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## Technical and economic feasibility of the use of airships within two Portuguese market niches: the tourism and the urban logistic case studies

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**TECHNICAL AND ECONOMIC FEASIBILITY OF THE USE OF AIRSHIPS  
WITHIN TWO PORTUGUESE MARKET NICHES.  
THE TOURISM AND THE URBAN LOGISTIC CASE STUDIES.**

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Urban Logistics.

**JEL Codes:** L93, O18, R11

**Abstract:**

All over the world there are several countries where airships are being used for military and civilian purposes.

The rebirth of this mean of transportation, capable of easily overcoming some deficiencies of the conventional ones, brings medium and long term economic benefits. In addition, they offer different services at lower costs, and they also may stimulate new commercial and industrial activities and even new transactional routes.

The background of airship technology comes from the XVIII century. Since then, all those years were of scientific and empirical knowledge. Now, they form the basis for a sustainable future in emerging technologies, making the return of airships possible.

This revived interest in airship technology brings a multitude of technical concepts resulting from interdisciplinary research. Consequently, the state of art of airships presents new research which paves the way for the reappearance of renewed horizons with regards to the use of airships. Companies are focused on the research, development and testing of new airship concepts and designs too.

Nowadays, airships are being studied for commercial transport in different parts of the globe, from Canada, Brazil, Peru, to Australia. India, for example, has studies about the connection to remote areas with poor surface infrastructure which only can be reached by air or walking. This way, it's expected that airships will become a competitive mean of transport to link areas served by deficient transport infrastructures.

Taking the principles of sustainable development of air transport, airships are the most environment-friendly vehicles with lower fuel consumption and with higher endurance. Therefore, as a result, they are paving the way for new markets.

This work examines these technological improvements and the economic feasibility of the use of airships in certain market niches. Mainly, this work makes use of a study concerning the viability of the use of airships within Portuguese Tourism and Urban Logistic activity sectors.

This paper is organized as follows: firstly, state of the art reviews about airships technological characteristics, operational constraints, operation scenarios, and international and national legislation. Secondly, some insights and challenges about two case studies within the Portuguese territory (touristic flights and urban logistic activity). And thirdly, some insights and challenges of (future) research that is still in progress.

## **1. INTRODUCTION**

In the beginning of its commercial history the airships (all of them called Zep-pelin) seemed to have a future, until suddenly they lost its merit, visibility and was forgotten. Now it's considered by many as a mere curiosity.

Technological progress in materials, aerodynamics, propulsion and the growing environmental concern, make these vehicles a more environmentally friendly alternative, for most of the users.

The revival of this means of transport is able to respond to specific niche markets and easily overcome some shortcomings of more conventional means. This provides medium / long-term economic benefits that offer different services at lower costs and can stimulate new commercial and industrial activities and even new transactional routes.

## **2. STATE OF ART**

The background of airship technology comes from the XVIII century. Since then, all these years were of scientific and empirical knowledge that act as basis for a sustainable future in emerging technologies thus making possible the return of airships. This revived interest in airship technology brings a multitude of technical concepts resulting from interdisciplinary research. Thus the state of art of airship presents new research that paves the way for the resurgence of renewed horizons for the application of airships including new technologies of production far away from the archaic ones used by mid Twentieth century; in fact, companies are focused on the research, development and testing of new airships concepts and designs.

The use of airships for the transportation of passengers, including within the tourism sector, is a quite well explore economic activity in several countries. The technology in use become each day more sophisticated and under safety patterns accepted for all

However, the growing world population, its expansion and cities overcrowding, is creating a traffic jam on air but also ashore. The logistics in large urban centers is associated with wide ranges of problems that affects the quality of life of surrounding populations and hinder the performance of shipping.

Such problems can be divided into two categories: problems that are common to means of transportation in general, and the road one in particular (emissions of pollutants, noise, accidents, congestion) - that have been discussed and addressed by a lot of investigations, and the specific problems of the logistics activities that are usually related to how these activities are using the infrastructure and urban space.

The solutions to these problems have been basically the use of “more” road infrastructure, already congested. As these solutions are not getting major results, the community is turn in into other solutions, where the use of airships can get some advantage.

## **2.1. Technological Characteristics**

The history of aviation is closely linked to technological progress, and the re-birth of the airship is due to the plunge of new technologies in materials and structure fields, without forgetting the avionics equipments and the propulsion systems. The advance in the area of structures and materials enabled the creation of tissues capable of dissipating only 1% of helium per year.

The progress of materials and structures created a division of opinions and according to Khoury and Gillett (2004) airships that have a rigid internal structure of the loading forces on the envelope are more balanced than the pressurized airships. Only because this structure being resistant decreases the concentration regions of tension efforts and enables better performance in flight. But for Miller and Mandel (2002), the technology of the fabric must meet all air navigability requirements. Such as the materials that compose the airship’s envelope have to be tested for stress analysis which must ensure that the ultimate strength of the envelope cloth is not less than four times the maximum loading of the fabric, as the material deteriorates due to the cyclical loading and depending on the environmental agents.

For NASA (2007) the use of numerous technical innovations in a single project may pose risks that need to be forewarned. It is necessary to analyze technological innovations and submit a sufficient number of rigorous tests before certifying the security of its application. It is also necessary to ensure that these tests cover all weather and environmental conditions of the transaction under which the aircraft is intended to operate.

## **2.2. Operational Constraints**

Accordingly with Tatievsky (2012) along with their great potential, airships have several inherent disadvantages. Compared with (conventional) aircraft they are more limited under bad weather operations; due to their large size they are more susceptible to winds, precipitations and ice. Their buoyancy is affected by sunlight as well as

air density and temperature. Also cargo airships are in general restricted to operations under 10,000ft, due not only to the increasing of wind speed profile but also the decreasing of air density, which change with altitude. For maintenance, manufacturing and long term storage, airships need huge hangars; mooring devices are needed too in order to anchor airships to the ground for parking and maintenance. Last, but not the least, current most applicative lifting gas is helium, which is relatively scarce and expensive.

In all accidents / incidents concerning the air mode in general, and conventional aircrafts in particular, over than 20% are the result of climatic agents, which can be summarized as in Table 1.

<b>Climatic Factors</b>	<b>Maritime</b>	<b>Road</b>	<b>Rail</b>	<b>Air</b>	<b>Airship</b>
<b>Thunderstorm</b>	Little affected	Little affected	Affected	Affected	Affected
<b>Heavy rain</b>	Little affected	Affected	Little affected	Affected	Affected
<b>Strong wind</b>	Affected	Little affected	Little affected	Affected	Much affected
<b>Storm</b>	Much affected	Much affected	Affected	Much affected	Much affected
<b>Ice</b>	Affected	Much affected	Little affected	Much affected	Much affected
<b>Hail</b>	Little affected	Affected	Little affected	Much affected	Affected

Table 1: Key Environmental Factors Affecting Transportation Modes (Pereira and Silva, 2011)

### 2.3. Operation Scenarios

Nowadays airships can be an answer in several areas of activity; here we two examples just for the transportation of passengers and goods:

- **PASSENGER TRANSPORT:** Airships give tourists the possibility to admire fascinating landscapes in a new, comfortable and romantic, air transport mean. Colozza and Dolce (2005) state that airships are capable of competing with railway in long distances for its ability of link point-to-point nodes; concerning road transport, airships are only able to compete in the tourism sector and

for distances over 200 km (108 mi); if compared with the maritime transport, the airship is competitive with cruises for distances between 200 km (108 mi) and 1,000 km (540 mi);

- **TRANSPORTATION OF GENERAL CARGO, HEAVY AND INDIVISIBLE LOAD, PERISHABLES:** The studies so far on the cost of operation, have proven to be more profitable. Thus the operating cost is much cheaper than the current aircraft with less maintenance costs and reduced rates of transport, so they are rise to a medium and long term as a sustainable alternative for freight transport system. Its implementation as an alternative means of transport must be as a complement to the existing transport network, a strategic position within the market.

## **2.4. International and National Legislation**

One of the most important safety requirements in Germany / Netherlands (TAR - Transport Airship Requirement), and in United States of America (FAA - Federal Aviation Authority) is the use of helium as a gas-lift airships, a choice for being a non-flammable and non-toxic gas.

The European Aviation Safety Agency (EASA), to solve problems related with the design, manufacture and certification, and for airworthiness purposes, considers the airship as an aircraft class ELA1 (EASA, 2003). Also EASA establishes specific requirements for certification of airships, the Airships Certification Specifications.

In Portugal the National Civil Aviation Institute (INAC) emitted the Technical Information 09-02 - ISSUE 1 - about airships, which is an adaptation of PART M REGULATION EC No 2042/2003.

## **3. CASE STUDIES (Insights and Challenges)**

Airships are being studied for commercial transport in different parts of the globe as in Canada, Brazil, Peru, Australia or even India, to connect remote areas with poor surface infrastructure which only can be reached by air or walking; in fact it's expected that airships will become a competitive mean of transport to link areas served by deficient transport infrastructures.

Taking the principles of sustainable development of the air transport airships are

the most environmentally friendlier vehicles with lower fuel consumption and with higher endurance (12) so they are paving the way for the emergence of new markets such as the eco-friendly tourism and/or the transportation cargo within urban scenarios.

### **3.1. Touristic Flight**

Pereira and Silva (2011) carried out a study to understand the viability of using airships in the ecotourism market within the Portuguese territory, precisely inside of a national park, the Parque Nacional da Peneda Gerês, located in the north of the country. This is still a market niche for this type of aircraft, as this inaccessible region offers tourists the pleasure of enjoying one of the most beautiful regions of the country.

To perform this study firstly the authors conducted an online survey between April and July 2011 to test the acceptability of an airship within an universe of potential users. The 705 respondents gave them very positive insights about the acceptability of an airship operating in the tourism sector in Portugal:

- 42% are aged of 18-29;
- 69% are male;
- 60% are employees;
- 73% have a high graduation;
- 44% know quite well what an airship is;
- 40% would have confidence on an airship flight;
- 85% admit that an airship would provide good tourism/cruise services;

After, Pereira and Silva (2011) develop some practical and interesting concepts about: technical data and mission parameters for airship selection; operational parameters of the selected airship, the Model Skyship 600; estimated costs for airship economic model; cost benefit analysis; operational parameters for the airship economic model.

Finally they conclude for future research needs focused on the estimation of costs - a very delicate issue as uncertainty is always present, mainly on Demand, which is not a controlled variable, as well as fuel price and maintenance costs.



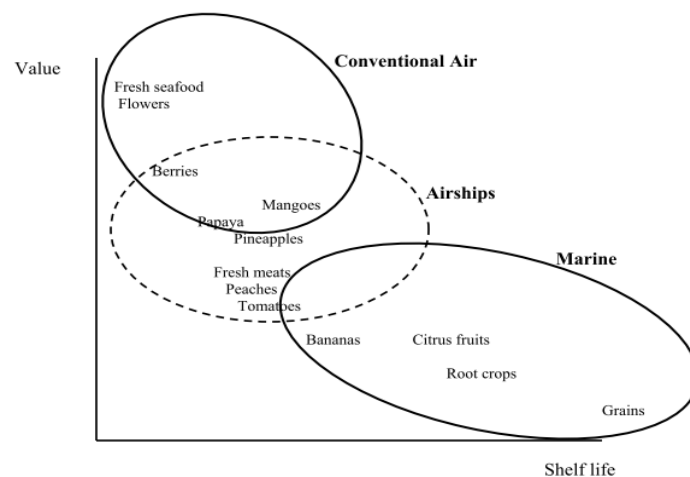
### 3.2. Urban Logistic

The resurgence of airships in the cargo market is designed specifically for a niche that is not optimally served by current (traditional) transport modes. Accordingly with the predictions of a study conducted by Boeing (2011), the growth of commodity trading and air traffic will triple in the next future.

According with Prentice, B. and J. Thomson (2003), Northern Canada represents a huge potential market for a new generation of cargo aircraft due some limiting factors in the development of this region: its harsh climate and a fragile ecosystem, and that the aboriginal tribes are reluctant to build ground lines of communication and combat their isolation - because many argue that the land should be left intact, and discourage commercial activities.

Although slower than airplanes, airships with its reappearance in the logistics market, have the advantage of being about 5 times faster than the usual shipping and not entering into direct competition but looking further a specific niche that is not properly served (Figure 1).

**Figure1: Value, Shelf Life, and Dominant Transport Modes in Intercontinental Movements of Foodstuffs and Ornamentals**  
(Khoury and Gillett, 2004)



Accordingly with Araújo (2007) the Brazilian Legal Amazon region, in addition

of being very broad, with little and adverse availability of transportation, it becomes an impediment in the development of northern Brazil. The author states that the operation of airships in this region of the globe will reduce annual spending on roads and railways, as well as their maintenance.

Airships are versatile and have a wide range of flight, as well as the possibility of transport of indivisible loads (towers and radar antennas, generators, metal bridges among others).

Prentice *et al.* (2010) underline that airships have operating costs two to three times higher than shipping, but reducing indirect logistics costs and implementing a market premium for freshness, they could help to gain market share. So it can be done in Portugal where a preliminary study about the use of airships in metropolitan areas has been conducted by the Technical University of Lisbon (transportation team) and the University of Beira Interior (aeronautical engineering team) with very promising preliminary results.

#### **4. CONCLUSIONS AND RECOMMENDATIONS**

The background of airship technology comes from the XVIII century. Since then all these years were of experimentation and empirical knowledge that act as basis for a sustainable future in emerging technologies thus making possible the return of airships. This revived interest in airship technology brings a multitude of technical concepts resulting from interdisciplinary research.

As previously mentioned the buoyancy control always has been a primary problem of airship projects but advances in the airship's technology are finding workable solutions to ensure safety control in its lift and buoyancy. For airships operations the influence of meteorological factors is evident too; however modern ones have onboard specific equipments which enable safety flights under the requirements established by International Civil Aviation Organization (ICAO).

Our case studies, still in progress, carried out some insights and challenges about the viability of using airships in Portugal not only to transport passengers / tourists inside an ecotourism market, but also to transport goods thus serving the logistic within urban areas.

For both case studies further research, still in progress, is needed for the selection of the appropriate airships, the related operational parameters and the operating costs, a technical and economic analysis based on a specific Cost Benefit balance, a comparison of costs among alternatives.

Also future research will be focused on the estimation of costs. That's a very delicate issue as uncertainty is always present mainly on Demand, which is not nowadays a controlled variable, as well as the fuel price and some maintenance operations.

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