Single European Sky – the transformation of the aviation industry based on the dynamic capabilities

Natalia HARTMAN*[,1], Mircea BOSCOIANU[2]

*Corresponding author
*[,1]National Defence University of Warsaw
00-910 Warszawa, al. Gen. A. Chruściela 103, Poland
natalka.hartman@gmail.com
[2]Romanian Air Force Academy
Str. Mihai Viteazul 160, Brasov 500187, Romania
boscoianu.mircea@yahoo.com

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Abstract**:** *Each year the demand of aviation services is increasing but the European airspace is still fragmented according to national borders. Delays of implementing Single European Sky are increasingly high. Consequently, each year the aviation industry loses a lot of money, among others, because of flight route extensions or higher fuel consumption. A comparison between Air Traffic Management-Related Operational Performance U.S./Europe shows how inefficient ATM is in Europe and how costly for the airspace users. This study also describes the benefits and costs of the SES full implementation.*

Key Words: *Single European Sky (SES), implementation, dynamic capabilities, aviation industry, air traffic management system, transformation*

1. INTRODUCTION

Air transport is considered to be the most modern and most dynamically developing branch of transport; therefore it plays a significant role in the economy and society of the European Union. An increasing interest concerning this type of transport may be noted as faster and safer aircraft wins the competition with other means of transport.

The aviation market analysts estimate that the average global growth will amount to 3.2%, which generates an increase in passenger transport of about 5%. (4.7% Airbus, Boeing, 5%). The air transport increasing of around a few percent per year will result in tripling of the air traffic in a decade. In Europe, the air traffic management system is fragmented and dominated by national entities having a monopoly on the provision of services in the aviation industry.

Improper operation of the air traffic management system and the lack of viable systemic solutions contributed to the increase of financial problems in the air transport sector. The interest in reducing the unnecessary costs was one of the direct causes of adoption of the single European sky. Implementing a new, consistent legislation was designed to facilitate the creation of a common air policy and also to create conditions for the smooth and sustainable development of the air transport sector.

Nevertheless, the Single European Sky program (SES) turned out to be one of the most ambitious plans for the European Union in the field of transport, maybe even too ambitious. There is discussion among the representatives of the aviation industry if the implementation

of the SES is still possible, needed and profitable. Athar Husai Khan, acting Secretary General of Association of European Airlines (AEA), believes that, for the moment at least, there is more hope than expectation that the Single European Sky will deliver on its performance targets.

The European Commission has long admitted experiencing problems with the pace of its Single Sky initiative, especially in consolidating the traffic management. There are many opinions of representatives from the aviation industry regarding the implementation of the Single European Sky but the interest will be always focused on long term efficiency, dynamic capabilities and transformation.

2. THE PATH DEPENDENCY OF SINGLE EUROPEAN SKY

The Single European Sky (SES) is a European Commission initiative designed to remove boundaries in the air. The SES main goal is to reform the architecture of the European air traffic control to meet future capacity and safety needs.

This will be achieved by improving the overall performance of Air Traffic Management (ATM) and Air Navigation Service (ANS) in Europe, with the aim to:

- Triple airspace capacity – this will reduce delays,
- A tenfold increase in security,
- Reduce environmental impact by 10%,
- Reduce the cost of ATM service to the airspace users by 50%.

SES consists of two major packages of legislation, SES-I (2004) and SES-II (2009), as well as a lot of supplementary implementing rules.

In October 2001 the European Commission adopted proposals for a Single European Sky, but the approval of Single European Sky first legislative package (SES-I) by the European Parliament and the Council happened in March 2004. SES-I consist of 4 Regulations of the European Parliament and the Council:

- No 549/2004: Framework – laying down the framework for the creation of the Single European Sky;
- No 550/2004: Service Provision – on the provision of air navigation services for the Single European Sky (It established inter alia: general minimum standards for carrying out air navigation services, a common system of certification for air navigation service providers and principles for imposing air navigation fees on airspace users);
- No 551/2004: Airspace – on the organization and use of the airspace in the Single European Sky (Airspace fragmentation - Functional Airspace Blocks (FABs) should not be based on national boundaries but on the optimization of the traffic flow),
- No 552/2004: Interoperability – on the interoperability of the European Air Traffic Management network.

The main aim of the first legislative project was:

- Improving standards of safety and efficiency of air transport in Europe,
- Reducing air traffic delays by increasing airspace capacity,
- Improving the air navigation services and minimizing the cost of their provision by reducing the fragmentation of the ATM in Europe,
- Incorporation of military systems CNS to the European ATM system,
- Meeting the requirements of all airspace users.

In spite of some success, the first package did not create the expected level of required changes to significantly improve the performance of the ATM in Europe. Therefore, in June 2008 the revision of the SES regulations was adopted under the name of Single European Sky second package (SES-II). In March 2009 EUROCONTROL endorsed the second Single European Sky package by EU Transport Ministers, following its adoption by the European Parliament. The legal footing was Regulation (EC) No 1070/2009 which amended Regulations (EC) No 549/2004, (EC) No 550/2004, (EC) No 551/2004 and (EC) No 552/2004 and it refers to further improve the efficiency of air traffic management system in Europe. The main aim of this package was:

- Ensuring the effectiveness of air navigation services and implementing the Network Manager (Eurocontrol),
- Establishing a single legal framework in order to facilitate the development of a harmonized safety regulations and their effective implementation force (EASA → EAA),
- Implementing new technologies to facilitate the use of new operational concepts, and increase the safety of flights,
- Improving the management of the airport capacity.

The overriding objective of SES-II is to increase the economic, financial and environmental performance of the provisions of the Air Navigation Services in Europe. Implemented amendments are based on four pillars:

- The Performance Scheme,
- The Functional Airspace Blocks,
- The Network Manager,
- The Charging Regulation.

Air traffic management (ATM) in the European Union is still organized in a fragmented way. The current organization of the 67 airspace blocks is based on national boundaries. This fragmentation could impact on safety, it limits capacity, and increases costs.

The Functional Airspace Blocks are airspace blocks based on operational requirements and established regardless of State boundaries. They aim to enhance the cooperation between the air navigation service providers (ANSPs) and the national supervisory authorities (NSAs). They can reach these objectives by de-fragmenting the airspace and thus increasing operational efficiency gains through such strategies as common procurement, training and optimization of air traffic controllers (ATCs) resources.

In the first legislative package (SES-I) the FAB concept was developed and defined as a way to reduce of airspace fragmentation. Instead, the second legislative package (SES-II) defined the creation of FABs in terms of service provision, in addition to the airspace organization issues.

The first implementation stage of the FAB ended on 4 December 2012 with the entry into force of nine FAB initiatives. Two of nine adopted have already been implemented, namely the UK-Ireland and Denmark-Sweden FABs:

- NEFAB (North European FAB): Estonia, Finland, Latvia, Norway,
- Denmark-Sweden: Denmark, Sweden,
- BALTIC FAB Poland, Lithuania,
- FABEC (FAB Europe Central): France, Germany, Belgium, Netherlands, Luxembourg, and Switzerland,
- FABCE (FAB Central Europe): Czech Republic, Slovak Republic, Austria, Hungary, Croatia, Slovenia, Bosnia and Herzegovina,

- DANUBE Bulgaria, Romania,
- BLUE MED Italy, Malta, Greece, Cyprus, (and Egypt, Tunisia, Albania, Jordan as observers),
- UK- IRELAND FAB United Kingdom, Ireland,
- SW FAB (South West FAB) Portugal, Spain.

Technological pillar of the Single European Sky is represented by the SESAR program (Single European Sky ATM Research). The aim of this program is to develop a modern air traffic management system capable to support the continuous growing volume of air operations. At the same time it should improving safety indicators and reducing costs. The use of modern technologies and procedures will also help to reduce the negative impact of aviation to the environment. The implementation of the SESAR program is divided into three parts:

- SESAR Definition Phase - implemented in the years 2005-2008,
- SESAR Development Phase - implemented in the years 2008-2013,
- SESAR Deployment Phase - planned for the years 2014-2020.

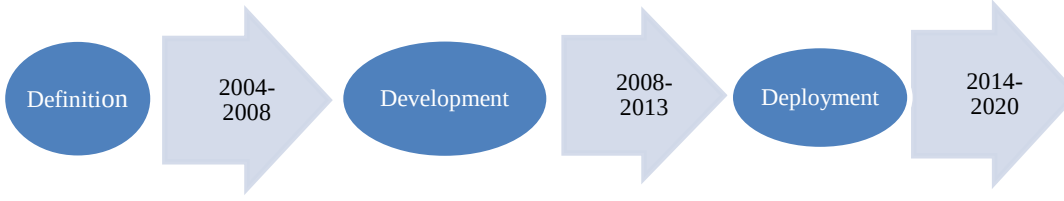

Fig. 1 A three phase project

3. ORGANIZATIONAL STRATEGY – THE ELEMENTS OF TRANSFORMATION

The current approach has not speeded up the evolution of the SES and the inefficiencies of the European Air Traffic Management (ATM) system are still generating more than €5 billion of direct additional costs and 8.1 million tones of additional CO2 emission every year. It results that the current ATM structure and performance is a serious threat to on-going development and stability of the European air transport sector.

Inappropriately addressed this will also negatively impact the European competitiveness, economic growth and job creation. Since the late 1990s, the introduction of two packages of EU rules, have so far failed to see SES fully implemented. It's one of the reason why in February 2013, airspace users (represented by IATA, the Association of European Airlines, and the European Regions Airline Association) published a Blueprint for a Single European Sky. A new package of EC proposals aims to reinvigorate the project, allowing for better safety oversight, strengthened performance monitoring, opening to competition of air traffic management support services and a more flexible approach to the Functional Airspace Blocks (FABs). European air traffic management is being freed too slowly due to the constraints at national competences level. Year over year, this brings losses in billions of euros and millions of tons of avoidable carbon emissions.

Yet implementation continues to drag on and member states have fallen far behind the targets, they set them for themselves. Problems with the SES implementation have an undertow in many areas, related inter alia to economy. A negative impact on the delay in the

SES implementation was due to the recent global economic crisis and the fragile path of recovery. It seems to be obvious, that the creation of Functional Airspace Blocks and also the adoption of the SESAR program impacted the financial performance, based on a better focus on cooperation between both developed and developing countries.

At the 4th EAirTRF were presented two different concepts for a common infrastructure approach: the Virtual Centers and the Centralized Services. Both concepts are focused on data management necessary to offer air navigation service and reducing the costs of air navigation services by centralizing part of the infrastructure. Virtual Centers seem to be more focused on the core of the operations albeit the Centralized Serviced deals with the service providers.

There were a lot of opinions regarding the efficiency of mixing these complementary approaches, but the focus should not be on technology but on services.

Primarily because the focus on technology will contribute to the lack of reconfiguration and transformation of actual situation hence the same old problems remain. In this case it is a critical need to continue the commitment to find the right solutions for SES. Despite this, it is still only prolonging the debate on this issue, and not putting it into effect.

4. A COMPARATIVE ANALYSIS OF THE AIR TRAFFIC MANAGEMENT-THE OPERATIONAL PERFORMANCE IN U.S. vs. EUROPE

Unfortunately, if we consider the terms of cost efficiency and also the quality of the service provider to flight, the European Union air traffic management system still stands behind its peers. European ATM has 51% lower performance and 95% higher costs than USA ATM.

Number of controlled flights per air traffic controller in USA is 2 times higher than in EU and the ATM cost per flight hour is 2 times lower than in EU. Even if the total surface of continental airspace is similar for Europe and the US, the US controls around 59% more flights operating under instrumental flight rules with less Air Traffic Controllers and fewer facilities.

The organization of the ATM system is one of the most visible differences. EU consist of 37 ANSPs and 63 Area Control Centres (ACC), in contrast, the US has only one ANSP and 20 Air Route Traffic Control Centres (ARTCC).

Europe has 260 Approach control units (APPs) as compared to US that have 162 Terminal Radar Approach Control Facilities (TRACONs) and Combined Facilities servicing a number of airports.

Also the number of total staff is really high in Europe, it is 38% higher than in USA. In Europe ATM is still mostly organized according to national boundaries which is reflected by the considerably higher number of en-route centers than in the US and a diversity of flight data processing systems. In Europe the ATM system is still organized according to the national boundaries with negative impact expressed by a bigger number of end-route centers than in the US and a variety of flight data processing systems. In Europe, the number of restricted and segregated areas is also higher and more scattered than in US with impact on flight inefficiencies.

The core idea of the SES is to shift the design of air traffic management from national level to the EU level. Nevertheless we have to answer some questions such as: is it possible to implement an ATM system in Europe that would be identical to that existing in the US? Will it be useful and effective? And how expensive it will be?

5. THE BASIC ELEMENTS FOR A STRATEGIC COST- BENEFIT ANALYSIS

There is an opinion that ATC fragmentation is some kind of "luxury" which costs money, time, and nature, but what are the benefits and what are the costs for SES implementation for airline industry?

In the Blueprint for a Single European Sky the main benefit of full implementation of Single European Sky specified in following areas:

1. Traffic – 20 million flights per year.
2. Punctuality – aircraft will arrive within 1 min of the planned arrival time.
3. Flight Duration – Travel has been reduced 10 min of the planned arrival time.
4. Cost Efficiency – inefficiency cost reduced by 3 billion Euros per annum.
5. Environment – CO2 saving – corresponding to 18 million tons of CO2 saving per annum.

All those benefits have effect for airline industry, but we should define it more precisely. I would venture to say that for the airlines the greatest benefit will be saving money. It can be achieve, inter alia, by flying in straight lines.

Airlines cannot usually operate their aircraft on the most direct route between origin and destination. For example direct connection between Paris and Munich takes up 680 km but actually the flown distance due to ATC restrictions takes up 910 km.

It has shown how inefficient the airspace fragmentation (national airspace and ATC system, service providers) can be; it makes for additional cost, higher fuel consumption and emissions of CO2. On average, European routes are longer about 5, 5% due to the ATC system.

On the other hand, the unit costs of air navigation services are on a downward trend. In real terms, the unit cost of air navigation services (ANS) in Europe fell by 5% in 2011, also the ANS costs fell by 0.4% but the number of service units grew by 4.9%. Between 2004 and 2011 the air navigation unit costs for end route services decreased by 15%, mainly due to the increase in traffic.

In the same period of time the service units have increased by more than 30%.The decrease in unit costs is welcome news for airlines, but the total cost to airspace users of air navigation needs to include the cost of inefficiencies in the system.

The report of the Performance Review Body (2011) shows that the inefficiencies of the air navigation services were still generating more than € 5 billion per annum of extra cost for the airspace users:

- En route delays (€900 million),
- Route extensions (€1930 million),
- Airports delays (€550 million),
- Arrivals holding and sequencing (€950 million),
- Taxi out (€850 million).

In addition, the cost of air navigation services provision is more than €8 billion per annum (end route and terminal air navigation services). This means that the total cost of air navigation services provision in 2011, including current system inefficiencies was €13 billion per annum.

The full implementation of single European sky should minimize the delays to 1 minute, thus the airline will be able to save money and also enhance their image. The aviation industry will be more competitive.

In 2012 the situation wasn't much better because of the total cost of the delay and additional time loss for airspace users and consumers which was estimated at EUR 11.2 billion. One additional implementation benefit of the SES for airlines will be also the payload increase.

Because of the elongation route of flight and delays, the aircraft have to take on board more fuel which leads to a higher price but also influences the disposable load.

The new generation of systems will facilitate the efficient routes and flight profiles that result in 300kg of fuel savings per flight; €6 billion of fuel cost savings and 18 million tones of CO2 emissions savings per annum.

Those new sophisticated tools necessitate to be modified or changed for a newer avionics and also require an upgrade of skills for the crew, which creates new costs. To imagine how high it may be those cost, a good example can be the cost of initial airplane-specific training typically range from €5 000 to €8 000.

It is worth to draw attention to crew cost reduction, if airlines will be flying in straight lines, the flight time will be shorter. This is relevant to the calculation of salary, except for basic salary, cabin crew gets extra pay for each hour spent in air, for example in NasAir it is:

- 7.60 €/ h in the range between 1-50h,
- 9.50 €/ h in the range between 51-75h,
- 14.30 €/ h in the range between 76-100h.

In spite of many benefits that can be obtained after the implementation of the Single European Sky, the airline should invest in an intelligent way.

I have already mentioned that airlines will be forced to made replacements with new avionics or to made avionics updates. It is strictly related to a grounded aircraft for the duration of the necessary modifications. The consequence of such an action is less airline efficiency, the need to appeal or to replace some of the connections and the really huge costs (20-150 thousand dollars).

The following graph provides a summary the costs and benefits for the airline resulting from the implementation of the SES. It has been prepared in 2011, but is still hold good.

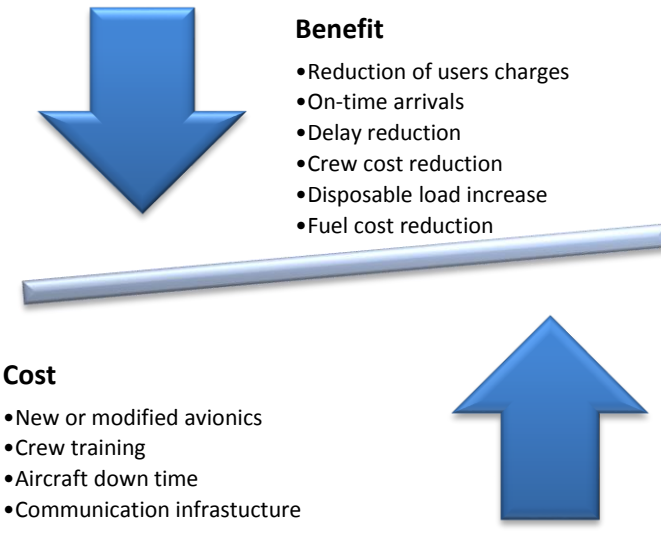

Fig. 2 Comparison of cost and benefits for airline industry of full implementation of single European sky

6. STRATEGIC CAPABILITIES AND THE DYNAMIC OF TRANSFORMATION

With respect to actual situation, European Union enforces and also modifies a lot of new regulations, like next package SES II+. In this section two types of environment analysis are presented which should support the dynamics of SES implementation together with emerging methods for dealing with the resistance to change.

6.1 The SWOT analysis

The SWOT analysis provides information about internal and external environment. Environmental factors internal usually can be classified as strengths (S) or weaknesses (W), and those external can be classified as opportunities (O) or threats (T).

The following diagram shows how a SWOT analysis fits into an environmental scan:

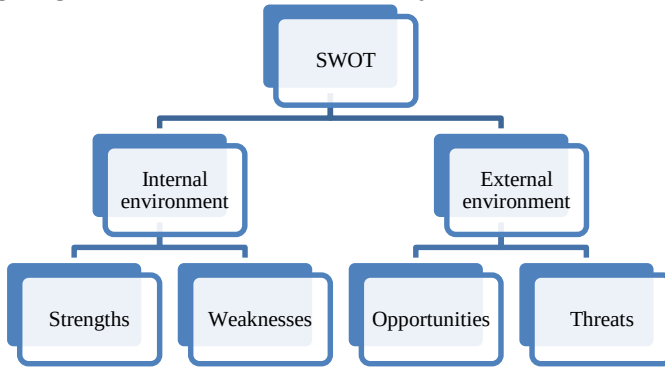

Fig. 3 SWOT environmental analysis

In this case the SWOT analysis will be focused on Single European Sky program, primarily from airline point of view.

Strengths • Updated implementation plan. • Updated legislation connected with program.	**Weakness** • Long implementation term. • High implementation cost • Costs connecting with: new or modified avionics, crew training, aircraft downtime, communication infrastructure.
Opportunities • Triple airspace capacity. • Reduce environmental impact. • Reduction of users' charges. • On-time arrivals. • Delay reduction. • Crew cost reduction. • Disposable load increase. • Fuel cost reduction.	**Threats** • Delays in implementation • Implementation cost increase • Withdrawal from the project • Problem with financing the SES program

The purpose of the SWOT analysis is to identify priorities for the development of the Single European Sky. SWOT analysis shows the strengths and weaknesses and the opportunities and threats for the development of the SES. When reviewing SES program SWOT analyses, each airline will approach the analysis differently. For instance, for one

airline the investment in new technologies will be equivalent to the possibility of development but for other it can be highly expensive. It is easy to notice how many opportunities the Single European Sky program has. It witness about benefits that can be achieved after full implementation of SES program. They are connected with cost efficiency (it is really important for airlines), increase in airspace capacity, in safety and in approach to ecology (it is important for the whole society).

There is a continued interest in implementing the SES as witnessed by strengths factors: updated implementation plan and updated legislation connected with program. Weaknesses are connected with costs, for example costs of new or modified avionics, crew training, aircraft downtime and communication infrastructure.

Instead the threats point that EU still has to work hard and find a way to full and speedy implementation of SES program.

6.2 The PESTLE analysis

The PESTLE analysis describes the external macro-environment in which an organization operates (PEST is the abbreviation for P- Political, E- Economic, S- Social, T- Technological, L- Legal and E- Environment).

There are certain questions that one needs to ask while conducting this analysis, for example:

- What is the political situation of the country and how can it affect the industry?
- What are the prevalent economic factors?
- What is the importance of the culture on the market and what are its determinants?
- What technological innovations are likely to pop up and affect the market structure?
- Is there a legislation governing the industry or any change in legislation for the industry may take place?
- What are the environmental concerns for the industry?

The diagram below shows a developed model of the PESTLE adaptation process:

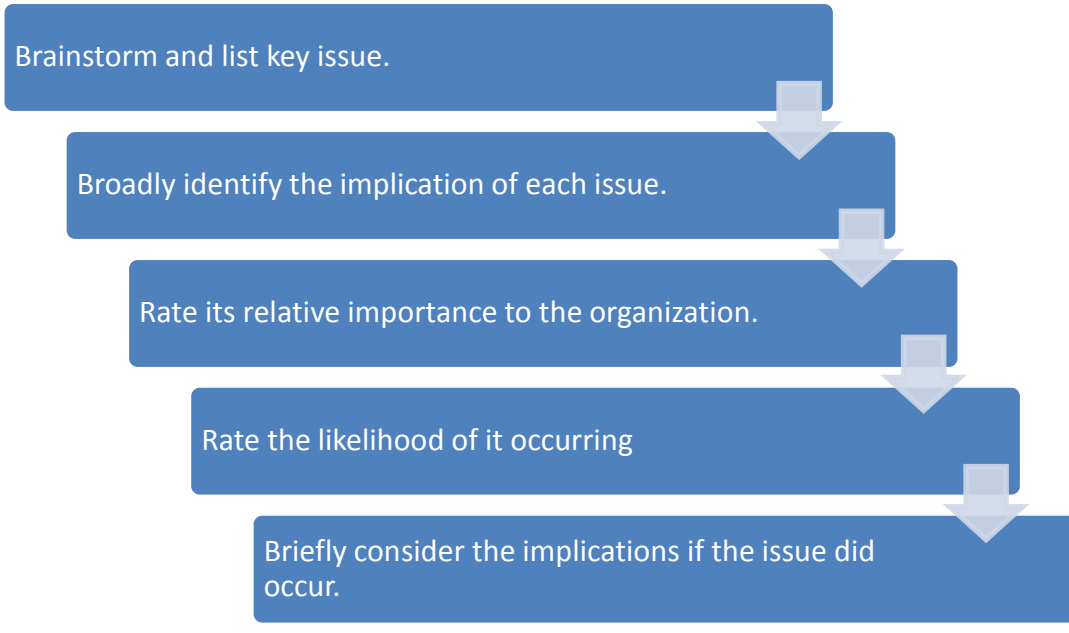

Fig. 4 Developed model of PESTLE adaptation process

POLITICAL FACTORS

- lack of consistent regulation about ATM services,
- decision making by Member States,
- increased number of euro sceptics,
- Member States cooperation,
- Still effective bilateral agreements.

ECONOMIC FACTORS

- A slow recovery after economic crisis and turbulences,
- problem with financing the SES program (high implementation cost),
- impact on the stability of the currency has the economic stability of the Member States.

SOCIAL FACTORS

- positive attitude of airspace users about the implementation of the program
- increased interest in aviation
- increase the level of education in the field of aviation, economics, law, etc. (specialized staff)
- air traffic controllers strikes

TECHNOLOGICAL FACTORS

- high-quality of scientific and research facilities,
- technology that decreases the impact on the environment,
- the slow pace of implementation of new technologies (SESAR, Galileo),
- differences in technological development between Member States,
- man –machine relationship

LEGAL FACTORS

- still effective bilateral agreements,
- a large amount of regulations,
- legislative updates.

ENVIRONMENT FACTORS

- increased importance of ecology and it is essential in this case because it offers a unique opportunities
- trend of reducing CO_2 emissions
- seasonality: the number of flights (holidays, vacation, etc)

In the case of this application, it is hard to define some factors because they are related with all of the Member States.

For example for the political factors there is a problem with still effective bilateral agreements, despite which all of the members have to cooperate under the same conditions. Making positive decisions for all of them it's truly difficult irrespective of agreements signed earlier.

The economic factors express the financing problems of the SES program implementation in the context of a slow recovery after the recent crises and turbulences.

Furthermore, the economic stability of the Member States have impact on the stability of the currency.

Social factors show a positive attitude of airspace users about the implementation of the SES but not all the air traffic controllers agree with its current form.

The technological factors could contribute to the dynamic reconfiguration of this process. Legal factors are connected with political factors, and a synergic strategy is necessary. Because of large amount of regulations the implementation of new ones in the Member States law is problematic. It is hard to be up to date and as the need arises to find the relevant acts.

Regarding the environmental aspects, the technology will support the actual trend of reducing CO2.

6.3 Methods for dealing with resistance to change

In Tab 1 the basic methods for dealing with the resistance to change are presented together with the associated advantages and disadvantages.

The implementation of the SES II+ package could also cope with the problem of resistance to change.

Tab. 1 Methods for dealing with resistance to change

Approach	Education & communication	Participation & involvement	Facilitation & support	Negotiation & agreement	Explicit & implicit coercion
Example situations	EU wants to implement Single European Sky program which was designed to remove boundaries in the air by reforming the architecture of European air traffic control. Air traffic controllers didn't agree with that - they tend to think that it's dangerous and ineffective	EU creates regulations and also has to update them because of changing environment, delays in program implementation, etc.	To create so large and complicated program like SES a lot of people have to work really hard for long time. It's also worth to notice that this kind of job can be monotonous.	EU wants to implement SES program which was designed to remove boundaries in the air by reforming the architecture of European air traffic control. Air traffic controllers didn't agree with that - they tend to think that it's dangerous and ineffective	EU creates regulations which have to be implemented in the Member States law. EU also assigns period of time for implementation, if some of Member States will miss a deadline, it will be penalized.
Solution	EU organizes a lot of meetings and conferences to explain all the aspects of SES program. EU creates a possibility to exchange points of view.	Meetings with members of the European Parliament and the Council	EU organizes a lot of meetings, conferences where experts in SES program can exchange views, experiences and problems. It should help with burnout.	Because air traffic controllers don't agree with current form of SES program, UE and governments of Member States try to negotiate to avoid strikes.	In Poland the institution which is responsible for the implementation of the EU regulations is applying explicit and implicit coercion. For example after each EU control if institutions miss a deadline of implementation, there is a threat that manager can get fired.

Advantages	When you persuade people once, they will often help with implementation of change, they also can try to work? convince ? their colleagues.	People who participated will be committed to implementation; they have knowledge about the change.	No other approach works as well with this kind of problem.	Sometimes it is quite easy way to avoid major resistance.	It is a fast way to solve problems and also can overcome almost any kind of resistance
Disadvantages	Can be very time consuming	Can be very time consuming and inefficient if participants design an appropriate change.	Can be time consuming, expensive and still fail.	It can be too expensive and time consuming	It can be risky especially if it concern people mad at the initiators.

7. CONCLUSION

The European air transport is experiencing a kind of boom after the slow recovery from the recent global crises and turbulences. We estimate a 5- 6% per year rate of development and the aim is to reduce costs and to offer better conditions for customers. At the same time, the air traffic management system in the Europe area is overload and unprepared for the critical tasks associated with the growing interest in this sector. The European Union is taking action to improve the operational capacity of the system in the actual context in which the initiatives are delayed.

The European Union should “deal” with the problem of the Single European Sky as soon as possible. The EU airspace is still divided into several dozen national air traffic control systems. Future investments in aviation infrastructure are critical in the actual context. Despite of all the obstacles in the transformation process toward a coherent system of air traffic management, it is not doubt in the validity of the initiative, because it is a big opportunity to improve the quality of the industry and, consequently, cheaper and faster connections for passengers.

It is worth to notice the reasons of this lower dynamics and the acceleration of the transformation by using the resource based view together with the dynamic capabilities could represent an emerging strategy.

All the actors should understand the advantages of a faster implementation. SES program is sometimes associated with a lower number of air traffic controllers via a better efficiency. On the other hand, it is necessary to cooperate in order to redefine the actual regulatory framework. Airspace users mainly agree that main institutional piece of the Single European Sky are in place, but the whole program is not delivering the expected performance.

The transformation of the Single European Sky program turned out to be one of the most ambitious plans for the European Union in the field of transport. Future work should reconsider the problems of costs reducing in the context of the risk control. In this case we propose to extend the cost benefit analysis or other methods linking costs and benefits like real options analysis which offers a better flexibility and it is not related to the restriction of the irreversibility.

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