

**ECONOMIC AND FINANCIAL CONTEXTS OF  
DEVELOPMENT OF AN AIR RESCUE CAPABILITY**

**Doctoral (PhD) thesis**

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**Economic and financial contexts for the development  
of an air rescue capability**

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## Introduction

The first airborne search and rescue mission is believed to have been carried out by US Lieutenant Carter Harmon in 1944 in Burma [1], who flew a YH-4 helicopter to rescue three British soldiers from behind enemy lines [2]. In the early days, therefore, the primary task of air ambulance missions was to transport wounded combatants rapidly from the front line to a place where trained medics could perform the necessary interventions in relatively orderly conditions and with potentially adequate equipment. In the time since then, air ambulance services have gradually become an integral part of healthcare systems: in 2022, Grand View Research estimated the European air ambulance market to be worth USD 3.6 billion in 2022 [3].

In the rescue chain, air ambulance is the "first responder", i.e. the first to arrive at the scene of an accident and provide medical care or transport.

The obvious advantage of aerial vehicles over ground ambulances is that they are not affected by the existence, accessibility, quality and traffic conditions of roads, and the transport vehicle itself, especially a fixed-wing aircraft, can reach significantly higher speeds.

At the same time, the acquisition of the fleet and the necessary infrastructure alone can be a costly undertaking in the magnitude of millions of Euros, not to mention the fixed costs of operation and the limitations of the aircraft in terms of safety and payload capacity.

In order to evaluate the justification for developing and maintaining an air rescue capability, it is necessary to understand who should bear the financial burden and to examine the technological / economical structure of the system. Also, within Europe, the potential revenue streams, the required investments

in equipment and infrastructure, the operational and security costs, the human resources required and the possible break-out points (new configurations, activity expansion) all influence the return on investment and the rentability of an air rescue operation.

The dissertation focuses on the economic feasibility of helicopter emergency medical services (HEMS), which is assessed on the basis of the activities that can be performed as defined by law, based on the specificities of the operating models used worldwide, with a consideration of the typical ownership backgrounds.

The social benefit of the dissertation is to contribute to the improvement of the efficiency of air ambulance services, to increase cost-effectiveness and to contribute to the economic (self-)sustainability of the service providers. The users of the results can be service providers and persons with political influence in the healthcare and healthcare financing fields.

## Scientific objectives, problem definition, hypotheses

In this dissertation

- 1) based on the Hungarian example and an international perspective, I will review the revenue opportunities, investments and expenditures needed to start and operate an air ambulance service and the main drivers behind them,
- 2) based on international market research and analysis of air ambulance companies, I will examine the existence of air ambulance services in the EU, the typical ownership backgrounds and their characteristics, potentially with cross-industry references,
- 3) present financing alternatives,

4) I hypothesise that

1. it needs to be expected that demand for air ambulance services to fall to zero;
2. there is a statistically significant correlation between a country's GDP per capita or population and the existence and ownership structure of an air ambulance service;
3. building and maintaining an air ambulance capability is not a task:
  - a. that must be implemented under state ownership,
  - b. that must to be financed by public funds.

The above analyses and hypothesis tests are carried out using the following research methods.

## Research methodology

The following research methods were used to achieve the research objectives:

- general, which includes the methods of comparison and generalisation;
- analytical-logical, which includes an evaluation of the current legal and internal regulatory environment and the formulation of proposals based on the conclusions drawn from it;
- an empirical method of analysis based mainly on professional experience in the field and interviews;
- literature, database and legislative research, which involved both the study and processing of relevant international and national documents;
- study of foreign and domestic technical solutions;

- processing, publishing and presenting partial research results at conferences and in educational settings;
- statistical analysis and (linear) regression on the database built up during the research;
- sending out and analysing questionnaires as primary research;
- consultation with recognised experts in the field of research.

The statistical analyses and regressions on the data were carried out using the Microsoft Excel Analysis Toolpak.

## Literature review

A systematic literature review was carried out along the input questions necessary to accept or reject the hypotheses, as follows:

- What are the investments and expenditures associated with the construction and operation of an ambulance helicopter fleet?
- What revenues are associated with the helicopter rescue service and who provides them?
- What risks, in particular occupational health and safety risks, are associated with the continuation of the air ambulance service?
- What is the ownership background of the air ambulance services in each European country?
- Based on international examples, what is the ownership and funding background for health investments, services and air ambulance services?

The literature review was carried out in the ScienceDirect database hosted by Elsevier and the Wiley Online Library hosted by Wiley. The results were

ranked in order of relevance according to the keywords related to each systematic research question. As a first step, the abstracts of the documents included in the longlist were processed: those containing information relevant to the search were used to compile a shortlist to be processed. The publications thus filtered were read entirely and the truly relevant, cited sources formed the basis of the bibliography used, as well as my own publications in international journals. The literature search was carried out between 8<sup>th</sup> February 2022 and 4<sup>th</sup> October 2023.

In addition to using the above databases, I reviewed the websites of companies concerned, their annual reports, their professional presentations and studies published by globally recognised consulting firms and professional associations.

### [Analysis of primary and secondary research](#)

After completing the literature review and conducting international market research, it was found that the majority of air ambulance operators in Europe are state-owned and receive dedicated funding for their operations from central or regional budgets, possibly from a health care fund. However, given that the operating loss of the Hungarian Air Ambulance Nonprofit Ltd. in 2022 was more than 954 million HUF [4], the question arises whether there is a need to maintain air ambulance capability in Hungary at all, whether there is a real alternative to state operation, or whether the population might have reservations about a privately owned operator. The way in which the operation is financed is also relevant to the research, so I asked not only whether they would be willing to see it publicly funded, but also whether they would be willing to make payments from their taxable income to maintain the capability, based on the German and Austrian examples.



The questionnaire was sent to 152 people, of whom 86 (n=86) completed it (response rate = 55.9%).

The gender breakdown of respondents was 65.1% female and 34.9% male.

## New findings

1. Hypothesis 1 can be rejected, as the sample has shown that the Hungarian Air Rescue Nonprofit Ltd. or a new entrant does not have to face the possibility that demand for the service will drop to zero or be deemed redundant: the population is almost unanimous in its view that there is a need to maintain the capability.
2. Based on the sample collected in the market research, hypothesis 2 can be rejected after demonstrating that there is no statistically significant correlation between GDP per capita, population and ownership of a country's air ambulance services based on linear regression.
3. The international perspective used in the research and the responses to the questionnaire sent out during the primary research both support and confirm hypothesis 3/a: air ambulance services are not an exclusively public function.
4. Hypothesis 3/a is also supported by the fact that if for some reason the Hungarian Air Ambulance Non-Profit Ltd. were in need to engage a private partner or a new private air ambulance service provider were to start operations, the sample suggests that, similarly to international examples, the Hungarian public would not be significantly bothered by the fact that it is not owned exclusively by the state. Another interesting finding is that the age of the population does not seem to influence whether individuals would be bothered by a change in ownership.

5. Hypothesis 3/b can be accepted, as the thesis has shown that a significant majority of the population believes that the maintenance of air ambulance services is not an exclusively public (budgetary) task, but rather that it is a combination of public, insurance and self-financing sources. So much so that a minority of the sample would be willing to pay an annual contribution to ensure that they receive the air ambulance service should they suffer an injury of this nature. Accordingly, it would be worthwhile for the funder to enter into negotiations with insurance companies and to collect donations and pledges, following the example of Austria and Germany.
6. Two thirds of the sample members would support a public or private air ambulance service provider with 1% of their taxes, so it is likely that, in addition to the budget appropriations, the provider should improve its activity during the tax donation period to achieve a higher support rate.
7. Although not a priority research topic, I have shown in the thesis that the social perception of the Hungarian Air Ambulance Nonprofit Ltd. is good or excellent based on the research sample, which is in line with the generally positive perception of air ambulance services in the international outlook.

### Further research directions

The dissertation does not include a full cost-benefit analysis of the service, an area that requires further research at international level. The research has also revealed that, given the relatively high variable cost ratio, one of the drivers of cost-effectiveness is the decision whether or not the service sends an ambulance helicopter to a scene. It may be worthwhile to investigate the appropriateness and effectiveness of such decisions through an international

data collection exercise, which could be used to decide whether it is necessary to build an algorithm that decides as objectively as possible whether to send an aircraft. A further area of research could be the possibility of using unmanned aerial vehicles in air rescue, which could help to transport certain payloads to the scene, thus sparing the helicopter from carrying additional weights and thus increasing cost-effectiveness.

## Own publications

### Own publications used in this dissertation

- Szabó Balázs Ádám, Kobolka István, Zádori Iván: Cost dynamics of helicopter emergency services: A Hungarian example
  - Heliyon, Volume 9, Issue 3., March 2023.
  - Impact factor: 3.776, Q1 classification.
  - DOI: [10.1016/j.heliyon.2023.e14336](https://doi.org/10.1016/j.heliyon.2023.e14336)
- Szabó Balázs Ádám, Dr. SzilvÁgyi Tibor, Dr. Kobolka István: Diszruptív technológiák alkalmazása a katonai célú pilóta nélküli repülésszerekben
  - Einnováció, Volume II., Issue 1, April 2024

### Own publications not used in this dissertation

- Ladányi Éva, Szabó Balázs Ádám, Marek Erika, Kobolka István: Terrorist financing through the hawala money transfer system and its legal sanction in Hungary
  - American Journal of Research Education and Development: 2 pp 11-20 (2022)
- Szabó Balázs Ádám, Dr. Ondrejcsák Eszter, Dr. Kobolka István: A poszttraumás stressz zavar megjelenítése irodalmi alkotásokban

- Einnováció: accepted, under publishing

### **Conferences, presentations**

- Amman, Jordan. 20<sup>th</sup> October, 2021 – Implementation of HEMS operations
- IDEB 2022, Bratislava. 9<sup>th</sup> May, 2022 – Costing of HEMS operations

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