

Marcin Rutkowski

Mgr gospodarki i zarządzania
publicznego
Pracownik instytucji finansowej
marcinbrock1@wp.pl

DOI: 10.35117/A_ENG_19_02_03

The phase nature of safety costs in civil aviation

Abstract: The exploratory problem of this article concerns with costs in civil aviation through a prism of phasic safety costs management. The article contains description of four phases costs management: design phase, production phase, operation phase and phase of total depreciation in which potential cost-generating factors were identified, and the management of civil aviation safety costs was defined. In the article there were described the benefits of taking into account the phase cost system in civil aviation safety management.

Keywords: Safety costs; Civil air transport

Introduction

Civil air transport is an important branch of the national economy. Air traffic is the movement of all aircraft during the flight and on the maneuvering area of the aerodrome. To ensure its proper and undisturbed functioning, it seems necessary to constantly analyze and counteract factors that negatively affect the level of security in civilian aviation. G. Zajac [6] defines aviation safety as a set of all standards, measures, and mechanisms taken by entities responsible for maintaining the highest safety standards in civil aviation. An example of a procedure that may contribute to the improvement of safety in civil aviation may be the identification of security costs in passenger air transport.

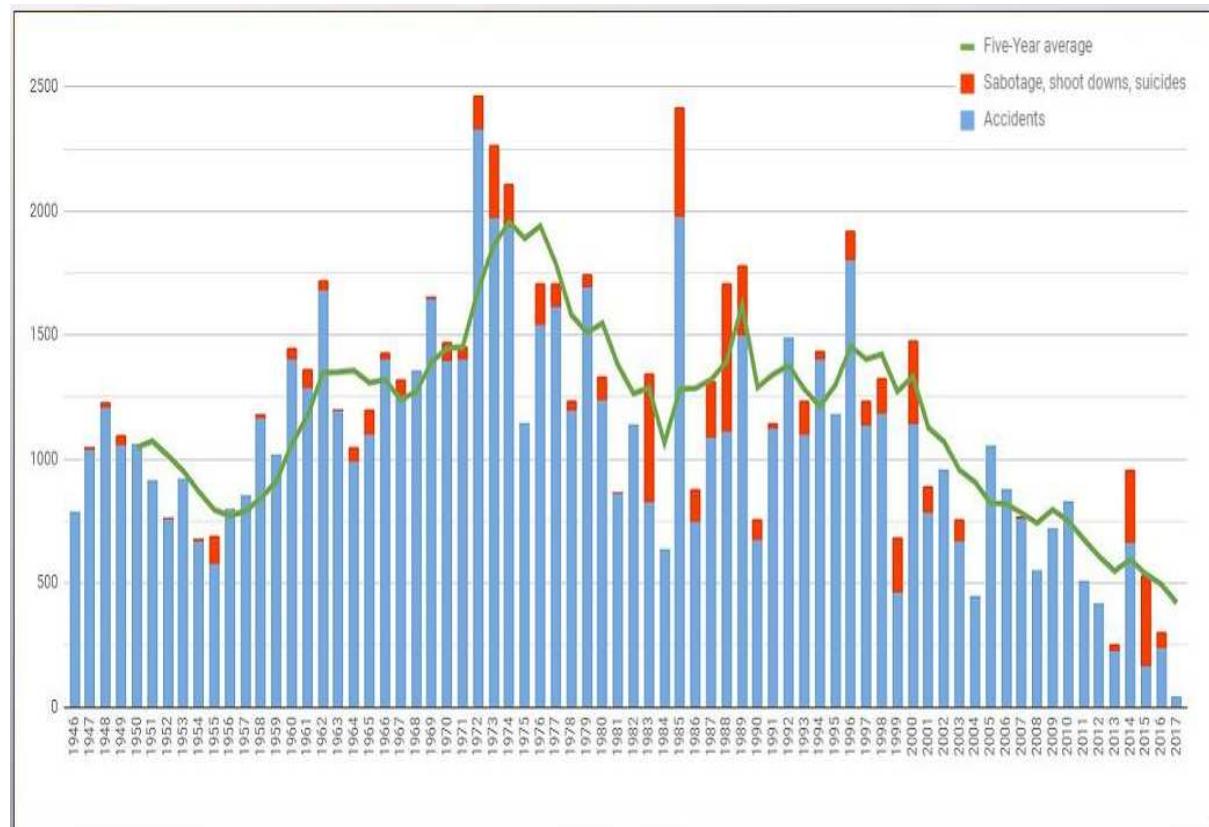
Why should security costs in civil aviation be investigated?

The costs of civil aviation safety constitute an important category in cost management among entities involved in maintaining an acceptable level of security in civil aviation. Many publications have been written on passenger air transport and the costs incurred in enterprises conducting the economic activity for civil aviation. Among the authors of the literature, one can point to the work of E. Marciszewska [1] on the classification of costs in air transport, A. Ruciński's publications [3] referring to the description of the air transport market and the work of J. Neider [2], which describes air transport also in terms of security. Important works are also published by A.K. Siadkowski [4], who focuses his research on security and protection in civil aviation. It can be assumed, however, that in relation to the costs related to the implementation of the security policy, there is a research gap, the fulfillment of which should contribute to the introduction of new or to improve current standards of civil aviation cost management. A detailed study of the costs incurred to maintain an acceptable level of safety in passenger air transport can contribute to the effective management of the safety of air operations and positively influence the financial aspect of the business of the undertaking representing civil aviation.

Despite the development of technology and the continuous identification of factors that threaten the safety of air operations, undesirable aviation events remain. Man is unable to completely eliminate all threats and identify all risks affecting aircraft operations. An important activity that is undertaken by civil aviation stakeholders is a continuous detection of security threats. It can be assumed that a systematic study of the air transport market in terms of hazard identification will require specific financial outlays. A separate issue is an extent to

which individual beneficiaries of air transport services will participate in the operational costs of aviation security.

The need to examine the costs incurred to improve safety in civil aviation is illustrated in Figure 1, which shows the number of fatalities of air crash victims in an annual time interval.



1. Number of fatal accidents in commercial aviation in the years 1946-2017 including passenger flights performed by aircraft with at least 14 passenger seats, the chart also includes cargo transport [7]

Figure 1 shows the change in the number of air fatalities in the years 1946-2017. In addition to air accidents, there was also a deliberate human activity that led to a plane crash in the form of sabotage, shooting down and suicidal activity. The largest number of victims was recorded in 1972 when 2,373 people died. According to the reports published in the NTSB [11] National Security Council's Internet database, the causes of the plane crash in 1972 were: bad aircraft configuration, pilot errors, material fatigue, terrorist activity, and bad weather conditions. Since 2000, in Fig. 1 there has been a visible drop in the deaths of air crash victims. In the first decade of the 21st century, aircraft manufacturers such as Airbus and Boeing began to research, which resulted in the construction of modern passenger aircraft such as Airbus A380, Airbus A350 and the American manufacturer Boeing 787 Dreamliner. Some construction solutions have been adapted to older types of passenger aircraft and were associated with the improvement of passenger flight safety. After the coup of September 11, 2001, airlines verified their security systems. An important element improving the safety of air operations was the installation of reinforced cockpit doors, which prevent unauthorized intrusion into the aircraft's command center.

The study of security costs in commercial aviation may be one of the methods of influencing the level of acceptable risk during air operations.

The concept and classification of costs in civil aviation

The aviation market is a branch of transport, where the operating costs of the entity on this market may be the same as the costs of safety management due to the complexity of this market and the dynamics of changes which it undergoes over time. The dynamics of changes refer to the exemplary variability of seasonal air connections in economic terms, as well as the reporting of engine operation during the flight to their producer with the technological approach.

Costs [13], according to the Accounting Act, are probable decreases in the reporting period of economic benefits, of a reliable specific value, in the form of a decrease in the value of assets, or an increase in liabilities and provisions that will lead to a decrease in equity or increase its shortage in other ways, than the withdrawal of funds by shareholders or owners.

The classification of costs in civil aviation can be presented based on specific criteria:

✓ a reference where the given cost has been assigned to a given activity or specific service based on a source document. In this approach, one can distinguish direct costs such as the cost of buying fuel at a given airport for a particular aircraft that performs a specific flight operation and indirect costs, which can be exemplified by the cost of purchasing fuel at a contracted price for the carrier's fleet.,

✓ time, where fixed costs are distinguished, for which their immutability is characteristic in a short period of time, an example of a fixed cost is the cost of performing the necessary aircraft inspection. Variable costs are also mentioned, which in the short term are subject to changes as a result of the profile of services provided. Such costs include costs related to the operation of charter flights,

✓ unitary dimension, which refers inter alia to the unit cost of transport services per passenger. Such costs can also include incidental costs due to operational activities such as damage to an aircraft by another aircraft when taxiing on an airport ramp.

The literature on the subject distinguishes the costs [5] of services provided at the airport, such as costs of airport charges, among which fees are exchanged for: take-off or landing, passenger, goods and noise charges as well as security charges, also indicated costs of navigational services - terminal and route, costs of handling services and costs of fuel.

The cost components include personnel costs of crews and cabin crew, propellants, maintenance and repairs, aircraft depreciation, airport and en-route charges, aircraft and passenger handling, freight handling, sales and promotion costs, general and administrative costs, other costs and financial costs. An important financial cost is the cost of insurance for aircraft. This category of costs presents the costs related to the loss of aircraft damage - aerocasco, carrier liability insurance against passengers for the carriage of passengers and their luggage (e.g. compensation for passengers for bodily injuries resulting from an aircraft accident), carrier's liability insurance for damages caused on the ground as a result of its operations, accident insurance for employees, cargo insurance and other insurance.

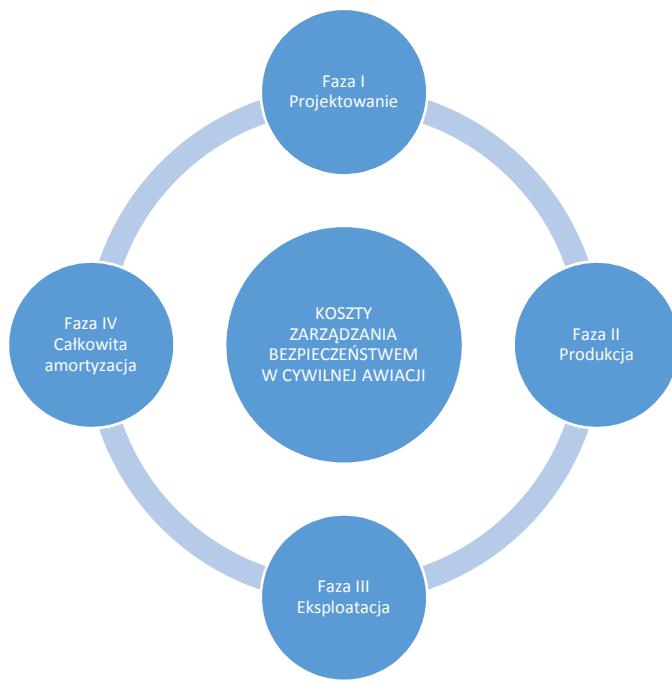
In order to provide a practical indication of the share of costs in safety in civil aviation, you can describe the costs in the functional dimension through the aspect of managing these costs. The management of security costs in passenger air transport consists in organizing financial resources for economic activity related to civil aviation, planning the structure of future costs, coordinating obtained financial resources, controlling the flow of these funds in the enterprise in order to maintain an acceptable level of aviation safety.

Phases of security cost management in civil aviation

The management of security costs in civil aviation takes place within a specific time interval in which four basic phases can be distinguished.

The first phase is the stage of designing a new aircraft, passenger terminal, airport, a given item, system or solution that is intended to contribute to the improvement of security in civilian aviation. The design phase is usually preceded by an analysis of the aviation market in terms of the expectations of stakeholders in passenger air transport. These tests concern, among others, the number of seats in the aircraft cabin, the capacity of the new passenger terminal, the performance of aircraft engines, the efficiency of all components and systems as well as airport infrastructure facilities. The first [8] passenger plane that was fully designed using computer technology was the Boeing 777, and the cost of the entire program was around US\$ 6 billion. In the design phase, the safety management costs are related to the design, which aims to present a model that meets certain security requirements foreseen for a given project. The model in this approach can be either an aircraft or a given electronic system of airport infrastructure as well as an innovative way of passport and baggage clearance.

Figure 2 presents the management stages of security costs in civil aviation. The cyclic phase system indicates the possible distribution of costs between the individual phases. Phase I is the phase initiating the creation of certain costs in the design of an aircraft or system that is to improve the safety of civil aviation.



2 Graphic presentation of the phases of managing security costs in civil aviation
Source: own study

The second phase of managing the costs of safety in passenger air transport is the production phase, where the production of a previously designed and tested product for a given scale of demand takes place. In the described phase, the fixed costs of production are usually kept constant over a long period of time, thanks to predefined cost-generating factors. Such factors can be considered: the type of material necessary for the production of a given part of the aircraft, a tool with machinery, technology - including all IT systems, energy consumption in the production plant, depreciation of machinery necessary to build a specific product, employees' remuneration. In the production phase, you can also indicate direct and indirect costs. The indirect cost of safety management in civil aviation may be the cost of

producing an aircraft that is fully airworthy and performing flight operations, while the direct cost will relate, for example, to the installation of chemical oxygen generators, usually located in the vicinity of the cabin hatch passenger seats. Lack of a device for several minutes of oxygen supply, lack of such cost would not affect the airworthiness of the passenger aircraft, but the level of safety of the aircraft operation performed by the aircraft without oxygen generators would be significantly reduced. The report and recommendations of national and international organizations dealing with security in civil aviation should be considered an important cost-generating factor. In Poland, the investigation of undesirable aviation events is carried out by the State Commission on Aircraft Accidents Investigation, PKBWL, which maintains a register of aviation accidents. After examining a specific aviation incident, the Commission issues recommendations aimed at improving safety in the aspect related to the specific stage of the aircraft operation and the recommendation to the aircraft manufacturer on this matter that there will be no similar aviation incidents in the future. For 2016, there are 3,200 registered aviation occurrences in the PKBWL register. The implementation of the Commission's recommendations should contribute to improving the level of safety in passenger air transport.

The operational phase is the next phase of managing security costs in civil aviation. It covers a product that has come into service for a specified period of use. The operating phase includes costs of: airport charges, navigation services, handling services, purchase of fuel, including the cost of testing its quality and compliance with specific standards, maintenance and servicing of aircraft, including cleaning of the aircraft along with disinfection for the deactivation of biological pathogens, costs of implementing a device, system or solution recommended by a given commission examining aviation incidents, costs of passenger safety checks and passport and baggage clearance, costs of aviation events such as collisions on the apron or in the air, aviation accidents, plane crashes. This phase also includes training costs for pilots, courses for future civil aviation adepts, training costs for cabin crew, ground staff, airport security services and measures necessary to maintain an acceptable level of safety such as fire trucks, medical help vehicles, hazardous or banned substance detectors, and the costs of promoting the safety policy of a given air carrier by promoting security policies using websites, safety instructions, brochures, and information cards. Important costs are also costs incurred for courses, training and workshops of future passengers who are afraid of flying. In this phase, there are costs incurred for air insurance - aerocasco, insurance of crews, passengers and various compensations.

For the interesting management of the third phase security costs, the operation of the Toronto International Airport Toronto-Pearson B. Pearson, which in its security management policy cooperates with many business entities and handling companies, which largely determine the level of flight operations. Therefore, in order to promote the idea of safety and the concept of zero injuries at work at the airport, he introduced the Safety and Security Award Recognition Program [15] - Rewarding Knowledge Protection and Safety Program, which aims to promote airport employees contributing to the promotion of protection culture and safety. Gratification of employees is of a financial nature and ranges from 5 to 50 Canadian dollars in the form of vouchers to be used in the port area. This attitude encourages employees to perform their duties with more emphasis on the security aspect in everyday tasks. The manager of the largest Canadian airport has also implemented the Vehicle Service Permit program in the Airport Operating Area - Airside Vehicle Operator's Permit, AVOP [14]. Port employees performing their duties in the airside area are obliged to pass tests on the safety of vehicles moving around the airport. The permit is issued for a limited time, which is why employees must periodically renew their permission to operate in the airside area. This measure aims to permanently enforce the knowledge of procedures and the skills of collision-free movement at the airport.

The last, fourth phase in the management of civil aviation safety costs is the phase of total depreciation of a given product - aircraft, device, system and solution. This phase includes the withdrawal from use of the aircraft, its demolition, termination of the lease agreement and return to the less or, replacement of the device for a new one, expiration of the insurance contract, withdrawal of the previously used system or a solution that was, inter alia, unfavorable or did not fulfill the assumed function and tasks, or have met them and will not continue its use.

The fourth phase includes the destruction of the aircraft as a result of a plane crash, hostilities, atmospheric factors, and the human factor. The costs associated with financial compensation borne by air carriers for relatives of victims of air crashes are regulated by the Montreal Convention of 1999, which determines the number of damages that the carrier may incur and amounts to 100,000 SDRs, Special Drawing Rights, constituting an international settlement unit. SDRs were created as reserve assets by the International Monetary Fund. In 2009, the last SDR issue took place at a rate of 1.56 SDR / USD. As at 04/02/2018, the average exchange rate [10] SDR/PLN was 4.8616. Therefore, the amount of compensation as at 04/02/2018, maximum according to the Convention, would amount to PLN 486160. In practice, compensation may be higher by concluding an appropriate settlement. This phase also includes costs related to securing the crash site, securing the bodies of victims, removing remains and rehabilitating the site of an aircraft accident. At this stage, there are both the costs of the work of the services, investigators, inspectors, and members of the committees involved in investigating the causes of aviation accidents.

An example of the fourth phase of civil aviation safety management may be the Singapore Airlines-line procedure [12] which, after less than five years of use of the four-engine Airbus A380, decided to withdraw the first aircraft produced by the European EADS consortium to two-engine Boeing 787 and Airbuses A350. New aircraft burn less fuel, which translates into financial savings for the line, are free from risk factors such as material fatigue, which may occur after a specified period of aircraft usage.

Summary

The element combining the safety policy in passenger air transport is the optimization of the economic account of entities involved in the management of civil aviation safety. The increase of financial outlays by airlines and entities involved in the safety of aviation operations should contribute to the improvement of the level of civil aviation safety.

An important feature of managing security costs taking into account the four described phases is the possibility of diversifying the costs covered between phases. The costs from the first phase may contribute to the improvement of the level of safety in the third phase in the operation of currently used aircraft. The costs from individual phases can interact cyclically - by following the next phase which is the reference one, the given phase affects a particular phase.

The management of security costs through the described phases may contribute to the improvement of civil aviation safety through:

- An attempt to develop an innovative model of safety cost management in passenger air transport that will effectively plan, organize and control costs closely related to the aspect of civil aviation safety in a given phase.
- Determining the optimal level of safety cost management in passenger air transport will create the possibility of transferring solutions in the field of detection of security threats for other sectors of the economy.
- Identification of alternative sources of financing and diversification of revenues of interested entities in order to optimize the costs of business operations.

- The increased safety level of performed aviation operations, reduction of incidents, serious incidents and aviation accidents through the detection of new aviation hazards.
- Optimization of operating costs of the involved entities.
- Increased attractiveness of the aviation industry, airport, and airline by increasing the awareness of security risks in passenger air transport.
- Attempt to estimate the cost of survival of a plane crash, verification of the number of premiums paid to insurance companies in respect of life insurance borne by passengers and airlines, determination of the level of dependence between the cost of the safety of air operations and the human factor [9].
- The decrease in the number of fatalities in air crashes.

The phase-out management of security costs in civil aviation can be an effective cost management model for companies operating on behalf of civil aviation as it includes historical data analysis, current data and includes future data represented by the forecasts of the air services market, and the phase reference may improve transport safety air.

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