to conciliate those targets with the EU wide performance targets.

**FUNCTIONAL AIRSPACE BLOCK CENTRAL EUROPE**

Functional airspace blocks are, along with the performance scheme, the basis for achieving the Single European Sky designed for the purpose of rational European air traffic management. Based on operational requirements and established regardless of State boundaries, FABs promote and enhance cooperation of individual air navigation service providers (Figure 1), .



**Figure 1**. Functional airspace blocks

Source: <http://www.lufthansagroup.com/fileadmin/downloads/en/policy-brief/10_2011/LH-PolicyBrief-October-2011-FABs.jpg>

Rationalization of European air traffic management system refers to reduction in the number of air traffic controls and standardization of ATM infrastructure. Costs caused by service providing decrease that way while flight efficiency increases. The best example of ATM rationalization is the United States. The United States manage the airspace of approximately equal spaciousness of the European airspace. With comparable number of airports (509 within the U.S., 450 within Europe), similar services and 38% less staff manage a 67% greater number of flights compared to Europe (15.9 million flights by comparison with the European 9.5 million), (Figure 2). Such undertaking requires major investments so as to achieve the Single European Sky and accomplish its competitiveness relative to the U.S. solid regulatory guidelines are necessary. The outset is precisely the full establishment of functional airspace blocks .

Figure 2. Differences between European and American ATM

Source: EUROCONTROL, FAA: U.S./Europe Comparison of ATM-Related Operational Performance, 2012.

Air navigation service providers in Europe work on different systems which amplify the costs and greatly complicate coordinated implementation of SES. The key to increasing the overall efficiency of service providers lies in a standardized and interoperable management system defined at EU level. System standardization allows the equal workload distribution but also automatically resolves unequal efficiency levels that arise from different operational and technical concepts.

With SES regulation 550/2004 on provision of services, Member States were requested to take all necessary measures in order to complete the FAB implementation till the end of 2012. Nine FABs were established (or under development) whose Member States are the following:

* UK-Ireland FAB
* Danish-Swedish FAB
* Baltic FAB - Lithuania, Poland,
* BLUE MED FAB - Cyprus, Greece, Italy and Malta,
* Danube FAB - Bulgaria, Romania,
* FAB CE - Austria, Bosnia & Herzegovina, Croatia, Czech Republic, Hungary, Slovak Republic, Slovenia,
* FABEC - Belgium, France, Germany, Luxembourg, the Netherlands and Switzerland,
* North European FAB - Estonia, Finland, Latvia, and Norway,
* South West FAB - Portugal, Spain.

Common strategic objectives of functional airspace blocks are:

* to provide a sufficient safety level despite air traffic growth,
* to satisfy the anticipated traffic increase with capacity,
* to balance ANS costs within functional airspace blocks with setting up more efficient routes and ATC services,
* to improve flight efficiency with a view to diminution of environmental pollution .

Functional airspace block Central Europe is a joint initiative of seven states: Austria, Bosnia and Herzegovina, Croatia, Czech Republic, Hungary, Slovak Republic and Slovenia. The role of functional airspace blocks is satisfying future air traffic growth through rationalization and abolition of national boundaries thus increasing capacity and overall efficiency. Mentioned objectives should be achieved through enhanced cooperation between member states. Implementation process is conducted by governing structures established at national (State) and ANSP level. National level structures make highest decisions related to implementation as well as operation of FAB and include:

* FAB CE Council as the highest joint-decision making body,
* JC-MACC (Joint Civil – Military Airspace Coordination Committee),
* NSA CC (National Supervisory Authorities Coordination Committee), .

Air navigation service providers’ structures are in charge of enhancing the cooperation between all ANSPs included:

* CEO Committee,
* FAB CE Steering Committee,
* Program Management,
* Sub-committees at executive/working level .

Implementation progress of functional airspace block Central Europe is shown on Figure 3. Since FAB CE is consisted of seven states, it was necessary to provide guidelines, examine its feasibility as to determine specific implementation phases. In 2008, feasibility study was adopted by all contracting states. Due to functional airspace block comprehension of lower and upper en-route airspace, for the purpose of ANSP coordination and compliance with feasibility study, states created a Memorandum of understanding and then finally adopted in 2009. Intention of abovementioned Memorandum was development of cooperation framework of the member states based on creating the interfaces which would enable proper coordination between ANSPs. It represents the preparatory phase of FAB CE establishment. Memorandum of cooperation was signed in 2010, after the finalization of preparatory activities delivering the ANSP planning documents to the states’ structures. Preparatory phase finished in 2011 when FAB CE agreement was signed .

**Figure 3.** Implementation process of Functional airspace block Central Europe

Source:FAB CE NSA CC: FAB Central Europe Information on the aggregated performance targets in accordance with Article 5(3) of Regulation (EU) No 691/2010, 2012.

Characteristics, of all functional airspace blocks predetermined by regulation 550/2004, are optimum use of airspace, consistency with European route network, flexible transfer of ATC[[11]](#footnote-11) responsibilities, optimization of flight information region and consistency with EU-wide performance targets. Ultimate aim of functional airspace blocks is achieving the required capacity and overall efficiency of air traffic management network with satisfactory safety level .

***FAB CE PERFORMANCE***

Consistency with EU-wide performance targets is one of the fundamental features of FABs. During the first reference period, performance targets are set at EU and national level, but not functional airspace block level which will be determined for second reference period.

According to regulation 691/2010, every EU member state had to develop its own performance scheme containing national performance targets consistent with the EU-wide. As far as FAB CE, five EU members (Austria, Czech Republic, Slovenia, Slovak Republic and Hungary) submitted their national performance scheme to the European Commission. Croatia did not since it entered the EU in 2013 but will for the second reference period. Bosnia and Herzegovina is a potential EU candidate.

EU-wide efficiency targets for first reference period are set within key performance areas environment, capacity and cost efficiency while for KPA[[12]](#footnote-12) safety only KPI[[13]](#footnote-13)s are being observed.

As far as EU-wide ANS[[14]](#footnote-14) performance altogether during the first year of the reference period, targets were almost reached. Argument lies mainly in air traffic decrease by -2.7% compared to 2011. Traffic decrease conveniently affected all key performance areas. For instance, there were no fatal accidents in 2012 caused by air navigation service providing. Enhancement of en-route flight efficiency was slowed down. However, in 2012 the route extension was 5.15% of the great circle distance and in 2013 even 5.11% (due to local free route airspace initiatives). Costs were reduced as well as delay which was 0.63 minutes per flight .

Since performance targets were not set for functional airspace block Central Europe for the first reference period, further analysis will be based on national performance targets of FAB CE member states to determine their position and contribution to EU-wide performance.

***KEY PERFORMANCE AREA SAFETY***

Key performance areas are safety, environment, capacity and cost efficiency.

Safety is the primary objective of air navigation service providing since it represents the condition in which the risk of danger for people or objects is reduced and maintained at or below an acceptable level, through continuous process of detecting hazards and risk management . In this KPA, following key performance indicators are identified:

* effectiveness of safety management,
* RAT[[15]](#footnote-15) method application for measuring the severity of events that lead to safety breaches,
* the level of voluntary error reporting, i.e. just culture.

Safety management effectiveness refers to implementation level of safety management system, a systematic approach to managing safety and state safety programme. Safety management system includes responsibilities, safety planning, measuring and monitoring safety performance, questionnaires, reporting and investigating accidents, continuous safety improvement – all for the ultimate aim of maintaining an acceptable safety level. It should identify potential hazards, ensure the implementation of corrective measures as well as continuous safety monitoring and safety management improvement. Implementation level is examined through questionnaires (where certain implementation degree is expressed by letter A to E) or equation:

|  |  |  |
| --- | --- | --- |
|  | $$S\_{j}= \frac{100 \sum\_{k=1}^{n\_{j}}r\_{k\_{j } ∙ W\_{k\_{j}} }}{4 \sum\_{k=1}^{n\_{j}}w\_{k\_{j}}}$$ | (1), |

where the final estimate can be expressed in two ways:

* by percentage 0 (0%) to 4 (100%) showing the position of a subject in the interval, or
* by number 0 to 4 as a result of aforementioned equation .

The risk analysis tool method is used for coherent reporting relating estimates on severity of events which lead to safety violation. Method can furthermore be decomposed to three performance sub indicators that will be even more developed during the second reference period up to 2019:

* separation minima infringement,
* runway incursion, and
* ATM specific technical events .

As a last safety KPI there is the just culture implementation level, measured through questionnaires determined in accordance with EUROCONTROLs’ regulation. Just culture is defined as an atmosphere of trust and refers to voluntary reporting of mistakes that led to risk but without punishing the responsible person. It is necessary to draw a clear line between acceptable and unacceptable behavior since there are four types of unsafe human behavior: human error, negligent conduct, reckless conduct and intentional violations.

Determining the difference between detrimental actions requiring discipline and those for which discipline is not required is a difficult task. In intentional lead to risk are included reckless conduct and intentional (willful) violation while in accidental human error and negligent conduct. Although there is a thin line within this division, thorough examination of each event that led to risk is required – from intent (behavior), act (caused by intention) to consequences. Human error in every system is inevitable thus constant monitoring, studying and, if necessary, mitigating the consequences is needed. Just culture implementation brings many advantages manifested in increased number of accident reports, creating the circle of trust and enhanced safety system .

This key performance indicator as the two aforesaid is being observed during the first reference period and will be completely developed for the second reference period.

Although targets in this key area were not set, every member state is obligated to monitor key performance indicators at state and ANSP level.

Safety management effectiveness concerns the states’ or ANSP ability to manage the State Safety Programme or Safety Management System. Figure 4 is showing the implementation level of safety management system. Given result is a product of questionnaires intended to examine SMS[[16]](#footnote-16) implementation throughout five levels showing the utmost position in interval from 0 to 100. For an insight in the EU-wide situation and comparison, 29 states were taken into account during the analysis. Concerning the state level, safety management effectiveness varies from 29 to 85 which is the average of all areas examined.

FAB CE member states are somewhere in between or at the beginning of the interval and belong to group of states which meet the posterior problems: inadequate safety performance of service provider, risk management, lack of adequate management of the internal interfaces within the NSA, etc.

As far as the ANSP level, results are satisfactory where Hungary is prominent with 84% of EoSM achieved. Same is followed by Austria and Czech Republic with 81%, Slovenia with 72% and finally Slovakia with 70% efficiency achieved. Safety management system of air navigation service providers consists of four closely affiliated components towards which safety management effectiveness is thoroughly examined. These are safety policy and objectives, safety risk management, safety assurance and safety promotion but only with key enabler safety culture represent the criteria for analysis.

According to Performance Review Body, critical areas for full SMS implementation are definition of ANSPs’ safety policy, establishing means for safety performance and risk management verification and means for safety promotion while the strongest areas are SMS documentation development, safety assurance, accident/incident reporting, safety training programme and establishment as well as safety culture promotion .



Figure 4. Effectiveness of safety management by states and ANSPs

All EU member states need to submit a report on severity of events that led to risk, i.e. separation minima infringements, runway incursion and ATM specific technical events. In 2012, most of the member states have reported the usage of RAT method through safety AST[[17]](#footnote-17) reporting system .

The results of FAB CE states differ. For example, Czech Republic and Hungary have zero reported separation minima infringements which can have dual meaning – SMI really did not happen or that mentioned occurrence was not been reported. Austria resulted with the highest number of SMI[[18]](#footnote-18) reported (38).

There were only a few runway incursions for every mentioned state. Austria with 28, Czech Republic with 14, Hungary with 1, Slovakia with 2 and Slovenia with 2 reported RI.

ATM specific technical events refer to disabled and jeopardized air traffic management due to failure of navigation, communication and surveillance systems. Hungary and Slovakia reported the highest number of ATM specific technical events with 100% severity assessed with risk analysis tools. Hungary with 302 and Slovakia with 225 reported events. Other states had negligible number of ATM specific technical events except maybe Austria with 64 recorded events (Figure 5).



Figure 5. Application of the severity classification of the RAT

The last key performance indicator monitored in KPA safety is implementation level of just culture. Given result is an outcome of three relevant areas examined: policy and implementation, jurisdiction and occurrence reporting and investigation. It is evident that Austria has achieved the best level of implementation with the highest number of “YES” answers although there is space for further upgrade. Slovakia and Slovenia follow the Austrian example. Czech Republic and Hungary have not achieved the expected with the most of “NO” answers – Czech Republic resulted with 11 and Hungary with 14 negative answers (Figure 6).



Figure 6. Just Culture implementation level

***KEY PERFORMANCE AREA ENVIRONMENT***

Performance in this area is measured on the basis of the average en-route flight efficiency consisted of horizontal (distance) and vertical (height) component. Greater importance is given the horizontal flight component as it is of more economic and ecological importance than the vertical one. Key performance indicator of horizontal flight is a route extension. Route extension is defined as the difference between the actual length of trajectory and great circle distance, not including the 40 NM[[19]](#footnote-19) of about outgoing and ingoing airport (Figure 7).

G

A

D

Figure 7. Route extension

Source: Performance Review Commission: Performance Review Report 2011, EUROCONTROL, Brussels, 2012.

Extension could be decomposed to:

* direct extension which represents the difference between actual and direct route, and
* final border areas that represents the difference between the distance of direct route and great circle.

When calculating the route extensions, following flights are taken into account:

* all commercial IFR[[20]](#footnote-20) flights within the European airspace,
* flights with take-off and landing outside the European airspace but only the European flight component is taken into account .

Deviations from the optimal trajectory cause additional flight duration, fuel combustion and emissions with concomitant impact on the environment and increase in costs for airspace users. Various factors can impact the flight efficiency, such as structure and route availability, airspace availability (civil/military structures), the ability of flight planning, priorities of users (flight time, fuel), air traffic control, natural disaster, etc.

The main objective by the end of 2014 to increase flight efficiency is reduction of difference between planned flight route and great circle by 0.75%. Reference year given for comparison is the 2009 when the average route extension amounted 5.42%. In order to meet all requirements, route reduction to 4.67% is planned to be achieved until the end of the reference period (Figure 8).



Figure 8. Horizontal en route flight efficiency

Following activities are undertaken for increasing the overall efficiency:

* annual improvement of ATS[[21]](#footnote-21) route network with priority given to implementation of a comprehensive annual improvement package and shorter routes,
* implementation of additional conditional routes on main traffic flows,
* increasing the airspace usability and route network availability through active support and involvement of aircraft operators and service providers
* gradually applying constraints relating route accessibility only when and where needed,
* effective design and use of terminal maneuvering areas through implementation of advanced navigation and continuous descent operations .

Determined objective is set only for European level and is not meant to be broken down at FAB level for the first reference period. Despite this fact, due to boundless characteristic of functional airspace blocks and operational requirements, airspace design of functional airspace block Central Europe will contribute to enhanced traffic flow therefore the better flight efficiency. It is estimated that 4 million kilometers will be saved by the end of the 2015 with the implementation of FRA[[22]](#footnote-22) concept. Free route airspace signifies free flight planning between an entry and exit point of a route regardless ATS route network of specific airspace where all flights are subjected to air traffic control. Enhancing the flight efficiency, consequently the $CO\_{2}$ emissions will be reduced. Specifically for FAB CE, by the end of 2015 these emissions will be reduced for 44 260 tons.

***KEY PERFORMANCE AREA CAPACITY***

The air traffic demand increase prerequisites an airport and airspace capacity multiplication, but often due to unsatisfactory capacity major delay occur. Delays may originate by combination and interference of a number of factors:

* weather conditions (affect the aircraft movement),
* airport (where the maximum demand or peak load occur due to the airlines’ effort to meet the requirements of all market segments),
* air traffic control (rerouting the aircraft, lack of trained personnel),
* airspace disturbances (the impact of volcanic ash, implementation of restricted areas, strikes, social tensions).

Transport systems’ feature is time dependence which means that the action of each element depends on the activity of the former and has an impact on the next. Delay consequently entails consequences that have negative effect on the overall efficiency.

Key performance indicator in this KPA is en-route ATFM[[23]](#footnote-23) delay per flight, calculated by Central air traffic flow management unit and includes all IFR flights. The main objective according to performance scheme in this KPA by 2014 is reduction of annual average delays to 0.5 min .

To minimize delay at network level certain activities must be done. Collaborative decision making is seen as an effective measure for reducing delay and increasing the predictability of events during the flight, especially focusing on the aircraft turn-around and pre departure sequencing process enabling the ATM network to run more fluently. It is estimated that with CDM[[24]](#footnote-24) usage anticipated delay could be reduced by at least 25%. Overall delay can also be reduced with “weekend delay reduction” referring to availability of conditional routes for flight planning and diminishing military operations as well as temporary segregated areas. Another method for minimizing the delay effects is reduction of penalties for individual flights. Increased traffic and application of regulations for flow and capacity management lead to delay and slot changes for most flights. EUROCONTROL seeks to manage these regulations, ensure that individual carriers do not suffer disproportionate penalties and that available capacity is exploited to its maximum. The objectives related to aforementioned problems set by EUROCONTROL are:

* reduction of route delay greater than 15 minutes from 0.87% (in 2011.) to 0.75%,
* reduction the percentage of flights affected by delay greater than 30 minutes from 2.6% (in 2011.) to 2.0% .

Capacity objective of 0.5 min per flight set at EU level is mandatory which means that it has to be adopted and respected by all states and functional airspace blocks. Figure 9 is showing delay targets of FAB CE for the first reference period. Targets are set for all reference years. Final values are product of individual delay per flight of each state with the expected traffic of the same divided by the expected traffic at EU level . According to the document “FAB CE Europe Information on aggregated performance targets” delay targets for the first reference period (average delay) are:

* 0.47 minutes per flight for 2012,
* 0.44 minutes per flight for 2013, and
* 0.15 minutes per flight for 2014 (Figure 9).

Target of 0.15 minutes per flight at FAB CE level is within the EU target frame and thus will adequately contribute to the overall efficiency enhancement of European air traffic.



Figure 9. Overview of individual delay by states and average, target delay

***KEY PERFORMANCE AREA COST EFFICIENCY***

One of the essential fundaments of the Single European Sky is charging regulation (1794/2006) of air navigation service providing. The regulation aims at fairer charging scheme which will reflect the costs directly or indirectly related to service providing. Scheme should contribute to greater transparency in determination, allocation and enforcement of charging to airspace users. Safety, performance and effective air navigation service providing to users (who finance the system and stimulate integrated service provision) are also the purpose of this scheme. Taking into account air traffic flows, particularly within the FABs, charging scheme should enable optimum use of airspace. Based on regulation 1794/2006, every member state is obliged to establish charging zone under its jurisdiction where air navigation services are provided to airspace users . Charging zone refers to volume of airspace for which single cost base and unit rate are established and is extending from the ground and up to upper airspace.

Users of the European airspace (air carriers) have to pay for provided services during each flight through controlled airspace. Air navigation service providers of the states participating in the route utilization charging scheme that way settle all costs related to air traffic control. Fees are paid for each flight within the airspace belonging to contracting states. The same include flight distance and aircraft weight. Total fee per flight is equal to the sum of all fees incurred in charging zones of individual states:

|  |  |  |
| --- | --- | --- |
|  | $$R= \sum\_{n}^{}r\_{i}$$ | (2) |

Individual fee is equal to the product of distance factor ($d\_{i}$), aircraft weight factor ($p$) and unit rate ($t\_{i}$):

|  |  |  |
| --- | --- | --- |
|  | $r\_{i}$ = $d\_{i} x p x t\_{i}$ | (3), |

whereby product ($d\_{i} x p$) is defined as a number of service unit in charging zone for particular flight.

The third factor of the equation is the unit rate which is a key performance indicator for first reference period. It is determined for each zone and consists of two parts:

* unit rate – obtained by dividing the charging zone cost base during the reference year with the estimated number of service units that will be generated in the airspace same year,
* administrative unit rate – obtained by dividing the costs with the number of service units generated in the charging zone as a whole (all zones under the jurisdiction of EUROCONTROL), .

Key performance indicator for first reference period is the agreed and determined average unit rate for air navigation service providing. The indicator is the result of ratio between determined costs and anticipated traffic, expressed in euros. Annual cost values are determined in advance for whole reference period. The actual unit costs are compared to determined unit rate when measuring performance. Determined unit rate is different from actual price charged to users whereat following has to be taken into account:

* differences between forecasts and actual inflation,
* bonuses and penalties arose from financial incentives capacity efficiency,
* VFR[[25]](#footnote-25) flight cost deduction,
* deduction of income from other resources .

Objective to be achieved by 2014 at EU level is determination of the unit rate at 53.92 euros.

Total costs and determined unit rates by individual states and FAB CE are shown on Figure 10. Determined unit rates are obtained by determined costs of each individual state with the expected service units within the same and then divided by the expected service units at EU level. Cost efficiency targets for the first reference period of FAB CE are as follow:

* 51.11 € for the 2012,
* 50.70 € for the 2013, and
* 48.84 € for the 2014.



Figure 10. Individual costs, service units and UR by states and determined FAB CE UR

**CONCLUSION**

There are number of factors affecting the European air traffic efficiency but the most relevant impact present air navigation service providers. Airspace fragmentation greatly influenced their work and in order to reduce it - idea of functional airspace blocks has been developed. Nine functional airspace blocks have been established but only two of them are fully operational so far.

Functional airspace block Central Europe is still in its implementation phase. Once implemented, it will contribute to efficiency increase through traffic flow enhancement, delay reduction and consequently cost reduction and safety increase. As foreseen by regulation 691/2010 and performance scheme implementation, all national and functional airspace block performance targets have to be consistent with the EU-wide targets to accomplish the anticipated efficiency increase.

Efficiency of air navigation service providers has been monitored since 2012, when the first reference period began. Performance schemes have been developed at national level for the first reference period which is not the case for the second reference period. For second reference period performance schemes will be developed at functional airspace block level. Accordingly, targets will be set at FAB level and states within will have to negotiate in order to harmonize their targets with FAB targets.

During the second reference period, information availability regarding efficiency will be greater. Safety data is not obligatory during the RP1, but will be for RP2 and targets in accordance with key performance indicators will be set. In key performance area capacity, targets will be set at FAB level respectively to EU targets, and reference values shall be provided to the states by Network Manager. Every deviation from the FAB capacity target shall result in financial incentive.

As far as the first reference period and targets specifically related to FAB CE, only targets in key performance areas capacity and cost efficiency have been set given the fact that targets in key area safety will be set for the second reference period and target in key area environment applies only to EU level.

Delay continuously decreases and it is expected it will be reduced to 0.5 min per flight at EU level. Delay targets for functional airspace block Central Europe given on the basis of five states taken into account are 0.47 for 2012, 0.44 minutes for 2013 and finally 0.15 minutes per flight by the end of 2014 [8]. The EU-wide cost efficiency target by the end of the first reference period is determination of unit rate at 53.92 €. Unit rates vary from state to state why it is necessary to adjust them and to adapt the costs in accordance with air traffic increase in order to provide economically viable services. Determined average unit rate for FAB CE by the end of 2014 is 48.84 € [8].

Above mentioned FAB CE targets are within the European frame which means it will successfully contribute to air traffic sustainability and efficiency increase. Specific targets in all key performance areas for functional airspace block Central Europe will be set for second reference period.

General estimate of the current performance scheme implementation level and given targets for the first reference period is conditional – on the one hand, five states are on realization threshold of the given targets but on the other hand, there is lack of data for Croatia as well as Bosnia and Herzegovina. The reason for data absence is that Croatia has just become an EU member (in 2013) while Bosnia and Herzegovina is a potential candidate. As another reason for data deficiency is considered to be the administrative capacity shortage of national supervisory authorities.

**REFERENCES**

1. IATA: A Blueprint for the Single European Sky, IATA, 2013.
2. Mihetec, T.: Performance scheme RP1 evolution process, CCAA, Zagreb, 2013.
3. SKYBRARY: Performance Plans, 2012.

<http://www.skybrary.aero/index.php/Regulation_691/2010_Performance_Scheme_for_Air_Navigation_Services_and_Network_Functions_in_Europe>, 2012.

1. PERFORMANCE REVIEW BODY: Union Wide Targets for the 2nd Reference Period of the Single European Sky Performance Scheme, EUROCONTROL, Brussels, 2013.
2. SKYBRARY: Functional Airspace Blocks, 2011.

[http://www.skybrary.aero/index.php/Functional\_Airspace\_Block\_(FAB)](http://www.skybrary.aero/index.php/Functional_Airspace_Block_%28FAB%29), 2011.

1. EUROCONTROL, FAA: U.S./Europe Comparison of ATM-Related Operational Performance, 2012.
2. FAB CE Legal Committee: FAB Central Europe Information pursuant to Commission Regulation (EU) 176/2011, 2012.
3. FAB CE NSA CC: FAB Central Europe Information on the aggregated performance targets in accordance with Article 5(3) of Regulation (EU) No 691/2010, 2012.
4. COMMISSION REGULATION (EC) No 550/2004: Provision of Air Navigation Service in the Single European Sky, 2004.
5. PERFORMANCE REVIEW BODY: PRB Annual monitoring Report 2012, Volume 1, European overview and PRB recommendations, EUROCONTROL, 2013.
6. ICAO Doc 9859 Safety Management Manual (SMM), Second Edition - 2009.
7. Steiner, S., Mihetec, T., Modić, A.: Performance Based Air Navigation Services, International Conference on Air Transport INAIR 2013, Bratislava, 2013.
8. Safety Regulation Commission: Annual Safety Report, 2011.
9. GAIN Working Group E: A Roadmap to a Just Culture: Enhancing the Safety Environment, EUROCONTROL, Brussels, 2004.
10. PERFORMANCE REVIEW BODY: PRB Annual Report 2012, Volume 4, Safety, EUROCONTROL, Brussels, 2013.
11. Performance Review Commission: Performance Review Report 2011, EUROCONTROL, Brussels, 2012.
12. Network Management Board: NM Performance Plan (NMPP), EUROCONTROL, Brussels, 2011.
13. Network Manager: European Network Operations Plan 2012 – 2014, EUROCONTROL, Brussels, 2012.
14. COMMISSION REGULATION (EC) No 1794/2006: Common Charging Scheme for Air Navigation Services, 2006.
15. EUROCONTROL: Establishing Route Charges, 2013.

<http://www.eurocontrol.int/articles/establishing-route-charges>, 2013.

1. PERFORMANCE REVIEW UNIT: Determined Unit Rate, 2013.

<http://prudata.webfactional.com/wiki/index.php/Determined_Unit_Rate_for_en_route_Air_Navigation_Services>, 2013.

1. ANSP – Air Navigation Service Providers [↑](#footnote-ref-1)
2. SES – Single European Sky [↑](#footnote-ref-2)
3. ATM – Air Traffic Management [↑](#footnote-ref-3)
4. EATMN – European Air Traffic Management Network [↑](#footnote-ref-4)
5. FAB – Functional Airspace Block [↑](#footnote-ref-5)
6. EU – European Union [↑](#footnote-ref-6)
7. RP – Reference Period [↑](#footnote-ref-7)
8. NSA – National Supervisory Authority [↑](#footnote-ref-8)
9. PRB – Performance Review Body [↑](#footnote-ref-9)
10. EoSM – Effectivennes of Safety Management [↑](#footnote-ref-10)
11. ATC – Air Traffic Control [↑](#footnote-ref-11)
12. KPA – Key Performance Area [↑](#footnote-ref-12)
13. KPI – Key Performance Indicator [↑](#footnote-ref-13)
14. ANS – Air Navigation Services [↑](#footnote-ref-14)
15. RAT – Risk Analysis Tool [↑](#footnote-ref-15)
16. SMS – Safety Management System [↑](#footnote-ref-16)
17. AST – Annual Summary Template [↑](#footnote-ref-17)
18. SMI – Separation Minima Infringements [↑](#footnote-ref-18)
19. NM – Nautical Mile [↑](#footnote-ref-19)
20. IFR – Instrument Flight Rules [↑](#footnote-ref-20)
21. ATS – Air Traffic Services [↑](#footnote-ref-21)
22. FRA – Free Route Airspace [↑](#footnote-ref-22)
23. ATFM – Air Traffic Flow Management [↑](#footnote-ref-23)
24. CDM – Collaborative Decision Making [↑](#footnote-ref-24)
25. VFR – Visual Flight Rules [↑](#footnote-ref-25)