

INNOVATIVE SOLUTIONS AT THE AIRPORTS

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Abstract: *In the last couple of years, air traffic is keeping up its growing tendency. Among other factors, this is due to the globalization process, and the wider movement of people who are travelling by air transport. The increase in air traffic flow resulted in airports, which are required and necessary points for the air transport, becoming busier. It has also led to the need to meet the requirement of implementing innovative solutions, aimed to increase major indicators such as security issues, capacity, efficiency, higher passengers flow. Nowadays, all these factors play a key role in the efficient functioning of airports. Fortunately, we may also observe the emergence of new era in industry, which depends and relies more on new technologies and innovative solutions. Many solutions which are directly aimed at improving security, capacity, the speed and safety of the passenger's flow and at the airports' sustainable development are being implemented. The article presents the solutions which have already been implemented, as well as those which may be implemented in order to ensure the higher efficiency of operations, better security indicators, the sustainable development of the airports, as well as the better and more economical air transportation's organization. The main research question was: "Do the implemented innovative solutions help increase airport security, efficiency, capacity and sustainability?"*

Keywords: *aviation, air transport, airports, innovations at the airports, new technologies.*

1. INTRODUCTION

There are many solutions considered innovative, which may be implemented in all branches of people's life. All of them basically rely on the progress made in the areas such as information technology, digitalization, innovations and new, modern technologies. Their implementation has an impact on the faster development of the business sector, which is required by the wide globalization process and huge competition between enterprises. Having the advantage on the market helps, and may conduct to the success of the company. This is also directly connected with the possibility to afford for the new technologies, development and implementation of ready-made tools. In XXI century there is huge competitiveness. Many companies, if they want to survive, are forced to reduce either their productivity or the cost of theirs' production. Although the productivity reduction results in a long-term variable, the costs is reachable and give the short-term variables. That first, depends on the technological environment of the company, their Research & Development and innovation's level, quality of infrastructure, speed of technology-diffusion, advance of innovativeness of the local small-medium size enterprises sector. The impact have also the characteristics such as national business policy, organizational' culture and values, general working ethic, applied management tools and leadership culture, effectiveness of legislative environment and governance, interests' protection activities, general sanitary and health conditions at the workplace, as well as the trust from the society to the certain company.

On the other hand, on the company's competitiveness influences productions' cost which decrease may be achieved by reduction of the labor forces' costs, redistributions' costs (which is directly connected with taxes etc.), capitals' costs (e.g. of the loans), technology-related costs and by reduction of logistics' costs (which basically depends of the distance, transportation system, shipment methods etc. of the goods).

Air transport is the youngest type of transportation. However, it is undoubtedly the most dynamically developing branch. The increase in air traffic flow is keeping since last dozen years (except the crisis in 2009). Thus, as well as the need of adjusting to the modern, many changes on the market and the need of being by the company profitable, caused that aviation sector has to develop, take the actions for continuous improvement and increase quality of it's service. It is known, that only companies which will be flexible enough to adjust themselves to the new challenges and those, which are able to catch up the competitiveness and other companies' developments will be able to be profitable, to cope and survive on the market.

2. SELF CHECK-IN INNOVATIONS

The first and the necessary point for air travels are airports. According to Polish law, airports are defined as public use aerodromes scarified for commercial flights and dedicated to commercial purposes. All the actions directed on the extension, improvement of the passengers' flow and the sustainable development of the airports are taken often nowadays. The goal is primarily put on the development of the airports based on the new, better, more efficient passenger and baggage security systems and on the solutions which help to increase passenger comfort at the airports. These changes are basically the solutions and activities which include and focus on improvements in the optimization and more efficient use of check-in and handling facilities. The implementation of solutions for improving the security management, passport control management, baggage handling are also common. All of them, undoubtedly, are new solutions that are included as the improvements of the industry, and which are considered as the innovative results of the industrial revolution.



FIG. 1. KIOSKS at the airport

There are provided plenty of solutions which may affect the quality of service, as well as the security issues at the airports. The first, already implemented almost at all airports are KIOSKS, called also as Common Use Self Service (CUSS). Those are the facilities for passengers to self check-in. The personal check-in may be conducted by all passengers, without any help of the handling agent hired at the airport.

The purpose of the KIOSKs' implementation is, among the others, the decrease of the number of traditional check-in desks [4]. What is more, their common use increases the usable area of airport's terminals and decrease the number of personnel needed, and hired for ground handling service at the airport. According to research conducted by one American airline, the use of such machines may bring some benefits as well to the airline. As it was presented, they have noticed that their profit after wide implementation of KIOSKs at the airports, where they operate from, had increased. On average, one passenger who is doing check-in by themselves at CUSS, generates 2.50 USD savings. Moreover, according to the same research, check-in with Custom Use Self Service machine by 40% of the passengers worldwide, can annually save 1 billion USD. To the proper functioning of the KIOSKs it is necessary to connect the system with the database which has current information about flights at the certain airport, as well as at the transfer airports. System has to be synchronized with the data of passengers who will be using air transport services in the near future, too. So KIOSKs are innovative, technology advanced solutions.

The success of CUSS caused that the airlines and the airport's management had begun to introduce the devices for self check-in for the passenger's checked luggage. This innovation is limited to the printing tags by the passenger for their own luggage. Although, this system is already used at some European airports, for example in Eindhoven in the Netherlands. Of course, there is provided some support and help of the handling agents in use of the self-check in device for the luggage. This solutions may be somehow a threat for the security aspects, because it increase the possibility of smuggling the forbidden stuffs in the luggage, as well as the thief from, and of, the luggage. On the other hand, so far the success of that solution caused, that some Asian airlines had already started to use and place special KIOSKs for the self- and luggage- check-in even in hotels' lobbies. The progress and development of the society's skills and the high level of their computerization will surely cause that printing own luggage's tags will be possible at passenger's homes, as it is common right now with the boarding passes. The implementation of CUSSs, both for passengers' and luggage check-in, instead of the traditional check-in desks at the airports influence onto limitation of its space and makes a possibility of using the free room more efficient. Unfortunately, the use of KIOSKs is a threat to the people as well, because they are replaced by a machine. Although, there are also many benefits of this solution. Among others, there is already mentioned reduction of space at the airports, huge economical savings, more efficient work of the hired at airports people and exclusion of human errors while the operational procedures.

3. INNOVATIONS AIMING TO INCREASE SAFETY AND SECURITY

Since last years, the problem of the losing the luggage while air transport is occurring more and more often. According to the international law, in this kind of circumstances the airlines are obligated to pay a compensation to the owner of missed luggage. To avoid the money expenses on those punishments, a solution for luggage tracking system called Radio-Frequency Identification (RFID) was created. It's been already implemented at Hong Kong International Airport, which is the largest user of this system in the Asia. RFID has generated 3.9 billion USD savings among Asian market, annually. According to Eric Wong, Hong Kong's International Airports' terminal manager, the use of Radio Frequently Identification tags to track and manage the movement of luggage can increase the productivity of ground handling and increase security aspects at the airports, as well as helps to reduce operational cost.

Another solution for better luggage's security management at airports is the implementation of the Integrated Baggage Management. This solution has been already used for several years at John F. Kennedy International Airport (JFK) in New York City. In 2015, it was estimated that airlines who provide it's service at that airport, thanks to that solutions, can save up to 1.2 billion USD annually.

Bar-Coded Boarding Passes (BCBP) have already been used for decades. However, the aviation industry has started to use them to encapsulated boarding passes few years ago. The International Air Transport Association (IATA) had even decided to support that solutions, aimed for increasing the efficiency and reducing time of the passenger's flow, and promote it globally. What is more, that organization had counted that solution to one out of five IATA's initiatives, which were designed to simplify and speed up the handling processes at airports. The wide use of BCBP is primarily influencing onto reduce of queues at airports and cause of enabling greater throughput and quicker baggage and boarding passes check-in processes.

To enter the restricted area of the airport, every person has to undergo the security checking point. It concerns the passengers, people who are hired at the airport as well as the airline's employees. However, before the security checking, people have to show the appropriate document which confirms and is theirs permission of receiving the access to the airport's operation area. In addition to the traditional, manual checking of document's such as boarding passes for air passengers, or airport staffs' IDs, automatic pass-scanning readers may be used at the airports. What is interesting, in the main Polish airport - Chopin Airport, the authorization checking control is carried out somehow in a semi-automatic way. It is due to the fact that the code reader is fully automated, however, if there occurs any problem with it, there is manual checking carried out by the handling company's employee.



FIG. 2. Identification checking point at Chopin Airport in Warsaw



FIG. 3. Scanner for security control

Is also possible to observe the impact of new technologies and innovative solutions during security checking processes. The traditional manual security control conducted by the magnetic gates includes the scanning of passengers in order to detect metal objects. There can also be used hand-held metal detectors and traces to detect the explosives materials (used for both, passenger's and their hand luggage checking). The security checking of the cabin and checked luggage is carried out usually with the help of a conventional X-ray machine. Those scanners, which are based on advance technology, are used for the checking and scanning what is inside of both, hand/cabin and registered luggage. To those purposes most common are the Heimann scanners, which value exceed 1 billion Euro. Those scanners are highly efficient and are resistant to explosions of any pyrotechnic loads. What is more, those machines are constructed in the way, which helps to protect the machine's operator from any explosion.

The implementation of special cabins, such is presented on the picture, aimed to people's scanning while security controls, is common not anymore only in the United States of America, but also at European airports. These scanners are used e.g. at Stansted Airport next to London. The benefit of the use of those kind of cabins is theirs ability to data savings, identifying suspects who have been considered as a potential threat by the handling and security staff. What is more, those scanners let provide quicker and more accurate scanning of people, because of the better and improved technology.

Next solution, which could contribute even better and more efficient security scanning processes and thereby improve airport security is the implementation of adequate equipment for complete X-ray scanning procedure of the controlled person. These X-ray scanners would have, among others, made it impossible to bring explosives materials and substances on airplane's board. Its implementation at American's airports was common till 2015 [1]. All people before entering the protected part of the airports had actually a choice of being scanned by this kind of scanner. Unfortunately, those scanners were showing the entire silhouette of the controlled person, including the intimate parts. Thus, this was the main reason for the numerous protests of passengers who did not want to "pose" naked to the airport security personnel. This solution also has met the opposition from the humanitarian organizations. This is not surprising that those scanners are not common at the airports anymore. Although the use of such scanners would definitely increase the level of security at airport's operational zone and on the airplane's board. However, the social debate has shown a solution to this, in the eyes of many people, unethical security checking method. The scanning data could be shown to the person, who has access to the received data showing naked person, in a different building than the person who is being controlled.

In the eyes of many people, the bottleneck while handling processes at the airport is passengers' boarding. Long queues, pushing passengers on each other are exemplary defects of the traditional, common use approach while the passengers boarding. The use of electronic gates would have a positive impact on the entry into the aerodrome operating area, as well as would speed up the whole process. The implementation of fully automated gates also would reduce the operational cost due to the reduction of the number of needed handling staff. This solutions is actually implemented at Chopin Airport in Warsaw. However it is still used under the supervision of handling agent.

An analogous solution could be provided on the border control. It's wide implementation would also remove a problem which irritates many passengers traveling primarily to countries outside the Schengen zone. In this case, automated gates could be used to facilitate passport clearance faster and more efficiently. However, those gates could be used, of course, only by those passengers, who have biometric passports.

That automatic checking system is based on the matching the face overview and fingerprints from the passport with the impression and personal appearance of the checked passenger [8]. Using such a solution which is classified to as innovative provides convenience for the passengers and also improves airport security. In Poland this solution is implemented so far only at one airport, in Modlin (which is located nearby Warsaw). The special gate was designed by the Military Technical University in Warsaw and the Border Guards. The automatic passport's checking facility is based on a research project of the Institute of the Optoelectronics from Warsaw. Undoubtedly, the advantage of this solution is the ability to detect possible falsification of documents such as passport [7], and the faster authorization process, in general.

The increase of passenger's comfort at airports may be achieved by implementation of many solutions, which depends on the advanced technology. Few months ago at Amsterdam Schiphol Airport was launched, by KLM airline, a robot, which was called Spencer [5]. This device is a guide for passengers. The KLM's robot is helping the transfer passengers find their way between the gate they entered the airport to another gate, as quick and efficient as it is possible, at that busy transfer airport. Spencer is able to help also to scan the boarding passes, estimate and report how much time it will take to reach any point at the airport. Its implementation eliminates the need of the hired handling support staff, increases comfort and provides passengers with reliable data.

According to law restrictions, to perform the cargo transport service there should be prepared specified documentation. Those include the documents which are required to the national and international transportation, including those forms, agreements which are necessary to be prepared by transportation forwarder and carriers before, during and after the whole good's transporting processes. The basic and essential document for air transport is Air Way Bill – AWB. The obligation of preparing the AWB exists since the implementation of the Warsaw Convention, which was signed in 1929. In this document there is specified the relation between export and import transportation movement. For the valuable cargo goods, packages there are prepared usually also other documents such as: MAWB – Master Air Way Bill and HAWB - House Air Way Bill. To increase the efficiency of the whole air transport system, there had been developed by International Air Transport Association (IATA) the project of E-Freight system. This initiative is aimed onto reduction and speeding up the processes needed to send all required for efficient cargo transportation documents. It leads also to the decrease of the amount of printed documents as well as on higher efficiency, and reduction of the transported cargo's weight (all paper documents used to be flying with the cargo freight on the airplane's board). As it was counted, the E-freight platform helps save even up to 4.9 mld USD annually. Just the use of e-AWB, which is one out of the 30 different documents required in the air transport, led to decrease of the need of printed, collected and archived many paper documents. It caused as well as money savings, and also reduced the time of providing services, helped to increase the efficiency of the air cargo's staff and gave a possibility of tracking the cargo package online. IATA counted that the implementation of e-AWB helps to save 7 800 tons of printed paper documents annually.

4. INNOVATIONS CONCERNING AIRPORT SUSTAINABILITY

The negative impact of air transports' pollution emission to the natural environment is unfortunately huge. According to the estimations made by International Civil Aviation Organization (ICAO) in next years it is going to be even worse. However, there are many initiatives, programs created, implemented by various institutions e.g. by European Union, ICAO which are aimed to stop those changes, which occur on Earth.

Airports are places which influence on and generate much pollution emitted to the local environment. Its impact may vary (but stays mainly negative). However, the most annoying seems to be the emission of noise. Apart from these, there are other negative impacts which are destroying and decreasing the value of the environment. The examples of how the airports influence on the local environment are presented on the picture 4.



FIG. 2. Types of waste produced by airports

Fortunately, many steps and actions are taken to protect people and environment from the pollution emitted and released at the airports. A key step in this area and a huge increase in passenger satisfaction may be the change of the airplane's engines for newer, quieter and with release of lower emissions of pollutants to the environment. Other solutions, which also have a positive impact on reducing the amount of pollutants emitted to the atmosphere, ground and water by the air transportation sector is the redesign of the airspace. This can happen due to the succeed and full implementation of the European Union's SESAR initiative. The other solution for protection of the environment is common connection of the aircrafts parked at the airport's ground, to the sources of current from terminal's buildings. Increasing the number of air traffic controllers and decreasing the waiting time for receiving slots to the airport parking area is another, simple solution for reducing the environmental degradation and devastation by aviation sector. Increasingly popular (especially at American airports) philosophy of "Green airports" is a solution that in the next few years will most likely not be astonishing to the public. Already used electric buses, or small, wind power plants are the solutions already found at several airports (mainly American). An example of the airport which wants to be environmentally friendly, and should be an example for the others, is Denver Airport in Texas, USA [2]. There are implemented solar panels which are producing the energy needed at the airport [6]. There also are recycled waste, such as paper, plastic bottles and aluminum. Daily at Denver International Airport is recycled more than 20 types of materials, including restaurant grease, organics, aircraft deicing fluid, glass and demolition materials [9]. The goal in this branch is to introduce that philosophy at other airports around the globe.

5. CONCLUSIONS

All innovations presented and described in this paper are focused on the improvement of management, the processes within the aviation sector, as well as on increasing efficiency and increasing the capacity of current passengers' terminals buildings.

It was estimated that presented solution may conduct to the increase of the airport's capacity in the range of 30 to 60% (with just the reorganization of current infrastructure). Nowadays, improvements at the airports, which are based on the implementation of the solutions based on better and more advanced technology, are conducted to achieve the positive changes in passenger air traffic flow, by its speed up, as well as through optimization of security controls and the use of the tricks which help and let to reduce the handling's service time. Undoubtedly, changes at airports have a greater impact and are more needed than the increase of the flow of airlines' passengers, because the load factor may be increased without such an effort, like the reorganization and changes, which have to be implemented at the airports. There is a tendency at the airports which is based on the reduction of the space needed for the handling service such as passenger's check-in or luggage check-in by using the innovative, revolutionary solutions. The area saved by the implementation of those solutions may be converted into space dedicated for social and commercial purposes. This has an impact on the higher quality service and higher satisfaction of the travelling by air people and a positive economic influence. Optimizing services provided at the airports, as well as operations taken at them, technological advance and increased capacity of the airports may make the airport's more competitive. Thus, it's development may be threaten, because of the changes and the (negative) impact of the airports onto the environment. The threat is also in the limit of enlarging the operational area. Although taking and implementing the solutions which could help to make the airports more eco-friendly can help to make airports more sustainable, than they are now. What's more important, thanks to the implementation of innovative solutions, the airports will be more safe, efficient and open for the new business opportunities [3].

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