SMALL AIRPORT PROJECT MANAGEMENT AND INNOVATION: A SCOPING REVIEW

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ABSTRACT

This study aims to provide a literature synthesis of what has been studied in the context of small airports, emphasizing topics such as airport project management and innovation to subsidize a future conceptual model for small airport project management based on innovation principles. Also, this paper is the first step of a major project that seeks to identify the capability of innovation in small airports. To this end, a scoping review of the literature, with elements of a comprehensive search, has resulted in a list of peer-reviewed papers showing the main lines of study about these infrastructures. The search using the descriptor "small airport" and synonyms through databases like ScienceDirect, Scopus, and Web of Science returned a universe of 3.746 unique studies for possible investigation in the last ten years. The present study shows the initial findings of an ongoing holistic evaluation of 1.186 documents with the potential to be included in the final review. Despite the significant number of papers that deal with each theme separately, a much smaller number deal with them together. Hence, the scoping review is the most appropriate methodology to verify opportunities, support the conceptual model mentioned above and future studies on the subject.

Keywords: Air transport, Building Information Modelling, Infrastructure, Technology.

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2. INTRODUCTION

The effects on the economy and social development given the presence of small airports, also known as catalytic impact, although recognized, are challenging to measure (Halpern & Bråthen, 2011) but continue to be investigated (Pot & Koster, 2022; Zhang & Xie, 2023).

In fact, not only the social and connectivity importance of small airports should be considered, as they can face challenges that can be even greater than traditional airports that have sufficient revenues to fund themselves or attract new operations (Červinka, 2017; Kazda, Hromádka & Mrekaj, 2017). Thus, the optimization of the resources involved becomes a prominent factor. Therefore, there are research lines in the literature that try to verify the efficiency of small airports (Gutiérrez & Lozano, 2016; Chutiphongdech & Vongsaroj, 2022), while others analyze the subsidies they receive (Wu & Qi, 2021). Also, the more there is a deepening in the context of these airports, the more lines emerge, such as those related to environmental issues (Harley, Timmis & Budd, 2020).

The examples above show that, over time, studies on the same subtopic, in this case, small airports, end up being segmented into several lines of research, and the vision of the whole may be lost since fragmentation can bring difficulties in synthesizing what has been questioned or already answered about a particular subject. At this point, a literature review indicating the main lines related to a specific theme and their gaps can be helpful. This is supported by a growing interest in research on small airports, and this subtheme could still be a potential focus of study. (Oliveira, Lohmann & Oliveira, 2022)

In addition, other lines can be detected with the revision, and other gaps can be highlighted. One may be concerning innovation, which has been pointed out as less pronounced in small airports, but the reasons need to be better investigated (Halpern, Mwesiumo, Suau-Sanchez, Budd & Bråthen, 2021).

To clarify, there is no consensus on an accurate and unique definition of what a "small airport" would be. It varies according to the context in which it is inserted. Even countries like Brazil, which, since 2015, have had a legal definition that considers an airport as regional if the annual passenger movement is less than 800.000 passengers per year for the Legal Amazon region or 600.000 pax/year for other regions (Silva, Granemann, Guarnieri & Da Silva, 2022), is still susceptible to debate. Harley et al. (2020), for example, adopt the number of five million passengers per year, in line with the documentation referenced by Karagkouni & Dimitriou (2022) of the European Parliamentary Research Service (EPRS). Furthermore, other requirements are mentioned, such as not being in capitals, covering point-to-point routes, and short and medium distances. ICAO (2016) also has its classification that divides airports into light, medium, and heavy, based on the number of aircraft movements. Although it is not a classification created with this debate in mind, it can serve as a basis for questioning whether the aerodrome operates as a regional airport. Another example is Bristol Airport, considered a busy regional airport (Risby, Guest, & Warnock-Smith, 2022), showing that the discussion of the characteristics of these airports can be expanded. Therefore, the recommendation is that the evaluation takes place on a case-by-case basis, aligned with the objectives of each research.

Product, process, organizational, and marketing innovations are mentioned in the literature (Whang, Chang & Lee, 2023). The last three can occur in small airports. Making a parallel between small companies and small airports, they could implement innovations under certain circumstances despite their financial limitations (Saka, Chan & Wuni, 2022). A practical example would be the implementation of Building Information Modelling (BIM) in some Brazilian small airport projects as a mandatory process. Given its relationship with project management methods (Peterson, Hartmann, Fruchter & Fischer, 2011), it can also be thought about how project management works in these infrastructures.

However, it is understood that, before dealing with innovation or project management in small airports, a previous step must be taken:

to know, through the literature, which elements have already received attention and which ones can still be explored.

Thus, this research aims to provide a literature review identifying what has been discussed about small airports and possible existing gaps, with a particular interest in innovation and project management, providing subsidies for future research.

The article was structured as follows: Section 2 presents the methodology in use and what stage the study is at. Section 3 brings some results and discussions based on the sample already analyzed and a first draft of the conceptual model of project management in small airports. Finally, Section 4 brings initial impressions of the results and possible directions.

3. METHODOLOGY

The paper consists of a scoping literature review (Munn et al., 2018) regarding small airports combined with project management and innovation. Such a review is adequate when one is not looking for an answer to a precise question but by mapping characteristics or concepts on a given topic, becoming aware of possible gaps, or even indicating the need for a systematic review. Another advantage of the scoping review is that it is inherently "systematic-like"; it also requires a rigorous approach in terms of protocols and methodological documentation while allowing more flexibility than a systematic review.

Furthermore, a comprehensive strategy in the literature search allows greater sensitivity in defining keywords through an iterative process, in which findings become subsidies for including new words (Ward, Stevens, Brentnall & Briddon, 2008). For example, small airports can appear as small, regional, remote, or rural (Baker & Donnet, 2012). Thus, if the search strategy does not include this feedback dynamism, this type of variation would most likely not be detected, leading to a bias in the search. Three significant databases were used: ScienceDirect, Scopus, and Web of Science (WoS). They concentrate the leading journals related to air transport. Furthermore, a database with complete texts like ScienceDirect also allows searching the full text, revealing the presence of chosen descriptors even if they are not in the abstract.

The fields considered for inclusion or exclusion of a paper were the title and abstract. The checklist followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (Tricco et al., 2018), which allows a more significant number of studies to be evaluated. For example, if at least one of the descriptors, "project management" or "innovation", combined with the descriptor "airport" are present in the abstract, the study was evaluated. Only peer-reviewed articles will be included in the study, this being the quality criterion. Its indexing in the databases partially guarantees this. Given the possibility of exceptions, a quick check was made for the papers cited in this study.

A combination of descriptors was used to conduct the review, as shown in Figure 1.

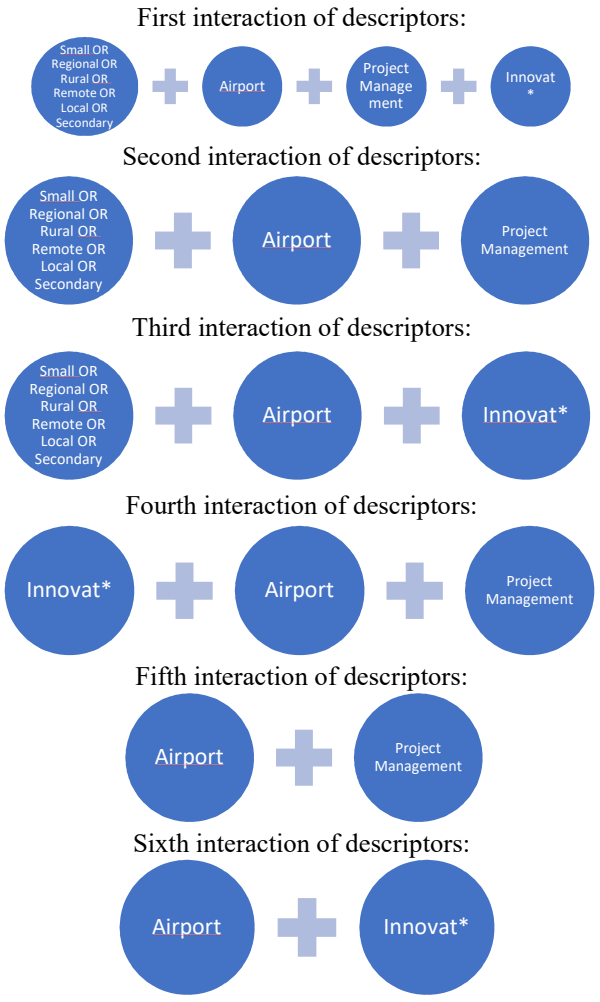


Figure 1 Combination of descriptors. Source: Authors.

According to Figure 1, the descriptors small, regional, rural, and remote, all followed by the descriptor airport, were combined with project management or innovation. The search strategy varies slightly according to the database, as different search engines have their specificities. A simple search was used in both WoS and Scopus, considering all fields. For a first contact with the topic, any prior limitations were avoided. The only exceptions were the combinations "airport" AND "project management" and “airport” AND “innovation”, which were limited to the title, abstract, and keywords fields to better direct the results. It should be noted that this limitation was only used in keywords considered supplementary.

After that, a filter was applied to limit the documents to articles and reviews. Conference papers, early access, or mini reviews were also considered, taking advantage of the source flexibility allowed by the scoping reviews. Additionally, conference papers may contain studies in progress like this. They were included to have a broader overview of lines of research initiated and prospect the topic for a more targeted review. Articles cited in the selected papers, when assessed as relevant, may also be used. Specifically for the case of ScienceDirect, truncation is not enabled in the database, so, after analysis, the descriptor innovat* was replaced by “innovation” or “innovative” to lead to approximately equivalent results among databases.

The other possibility is the combination of “innovation” AND “airport”, but a recent systematic review supports this search strategy. (Kiliç, Ucler & Martin-Domingo, 2021). Therefore, only papers from 2020 onwards were prospected in this case, although the overall article count includes all entries. Emphasis will be given only if the papers deal with small airports or innovations adaptable to small airports.

To ensure contemporaneity, the last ten years were considered, that is, 2012 to 2022 (Paré, Trudel, Jaana & Kitsiou, 2015). In addition, the results include papers from January to August 2023. Thus, until the moment, 2.695 papers were minimally evaluated, focusing on title and abstract. Of these, 1.185 were chosen for closer evaluation. As this is ongoing and relatively complex research, given the need for analogies among distinct and fragmented themes, the detailed review of each paper is still in progress, limiting citations to those completed. Thus, the final count may vary until completion, as the search is comprehensive. Some older articles may be cited, but only for contextualization, and are not part of the results.

To reduce bias, desirable in scope reviews, some procedures were followed. One of them is the evaluation of abstracts without checking the authors and journal of origin. This allowed only the content to be focused, with the quality assessment being made only in the next step. This avoids a tendency to consider journals that have the highest metrics. As a language requirement, only articles with abstracts in English were evaluated.

Before the quality assessment, the inclusion/exclusion criteria were defined, which was done comprehensively. Around 20% of the database was evaluated. From the initial keyword search, which necessarily included “small” and similar terms, due to the relatively low number of articles specific to small airports, the scope was expanded. Thus, the inclusion criteria were as follows:

Articles that contained the theme of innovation, technologies, or project management in related areas such as infrastructure projects or buildings. It is imagined that some of the case studies presented, with due investigation, could be transferred to the theme of small airports. In the case of spillovers, they were generally disregarded unless the analogy for use in small airports in the project phase was clear. For example, BIM is a field with many studies in recent years. BIM articles that mention its interface with projects were included, while those that deal exclusively with implementing BIM in organizations, which would be a previous step, were excluded. The same reasoning is used for purely methodological papers or in the case of the public-private partnership (PPP) contracting format without relation to the project phase. However, it is recognized that this may have an impact on the way the project unfolds.

Also, possible identical articles with different Digital Object Identifier (DOI) or the same abstract were evaluated for similarity, being eliminated if they had the same content. In the case of a paper published at a conference and later published in a Journal, the Journal article prevails.

As an initial contact with the topic, automated computational tools were avoided, except for spreadsheets and reference organizers. After the complete evaluation, such tools will be considered in the results synthesis stage.

4. RESULTS

The search, with the descriptors “small”, “regional”, “rural”, “remote”, “local,”, and secondary combined with airports, project management, and innovation, leads to the quantities shown in Table 1.

Table 1 Search results

Descriptor 1	*Descriptor 2*	*Descriptor 3*	*Paper count*
Small Airport	Innovat*	Project management	10
Regional Airport			43
Rural Airport			0
Remote Airport			0
Local Airport			8
Secondary Airport			5
Small Airport	Innovat*	-	493
RegionalAirport			923
Rural Airport			13
Remote Airport			77
Local Airport			291
Secondary Airport			313
Small Airport	-	Project Management	12
Regional Airport			58
Rural Airport			0
Remote Airport			0
Local Airport			10
Secondary Airport			6
Airport	Innovat*	Project Management	2442
Airport	-	Project Management	798
Airport	Innovat*	-	2366
Total			7868

The results in Table 1 demonstrate the papers returned by the databases before filtering, that is, with their duplicates. The third column shows how many articles were initially returned.

In general, when looking at the specific descriptors of small airports (rural, remote, regional, etc.), there is a small number of papers, considering there will be duplicates or eliminated papers after the evaluation. In this case, as a scoping review and considering that some project management practices can be adapted for smaller projects, the other approach was to exclude the airport's size in the descriptors. This leads to 5511 unique articles, which, after the 10-year time limitation, as explained in Section 2, leads to the 3.746 that are part of the evaluation. Until the completion of this paper, 2.695 were evaluated based on the title and abstract, resulting in 1.186 pre-selected, and a sample was chosen for more detailed evaluation, quality checking, and development of this article. Since this is research in progress, the numbers may vary in the end.

The articles that have the keywords of most significant interest like "small", "regional", "rural", "local", "remote" and "secondary" correspond to only 2.262 articles, that is, around 28.7% of the total sample of 7.868 articles. Of these 2,262, the vast majority (2110) was combined with the word “innovation”. This number would be even smaller if the search were restricted to the title, abstracts, and keywords fields, similar to what was done with the complementary keywords (those combined with just "airport"). Therefore, ignoring what is also being applied at larger airports would probably bring bias to the research. Thus, the option of adding combinations with the word "airport", without "small" and synonyms sought to verify whether design practices and innovations present in these larger airports could somehow be brought to the reality of small airports.

After these considerations, the articles were grouped and carefully checked for duplicates. This includes mandatory reading of the abstract and checking the DOI before making any exclusion decision.

Only a few of these papers can be effectively considered as dealing specifically

with small airports related to innovation and project management. Taking, for example, the term “small airport”, a system of radar sensors is proposed for very small airports or private runways that can detect aircraft and pedestrians within a specific range, seeking safety in operations, with low cost as one of the advantages (Martelli et al., 2016). The proposed innovation uses the WiFi network, so an insight would be to consider using mobile networks in the future to reduce their cost further.

Still, in technologies in small airports, there is the development of a new method for monitoring defects on runways, using a more automated approach instead of manual measurements (Kovačič, Doler & Sever, 2021). The experiment was carried out at a regional airport in Slovenia. However, it is noted that the method can be used on other runways and is therefore adaptable to other types of infrastructures that require the same type of measurements.

The cost issue seems to be essential for small airports. Remencová & Sedláčková (2021) investigated self-service technologies in check-in areas using kiosks and that, although acquisition and maintenance costs are high for the reality of a regional airport, the investment can cost around five times less than remaining with traditional check-in methods. Despite the possible variations, it is an effort to relate the benefits of a possible digital transformation in airports of this size.

Another approach is the adaptation of existing systems at larger airports, such as, for example, the Airport Collaborative Decision Making (ACDM). For small airports, the so-called ACDM Lite is proposed (Schultz, Rosenow & Olive, 2019). Although the maintenance and implementation value of the 16 ACDM milestones is unfeasible for small airports, its simplified design can meet 8 of these milestones using public data from automatic dependent surveillance-broadcast (ADS-B). In some cases, the need to implement ACDM Lite goes beyond the airport's individual needs, which, given its simplicity, does not require the system, but on improving the management of the whole airport network at an acceptable cost.

These initiatives show there is potential for small airports to become potential environments for developing new technologies. Its low movement, with larger operational windows and structures that often resemble some components of larger airports, allow for initial testing of products that can later be applied to larger airports.

Another point of interest in the literature is Urban Air Mobility (UAM). Although some articles were not selected due to the exclusion criteria, as they deal exclusively with aspects related to aircraft or routes, the issue of vertiports and small airports may be a topic. Thinking about the scale of these airports and the cost aspect, the implementation of vertipads can also be an alternative, as it is the smallest infrastructure mentioned in the literature (Brunelli, Ditta, & Postorino, 2023b), but other alternatives, such as vertihubs cannot be ruled out. The three differ in terms of the number of simultaneous aircraft. Targeted research in ScienceDirect with the descriptor vertiport returns, in the last three years returned 86 results, including reviews and articles, which shows that much effort has been demanded on the topic. Brunelli et al (2023b) bring a literature review based on design, capacity, and location. However, it is difficult to establish a standard size for these infrastructures as they depend on critical aircraft, and several configurations are still under development, with the Federal Aviation Administration (FAA) itself saying that the Advisory Circular (AC) will be defined in the future.

Another point is the limited range considered for the electric Vertical Take-Off and Landing (eVTOL) (Ribeiro, Borille, Caetano & Silva, 2023; Brunelli et al., 2023b), indicating that not all regional airports could be used. In this case, the study by Ribeiro et al. (2023), which verifies the potential for using existing aerodromes and heliports in the State of São Paulo, Brazil, as potential infrastructures to receive these aircraft, can be used as a basis for eventual research considering the associated implementation or adaptation costs and checking the willingness to pay of the managers of these aerodromes through possible layouts and identifying the acceptance based on the price and reality of

each airport. It is understood that these requirements of minimum spaces and elements are necessary for a correct cost estimate. However, it would be a possible path while the definitive dimensions of the vertiports are still under study. This approach already finds support in specific UAM literature, but in other contexts, such as demand forecasting for airport shuttles in the Italian context (Brunelli, Ditta, & Postorino, 2023a)

Given the limitations of specific studies in small airports, this project was carried out through analogies with related areas. This approach is not new in the literature. When verifying environmental practices in a population of 441 Small European airports and the factors that lead to adopting these practices, Harley et al. (2020) use analogies with small organizations. Similarly, the investigation of environmental issues at small Canadian airports considers small airports as Small and Medium-sized Enterprises (SMEs) (Boiral, Ebrahimi, Kuyken & Talbot, 2019), making this type of practice feasible under a careful approach. This type of analogy requires empirical confirmation to verify in the field which factors are applicable or not, something that both articles do. Based on this kind of analogy, Figure 2 presents the current word cloud of the pre-selected articles:



Figure 2 Word Cloud of pre-selected papers. Source: Authors.

Figure 2 was created using the articles' keywords with the exclusion of descriptors such as "project" or "airport", since these words, which were part of the search strategy, distorted the cloud. The treatment also included the removal of words such as country names. Thus, it is noted that terms related to construction and design appear the most, followed by decision-making, sustainable development, risk management, and life cycle. Also, on a smaller but relevant count, megaprojects and costs.

Based on the most frequently occurring keywords up to this stage of the study, the future conceptual model for small airport projects will be developed around the concepts presented in Figure 3:



Figure 3 Initially proposed conceptual model Source: Authors.

As shown in Figure 3, the central theme is the design of small airports. Around it gravitate concepts such as BIM, Lean Construction, sustainability, and Agile methodologies, as well as good practices in megaprojects and risk management. As the detailed analysis of the articles progresses, new insights can be added or concepts merged. In this model, there are still no hierarchies and interdependencies, but the objective is that, in the end, the best project management and innovation practices are brought into the model.

BIM seems to be a trend. Seventy-eight articles, or around 6% of the pre-selected papers, present the topic in their keywords. Of these, around 61.5% in the last five years.

Some are combined with other concepts, such as lean construction, including real applications at Istanbul Airport. (Michalski, Głodziński & Böde, 2022). It can be seen from the paper that, in terms of equipment, tablets were used to monitor the work in connection with the model, thus providing insights into the application of this practice in a small airport project. BIM and Lean Construction seem to be a topic of investigation already since, in the literature, there is a suggestion of using the two combined to remove inefficiencies in small constructions (Eivindson, Innvær, Kolberg, Merschbrock & Rolfsen, 2017). Furthermore, there is the integration of lean BIM and sustainability through a systematic literature review (Moradi & Sormunen, 2023).

Agile practices have also been studied in the management of transport projects (Šimíčková, Buganová & Mošková, 2021). In the argumentation, there was a mention of regional airport projects, with the understanding that the study was also consistent with this reality. Two of the ten main risks identified in project management in companies were: lacking in risk management and in the project itself. However, factors such as deficiencies in training or support from senior management, which can be understood as directly related to the first two deficiencies, are also on the list, thus increasing the number of challenges related to management. The authors also point out that even simpler projects present elements of risk. After the qualitative evaluation of four agile methodologies, Scrum, Kanban, ScrumBan, and Extreme Programming, they concluded that the first three could be used in the context of transport projects, with an emphasis on ScrumBan.

The issue of sustainability in small airports has already been discussed previously in this study, but here, it is worth clarifying that not only environmental aspects are part of this term. When thinking about sustainability dimensions, two more can be highlighted in addition to the environmental one: social dimension and economic dimension (Sreenath, Sudhakar & Yusop, 2021). The social dimension includes noise management, employee development, and community investment, while the economic dimension is the sum of direct, indirect, catalytic, and induced impacts by the presence of the airport. Also included in this dimension are the passenger experience, airport safety, and security. The Triple Bottom line (TBL) or 3P (people, planet, profit) concept used in the construction of the previously mentioned article means that these other aspects should be considered, that is, an approach that goes beyond pure and straightforward financial performance (Hammer, & Pivo, 2017; Sreenath, et al., 2021).

TBL maintains a close relationship with Integrated project delivery (IPD), which focuses on the integration of people, business structures, systems, and practices to improve the results of a project through a collaborative process in all its stages of execution (Karasu, Aaltonen & Haapasalo, 2023).

Finally, good management and innovation practices in megaprojects and complex projects can be used to support the conceptual model. Despite the massive difference in scale, some principles are common to small airport projects. For example, Ashkanani & Franzoi (2023), in search for gaps in the literature on the topic of megaprojects management systems, classified the results into nine clusters:

1. Project planning and control;
2. Conceptualization and execution strategies;
3. Organizational structure and project governance;
4. Safety, health and environment;
5. Cost and schedule;
6. Risk analysis and management;
7. Procurement process,
8. Stakeholder alignment, engagement, and satisfaction;
9. Project closeout.

These are the same design steps followed at a small airport. It is worth remembering that despite the term "small", these infrastructures have their complexity, mainly because they combine different engineering specialties, including different specializations for airside and landside. Therefore, even if only some of the elements contained in these stages apply to a regional airport's reality, it is worth investigating what can or cannot be brought to simpler realities.

5. CONCLUSIONS

The objective of this paper was a general presentation of the progress of the project and a broad overview of what has been researched regarding small airports, with greater detail on topics such as innovation and project management, establishing a basis for research on derived topics such as the capability of innovation of small airports.

The prospected articles could be more extensive in terms of scope when compared to what has been researched at larger airports regarding innovation and project management. Despite the descriptors being focused on these topics, the results returned only allow the construction of reasoning with analogies, making research on innovation in small airports a complex issue. The most significant difficulty is given by the financial limitations of these infrastructures. This need for adaptation suggests that the most appropriate approach to the problem, in addition to the final scoping review, is the segmentation of themes in systematic reviews and field research to obtain an answer from the point of view of the managers of these airports.

As mentioned, this is ongoing research in which several points for improvement have already been identified, and this refinement will allow the proposition of the conceptual model of project management with innovation principles in small airports.

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