

Performance Measurement in Airport Settings: A Systematic Literature Review

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Purpose

This study aims to provide a comprehensive overview of the literature related to performance measurement in airport settings. Two research questions were addressed: a. how the literature has evolved during the last forty-five years; b. which performance dimensions have been emphasized during this period.

Design/methodology/approach

For the purpose of this study, 380 documents, published between 1970 and 2015 were systematically analyzed. The literature reviewed comprises academic peer-reviewed articles, and studies published by other relevant sources, including professional-related literature.

Findings

The literature reviewed points to three stages relating to the evolution of the performance measurement in airport settings during the period analyzed. Although with a significant lag, this evolution seems to have followed the broad literature on performance measurement. Moreover, a relationship between these stages and the changes occurring at the airport industry was found. Several aspects of airport multidimensional performance are identified and discussed.

Research limitations/implications

Based on the findings of this study, it is concluded that a more comprehensive approach to airport performance measurement is needed. In this context, a research agenda is suggested.

Practical implications

The findings of this study have relevant practical implications for the airport industry. In this context, a framework representing a comprehensive approach to airport performance dimensions with impact on external stakeholders is presented. This framework can be a relevant contribution for researchers and practitioners which are looking for a more comprehensive and multidimensional approach to airport performance measurement.

Originality/value

To the best of our knowledge, this study appears to be the first to examine the literature related to airport performance measurement according to such a comprehensive approach. A framework of the performance dimensions related to the airport business is provided.

Keywords: Performance measurement; Systematic Literature Review; Airport performance; Performance dimensions.

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1. Introduction

The interest in performance measurement has increased in the last decades, with the recognition of its importance for private and public organizations in a constantly changing business environment. This long time interest has been reflected in the development of actual performance measurement practices and consistent research literature (Bourne et al., 2014; Choong, 2013; Franco-Santos et al., 2012; Lampe and Hilgers, 2015; Mathur et al., 2011; Neely, 2005).

In addition to the typical reasons for considering performance measurement essential for organizations (Hamann et al., 2013; Neely, 2005; Sharma et al., 2005), concerning airports some particular issues can be added, such as: the increasing air traffic demand, the deregulation process that air transport sector has been subjected, and the movement for changing airport ownership and governance forms.

Currently, airports worldwide have been no longer considered solely as huge facilities and public utilities, but complex service organizations operated in a commercial-like way (Gillen, 2011; Graham, 2009). Consequently, a broader perspective of airport performance is needed, as well as the development of reliable performance measurement practices. In this context, understanding how the airport industry has evolved and addressed different aspects of performance measurement are timely and relevant issues.

The objective of this study is to provide, according to replicable procedures, a comprehensive overview of the studies related to the subject. Explicitly, the following research questions were addressed in the process of systematic literature review.

- a) How the literature related to airport performance measurement has evolved since the 1970s?

- b) Which performance dimensions related to the airport business have been emphasized?

The next section provides a background on performance measurement and relevant trends related to the airport business with implication for airport performance measurement. In the methods section, research design and criteria are described. The results are presented and discussed in the fourth section. Finally, a summary of the findings, implications, and considerations on a research agenda are delivered.

2. Background

2.1. Performance Measurement

Current issues in empirical research are related to the design and implementation of Performance Measurement Systems, including the integration of performance measurement with the organization's strategic management practices and culture (Bourne et al., 2014; Choong, 2013; Franco-Santos et al., 2012; Nudurupati et al., 2011). Regarding theoretical studies, there are concerns about research and practical implications of the performance construct's multidimensionality, including the reliability and validity of performance measures (Boyd et al., 2005; Hamann et al., 2013; Sharma et al., 2008).

The literature on performance measurement is currently vast and varied, comprising different sources, from reports on ad hoc projects, to books and papers published in several academic journals, some of them exclusively dedicated to the subject (Bourne et al., 2014; Nudurupati et al., 2011; Taticchi et al., 2010). However, due to its multidisciplinary nature there are different approaches to the performance construct, depending on the authors' background and the research purposes. Concerning the problem of measuring performance, this may lead to imprecise conclusions and ambiguous managerial implications (Combs et al., 2005; Richard et al., 2008). Therefore, any discussion on performance should be preceded by sufficient

clarification in order to provide an appropriate construct definition and clear approach to the subject.

In this context, our research was based on the background provided by the strategic management field and considered organizational performance as an extended concept of organizational effectiveness. This extended concept concerns not only to the degree to which organizations are attaining their stated goals, but also for the economic and social outcomes resulting from the interaction between the organization and its environment (Cameron, 1986; Combs et al., 2005; Hamann et al., 2013; Venkatraman and Ramanujam, 1986).

Such a broad concept embraces the current concerns on the economic, environmental and social outcomes of the organization's activities (Brammer et al., 2012). However, an effective performance measurement approach needs to be complemented by a more intra-firm perspective (Bhagwat and Sharma, 2007). Thus, we also considered the concept of operational performance, which accounts for specific operational dimensions of the business activities (Hamann et al., 2013; Venkatraman and Ramanujam, 1986).

The operational performance includes the activities that support the product/service production and delivery to customers (Ray et al., 2004). Therefore, their outcomes are directly perceived only in the firm level and their effects on the organizational dimension are not necessarily independent of each other. In this context, the operational performance mediates the effects of these activities and organizational capabilities in the organizational performance domain (Combs et al., 2005; Ray et al., 2004).

Based on this aforementioned discussion, this study approaches performance measurement according to these two distinct but interrelated domains of performance analysis: operational and organizational performance.

2.2. Trends in Airport Business

Airports have experienced significant challenges in the last decades. Some factors may have been particularly related to airport performance measurement: i) increasing air transport demand; ii) deregulation of the air transport market; and iii) changes in airport ownership and governance forms. Consequently, it seems that there is a more commercial perspective for airport management.

The air transport industry has strongly increased worldwide. From 1990 to 2014, the number of passengers improved by 214% (World Bank, 2015). The demand for air travel is expected to grow at a 4.1% average annual rate, reaching 7.3 billion/year by 2034, which is more than twice the 3.3 billion passengers in 2014 (IATA, 2015). As airports are infrastructure-intensive, they require a high amount of investments and they are subject to step changes in size and capacity (Graham, 2014). Therefore, a non-effective response to the increasing traffic demand may lead to significant events of congestion or even to capacity crunches. On the other hand, improving capacity in anticipation may be inefficient. In this context, airport managers have been expected to efficiently accomplish investment programs, optimize the available resources and review operating processes (Adler and Liebert, 2014; Diana, 2010). In this context, performance measurement becomes an essential activity for supporting decision-makers regarding the airport investment cycle.

Since the late 1970s there has been a movement for deregulation in the air transport market (Jarach, 2001). Beginning in the US and followed by other countries at different times, Firstly, the emphasis was on fostering competition among airlines. More recently, the organization and delivering of infrastructure services have been considered (Gillen, 2011; Janic, 2008). In this scenario, airports may now compete not only in the context of long haul connecting hubs, but also in the context of multi-airport systems bidding for airlines to provide service and to base aircrafts at the airport (Assaf et al., 2014). Since airports have been facing

increased pressure for higher quality and efficiency (Fry, Humphreys, et al., 2005; Green, 2014), there is the need for an effective performance measurement process.

Changing airport's ownership and governance forms appeared to be a response to the increasing demand and to the new airline's business models (Graham, 2011; Oum et al., 2008). Different types of privatization have been implemented worldwide (Gillen and Mantin, 2014; Oum et al., 2008). Regardless the model adopted, privatization implies regular performance monitoring and measurement within the State's regulatory function (Adler et al., 2015; Gillen and Mantin, 2014). Accordingly, airport privatization has not only brought a different management perspective to the airport sector, but also has required the definition of objectives and performance targets to be satisfied by the airport managers within the regulatory context.

In this current business environment, airports have become modern organizations delivering efficient and high quality services to different customers, including airlines, passengers, retailers, and users in general (Gillen, 2011; Graham, 2009; Jarach, 2001). The perception of airports as complex service organizations leads to considering the interests of the different stakeholders, including the environmental and social issues related to the aeronautical activities (Skouloudis et al., 2012; Zakrzewski, 2008). This more comprehensive approach has implied significant challenges for airport performance measurement, once the most appropriate measures for the performance aspects of interest of the stakeholders, such as customers, local governments, regulators, and community, are usually non-financial (Adler and Liebert, 2014; Humphreys et al., 2002; Neely, 2005).

In this context, the focus of airport performance measurement has been progressively moved from measuring just operational and financial performance to a more holistic and multidimensional approach, in which other aspects of the airport performance are equally relevant (Fernandes and Pacheco, 2007; Gillen, 2011; Skouloudis et al., 2012). Therefore, it has

become ever more important the identification, measurement, analysis and withdrawal of relevant information regarding the several aspects of the airport performance.

3. Methods

This study was undertaken according to the Systematic Literature Review method, concerning to reduce systematic errors or bias. For that purpose, the research procedures need to be documented and an audit trail of the research must be provided (Ginieis et al., 2012).

A systematic literature review aims to identify, appraise and summarize relevant studies to answer one or more research questions (Petticrew and Roberts, 2006). As presented in the introduction section, the two research questions addressed are related to the evolution of the literature on airport performance measurement since the 1970s and the performance dimensions related to the airport business that have been emphasized.

3.1. Research Criteria

For the purpose of this study, the following online sources were used: Elsevier Online Database (Science Direct), Emerald Insight, SAGE Publications, SpringerLink, Taylor & Francis, Wiley Online Library, Blackwell, Scopus, and Proquest. Additional searches were processed in the TRID database (Transportation Research Board, 2015), since it was expected to find relevant grey literature (Juricek, 2009), i.e. studies published outside academic journals, but released by relevant sources. These additional searches included books, book chapters, technical or research reports, and some conference proceedings¹.

Date range comprised the period from 1970 to May/2015. The research effort was undertaken from January/2015 to May/2015. The results with keywords appearing in the document's title, abstract or document's keywords were considered potentially relevant.

¹Proceedings provided by the referred publishers or TRID database were considered in the literature sample.

The literature review comprised two phases. The first phase focused on airport performance according to a wider perspective. Therefore, the following keyword combinations were used: airport + performance, airport + measurement, and airport + management. The second phase aimed to identify the several aspects related to airport performance. Thus, compound keywords with the terms “airport” and “performance” along with terms referring to the several aspects previously identified in the first phase have been used, such as: efficiency, productivity, benchmarking, financial, finance, economic, service quality, level of service, satisfaction, customers, safety, security, operational, operation, competition, competitiveness, environmental, noise, pollution, and social.

3.2. Classification Categories

Consistent with the study’s purpose and research questions addressed, the documents were assessed and classified according to the following categories:

- Period of time of the publication;
- Source of publication (whether academic journal or grey literature);
- Type of document (whether article, book, book chapter or report);
- Nature of the study (whether empirical, conceptual, case study, literature review, simulation, report, case study or practical guidance);
- Performance dimensions emphasized.

As regards the performance dimensions, we have based on the background previously discussed. Moreover, we followed the premise that performance measures should be derived from the need of stakeholders, instead from prescriptive strategies (Neely et al., 2001). Hence, we aimed to provide a framework of the performance dimensions with interest by external stakeholders. The identification of airport’s external stakeholders was based on Zakrzewski (2008), comprising: customers (airlines, other air operators, passengers, passenger’s

companions, other airport users); infrastructure asset providers; suppliers and partners; investors/shareholders; government; regulators; community; and environmental groups.

Therefore, we firstly identified the aspects related to airport performance measurement during the literature review. Then, we submitted the set of potential performance dimensions to content validation by nine specialists, among scholars and professionals in three different countries. These specialists were contacted personally or by email and asked to state their opinions on the proposed categorization vis-à-vis a definition of scope and a set of examples of related performance measures. The objective was to obtain the specialists' opinion on whether the proposed dimensions appropriately comprised the respective performance measures and whether these dimensions were sufficiently discriminant among each other.

3.3. Data treatment

Following the research criteria, 370 potentially relevant studies were identified through the searching databases. Additionally, 72 potentially relevant grey literature documents were found. However, after careful examination of the abstracts and introductory sections, we realized that some documents have used the terms in contexts not relevant to this study. Therefore, the documents not actually pertinent were excluded and the 380 remaining documents were considered for analysis (Figure 1).

[Insert Figure 1 here]

4. Results

The knowledge on airport performance measurement is well documented, comprising empirical studies, theoretical essays and literature reviews, along with professional studies. However, only by the middle of the 1990s performance measurement issues become more evident (Figure 2).

[Insert Figure 2 here]

As regards the research literature, five journals concentrate about 41% of the publications, namely the Journal of Air Transport Management, Transportation Research: Part E, Transportation Research Record; Journal of Airport Management, and Transportation Research: Part A (Figure 3).

[Insert Figure 3 here]

The figure 4 presents the studies according to their nature: empirical, conceptual, case study, literature reviews, simulation, practical guidance, and reports. Empirical studies represent about 73% of the sample literature, followed by conceptual studies and literature reviews, both with 7%.

[Insert Figure 4 here]

4.1. The Evolution of Airport Performance Measurement

Based on the literature reviewed, the evolution of airport performance measurement may be explained in three stages. The first stage comprises the 1970s and 1980s. The second stage comprises the 1990s and the early 2000s. The third stage comprises the period from the early 2000s until the present days. The figure 5 illustrates this evolution along with information regarding the airport business environment and the broad literature on performance measurement (PM).

[Insert Figure 5 here]

Stage I

In this first stage, studies related to airport performance measurement were scarce in the literature. (See figure 2). This lack of interest might be associated with the weak business pressures within the airport industry, once airports were mostly under government ownership (Francis et al., 2002; Gillen, 2011; Graham, 2005).

As regards this time period, few studies have been identified, basically focusing on the operational, efficiency and financial aspects of airport performance (Doganis and Graham, 1987; Doganis and Nuutinen, 1983; Doganis and Thompson, 1974; Doganis et al., 1978; Keeler, 1970; Whitbread, 1971). The assessment of the level of service (LOS) in passenger's terminals has also received attention (Bennets et al., 1975; Mumayiz and Ashford, 1986; Omer and Khan, 1988; Tasic and Babic, 1984).

In general, during this first stage the airport industry had been aligned with the issues and practices reported by the broad literature on performance measurement. Notwithstanding, airports seem to have been slow in adopting a non-financial approach to performance measurement, which was emphasized in several other contexts at the late 1980s (Assaf, 2011b; Yasin and Gomes, 2010). Focusing on the European context, Doganis and Graham (1987) concluded that few airports had implemented comprehensive and systematic performance practices, mostly stressing the use of financial and operational indicators.

Stage II

Following the trend towards making airports financially self-sufficient, the airport industry has been progressively motivated to adopt a different approach regarding performance measurement (Graham, 2005; Jarach, 2001). During this period, airports have increasingly been recognized as mature firms that should be able to stand-alone and operate without government support (Gillen & Lall, 1997).

There was a significant increase in the literature during the decade of 1990, what appears to have led to its recognition as trending topic in airport-related literature (Gillen and Waters, 1997). Airport benchmarking arose as the main topic, with efforts for improving the methods for efficiency/productivity assessment (for further discussion, see Graham, 2005; Lai et al., 2012; Vogel and Graham, 2013). It has also become object of regular studies carried out by

organizations within the airport industry (Air Transport Research Society, 2002; Transport Research Laboratory, 1999).

Despite this increasing interest in airport benchmarking, the limited value of simple comparisons among performance indicators was emphasized. Some authors have advocated the need for exploring the effects of airport characteristics, managerial factors, and exogenous variables on airport efficiency/productivity to provide more useful insights from the benchmarking results (e.g. Bazargan and Vasigh, 2003; Gillen and Lall, 1997; Humphreys and Francis, 2002; Parker, 1999; Sarkis, 2000; Yoshida and Fujimoto, 2004).

Additionally, during this second stage, the following issues have emerged:

- Environmental and social issues associated with the airport activities (e.g. Ignaccolo, 2000; Inamete, 1993; Morrell and Lu, 2000; Pitt and Smith, 2003);
- Advances in terminal level of service (LOS) assessment by simulation-based models (e.g. Brunetta et al., 1999; Ignaccolo, 2003) and by passenger's perception regarding the terminal elements and airport processes (i.e. check-in, security screening, etc.) (Hackett and Foxall, 1997; Lemer, 1992; Muller and Gosling, 1991; Mumayiz, 1991; Seneviratne and Martel, 1991, 1994);
- Aspects of competition within the airport industry (e.g. Park, 1997, 2003; Pathomsiri and Haghani, 2004);
- Considerations on the airport performance multidimensionality and relevance of the airport stakeholders (e.g. Francis et al., 2002; Humphreys et al., 2002; Janic, 2003).

Regarding the broad literature on performance measurement, there was a peak of research activity by the late 1990s, with emphasis on the multidimensional perspective for performance measurement and the development of performance measurement systems (Neely, 2005; Neely et al., 2000; Taticchi et al., 2010; Yasin and Gomes, 2010). It is noteworthy that

the airport-related literature has followed these trends with a significant lag (Francis et al., 2002; Graham, 2005).

By the early 2000's, some literature reviews and empirical studies on the actual practices of airport performance were published (e.g. Francis et al., 2002; Humphreys and Francis, 2002; Humphreys et al., 2002). A review on the evaluation of airport level of service was provided by Correia and Wirasinghe (2004). There were also reviews of previous benchmarking studies focusing on airport efficiency (Fry, Humphreys, et al., 2005; Graham, 2005; Mackenzie-Williams, 2005).

In this context, for the purpose of describing the evolution of the literature on airport performance measurement, these more systematic efforts of literature review and critical analysis may represent a significant milestone, since they may reveal a maturing of the research on airport performance measurement.

Stage III

The literature kept increasing in terms of quantity and range of performance aspects considered. About the middle of the decade of 2000, besides significant developments in the performance benchmarking and LOS studies, a broader approach to the performance construct began to be more evident in the airport related literature.

Covering the last decade, this third stage seems to reveal an increasing interest in approaches and methods currently used in other service settings. The following issues are representative of the more recent literature on airport performance measurement (Table 1):

[Insert Table 1 here]

Despite the introduction of relevant issues, airport benchmarking remains as the main topic of interest. Benchmarking practices are paramount for improving performance, however, while airports are required to identify the organizational practices that might be related to the

superior performance (Adler et al., 2013), it seems that the airport-related literature mostly adopt an efficiency-based perspective for benchmarking (Hong et al., 2012).

Airport service quality appears as the second more frequent topic, with some approaches and methods usually applied within other industries appearing to have gained momentum (see Bogicevic et al., 2013; Fodness and Murray, 2007; Mikulic and Prebežac, 2008; Park and Jung, 2011; Prebezac et al., 2010). It seems there is an increasing interest in a broader understanding of airport service quality multidimensionality, particularly from a passenger perspective (Bezerra and Gomes, 2015; Fodness and Murray, 2007). Moreover, international agencies have been systematically undertaken surveys (ACI, 2014; IATA, 2012), besides ad hoc initiatives by other organizations and airports (Zidarova and Zografos, 2011).

Also, there were attempts to examine airport performance in a strategic approach (e.g. Fernandes and Pacheco, 2007, 2010; Halpern and Pagliari, 2008; Halpern, 2010). To be noted that these efforts occurred with a significant lag in comparison with the broader literature on performance measurement. As regards performance measurement practices, Graham (2014) observed the adoption of performance measurement frameworks by some airports, namely the Balanced Scorecard.

Some critical essays discussed the practical implications and the methods used for airport efficiency/productivity assessment and benchmarking (Adler et al., 2009; Lai et al., 2012; Liebert and Niemeier, 2013; Merkert et al., 2012; Morrison, 2009).

Regarding the professional related literature, there are efforts to provide more comprehensive frameworks for airport performance measurement (Airports Council International, 2012; Hazel et al., 2011; Infrastructure Management Group, 2010; Kramer et al., 2013). It is noteworthy that these industry best practices comprise a wide range of performance aspects that have not been commonly present within research studies.

4.2. Airport Performance Dimensions

The most part of the studies reviewed seems to have avoided the complexity inherent to airport business. Nonetheless, the multifaceted nature of airport performance has been covered by some research studies and professional literature (e.g. Airports Council International, 2012; Fernandes and Pacheco, 2007; Francis et al., 2002; Gillen and Lall, 1997; Graham, 2005; Hazel et al., 2011; Hooper and Hensher, 1997; ICAO, 2006; Infrastructure Management Group, 2010; Janic, 2008; Lai et al., 2012; Yeh et al., 2011; Zakrzewski, 2008; Zografos et al., 2013).

Together, these contributions comprise relevant aspects of the multifaceted nature of airport performance and vary depending on the approach and study's objectives. Some approaches are more concise, with one category referring to more than one aspect of performance, as the case of Graham (2005), in which the area "Economic" comprise measures of efficiency, productivity, revenue generation and profitability. On the other hand, some studies have been very specific, including a diverse set of key performance areas, as the case of the industry best practices (Airports Council International, 2012; Hazel et al., 2011; Infrastructure Management Group, 2010).

Based on the literature reviewed, the following dimensions may embody the diversity of airport performance aspects perceived by external stakeholders: Efficiency/productivity, Service Quality, Safety, Security, Commercial, Economic/financial, Environmental, Social, and Competitiveness. These nine distinct dimensions may be grouped within the domains of organizational and operational performance (Figure 6).

[Insert Figure 6 here]

This framework, which is validated by the extensive literature reviewed, stresses a strategic perspective for the airport performance measurement. According to this perspective, the operational domain is an antecedent of the organizational domain (Combs et al., 2005; Hamann et al., 2013; Ray et al., 2004).

The domain of organizational performance refers to an extended concept of the airport effectiveness. The four dimensions related to this domain (i.e. Economic-financial, Environmental, Social, and Competitiveness) are interrelated. Therefore, an integrated assessment of airport performance regarding these dimensions should provide meaningful information on airport's sustainability according to the perspective of different stakeholders.

As regards the domain of operational performance, it mediates the relationship between the airport's internal activities and the organizational performance domain. This operational domain characterizes the outcomes of the airport's internal activities and capabilities that may be effectively perceived by the external stakeholders. For instance, an excellent performance as regard human resources or information technology are not directly perceived by the passengers, but only their effects on the service quality dimension.

The appendix A summarizes the nine performance dimensions along with their respective scopes and examples of measures. Regarding their occurrence on the literature reviewed, the studies related to the airport efficiency/productivity are predominant, with about 38% of the studies covering this dimension. Mostly, there are benchmarking studies covering different methodologies and countries (see Assaf et al., 2014; Graham, 2014; Lai et al., 2012; Liebert and Niemeier, 2010 for further review on this topic). Service quality (21.2%) and economic/financial (16%) have also been covered with more frequency. The other dimensions of airport performance have received less attention (Figure 7).

[Insert Figure 7 here]

To be noted that many studies have covered simultaneously two or three performance dimensions, usually efficiency-productivity and service quality or efficiency-productivity and economic-financial. It is worth mentioning that only a small number of studies have adopted a wider multidimensional approach.

5. Conclusions and Implications

The airport industry has experienced significant challenges since the 1970s, leading to a new perspective of the airport business. In this context, understanding how this industry has addressed different aspects of performance is a timely and relevant subject. Research articles and other relevant documents published between 1970 and 2015 were analyzed, following explicit criteria and replicable procedures. Relevant information on airport performance measurement literature is emphasized, stressing its evolution and the performance dimensions. To the best of our knowledge, this research effort seems to be the first to extensively examine the literature related to airport performance measurement according to such a comprehensive perspective.

For the purpose of this study, two research questions were addressed. As regards the first research question, the results suggested that airport performance measurement has been subject of increasing interest since the beginning of the 1990s. The evolution of the literature may comprise three distinct stages, what appears to have followed changes occurring at the industry level, as well as the developments of the broad literature on performance measurement, although the later with a significant lag. The first stage is characterized by the emphasis on operational and financial aspects. In the second stage, efficiency/productivity benchmarking became the main topic of interest, nonetheless a broader perspective for the airport performance measurement was also introduced. Finally, the third stage seems to stress a more market-oriented approach for performance measurement. Based on the results, a gap between performance measurement practices in airport settings and other relevant business settings was found.

As regards the second research question, the results revealed several aspects of airport performance covered by the literature. Moreover, a framework of the performance dimensions related to the airport business was provided. This framework comprises different aspects of the

airport performance with impact on external stakeholders. It considers two domains of airport performance, with operational performance being an antecedent to organizational performance.

The findings arising from this study are a relevant contribution for researchers and practitioners interested in a more comprehensive approach to performance measurement within the airport context, particularly in cases where the multidimensionality of performance and its practical implication for airport management are considered. Since ever more airports worldwide are operated as business organizations, airport managers are challenged to effectively identify and meet their stakeholders' needs. Therefore, airport performance must be measured according to a broader perspective in which measures should be derived from the stakeholders' needs, more than a prescriptive exercise.

In this context, the following four specific lines of future research can be stressed:

- First, more research is required to systematize the knowledge on current performance measurement practices in airports, including how airports have considered the stakeholders' needs and contributions to these practices.
- Second, in recognition of the relevance of benchmarking for improving airport performance, empirical research should emphasize the identification of organizational practices that might be related to a superior performance.
- Third, as regards the increasing relevance of service quality within the airport context, further research on this subject is necessary, particularly on the multidimensional nature of airport service quality and the relationships between the antecedents and consequences of passengers' satisfaction.
- Fourth, empirical studies are required to test for the suitability of the performance dimensions identified in this study, particularly regarding the reliability of the metrics related to these dimensions.

Finally, in spite of the rigor applied, the results are conditioned to the research criteria

adopted. Nevertheless, the findings arising from this research effort may be useful for researchers and practitioners interested in the subject, particularly for providing an overview of the state of the art and implications for future research and performance measurement practices. Additionally, the proposed framework may be useful for researchers and practitioners looking for a more comprehensive approach to airport performance measurement.

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Note: Due to space limitations, the full list of the 380 studies assessed with their respective nature and dimensions it is not included in this document. It can be provided upon request.

Appendix A – Airport performance dimensions

Dimension	Scope	Example of measures
Efficiency/ Productivity	Related to how well the airport is using the available resources in processing aircrafts, passengers, cargo and mail (may comprise an economic and a technological perspective).	Several physical and financial inputs and outputs used as ratios or within parametric or non-parametric models: Air traffic movements; Passengers; Cargo; Work Load Unit; Aeronautical revenue; Operating revenue; Number of employees; Labor cost; Operating cost; Etc.
Service Quality	Related to a broad concept of quality, which may include both customer perception and objective performance indicators (comprises aspects of quality of service and level of service (LOS)).	Subjective measures related to customers' perception about infrastructure and service attributes. Quantitative measures regarding the availability of area per passenger; availability of equipment; waiting times; processing times; delays; Etc.
Safety	The state in which risks associated with aviation activities, related to, or in direct support of the operation of aircraft, are reduced and controlled to an acceptable level (ICAO, 2013).	Outcomes: Accidents; Incidents; Other safety-related occurrences. Drivers: Runway conditions; Number of safety training courses conducted; Number of attendees at safety training courses; Number of warning citations issued; Etc.
Security	The state in which people and properties within the airport's boundaries are protected from potential injury/loss caused by deliberate illicit actions performed by people.	Number of reported security breaches; Number of security inspections conducted; Destructive or criminal behavior within the airport; Time it takes to resume normal service after security incidences; Security screening process; Etc.
Commercial	Related to the broad notion of airport business, in which the airport is seen as a firm providing a variety of services and products with focus on different customers and stakeholders (comprises ancillary services such as terminal retail, food and beverage, parking, hospitality, Etc.).	Non aeronautical revenue; Commercial area leased; Number of parking spaces per passenger; Parking turnover rate, Duty and Tax free income per passenger; Concession revenue per m ² ; Average ticket; Sales by type of retail; Branding; Market value; Etc.
Economic/ financial	Related to the economic outcomes resulting from the interplay among an organization's attributes, actions, and its environment, including the concepts of financial and economic performance.	Revenues, Expenditures; Cash flow; Profit/Loss; Return on Sales; Return on Assets; Internal Rate of Return; Economic Value Added; Return on Investment; Debt Service; Investment growth rate; EBITDA; Etc.
Environmental	Related to the externalities generated by aeronautical and airport activities that impact on the local environmental sustainability (comprises noise, air quality, water quality, energy conservation and ecology).	Energy consumption; Water consumption; Gaseous pollutants (ambient concentrations of pollutants); Waste; Aircraft noise emissions; Number of complaints regarding noise; number of homes or people subjected to noise within a certain noise contour; Etc.
Social	Related to the impacts of airport activities on the interests of the local community (comprises relationship with the local community, job creation, investments attraction, effects on housing prices; Etc.).	Number of jobs created; % women, minorities, and people with disabilities of the total workforce; Social programs; Sporting/social/cultural sponsorship; Number of activities focused on community; Media contact indicators; Impact on real state pricing; Etc.
Competitiveness	Related to the ability to offer a range of products and services that meet its market quality standards at reasonable prices.	Market share for airports; Airline competition at the airport; Number of destinations (non-stop); Airline operating expenses per passenger at the airport; Etc.

Figure 1. Data treatment flowchart.

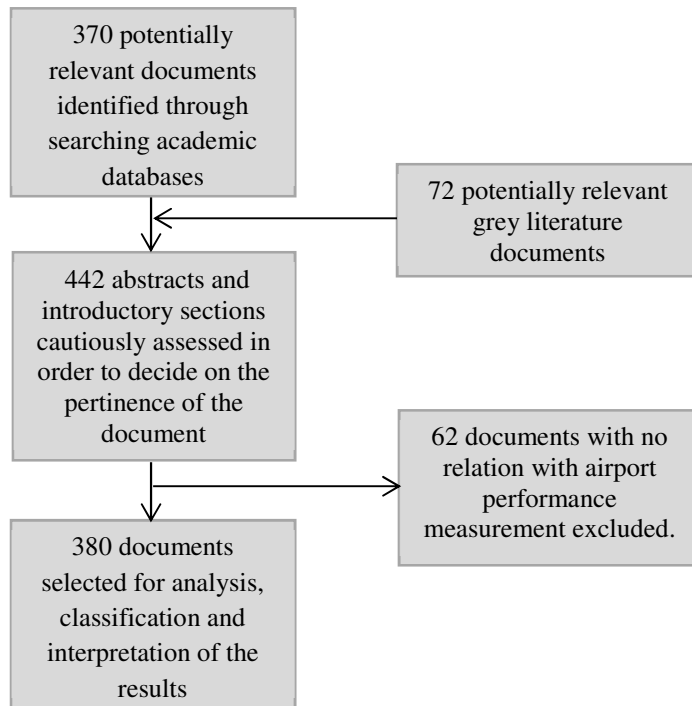
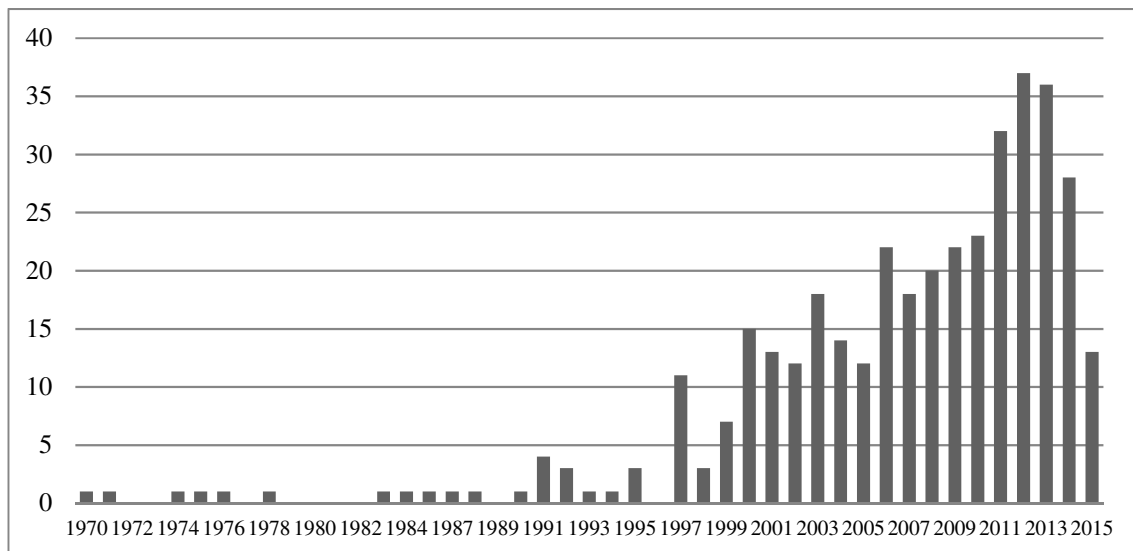
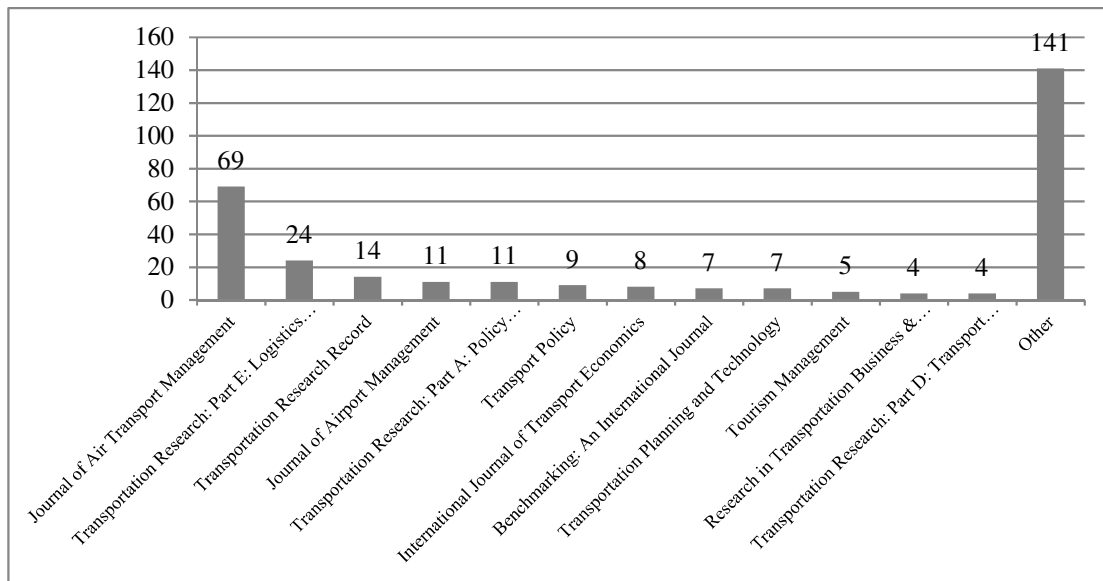


Figure 2. Documents published in airport sector by year (1970 to May/2015).



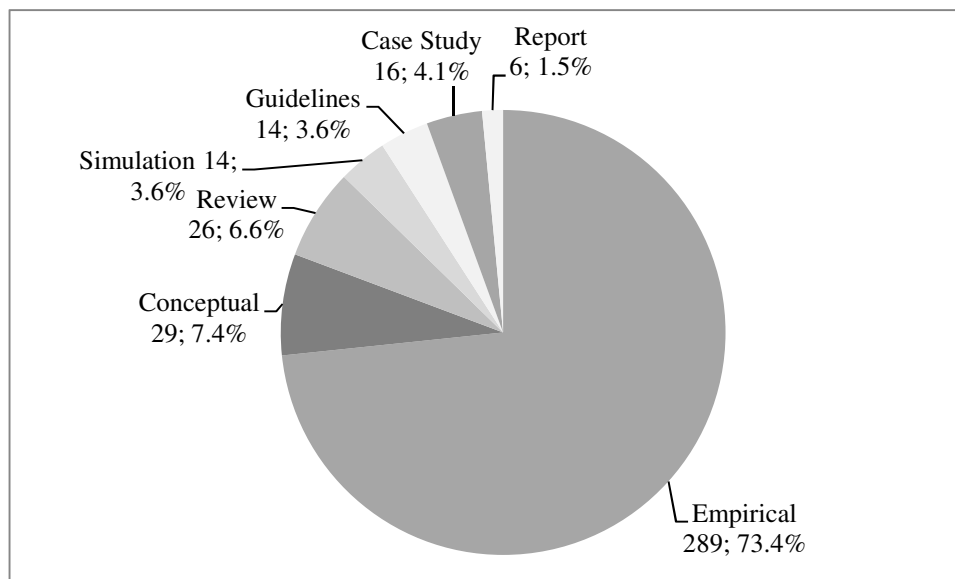
Notes: Only the first edition of books and periodical reports was considered.

Figure 3. Distribution of academic studies by journal of publication.



Note: All the journals with less than four papers published on the subject were classified as “other”.

Figure 4. Distribution of studies according to the nature.



Notes: Some studies are classified in more than one category.

Figure 5. Evolution of the literature on airport performance measurement

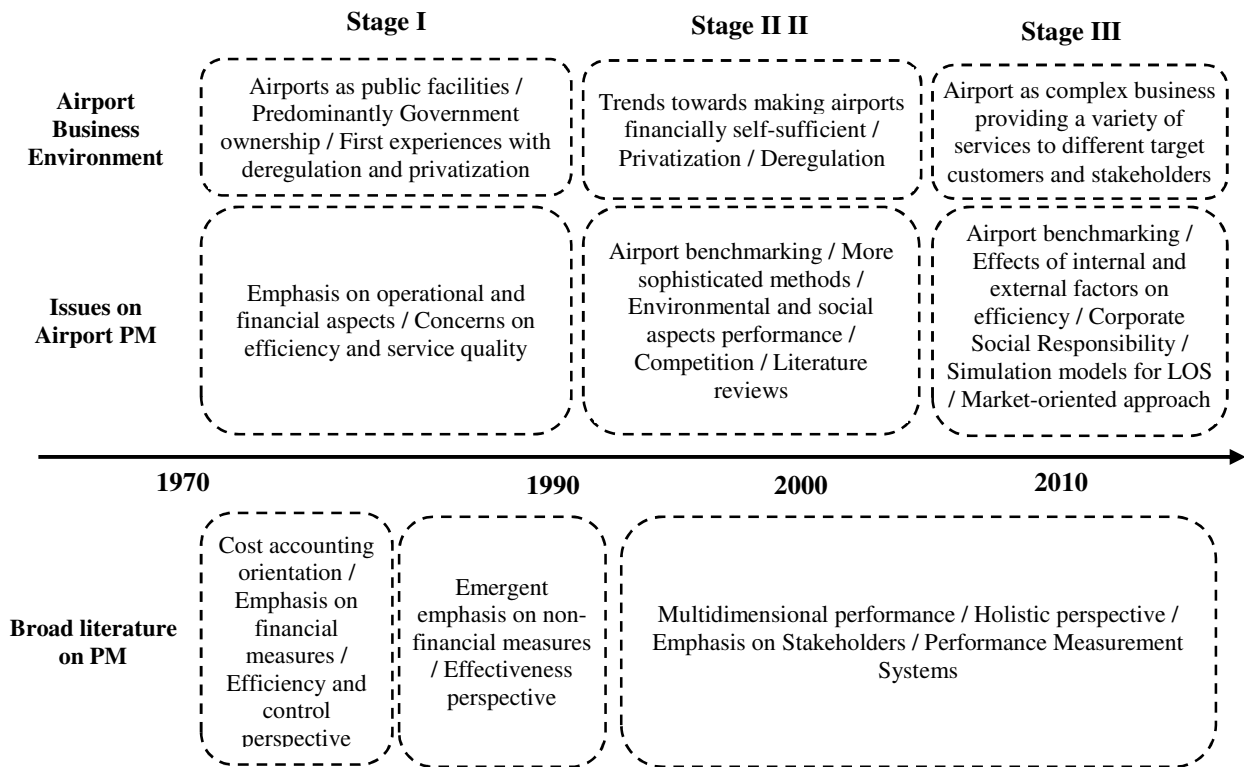


Figure 6. Airport performance dimensions

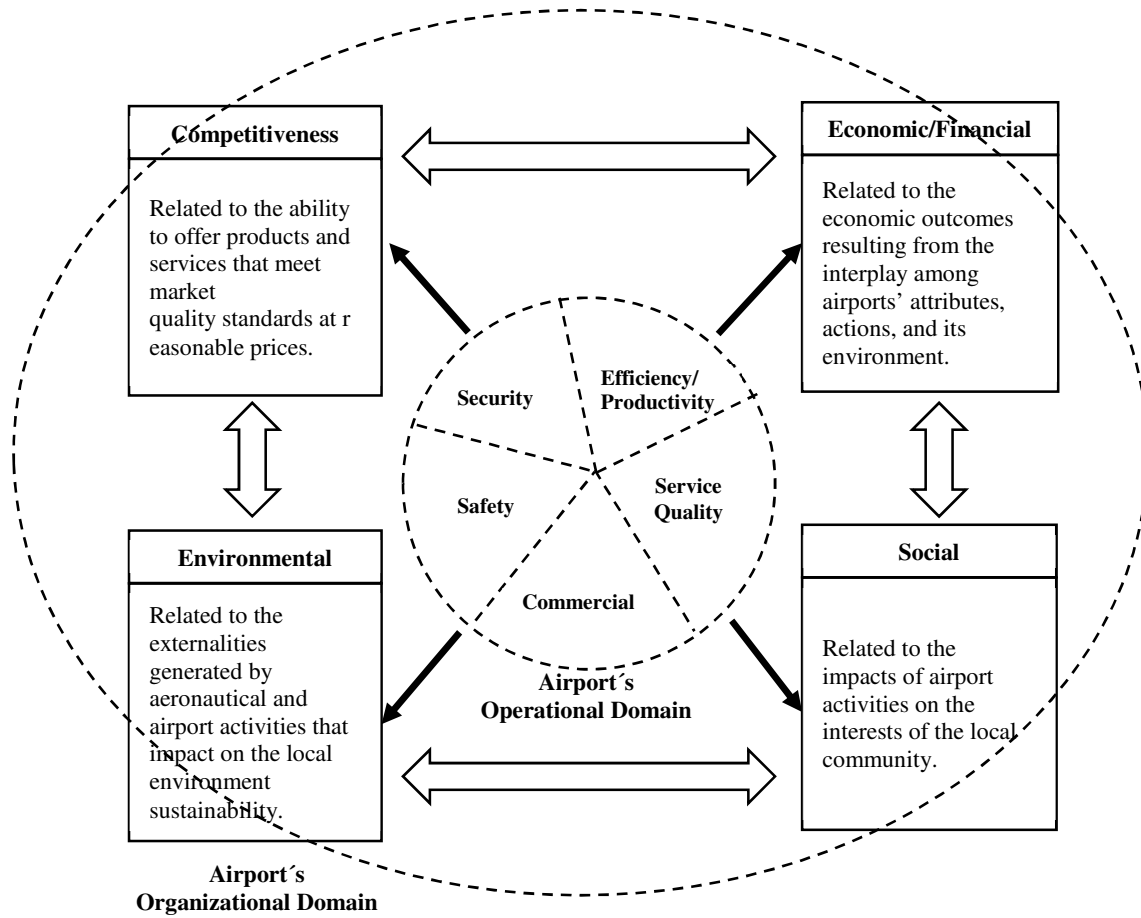
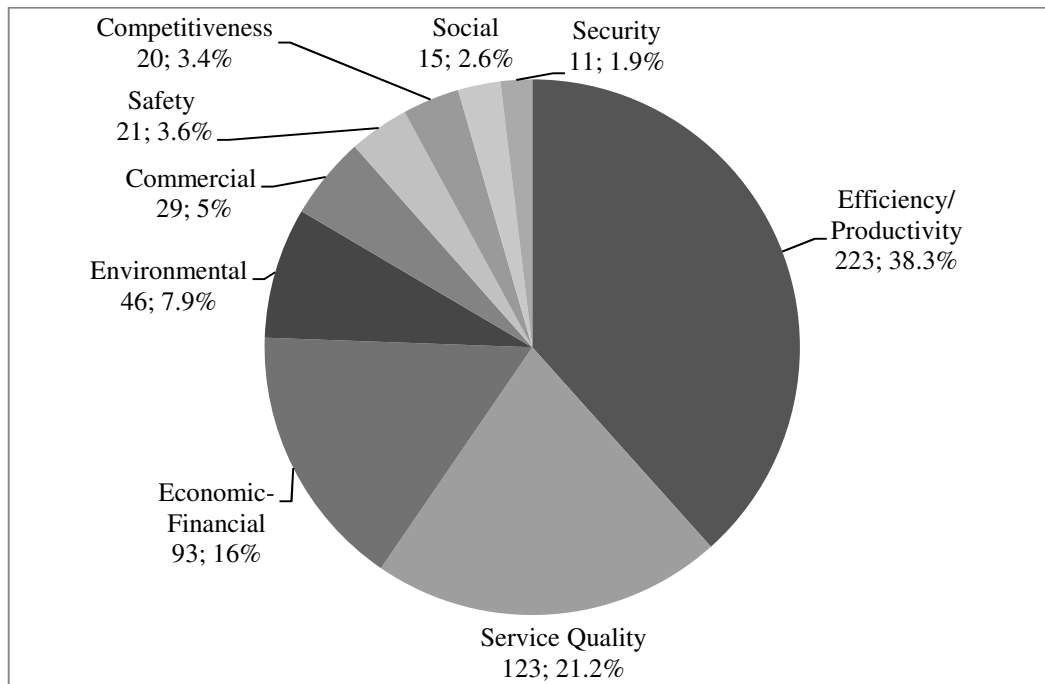


Figure 7. Documents by performance dimension considered



Notes: Some studies were classified in more than one category

Table 1. Issues in the more recent literature on airport performance measurement.

Issue	Authors
Sophistication of the methods for airport efficiency/productivity benchmarking	(Abrate and Erbetta, 2010; Assaf, 2011a; Assaf et al., 2014; Barros and Dieke, 2008; Barros, 2009; Jessop, 2009; Lai et al., 2015; Martín and Román, 2006; Martín et al., 2009; Suzuki et al., 2010; Yu, 2010)
The effects of different internal and external variables on airport efficiency (including airport size and characteristics, managerial factors, ownership/governance forms, regulatory aspects, economic downturn, undesirable outputs, etc.)	(Adler and Liebert, 2014; Chi-Lok and Zhang, 2009; Fan et al., 2014; Martín et al., 2013; Merkert and Mangia, 2014; Oum et al., 2006; Pathomsiri et al., 2008; Voltes-Dorta and Pagliarib, 2012; Yu et al., 2008)
Accounting for service quality within studies on airport efficiency measurement	(Merkert and Assaf, 2015; De Nicola et al., 2013)
Passenger perception of quality and his/her level of satisfaction with different airport service attributes	(de Barros et al., 2007; Bogicevic et al., 2013; Chen, 2007; Chien-Chang, 2012; Correia et al., 2008; Mikulic and Prebežac, 2008)
Discussions on service quality measurement, including exploratory studies on ASQ multidimensionality	(Bezerra and Gomes, 2015; Fodness and Murray, 2007; George et al., 2013)
Improvement of simulation models for assessing airport terminal LOS	(Andreatta et al., 2007; Manataki and Zografos, 2009; Zografos and Madas, 2006; Zografos et al., 2013)
Safety performance measurement	(Chang et al., 2015; Enoma and Allen, 2007; Enoma et al., 2009; Leva et al., 2015; Pacheco et al., 2014; Roelen and Blom, 2013)
Security measures and their impact on passenger perception of quality	(Enoma and Allen, 2007; Enoma et al., 2009; Gkritza et al., 2006; Sindhav et al., 2006)
The impact of non-aeronautical revenues on financial performance and sustainability, according to a market-oriented approach to the airport business	(Graham, 2009; Halpern and Pagliari, 2008; Halpern, 2010; Merkert and Assaf, 2015; Vogel and Graham, 2010; Vogel, 2011)