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INNOVATION SYSTEM IN AIR TRANSPORT MANAGEMENT*

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ABSTRACT

Identifying previous research subjects on innovation management in air transport provides not only updated references on new technologies in this industry, but also indicates which areas need to be prioritized in future research. A systematic literature review of publications in this field over the past decade, from 2005 to 2015, including 2016 publications in progress, was carried out, adopting as a control document the proceedings from the 19th ATRS World Conference, held in Singapore in 2015. The searches were done on ScienceDirect and included reports from over 2,500 journals. The abstracts, titles, and keywords were considered, and Boolean connectors were used. The term "innovation" was combined with at least one of eight different strings: air* (e.g., airport, airline, and aircraft), flight, transport, aviation, carrier, lcc, fsc and seat, which were identified as the terms with the highest frequency of incidence in the 129 files in the control document. From the 731 articles identified and analyzed, 92 were considered as directly related to innovation management in air transport. The results showed that the areas with a higher incidence of studies were the aircraft industry (energy efficiency, industrial process, and noise and pollutant emission reduction), airlines (business model, IT and planning and management), policies (sustainable transport, incentive mechanisms and societal aspirations), and airport (services, security, self-financing and air traffic control and projects). From this review, it was determined that, in addition to the limited studies on this subject, there is also a lack of research on innovations in airport structure, such as runway pavements and the optimization of airport sites, as well as on new forms of disposal of wastes generated during the flight, crew training and integrated innovation planning in the sector. These can direct future studies on the subject in the four application areas identified and promote the development of an integrated innovation system in air transport management.

Keywords: Air Transport; Bibliographic Literature Review; Innovation Management.

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INTRODUCTION

When it comes to air transport competitiveness, there is no denying their association with the management of innovation, for both manufacturing and service companies must constantly seek innovation of its products, services and processes (Utterback, 1996). In this sense, based on a systematic literature review, this study aims to identify what the recent literature considers as innovation in the air transport sector.

RESEARCH PROCEDURE

To identify previous topics in the literature on innovation in air transport, a systematic review of reports published in the last 10 years (from 2005 to 2015, including 2016 publications in progress) was carried out. The search used as a control document the proceedings from the 19th ATRS World Conference, held in Singapore in 2015, which includes 129 papers. The main strings were collected based on the frequency of incidence of the search terms, as shown in Fig. 1.



Figure 1: Strings identified in the ATRS 2015 Conference proceedings.

After the identification of the main terms related to air transport in the ATRS 2015 Conference proceedings, the search was carried out on the ScienceDirect database, which includes reports from over 2,500 journals. The abstracts, titles, and keywords were considered, and Boolean connectors

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were used. The term "innovation" was combined with at least one of eight different strings: air* (e.g., airport, airline, and aircraft), flight, transport, aviation, carrier, lcc, fsc and seat, which were identified as the terms with the highest frequency of incidence in the control document.

The ScienceDirect database includes journals from different fields of study: agricultural and biological sciences, arts and humanities, biochemistry, genetics and molecular biology, business, management and accounting, chemical engineering, chemistry, computer science, decision sciences, design, earth and planetary sciences, economics, econometrics and finance, energy, engineering, environmental science, immunology and microbiology, linguistics, materials science, mathematics, medicine and dentistry, neuroscience, nursing and health professions, pharmacology, toxicology and pharmaceutical science, philosophy, physics and astronomy, psychology, social sciences, sports and recreation, and veterinary science and veterinary medicine.

Of the 731 articles identified and analyzed, 639 were discarded as they deal directly from the air transport issue, because a lot of them treated on air conditioning, other modes of transport, etc. The remaining 92 articles, which were directly related to innovation management in air transport, were thoroughly analyzed with an interpretive approach and described in this study. For this purpose, the method of content analysis was applied (Krippendord, 2004).

RESULTS

The results showed that the areas with a higher incidence of studies on innovation in air transport were the aircraft industry (energy efficiency, industrial process, and noise and pollutant emission reduction), airlines (business model, IT, and planning and management), policies (sustainable transport, incentive mechanisms, and societal aspirations), and airports (security, self-financing, and air traffic control and projects). These were identified as the four application areas of study in air transport innovation. Table 1 presents these four areas according to their frequency of occurrence in the analyzed articles.

Table 1: Application areas of study.

	Frequency	**Percent**
Aircraft	37	40,2
Policy	22	23,9
Airline	21	22,8
Airport	12	13,0
Total	92	100,0

As shown in Fig. 2, the area with the highest prevalence of studies is the aircraft industry, which accounts for about 40% of the articles; the area with the least occurrence of studies is airports, with nearly 10% of the articles. This indicates that airports receive the least attention when it comes to air transport innovation. Figure 3 presents a summary of the authors, journals, application areas, and focuses of innovation.

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Table 2: Authors, journals, application areas and focuses of innovation.

	Authors	Journal	Area	Innovation Focus
1	Boy (2014)	Annual Reviews in Control	Aircraft	Automation.
2	Braga et al. (2014)	Progress in Aerospace Sciences		Lightweight structures.
3	Brueckner and Pai (2009)	International Journal of Industrial Organization		The regional jet as a new technological innovation.
4	Carlsson-Wall and Kraus (2015)	Industrial Marketing Management		The role of accounting practices in the fuzzy front-end of product innovation.
5	Catelani et al. (2016)	Measurement		Liquid Crystal Display (LCD).
6	Chen (2009)	Technology in Society		Y-10, the China's large airplane.
7	Chiaramonti et al. (2014)	Applied Energy		Aviation biofuels.
8	Chunxiang et al. (2011)	Materials and Design		Structural materials - titanium alloy.
9	Comes (2015)	International Federation of Automatic Control		Virtual testing.
10	Dranev and Chulok (2015)	Technological Forecasting & Social Change		Technology road mapping.
11	Geels (2006)	Technovation		The transition from aviation systems based on propeller-aircraft to aviation systems based on turbojet aircraft (1930–1970).
12	Grahamn and Morales (2014)	Transport Policy		Future aircraft technology for noise and pollutant emissions reduction.
13	Guirong et al. (2015)	Procedia Engineering		Penetrant testing for airplane parts.
14	Hajiyev (2012)	ISA Transactions		Aircraft flight control system.
15	Hajiyev (2014)	Measurement		Aircraft flight control system.
16	Hall et al. (2013)	Propulsion and Power Research		Aircraft cabins.
17	Ibsen (2009)	Technology in Society		Technological frame.
18	Kamoun, Afungchui and Chauvin (2005)	Renewable Energy		Wind turbine.
19	Kehrt (2006)	Endeavour		Environments for pilots (cabins).
20	Koroglu and Eceral (2015)	Procedia - Social and Behavioral Sciences		Human capital.
21	Kownacki (2015)	Aerospace Science and Technology		On-board sensors.
22	Lee (2010)	Energy Conversion and Management		Energy efficiency.
23	Lin et al. (2015)	Procedia Engineering		Performance simulation airplane.
24	Molent et al. (2009)	International Journal of Fatigue		Damage tolerance requirements.
25	O'Connell et al. (2013)	Procedia Computer Science		Systems engineering.
26	Pornet and Isikveren (2015)	Progress in Aerospace Sciences		Hybrid-electric technology.
27	Preez et al. (2005)	CIRP Annals - Manufacturing Technology		Documents as knowledge transcription.

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Table 2: Cont.

	Authors	Journal	Area	Innovation Focus
28	Schwabe, Shehab and Erkoyuncu (2015)	Progress in Aerospace Sciences	Aircraft	Metrics fo product life cycle cost.
29	Scranton (2007).	European Management Journal		Dynamic innovation of jet propulsion development.
30	Shukla et al. (2014)	Procedia Engineering		Integrated logistics system.
31	Slayton and Spinardi (2016)	Technovation		Radical innovation.
32	Tang (2006)	Technological Forecasting & Social Change		Navigation technology.
33	Uhlmann et al. (2015)	Procedia CIRP 35		Structural materials - titanium alloy.
34	Vazquez et al. (2011a)	Composites: Part A		Structural materials - Z-pinned composite.
35	Vazquez et al. (2011b)	Composites: Part A		Structural materials - Z-pinned composite.
36	Vishnevskiy, Karasev and Meissner (2015)	Technological Forecasting & Social Change		Corporate foresight - roadmapping.
37	Zhu, Zhang and Ding (2013)	International Journal of Machine Tools & Manufacture		Engines - nickel-based superalloys.
38	Akamavi et al. (2015)	Tourism Management	Airline	Passenger loyalty.
39	Akartunalı (2013)	Computers & Operations Research		Airline planning.
40	Akartunalı et al. (2014)	Computers & Operations Research		Airline planning.
41	Brown (2009)	Business Horizons		Corporate innovation.
42	Budd and Vorley (2013)	Research in Transportation Business & Management		Mobile software applications.
43	Bygstad (2010)	Information and Organization		Information infrastructures.
44	Chen and Chen (2010)	Expert Systems with Applications		Aviatic innovation system.
45	Fageda and Flores-Fillol (2012)	Regional Science and Urban Economics		Regional jet technology versus the low-cost business model.
46	Fageda and Flores-Fillol (2012)	European Economic Review		Distribution of traffic of network carriers.
47	Franke (2007)	Journal of Air Transport Management		Business model.
48	Gemicia and Alpkan (2015)	Procedia - Social and Behavioral Sciences		Determining factors of embracing disruptive innovation.
49	Hazledine (2011)	Journal of Air Transport Management		Business model.
50	Heracleous and Wirtz (2009)	Journal of Air Transport Management		Innovation strategy.
51	Kurt, Yilmaz and Karakadilar (2013)	Procedia - Social and Behavioral Sciences		Innovation practices.
52	Lin (2015)	Journal of Business Research		Innovative brand.
53	Meng et al. (2010)	Journal of Air Transport Management		Services of air cargo logistics providers.
54	Nicolau and Santa-María (2012)	Journal of Air Transport Management		Innovation on operating leverage.
55	Nicolau and Santa-María (2012)	Journal of Air Transport Management		Effect of innovations on market value.
56	Pereira and Caetano (2015)	Journal of Air Transport Management		Business model.
57	Ucler and Gok (2015)	Procedia - Social and Behavioral Sciences		Management system.
58	Yeh (2014)	Journal of Air Transport Management		Employee advocacy.

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Table 2: Cont.

	Authors	Journal	Area	Innovation Focus
59	Ahn and Min (2014)	Journal of Air Transport Management	Airport	Examination of the operational efficiency.
60	Arif, Gupta and Williams (2013)	Journal of Air Transport Management		Customer service.
61	Arvidsson et al. (2006)	Applied Ergonomics		Organizational climate.
62	Boussadia (2009)	Biometric Technology Today		Electronic security equipment.
63	Chen, Batchuluun and Batnasan (2015)	Technology in Society		Services innovation.
64	Doll and Karagyozov (2010)	Research in Transportation Economics		Financing structures.
65	Evans and Schäfer (2013)	Energy Economics		The rebound effect.
66	Gil, Miozzob and Massini (2012)	Research Policy		New infrastructure development.
67	Grant et al. (2013)	International Journal of Information Management		Services innovation.
68	Halpern (2010)	Journal of Air Transport Management		Marketing innovation.
69	Silvester et al. (2013)	Journal of Cleaner Production		Integration of electric vehicles in local energy infrastructures.
70	Sulmona, Edgington and Denike (2014)	Journal of Transport Geography		Border control.
71	Adriaensen et al. (2015)	Acta Astronautica	Policy	International relations between countries.
72	Andrew (2012)	Journal of Air Transport Management		Institutional policy innovation.
73	Benda (2015)	Journal of Air Transport Management		Innovations to enhance aviation security.
74	Chapman (2007)	Journal of Transport Geography		Greenhouse gas emissions.
75	Chèze, Gastineau and Chevallier (2011)	International Economics		Energy efficiency.
76	Coccia (2005)	Technological Forecasting & Social Change		Technological change.
77	Cohen (2010)	Research Policy		Personal aeromobility.
78	Eceral and Köroglu (2015)	Procedia - Social and Behavioral Sciences		Incentive mechanisms.
79	Ediger and Camdalı (2007)	Energy Policy		Energy and exergy efficiencies.
80	Fox (2014)	Research in Transportation Economics		EU framework concerning safety and security.
81	Harper (2013)	Journal of Economic Behavior & Organization		Economic coordination and property rights.
82	Knowles (2006)	Journal of Transport Geography		The role of transport in shaping space.
83	Koh (2007)	Technological Forecasting & Social Change		The impact of terrorism on economic growth and technological innovation.
84	L'Hostis (2009)	Journal of Transport Geography		Representation of global time–space.
85	Macauley (2005)	Space Policy		Prizes for innovation.
86	Macintosh and Wallace (2009)	Energy Policy		Aviation emissions.
87	Meric, Erb and Goruna (2015)	Procedia - Social and Behavioral Sciences		Higher Education.
88	Murakami and Matsuse (2014)	The Asian Journal of Shipping and Logistics.		Choices of air over seaborne transportation.
89	Nair and Paulose (2014)	Energy Policy		Green business model.
90	Smith (2008)	Energy Policy		Energy efficiency.
91	Wiesenthal, Condeço-Melhorado and Leduc (2015)	Transport Policy		Incentives to innovate in transport.
92	Yeoman et al. (2007)	Tourism Management		Oil market.

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Note in Tab 2 that each of the areas has the prevalence studies in particular subject. In the aircraft industry, the focus is on developing materials for building lighter and resistant structures, leading to reduced fuel consumption. In airlines, studies are directed toward the development of new business models to ensure the longevity of companies. Researches on airports look into the provision of quality services to passengers. Finally, in the area of policies, several studies focus on identifying instruments that could decrease emissions and increase energy efficiency in the sector.

Some specific studies presented in Tab. 2 draw attention to particular innovative practices. Chen (2009) compared aircraft imitation and innovation practices between the YUN-10 (Y-10), a large airplane developed in China, and the Boeing 707-020. Addressing a current concern, Chèze, Gastineau and Chevallier (2011) presented some of the most energy-efficient aircraft in terms of jet fuel consumption, ASK and RPK, as well as the geographic areas with high energy efficiency.

INNOVATION SYSTEM IN AIR TRANSPORT MANAGEMENT

The review of previous studies, which considered the number of studies on each area out of the 92 studies identified, resulted in the identification of four main application areas for a proposed innovation system in air transport management, as shown in Fig. 2.

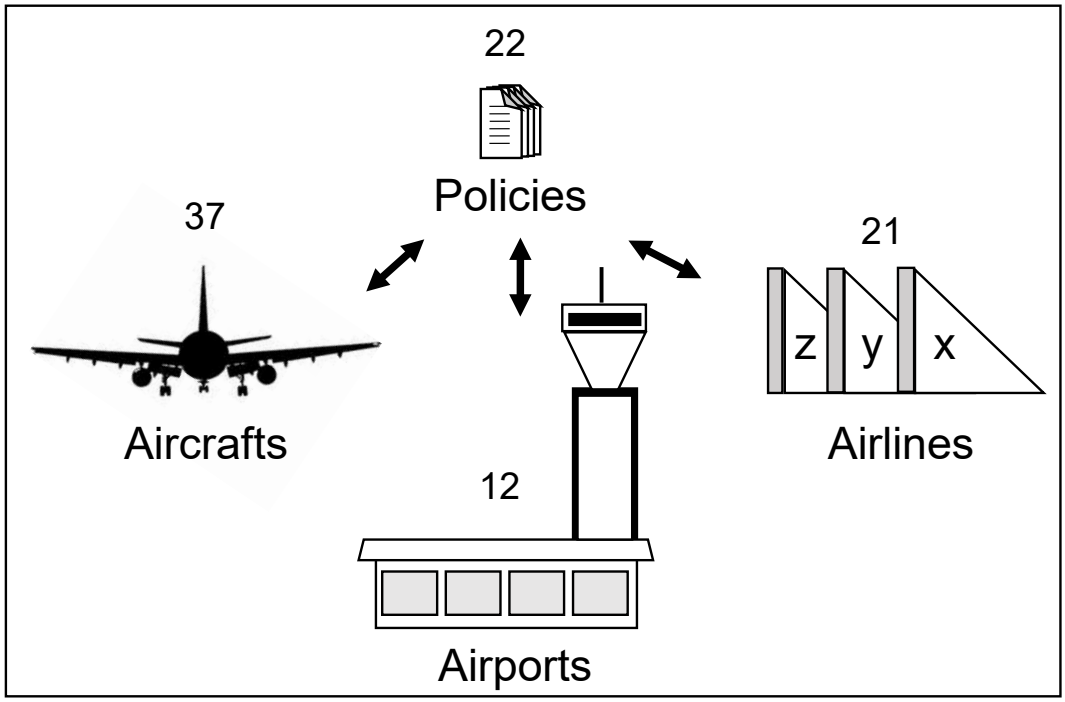

Figure 2: Innovation system in air transport management.

Figure 2 presents the innovation policies, in particular for the aircraft industry, airlines, and airports. The data indicate that there is a gap in innovation in this sector, specifically in the development of new products. For example, the aircraft industry should consider not only the demands of airlines

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or consumers but also the airport limitations, and vice versa. Note that some large aircraft, such as the A380 or the Boeing 747, cannot operate in most regional airports in the world. Given these considerations, it is necessary to take into account the best practices in other application areas in developing new products, services or processes.

FINAL CONSIDERATIONS

This study identified the main application areas of studies on innovation in air transport. Further, this research found that, in addition to the limited studies on this topic, there is also a lack of studies on innovations in airport structure, such as runway pavements and the optimization of airport sites, as well as on new forms of disposal of wastes generated during the flight, crew training and integrated innovation planning in the sector. These findings can direct future studies on the subject and promote the development of an integrated framework for a management system in air transport innovation.

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