This item was submitted to [Loughborough's Research Repository](#) by the author.
Items in Figshare are protected by copyright, with all rights reserved, unless otherwise indicated.

Factors affecting environmental practice adoption at small European airports: an investigation

PLEASE CITE THE PUBLISHED VERSION

<https://doi.org/10.1016/j.trd.2020.102572>

PUBLISHER

Elsevier

VERSION

AM (Accepted Manuscript)

PUBLISHER STATEMENT

This paper was accepted for publication in the journal Transportation Research Part D: Transport and Environment and the definitive published version is available at <https://doi.org/10.1016/j.trd.2020.102572>.

LICENCE

CC BY-NC-ND 4.0

REPOSITORY RECORD

Crowley, Grace, Andrew Timmis, and Lucy Budd. 2020. "Factors Affecting Environmental Practice Adoption at Small European Airports: An Investigation". Loughborough University.
<https://hdl.handle.net/2134/13582661.v1>.

Factors affecting environmental practice adoption at small European airports: an investigation

Grace Harley¹, Andrew Timmis¹ and Lucy Budd²

¹ Transport Studies Group, School of Architecture, Building and Civil Engineering, Loughborough University, Loughborough, Leicestershire, UK, LE11 3TU.

² Leicester Castle Business School, De Montfort University, Leicester, LE1 9BH, UK

Corresponding author: lucy.budd@dmu.ac.uk

Please cite as:

Harley, G., Timmis, A., Budd, L. (2020) Factors affecting environmental practice adoption at small European Airports: an investigation. *Transportation Research Part D: Transport and Environment*, 88, 102572.

Factors affecting environmental practice adoption at small European airports: an investigation

Keywords: environmental practices; small airports; determinant factors; air transport; TOE framework; Europe.

Abstract

The majority of the world's 3,759 commercial airports handle under 5 million passengers a year and these small airports rarely employ practices to address their environmental externalities. The aim of this research is to investigate the range of environmental practices (EPs) that are employed at small European airports and identify the factors which affect their adoption. The findings of an online survey of 413 small airports in the European Common Aviation Area reveal that the EPs most commonly adopted concern waste management and noise reduction. Privately owned airports were generally more engaged with EPs than publicly owned ones. Consumer pressure, regulatory intervention, and airport size positively affected the adoption of environmental practices whereas complexity, perceived relative advantage and human resource constraints acted as barriers to adoption. The paper concludes with recommendations for policy and practice to support EP engagement and reduce the environmental impact of small airport operations worldwide.

1 Introduction

Prior to the COVID-19 global pandemic, airports facilitated the worldwide transportation of over 4.4 billion passengers and 62 million tonnes of airfreight each year and generated \$2.7 trillion in global economic activity (ATAG, 2018). Commercial aviation activities generate significant global and local

environmental externality effects. By 2040, aviation related NO_x and CO₂ emissions are predicted to increase by 16% and 21% respectively (Aviation Environment Federation, 2016; CAA, 2017; EASA, 2019) and tens of millions of residents of local airport communities are exposed to levels of aircraft noise that exceed WHO recommended thresholds. The global air transport industry is coming under increased political and consumer pressure to reconcile global demand for flight with commitments to improve its environmental performance (ACI-Europe, 2009b). Although aircraft emissions have been the focus of systematic academic research since the 1950s, it is only more recently that the need to address airports' wide-ranging environmental impacts, which include 'noise pollution, energy consumption, water pollution, waste management, and the storage and control of hazardous materials' (Boiral et al., 2017, p. 1), has begun to be recognised.

An airport's negative environmental externalities arise as a result of both airside and landside operations. Many are the result of third-party operations (e.g. aircraft noise and local air pollution) which are facilitated by the airport operator. Despite airport operators having little direct ownership of many of the sources of environmental impacts within the airport system, they have a unique role in their management and a significant role in affecting change (for example by setting operational procedures and targets).

Many large airports have recognised the incompatibility of future operations with the principles of sustainability and have adopted mitigating actions in the form of sustainability programmes. London Heathrow's 'Heathrow 2.0' strategy and Hartsfield–Jackson Atlanta International's 'GreeningATL' are examples of how large airports are embedding environmental practices (EPs) in their operations (Your Heathrow, 2018; Hartsfield-Jackson Atlanta International Airport, 2019). In this context, EPs are defined as 'techniques, policies and procedures a firm uses that are specifically aimed at monitoring and controlling the impact of its operations on the natural environment' (Montabon et al, 2007, p. 998). Examples of EPs which can be employed at airport sites include, but are not limited to, practices which reduce noise pollution, such as imposing noise preferential routes (NPRs,)

continuous descent operations (CDOs) and continuous climb operations (CCOs) and preferential runway usage (Netjasov, 2012; Graham, 2018); practices which address waste management, such as bulk buying products and/or materials, going paperless in administrative areas and recycling waste (Budd et al., 2015; ACRP, 2018); and practices which preserve and protect wildlife, such as using non-lethal management techniques and providing conservation areas (Devault et al., 2013; Martin et al., 2013).

Although Heathrow and Atlanta are the busiest passenger airports in the UK and US respectively in terms of traveller numbers, small airports (handling under 5 million passengers per annum) are the most numerous and account for the majority of the world's airports (ANNA.AERO, 2019; FAA, 2019). Within the European Common Aviation Area¹ (ECAA), over 80% of airports, equivalent to over 400 separate facilities, fall into this category² (ANNA.AERO, 2019). Collectively, these sites handle almost four times as many passengers a year as the 80 million processed at Heathrow. Indeed, in many European countries, air transport activity at small airports caters to a significant proportion of national demand. Small airports account for approximately 40% of annual air transport movements in the UK and remote/regional airports fulfil important economic functions in other European countries including France, Norway and Greece (CAA, 2017b; ANNA.AERO, 2019). These small airports often provide lifeline connectivity services or are a major employer and economic driver in the region. Consequently, the social and economic benefits they bring are often considered to outweigh their environmental costs (Chassé and Boiral, 2016).

Despite the prevalence of small airports their adoption of EPs is limited. For example, small airport participation in the Airport Carbon Accreditation (ACA) Scheme, an industry initiative to promote 'greener' aviation, is low. The ACA Scheme, launched in 2009, 'is the only institutionally-endorsed,

¹ The ECAA encompasses Albania, Bosnia and Herzegovina, North Macedonia, Montenegro, Serbia, Kosovo, the EU, Norway and Iceland; the area is subject to a unilateral agreement forming a single aviation market and the uniform enforcement of regulations across all participating countries (European Commission, 2019).

² ACI Europe airport size classifications: Group 1 - Over 25 million passengers a year; Group 2 - Between 10 million and 25 million passengers a year; Group 3 - Between 5 million and 10 million passengers a year; Group 4 - Less than 5 million passengers a year (ACI-Europe, 2018).

carbon management certification standard for airports' (ACI-Europe, 2009a). While over 70% of larger airports in the ECAA participate in the scheme (25% of which operate at the highest level of accreditation - 'neutrality'), only 13% of smaller airports participate in the programme. Such statistics corroborate the findings of industry and academic studies which have reported that 'specific measures for sustainability are almost non-existent in small airports' and that 'small airports rated their [environmental] performance lowest of all [studied airports]' (ACRP, 2016, p. 41; Boiral et al., 2017, p. 7). As such, the potential for further environmental mitigation at small airports exists.

According to Boiral et al (2017, p.11) due to 'their isolation [and] frequent lack of institutional pressures... [small airports] may address sustainability issues in a different manner than other organizations'. This poses a series of important questions relating to the range of EPs that are employed at small airports, the factors which affect EP adoption, and the extent of their adoption. The aim of this research is to identify the range of EPs that are currently employed at small airports in the ECAA, observe which environmental impact categories are prioritised, and better understand the motivations and barriers to EP adoption in order to propose recommendations for future policy and practice.

The rest of this paper is structured as follows: The next section critically reviews the literature concerning airports' environmental impacts, details how EPs can be adopted in small organisations (including airports) and proposes the Technological, Organisational and Environmental (TOE) framework as a suitable theoretical underpinning for the research. The methods used for the empirical data collection and subsequent analysis are then described in section 3 before the results are presented and their significance discussed. The paper concludes with recommendations for future policy and practice.

2 Literature review

The negative environmental impacts of airport operations result from both landside (before security) and airside (after security) activity. Environmental externalities encompass a wide range of impacts (see Ashford et al., (2013); Graham, (2013b); Roberts-Hughes, (2014); Budd et al., (2015); Koç and Durmaz, (2015); Sameh and Scavuzzi, (2016); Boiral et al., (2017)) which can be classified into eight broad categories:

1	1. Water use and quality degradation	5	5. Biodiversity impacts
2	2. Air quality and air pollution emissions	6	6. Waste production
3	3. Energy consumption	7	7. Land use
4	4. Noise pollution	8	8. Construction and building

To address and mitigate these impacts, which vary in terms of their severity and scale, airports can employ a range of environmental practices (EPs). The scope of EPs are broad and may address impacts which the airports are directly responsible for creating or those where they can influence third-party sources (e.g. aircraft engine emissions). However, extant research has shown that small airports struggle to engage with EPs (ACRP, 2008). A 2016 study, for example, discovered that almost 40% of small US airports did not employ any EPs (ACRP, 2016). Of the airports which did, 51% focused on addressing energy use using practices such as installing efficient lighting and utilising photovoltaic solar fields, 26% sought to reduce water consumption/improve water quality by taking actions such as modifying irrigation systems and installing low-flow toilets, 5% employed noise reduction practices, which mainly focused on measuring and monitoring noise, and 2% addressed air quality and emissions by utilising electric utility vehicles and retrofitting terminal heating, ventilation and air conditioning (HVAC) systems (ACRP, 2016). Possible reasons for the low adoption of EPs at small airports relate to cost, a lack of resources and possible unwillingness on behalf of the operator to engage with tenant companies on site. For example, EPs which involve modifying a third party's

operations (for example, airlines or concessionaires) are often avoided by smaller airports for fear of alienating customers and losing revenue (Ratliff et al., 2009; Boiral et al., 2017). Furthermore, despite the availability of ‘guidebook-type’ resources for small airports in the US (ACRP, 2008, 2010, 2011, 2012, 2015) best practice guidance for small airports in other world regions is limited. This is potentially problematic as the US is atypical in that the majority of its small airports remain in full public ownership (Ryerson, 2016). In many other global markets, airports are increasingly privately-owned or are operated under a mixed public-private ownership structure³. This has the potential to affect their environmental behaviours and priorities.

Although research which directly relates to small airport engagement with EPs is scarce, an extensive body of research into small organisations’ engagement, across a wide range of industries, with EPs, does exist. As small airports share many of the characteristics of small organisations (they employ low numbers of staff, have limited financial resources relative to larger firms in the same industry and are many in number (Berisha and Pula, 2015)), they are considered to be small organisations for the purpose of this research.

Organisational adoption of EPs often takes a structured approach which seeks to incorporate environmental considerations at the design and construction phase of a project. They also typically implement environmental management systems (such as ISO 14001), create environmental plans, conduct environmental reporting and integrate formal environmental management or Master Plans into the business (Monsalud et al., 2014). Certainly, development of Master Plans is now relatively commonplace within the airports sector (ACRP, 2016). However, in smaller organisations (particularly where the publication of a Master Plan is not mandated), it tends to be conducted in a more ad-hoc and less formalised way than at larger companies (Chan, 2011; ACRP, 2015; D’Souza and Taghian, 2018). According to ACRP (2016), the implementation of sustainable initiatives at

³ In which the airport is operated by an independently acting enterprise whose shares are held both by private investors and public authorities (see ACI-Europe, 2016, p. 2 for further definitions.)

airports requires the development of dedicated strategies, the identification of champions, the development of dedicated committees and teams, and consistent target setting and monitoring (ACRP, 2016). Such processes can be challenging and costly for small airports.

The Technological, Organisational and Environmental (TOE) Framework, proposed by Tornatzky and Fleisher (1990), has been used to explore EP adoption within small organisations. The TOE framework posits that there are conceptualised factors which can encourage and/or prevent the organisational adoption of practices and innovations (Tornatzky and Fleischer, 1990). These include: (1) technological factors, (2) organisational factors and (3) environmental factors (Lippert and Govindarajulu, 2006; Angeles, 2013; Baker, 2011; Angeles, 2014). The framework is generic and flexible, and variables can be added or removed according to context (Baker, 2011). Such flexibility enables the TOE framework to be used to examine the factors which affect EP adoption at small European airports.

As well as enabling researchers to appreciate the factors which promote the adoption of EPs, the TOE framework also permits the identification of barriers to implementation. These barriers may include (but are not limited to): a lack of funding, a lack of human resources, a lack of awareness of financial support mechanisms such as grants, competing commercial priorities, and a lack of awareness of the potential commercial benefits of adoption (ACRP, 2008, 2016; Devault et al., 2009; Boiral et al., 2017; Jaiyeola, 2017). While limited funding is often cited as the primary barrier to EP engagement, it is often a 'lack of human resources' which actually pose the greatest barrier to adoption (Hillary, 2004, p. 568). Human resources can be limited by incumbent staff members' knowledge base and skill sets (ACRP, 2008, 2016; Boiral et al., 2017). Smaller organisations often do not have access to specialist training facilities and/or cannot afford to hire dedicated staff who have the necessary knowledge and skills to adopt EPs (Simpson et al., 2004; Gupta and Barua, 2018). Staff with less specialised training will also be less able to adopt and employ complex technologies and practices, which presents a further barrier to adoption (Lin and Ho, 2008, 2011; Weng and Lin, 2011;

Hwang et al., 2016; Kousar et al., 2017). At smaller organisations, staff may also have many roles and so balancing duties and responsibilities can be challenging and environmental concerns may not be a priority (Chassé and Boiral, 2016).

A limited understanding and awareness on the part of an organisation's senior management team can also hinder EP adoption (ACRP, 2008, 2016; Boiral et al., 2017). If this limited awareness results in senior managers not supporting EP it is unlikely EPs will be adopted (Ramakrishnan et al., 2015; Gupta and Barua, 2018). Equally, if senior managers believe 'that making the airport's operations more sustainable is the right thing to do' this can drive EP adoption (ACRP, 2015, p. 14).

Technological resources can also affect the adoption of EPs. The (in)compatibility of EPs with existing airport operations and technologies can present another obstacle to implementation. If EPs are not perceived to be easy to integrate with existing operations, EP adoption will be less likely (Weng and Lin, 2011; Hwang et al., 2016).

Although barriers to EP adoption exist, there are factors which have been shown to encourage engagement. However, there is significant debate regarding the consistency of these drivers in all operational contexts. For example, many airports' EP adoption is driven by strategic intent (Lee, 2009; Brammer et al., 2012; Agan et al., 2013). Some EPs can be advantageous for organisations as they may deliver cost reductions, improve environmental performance, enhance corporate reputation and ensure regulatory compliance (ACRP, 2015, 2016). However, small organisations do not (or cannot) always benefit from the rewards from EP adoption as the implementation costs can outweigh any financial or competitive benefits they deliver (Hillary, 2004; Simpson et al., 2004; Revell and Blackburn, 2007). However, cost reduction, improved environmental performance, enhanced stakeholder relations and legislative compliance are often anticipated outcomes of EP adoption (ACRP, 2015, 2016).

Social and consumer pressures also have the potential to encourage EP adoption. An ACRP (2016) survey reported that airports who had not employed EPs stated that they would be more likely to do

so if communities surrounding airports and passengers expressed concerns about the environment and demanded change (ACRP, 2016). It has been suggested that smaller organisations are often responsive to social pressure, however, in some cases (particularly where organisations are in more rural locations) these pressures are not necessarily present and so do not act as drivers for change (Darnall et al., 2010).

Where drivers for the voluntary adoption of EPs are ineffective, legislation and regulation can act as a powerful incentive to adoption (ACRP, 2016). However, a study of small Canadian airports noted that despite the introduction of new regulations governing surface runoff, staff did not have the time or resources to receive the training that was necessary for compliance (Boiral et al., 2017). Many small firms are also not 'eco-literate' and often lack the resources and knowledge to appreciate how legislation affects them (Hörisch et al., 2015). In addition, legislation is often inapplicable to smaller organisations and compliance is not monitored or policed (Brammer et al., 2012; Agan et al., 2013). For example, the EU Environmental Noise Directive (which concerns the assessment and management of airport noise) does not apply to airports with fewer than 50,000 annual aircraft movements (European Union, 2002).

Regulation of small airports is problematic as 'frequently these airports are subject to multiple levels of policy compliance with respect to their aviation operations... environmental impacts, and relationship to other airports' (Donehue and Baker, 2012, p. 235). Certainly, relatively little is known about the types and range of employed EPs at small airports, particularly outside of the US. There is a need for both academics and policy makers to understand the status of small airport engagement with EPs and appreciate how to encourage adoption in order to mitigate the environmental impact these airports generate.

118 3 Method

119 An online self-completion questionnaire was developed and distributed via email to all commercial
120 airports within the ECAA which handled under 5 million passengers in 2017 (and hence defined as
121 'small'). Data was obtained from national reporting bodies (most commonly national aviation
122 authorities) or, where this was unavailable, from official passenger statistics of individual airports.
123 This provided a total population of 441 airports. Airports were excluded from the study if they did
124 not have an accessible website and/or a contact email. As a result, 28 airports were excluded,
125 leaving a population of 413. Figure 1 displays the ECAA, divided into geographical regions of north,
126 south, east and west (as defined by the UN.) and the location of the 413 small airports.

Geographic region

- East
- North
- South
- West

Figure 1 Small airport distribution across regions of ECAA
Source: (United Nations, 2020)

The ECAA offers an interesting and varied region of study as it is one of the largest aviation markets in the world, comprises multiple sovereign states and supports a mature aviation market which has been progressively liberalised since the mid-1990s. The focus on a mature market was deliberate as ‘in general, emerging markets lag behind developed economies in environmental stewardship’ (Jayanti and Rajeev Gowda, 2014, p. 130).

The online survey was conducted in English as English is the international language of commercial aviation and international airport operations. Participants were assured anonymity in exchange for their participation to encourage truthful and honest responses. Ethical approval was received from the lead researcher’s institution. A list of the managers and/or environmental officers’ email

addresses for each airport was compiled from each individual airport's website. A link to the survey was emailed on March 29th 2019. Follow up emails were sent to those who had not completed the survey on April 15th and 22nd to encourage additional responses. The survey was live for 6 weeks and this enabled the whole population to be approached (Wright, 2005). An email survey was chosen to promote a high response rate as previous research into small organisations reported low response rates on account of the limited time of staff members to complete survey requests (Macpherson and Wilson, 2003; Gadenne et al., 2009).

The survey comprised four distinct sections. The first and second obtained information about the respondent and the airport (or airports) they worked for. The third section asked respondents to rate the extent of EP adoption at their airport/s and identify which EP practice types were currently employed across eight environmental target areas: (1) water use reduction/quality improvement, (2) emissions reduction, (3) energy-use reduction, (4) noise reduction, (5) biodiversity improvement/protection, (6) waste reduction, (7) land use management, (8) design of green buildings. For each target area, respondents selected a value on a 5-point Likert scale from "not at all" to "to a great extent". The sum of these responses provided an overall value of the extent of EP adoption (see Lin and Ho, 2008, 2011; Weng and Lin, 2011). To encourage respondents to consider and identify all relevant practices, indicative (but not exhaustive) examples from the literature were included in each question by way of prompts. In addition, the scope of relevant practices included those environmental impact sources that the airport operator has direct control over and those where they can influence third-party operations. For instance, respondents were asked "Does your airport: Reduce noise from airborne aircraft (e.g.: modify descent patterns, employ noise abatement procedures)?" and "Does your airport: Reduce emissions from surface access traffic (e.g.: provide incentives for low emission passenger vehicles, encourage trip reduction schemes such as subsidising public transit for passengers or providing staff ride share schemes, provide infrastructure for alternatively fuelled vehicles)?" The provision of such examples encouraged respondents not only to report the practices implemented which directly affect airport operations, but also those

imposed by the airport which affect third parties' operations at the airport (including airlines, concessionaires, and ground access companies).

The fourth section of the survey asked respondents to indicate their level of agreement with a number of predefined statements. Responses were obtained through a 5-point Likert scale which offered a range of options from "strongly disagree" to "strongly agree". The statements were developed using Tornatzky and Fleisher's (1990) TOE Framework (see Table 1).

Table 1 Factors investigated in the survey (based on the TOE framework)

Context	Factor	Definition
Technological	Complexity	The degree to which a new practice 'is seen as difficult to understand and use' (Ruslan et al., 2014, p. 61).
	Compatibility	The degree to which a new technology matches the existing needs, values and experiences of a firm (Ramdani et al., 2013; Bin Ibrahim and Binti Jaafar, 2016).
	Relative advantage	The perception that a new practice is better than what is already in place (Wang et al., 2010; Weng and Lin, 2011).
Organisational	Top management support	The extent to which an organisation helps and encourages staff members to use a new practice (Weng and Lin, 2011).
	Human resources	The 'learning and innovative capabilities' of staff members (Lin and Ho, 2011, p. 75).
	Size	Total annual passengers 2017.
Environmental	Consumer pressure	The force of 'normative pressures' on an organisation causing behaviour modification in the search for legitimacy (Hwang et al., 2016, p. 9).

	Regulatory pressure	'Coercive pressures, such as threats or legal sanctions' exerted from national and supranational organisations (Hwang et al., 2016, p. 8).
	Support	Mechanisms such as 'financial incentives, technical resources [and] human resource training' provided by Government bodies and external stakeholders (Piaralal et al., 2015, p. 256).

169

170 The survey was pilot tested between March 6th and March 17th, 2019, on a sample of 54 airports
171 (13% of the total population). Results from the pilot survey indicated that some of the statements in
172 the fourth part of the survey were not (based on Cronbach's Alpha and factor analysis) reliable
173 indicators for the factors they intended to measure. These statements were subsequently modified
174 to improve the construct validity of the final survey instrument. Additionally, the phrasing of certain
175 questions and statements was modified to improve their clarity and prevent confusion among
176 respondents for whom English was not their first language.

177 Factor analysis was conducted on the measurement statements to confirm the validity of the final
178 survey instrument (Roberts and Priest, 2006). A principal components analysis with direct oblimin
179 rotation was used as the factors were correlated. The quality of the factor analysis was assessed
180 using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity;
181 the KMO was 0.683, above the recommended value of 0.5. Bartlett's test was significant ($\chi^2 =$
182 3469.680, $p < .001$) (Williams et al., 2010). Cronbach's Alpha was used to test for internal
183 consistency; as all alpha values are above 0.7, the consistency was confirmed (Tavakol and Dennick,
184 2011). Factor scores were also obtained which were used in the subsequent regression. The results
185 of the factor analysis are presented in Table 2.

186 As the survey employed a single informant technique it was necessary to test for common method
187 bias. Harman's single factor test was used. The results showed that a single factor accounted for only
188 41% of the total variance, indicating that common method bias was not an issue (Podsakoff et al.,
189 2003). A response rate of 26.4% was achieved (Northern Europe = 40.2%; Eastern Europe = 20.9%;
190 Southern Europe = 23.4%; Western Europe = 3.6%), which is comparable with other studies
191 investigating environmental behaviours of organisations and small organisations (Gadenne et al.,
192 2009; Sroufe, 2009; Darnall et al., 2010). Given this figure, it was necessary to check for non-
193 response bias. It is assumed that non-respondents are more similar to late-respondents than they
194 are to early-respondents (Weng and Lin, 2011). By using Armstrong and Overton's (1977) method,
195 comparing the average responses of late (those who responded in the second three weeks) and
196 early respondents (those who responded in the first three weeks) using an independent samples T-
197 test, it was found that non-response bias was not a concern, as there were no significant differences
198 in the responses (Armstrong and Overton, 1977).

Context	Factor	Statement	Factor loading
Technological	Complexity $\alpha = .814$	Understanding environmental practices is difficult	.788
		Learning about environmental practices is difficult	.539
		Previous experience of having adopted environmental practices makes adopting environmental practices easier	.718
		Sharing knowledge of environmental practices is difficult	.987
	Compatibility $\alpha = .944$	Environmental practices are compatible with our existing airport practices and operations	.866
		Environmental practices are consistent with our airport's(') values	.944
		Environmental practices are consistent with our airport's(') environmental goals	.906
		Environmental practices are consistent with our airport's(') strategic goals	.918
	Relative advantage $\alpha = .706$	Environmental practices can enhance our airport's(') reputation	.775
		Environmental practices can improve the financial performance of our airport(s)	.759
		Environmental practices can provide competitive advantages for our airport(s)	.786

Organisational	Top management support $\alpha = .911$	Senior management encourages staff members to learn about environmental practices	.952
		Senior management provides support for staff members to learn about environmental practices	.950
		Senior management can help staff members dealing with environmental problems	.873
	Human resources $\alpha = .814$	Staff members can share knowledge with each other easily	.961
		Staff members can use new practices to solve operational issues easily	.862
	Size	No statements used; 2017 passenger statistics taken as objective measure	
Environmental	Consumer pressure $\alpha = .810$	Our passengers require us to improve environmental performance	.709
		Caring for the environment is an important consideration for our passengers	.923
		Caring for the environment is an important consideration for the airlines at our airport(s)	.861
	Regulatory pressure $\alpha = .895$	National Government sets stringent environmental regulations	.643
		The environmental regulations set by national government affect our airport(s) operations	.748
		National environmental regulations do not affect our airport(s) operations	.983

		European environmental regulations do not affect our airport(s) operations	.965
	Support	National Government provides financial support for adopting environmental practices	.976
	$\alpha = .872$	National Government provides information for adopting environmental practices	.466
		National Government provides specialist training opportunities for staff members to learn environmental practices and related skills	.835
		External stakeholders (e.g.: industry associations, local companies, specialist groups) provide financial support for adopting environmental practices	.789

4 Discussion and analysis

The survey received 109 valid responses from airports across Europe. Table 3 shows the geographical location, ownership⁴ and number of staff members employed at the airports who responded to the survey. The average number of passengers at the respondent airports was 403,465 in 2017.

Table 3 Airport characteristics

Variable	Category	Percentage of sample
Location	Northern Europe	66.1
	Southern Europe	22.9
	Eastern Europe	8.3
	Western Europe	2.8
Ownership	Public	26.6
	Private	11.0
	Mixed	62.4
Number of staff members	< 10	1.8
	10 – 49	24.8
	50 – 99	35.8
	100 – 149	20.2
	150 – 199	2.8
	200 – 249	11.9
	250 +	2.8

⁴ Ownership is defined in accordance with the definitions used in ACI-E's airport ownership report (see ACI-Europe, 2016, p. 2)

208 4.1 Target areas

209 Within the study, respondents were asked to identify which practice types, if any, their airport had
210 adopted. Figure 2 shows the percentage of airports addressing⁵ each of the 8 target areas, by
211 geographic region and the overall percentage. The figure also shows the mean⁶ number of practice
212 types employed to address each target.

213

⁵ Meaning that an airport had at least one EP employed addressing the target area.

⁶ For each target area at least two example practices were offered for selection in the survey and an additional option of 'other' was provided so that any unlisted practices could be added by the respondent, so as to not limit the range of possible practices.

Figure 2 Environmental target areas addressed

The most commonly addressed target areas were waste and noise reduction, and the least common were emissions reductions and the design of green buildings.

Airports in Western Europe employed, on average, a greater number of practice types to address noise reduction. For waste reduction, the target is addressed by a higher percentage of airports in Northern and Southern Europe. Airports in Northern Europe also employed, on average, a greater number of practice types to address waste reduction. In Eastern Europe, a higher percentage of airports have employed green buildings than other regions. Airports in North and West Europe tend to address more environmental target areas with more EPs. There is a potential that being close geographical neighbours they have a shared environmental culture influencing their behaviour.

It is possible that different population densities around the individual airports result in noise reduction being a greater focus for Western Europe (where the population densities in Germany and the Netherlands the 236.7 and 508.5 people/km² respectively) than in Northern Europe (where the population densities in Norway and Sweden are 14.5 and 24.7 people/km² respectively) (World Bank, 2017). This would suggest that fewer people are impacted by noise in Northern Europe than other regions.

Green buildings were not a common target in any region which is likely a result of the high cost associated with their design, building and certification. One respondent highlighted that buildings at their airport had been built to formal certification standards, however certification had not been pursued as the administrative costs were too high. In Eastern Europe, the majority of airports indicated that where green buildings had been constructed, they were done so in accordance with national guidelines, as opposed to formal certification standards. This suggests that while there is interest in designing green buildings in this region, formal recognition is not important.

Figure 3 Average number of EPs implemented by airport ownership type

Figure 4 Average number of EPs implemented by environmental target area and airport ownership type

238 Figures 3 and 4 show EP employment by airport ownership type. The results show that, on average,
 239 privately owned airports employ more EPs in total and across all environmental target areas, with
 240 the exception of waste reduction and land use management. This suggests that commercial
 241 involvement has a positive impact on EP adoption as EP adoption could impart potentially important
 242 reputational benefits as being a responsible company and thus attracting/retaining custom. This
 243 supports Lee (2009), Brammer et al (2012) and Agan et al. (2013) who suggest that there are

commercial benefits to be gained from EP adoption. Publicly owned airports may employ fewer EPs as they tend to be the smallest airports which are focused on regional connectivity, therefore environmental concerns may be a lesser concern for them owing to their size and primary strategic goals. However, again, further research is needed to confirm this.

4.2 Practice types

Following the examination of the target areas, further analysis explored the practice types which are employed to address these target areas. Figure 5 displays the % of airports employing each practice type⁷ and whether the practice involves the airport modifying third party operators' operations (demarked by an asterisk.)

⁷ Building Research Establishment Environmental Assessment Method (BREEAM) and Leadership in Energy and Efficiency Design (LEED) are examples of green building certification programs, meaning that buildings have been built to certain environmental standards and meet specified criteria set by certification boards.

Figure 5 Frequency of practices types employed (%)

On average, airports employed eight practice types across five target areas. All respondent airports employed at least one practice type; no respondents employed all practice types, indicating that there is scope for improvement with regards to EP engagement.

Only six practice types were employed by over 50% of respondents. In comparison, ten practice types were employed by fewer than 10%. Of the six most commonly employed practice types, three were aimed at reducing waste. Almost all airports reported addressing waste; the majority of which did so by recycling waste from administrative areas and passenger terminals. A large proportion of airports also indicated that they composted organic materials; this corroborates findings from the 2018 ACRP study which indicated that composting was a practice growing in popularity at airports (ACRP, 2018). It is not evident from this study's results, however, for what purpose the resulting compost is used. Future research may usefully explore this. Recycling waste from aircraft was identified as a further, however less common, practice aimed at reducing waste. Existing literature focusing on waste management at larger airports highlights that recycling waste from aircraft is not common practice as international health and safety legislation aimed at maintaining a nation's sanitary border require international catering waste to be sent to deep landfill or incinerated (Pitt et al., 2002). The survey results here showed that almost 15% of the airports reported recycling waste from aircraft; this is likely because many of these smaller airports receive domestic flights only and so international health and sanitary regulations do not apply.

The remaining three most common practice types were aimed at improving water quality by managing surface run-off pollution, managing land use by avoiding operating on/remediating contaminated land and protecting/improving biodiversity by having conservation areas within the airport boundary. Having conservation programmes within the boundary has the potential to increase wildlife hazards which makes them uncommon at larger airports (Martin et al., 2013). However, it is likely that at these smaller airports the risk of wildlife strike is lower and so conservation programmes can be safely pursued.

Practices targeting noise reduction do not feature among the most common practice types. It is frequently stated in literature that noise is the greatest environmental concern for airports (Wolfe et al., 2014; Grampella et al., 2017; Rodríguez-Díaz et al., 2017), however, while noise reduction is a commonly targeted area for airports, very few small airports (just over 25%) indicated that they employed more than one practice type to address the issue. Where noise reducing practices were employed, almost 25% of airports in this study indicated that they employed practices to reduce noise emissions which restricted or modified airlines' operations. Extant research into the environmental practices of small airports indicated that such facilities were reluctant to impose operational restrictions on airlines for fear of losing custom (Dimitriou and Voskaki, 2010; Boiral et al., 2017).

Of the least common practice types (employed by fewer than 10% of respondents) the majority feature practices and technologies which are complex and/or expensive; for example collecting and reusing water (see Ashford et al., 2013; Couto et al., 2015). It would be important to consider that the airports using these practice types may be situated in more remote areas in which connections to mains water supplies are limited and reuse of water may be a necessity. Also uncommon is the design of green buildings. Where small airports report designing green buildings, they are often built in accordance with national standards, and not to certified levels of international bodies such as LEED and BREEAM. The limited engagement was attributed to cost by some respondents.

Practices which involve modifying third party operations are also not commonly implemented. While some scholars have suggested that airports have a limited jurisdiction over pollutants, others contend that airports can exert some influence over third party operators' actions (Hansen et al., 2013, p. 166; Ryerson, 2016). A limited number of respondent airports indicated that they imposed practices on airlines to address noise pollution, however, such interventions were not widespread and, as such, our findings corroborate those of Boiral et al. (2017).

303 Practices targeting emissions reductions (either local air pollution or greenhouse gases) were not
304 commonly employed. After noise, atmospheric emissions have been identified as a significant
305 environmental concern for airports (Daley, 2010; Wolfe et al., 2014; Rodríguez-Díaz et al., 2017;
306 Gudmundsson, 2018). However, our results show that fewer than half of small airports are
307 addressing this target area. One respondent stated that their airport conducted regular air quality
308 monitoring and that the results indicated that no mitigating action was required. Thus, it may be the
309 case that for many smaller airports there are limited air quality and emission issues and so minimal
310 action is taken. However, the act of monitoring would suggest that concern and awareness exist.

311 On average, each practice type was employed more commonly by the 'larger small airports' (those
312 with more than 1 million passengers a year,) with the exception of some practices addressing waste
313 reduction, biodiversity management and green buildings. Airports handling under 1 million
314 passengers a year recycled waste from both terminal areas and aircraft, composted organics,
315 employed conservation programmes both inside and outside of the airport site, used non-lethal
316 wildlife control methods and constructed buildings to LEED, BREEAM and national standards more
317 commonly than the larger airports in the sample. It is possible that recycling waste from buildings
318 may be easier for smaller airports as there is less to manage than at larger airports; also, as
319 discussed previously, the smaller airports tend to handle primarily domestic traffic, meaning that
320 international food waste laws do not apply and they are able to recycle more waste from aircraft. It
321 may also be the case that the smaller airports in the sample handle fewer aircraft annually than their
322 larger counterparts, and so are able to employ conservation programmes as the exposure risk for
323 aircraft strikes with wildlife is less than at airports with more annual movements. It is unclear from
324 the results why green buildings are more commonly constructed by the smaller airports in the
325 sample, as the cost of such projects has specifically been highlighted as a barrier to their
326 construction. There is potential that smaller scale construction at smaller sites has a lesser cost
327 attached and that the cost savings that green buildings can bring (e.g. from reduced heating

requirements) are appealing and cost effective at smaller sites. Further research would be required to confirm this.

4.3 Classification of airports by EP engagement

The survey enabled airports to be clustered into three groups according to the number of environmental impact target areas they addressed and how many environmental practice types they employed.

Figure 6 Classification of airports by EP engagement levels
Plot size representative of how many airports represented by plot point.

Figure 6 shows that the majority of airports fall within Group 2, i.e. they are 'attempting engagement' by employing a mid-range number of practice types which address a medium-to-high number of target areas. These airports appear to be attempting engagement with EPs but are not engaging at the same level as the 9 'industry leaders' in Group 3. Airports in Group 3 employ a broad range of practice types that address a high number of target areas. This contrasts with Group

1 airports who we define as ‘minimally engaged’ as they employ few practice types and address few of the target areas.

Airports within each group were then segmented by size (Table 4). Results showed that, on average, the ‘larger’ small airports (handling 1-5 million p.p.a) employed significantly more practice types and addressed more targets than the ‘smaller’ small airports (which handled under 1 million p.p.a). This suggests that subgroupings by size exist within this population which impact an airport’s ability or need to engage with EPs.

Table 4 Mean number of practice types and targets addressed by airport size

Size group	Practice types employed				Target areas addressed			
	Mean	t	df	p	Mean	t	df	p
< 1 million PPA (smaller)	7.50	-3.526	15.961	0.03	5.13	-3.018	107	0.03
> 1 million PPA (larger)	12.33				6.40			

The identification of size subgroups led to an additional difference being noted between the engagement groups identified in Figure 6. Airports with more than 1 million p.p.a are found more commonly in EP engagement group 3 (and somewhat in group 2), whereas all cases in EP engagement group 1 are airports handling under 1 million p.p.a. This suggests that the size of the airport impacts either the capability or need to engage with EPs. However, there are a large number of airports with less than 1 million p.p.a in group 2 and some more anomalous cases found in group 3. This would suggest that the size of the airport is not the only factor affecting EP engagement. Based on the TOE framework (Tornatzky and Fleischer, 1990), further analysis was therefore conducted to explore the relationships between the technological, organisational and environmental factors and EP adoption.

4.4 Factors affecting EP adoption

The following subsections discuss the contextual factors affecting EP adoption at small European airports.

4.4.1 Technological context

Figure 7 presents the mean responses⁸ to individual statements in the survey relating to the technological context.

Figure 7 Technological context: mean statement responses

Broadly speaking, respondents did not perceive EPs as being complex and challenging to learn and engage with. However, the regression analysis (discussed in section 4.4.4) revealed that where respondents did perceive practices to be complex, they were less likely to adopt EPs. The results corroborate the work of Hillary (2004), Simpson et al. (2004), Lee (2009) and Weng and Lin (2011) who suggest that increased perceived complexity results in reduced practice adoption, however the responses contradict their suggestions that smaller organisations feel that EPs are too complex and

⁸ The spread of responses to the statements ranged from 1 (strongly disagree) to 5 (strongly agree.)

challenging to adopt. In order to further encourage EP engagement, practice complexities should be kept to a minimum, as adoption is less likely when perceived complexity increases.

Over 40% of airports indicated that they felt that adopting practices is easier when coupled with previous experience. This supports Upham and Mills (2005), who suggested that exposure to best practice and success stories makes adoption more likely. Increased networking and experience showcasing opportunities would likely be the most effective approach to this, as ‘airports rely on peer group learning for their most critical decision making’ and, furthermore, the literature has suggested that the dissemination of ‘guidebook’ type materials has been ineffective (ACRP, 2011, 2016; Ryerson, 2016, p. 1).

The majority of respondents agreed that EPs are compatible with existing operations, corporate values, and environmental and strategic goals. However, very few strongly agreed with these statements. Even in the case of practices being compatible with the environmental goals of the airports, fewer than 14% strongly agreed with the statement. This suggests that additional research is required to establish what small airport strategic and environmental goals are, in order to design EPs which best align with them.

Responses showed that airports generally perceived EPs to bring relative advantages. Over 80% strongly agreed that the practices could enhance their airport’s reputation. This was not anticipated, as extant literature generally focuses on the social benefits brought about by small airports, providing connecting services to comparatively isolated communities. Chassé and Boiral, (2016) suggest that small organisations’ environmental impacts are often overlooked, excused by the social benefits they bring, thus it was not expected that the airports would feel there was reputational advantage to be gained by appearing to be ‘environmentally friendly’. It would likely be effective to further highlight the advantages which can be elicited from EPs to drive practice engagement.

4.4.2 Organisational context

Figure 8 Organisational context: mean statement responses

Figure 8 presents the mean response to the individual statements relating to organisational context. Generally, support provided by top management in the pursuit of EPs is present. However, the regression analysis did not find the relationship between top management support and adoption to be significant. This disagrees with conclusions drawn by Jenkins, (2006), Walker et al., (2008) and Lee, (2009) however corroborates similar findings from Ramakrishnan et al., (2015), suggesting that, while beneficial, top management support is not a vital factor for adopting EPs in this context.

For human resources, respondents indicated that they generally agreed with the provided statements and the regression analysis found the relationship to be significant. This agrees with results from Lin and Ho, (2008, 2011) and Weng and Lin, (2011) who also found the relationship to be significant. However, in previous studies, the relationship between human resources and EP adoption has not been negative when included in a regression model. Further investigation would be required to explore the effect of confounding variables.

Airport size also has a significant relationship with EP adoption, suggesting that bigger airports are more likely to adopt practices. However, the beta weight of this variable was not large, and other variables provided much stronger weightings. This suggests that while size may play a role in affecting adoption, it does not play as significant a role as is suggested in other studies (Cassells and Lewis, 2011; Agan et al., 2013; Hoogendoorn et al., 2015).

4.4.3 Environmental context

Figure 9 displays the mean response to the individual statements in the survey relating to the environmental context.

Figure 9 Environmental context: mean statement responses

The regression analysis (Section 4.4.4) revealed consumer pressure to have the largest beta weighting relating to EP adoption, suggesting that the greater the perceived pressure from consumers the more likely small airports are to adopt. Respondents expressing that they generally felt that consumers demanded environmental performance improvement largely disagrees with Hillary (2004) and Gadenne et al. (2009) who claimed that pressures of this kind are not felt by smaller organisations. However, this result does agree with Darnall et al. (2010), who said that when smaller organisations recognise consumer pressures, they are usually responsive.

Regulatory pressure was found to have the second highest beta weight in the regression analysis.

Respondents indicated that they felt that both national and European regulations impacted their operations. Regulatory pressure perceptions were also the only factor found to significantly vary⁹ by

⁹ Using independent samples t-tests.

434 geographical location. Airports in Northern Europe had a statistically larger average overall response
435 to regulatory pressure, compared to the other European regions (see Figure 10).

Figure 10 Mean responses to regulatory pressure split by geographic region

This geographical variation in perceptions warrants further investigation to potentially identify best regulatory practices to employ in other regions. The results in the analysis do, however, largely contradict much existing literature (Revell and Blackburn, 2007; Brammer et al., 2012; Agan et al., 2013) which suggests that regulation at small organisations is either ineffective or unpoliced. This research would suggest that regulation is effective and is encouraging engagement with EPs.

While support was not found to be significant in the regression analysis and had an unexpected negative relationship with EP (something which, in itself, warrants further investigation) the trends shown in responses to the statements provide valuable insight. The majority of airports reported that they did not feel that their governments provided sufficient financial support to assist in the pursuit of EPs; they did, however, agree that support in the form of information is provided. The majority of respondents neither agreed nor disagreed with the final two statements. This suggests that perhaps there is an opportunity to be exploited in which specialist training can be provided to small airports to assist in the adoption of EPs and also that external stakeholders can provide additional support.

From Northern European airports, the mean overall response to support was larger than the responses from the other European regions. There is potential that with the greater regulatory pressure exuded from national bodies in Northern Europe comes greater support. This, again, is worthy of further investigation.

4.4.4 Regression analysis

To explore the relationships between the nine factors (discussed in section 4 of the survey) and EP adoption at small airports, an OLS regression was conducted. OLS regression was appropriate as the dependant variable was continuous and the assumptions of multicollinearity, normality and homoscedasticity were met.

All nine factors were taken as independent variables and the total extent of adoption as the dependant variable (DV) (mean = 22.32; SD = 6.339). The total extent of adoption was calculated by

summing the self-reported extent of EP adoption across the eight environmental target areas (indicated on a 1 – 5 Likert scale,) as discussed in section 3. As such, it is assumed that all environmental target areas are of equal importance. The total extent of adoption is therefore an indicative measure of the relative importance an airport operator places on integrating environmental management within their operations. The minimum possible value of the DV was eight (indicating that the respondent airport was not at all engaged with any of the target areas,) and the maximum possible value of the DV was 40 (indicating that the reporting airport was engaged to a great extent with all target areas.) Table 5 shows the results of the regression analysis.

Table 5 Regression analysis

Model	Standardized Coefficients		VIF
	Beta ¹⁰	t	
(Constant)		65.667	
Compatibility	.093	1.063	3.551
Complexity	-.191*	-2.855	2.071
Relative advantage	-.141*	-2.289	1.761
Top management support	.176	1.977	3.681
Human resources	-.171*	-3.083	1.418
Size	.186**	3.904	1.049
Regulatory pressure	.394**	5.265	2.591
Consumer pressure	.446**	6.169	2.422
Support	-.145	-1.928	2.618
N = 109		R ² = .786	

¹⁰ * and ** indicates significance at the 95% and 99% level, respectively.

The results found that compatibility, senior management support, airport size, regulatory pressure and consumer pressure have a positive relationship with EP adoption, while complexity, relative advantage, human resources and support have a negative relationship.

The analysis indicates that increased perceptions of consumer pressure, regulatory pressure and larger airport sizes will likely result in airports being more engaged with EPs. It also indicates that the more complex airports perceive EPs to be, the less likely they are to adopt them. This analysis also suggests that an increase in perceived relative advantage and the quality of human resources results in reduced engagement. When taken as standalone independent variables, both have a positive association with EP adoption, however when other variables are added to the model the association becomes negative (the same applies to support however this variable was not found to be significant.) It is anticipated that this is the result of confounding variables and requires further investigation.

5 Conclusion

This research has provided new insights into the current environmental behaviours of small European airports. It has shown that there are some types of EPs which are more and less favoured by small airports, and target areas to which small airports are more and less committed to. Importantly, EP adoption by small airports is identified as being different from larger airports. Regulatory interventions, consumer pressure, technological complexity, airport size, the quality of human resources and relative advantage were identified as having significant impacts on the likelihood of airports adopting EPs. Existing literature on small organisation adoption of EPs focuses on the limitations small size can impose on the adoption process. The results here show that for aviation, size may have an impact, however other factors have a more substantive effect on EP adoption. Therefore, it is necessary to target more specifically these other factors to further encourage EP adoption amongst small airports.

501 The environmental and technological contexts, which were identified thorough the TOE framework,
502 have a greater effect than the organisational context on EP adoption. Therefore, it is recommended
503 that airlines, passengers and regulatory bodies continue to demand environmental behaviour from
504 airports and that exceptions and exclusions are not be made based on size alone. This should be
505 coupled with increased networking and showcasing opportunities and support where required,
506 specifically in the form of specialist staff training. With this being said, however, it is now also
507 important to consider the impact of the COVID-19 pandemic on future small airport engagement
508 with EPs. Although great uncertainty surrounds the realistic impact on the aviation industry and how
509 industry recovery will look, it is likely that airports, particularly smaller airports, will see decreased
510 revenues and compounded financial challenges. This will likely exacerbate resource issues at small
511 airports, limiting their ability to engage with EPs. Furthermore, with decreased demand for air travel,
512 the environmental impact of airports will also decrease, lessening the imminent need to address
513 environmental externalities.

514 This paper makes several important contributions by adding to the limited field of study focusing on
515 small airports, specifically focusing on their environmental behaviours and the factors affecting this
516 behaviour. The research has revealed that some of the claims in the existing literature regarding EP
517 adoption at airports do not necessarily hold true in the context of small European airports. This,
518 therefore, has the potential to more effectively inform policy. Existing aviation environmental
519 policies, guided by existing literature, have been primarily based on information relevant to larger
520 airports; this study's contribution will allow more appropriate and effective environmental policies
521 to be designed for small airports.

522 The exploration of environmental target areas and employed practice types in this study builds on
523 the previously conducted ACRP studies (ACRP, 2016, 2008), however adds to the literature by
524 examining a new geographic area, subject to different regulatory regimes and operational

boundaries. Whereas ACRP (2016, 2008¹¹) examined only small airports in the United States, this research has provided the first examination of the European airport industry and examined small airports spanning across 36 different countries. Furthermore, while the ACRP studies had examined the influence of various drivers and barriers to EP engagement, they had not considered the role that airport ownership plays. This study's examination of this factor presents a further development of the previous work. In addition to presenting the first large scale, European based survey of small airports, this research also presents the first application of the TOE framework and regression in an aviation context. Further research is required to explore and confirm the patterns and trends of practice adoption found in this study. This should in particular focus on examining further the causal relationships indicated in this study and understanding why certain environmental target areas were prioritised over others.

Furthermore, the classifying of airports by EP engagement level and exploring the features of the identified groups presents an additional contribution. Combining the segmented EP engagement groups with the novel identification of factors affecting EP adoption can assist in the encouraging of EP engagement.

The research may be valuable to small airport managers and national and international regulatory bodies. Identifying current trends in EP adoption and segmenting airports by EP engagement allows managers to place their airport's activities in the identified engagement groups for benchmarking purposes. Suggesting factors to further encourage EP engagement can assist policy makers in the design of new practices, packages and policies to increase adoption and reduce or mitigate the environmental impact of airport operations and future growth.

6 References

ACI-Europe (2009a) *Airport Carbon Accreditation - Welcome to the Airport Carbon Accreditation*

¹¹ ACRP (2008) did include 21 airports from outside of the United States, however their size was not specified.

548 Available from <https://www.airportcarbonaccreditation.org/> [accessed 7 January 2019].

549 ACI-Europe (2009b) *Airport Carbon Accreditation - What is it?* Available from

550 <https://www.airportcarbonaccreditation.org/about/what-is-it.html> [accessed 7 January 2019].

551 ACI-Europe (2018) *Airport Traffic Report* Available from [https://www.aci-europe.org/media-room-](https://www.aci-europe.org/media-room-airport-traffic-report/member.html)

552 [airport-traffic-report/member.html](https://www.aci-europe.org/media-room-airport-traffic-report/member.html) [accessed 10 July 2018].

553 ACI-Europe (2016) *The Ownership of Europe's Airports*.

554 ACI-NA (n.d.) *Going Greener - Minimizing airport environmental impacts*. Washington DC: .

555 ACRP (2011) *ACRP Report 43: Guidebook of Practices for Improving Environmental Performance at*

556 *Small Airports*. Washington DC: .

557 ACRP (2012) *ACRP Report 80: Guidebook for Incorporating Sustainability into Traditional Airport*

558 *Projects*. Washington DC: .

559 ACRP (2008) *ACRP Synthesis 10: Airport Sustainability Practices*. Washington DC: .

560 ACRP (2010) *ACRP Synthesis 21: Airport Energy Efficiency and Cost Reduction*. Washington DC: .

561 ACRP (2015) *ACRP Synthesis 66: Lessons Learned from Airport Sustainability Plans*. Washington DC: .

562 ACRP (2016) *ACRP Synthesis 69: Airport Sustainability Practices - Drivers and Outcomes for Small*

563 *Commercial and General Aviation Airports*. Washington DC: .

564 ACRP (2018) *ACRP Synthesis 92: Airport Waste Management and Recycling Practices*. Washington

565 DC: .

566 AEF (2016) *New report finds aircraft noise policy puts the health of over one million people at risk*

567 Available from [https://www.aef.org.uk/2016/01/12/new-report-finds-aircraft-noise-policies-](https://www.aef.org.uk/2016/01/12/new-report-finds-aircraft-noise-policies-put-the-health-of-over-one-million-people-at-risk/)

568 [put-the-health-of-over-one-million-people-at-risk/](https://www.aef.org.uk/2016/01/12/new-report-finds-aircraft-noise-policies-put-the-health-of-over-one-million-people-at-risk/) [accessed 22 July 2019].

569 AEF (2008) *What are an airport's impacts?* Available from

570 <https://www.aef.org.uk/uploads/PlanningGuide2.pdf> [accessed 9 January 2019].

571 Agan, Y., Acar, M.F. and Borodin, A. (2013) Drivers of environmental processes and their impact on
 572 performance: a study of Turkish SMEs. *Journal of Cleaner Production*, 51 23–33.

573 Angeles, R. (2013) Using the Technology-Organization-Environment Framework and Zuboff's
 574 Concepts for Understanding Environmental Sustainability and RFID: Two Case Studies. *World
 575 Academy of Science, Engineering and Technology International Journal of Economics and
 576 Management Engineering*, 7(11) 2878–2887.

577 Angeles, R. (2014) Using the Technology-Organization-Environment Framework for Analyzing Nike's
 578 "Considered Index" Green Initiative, a Decision Support System-Driven System. *Journal of
 579 Management and Sustainability*, 4(1) 96–113.

580 ANNA.AERO (2019) *Databases* Available from <https://www.anna.aero/databases/> [accessed 29 July
 581 2019].

582 Armstrong, S.J. and Overton, M.T.S. (1977) Estimating nonresponse bias in mail surveys. *Journal of
 583 Marketing Research*, 14(3) 396–402.

584 Ashford, N., Stanton, H.P.M., Moore, C.A., Coutu, P. and Beasley, J.R. (2013) *Airport operations*. 3rd
 585 edition. McGraw-Hill.

586 Awa, H.O., Ukoha, O. and Igwe, S.R. (2017) Revisiting technology-organization-environment (T-O-E)
 587 theory for enriched applicability. *The Bottom Line*, 30(1) 2–22.

588 Baker, J. (2011) The technology-organization-environment framework. In: Y.K. Dwivedi et al. (ed.)
 589 *Information Systems Theory: Explaining and Predicting Our Digital Society, Vol. 1*. New York:
 590 Springer, 231–246.

591 Berisha, G. and Pula, J.S. (2015) Defining Small and Medium Enterprises a critical review. *Academic
 592 Journal of Business, Administration, Law and Social Sciences*, 1(1) 17–28.

593 Boiral, O., Ebrahimi, M., Kuyken, K. and Talbot, D. (2017) Greening Remote SMEs: The Case of Small
594 Regional Airports. *Journal of Business Ethics*, 1–15.

595 Brammer, S., Hoejmoser, S. and Marchant, K. (2012) Environmental Management in SMEs in the UK:
596 Practices, Pressures and Perceived Benefits. *Business Strategy and the Environment*, 21(7) 423–
597 434.

598 Budd, T., Budd, L. and Ison, S. (2015) Environmentally sustainable practices at UK airports.
599 *Proceedings of the ICE-Transport*, 168(2) 116–123.

600 CAA (2017a) *Airport data 2017* Available from [https://www.caa.co.uk/Data-and-analysis/UK-](https://www.caa.co.uk/Data-and-analysis/UK-aviation-market/Airports/Datasets/UK-Airport-data/Airport-data-2017/)
601 [aviation-market/Airports/Datasets/UK-Airport-data/Airport-data-2017/](https://www.caa.co.uk/Data-and-analysis/UK-aviation-market/Airports/Datasets/UK-Airport-data/Airport-data-2017/) [accessed 15 January
602 2019].

603 CAA (2017b) *Information on aviation's environmental impact*. West Sussex: .

604 Cassells, S. and Lewis, K. (2011) SMEs and environmental responsibility: Do actions reflect attitudes?
605 *Corporate Social Responsibility and Environmental Management*, 18(3) 186–199.

606 Chan, E.S.W. (2011) Implementing Environmental Management Systems in Small-And Medium-Sized
607 Hotels: Obstacles. *Journal of Hospitality & Tourism Research*, 35(1) 3–23.

608 Chassé, S. and Boiral, O. (2016) Legitimizing Corporate (Un) Sustainability: A Case Study of Passive
609 SMEs. *Organization & Environment*, 1–22.

610 Couto, E. de A. do, Calijuri, M.L., Assemany, P.P., Santiago, A. da F. and Lopes, L.S. (2015) Greywater
611 treatment in airports using anaerobic filter followed by UV disinfection: an efficient and low
612 cost alternative. *Journal of Cleaner Production*, 106 372–379.

613 D'Souza, C. and Taghian, M. (2018) Small and medium size firm's marketing competitive advantage
614 and environmental initiatives in the Middle East. *Journal of Strategic Marketing*, 26(7) 568–
615 582.

616 Daley, B. (2010) *Air Transport and the Environment*. 1st edition. London: Routledge.

617 Darnall, N., Henriques, I. and Sadorsky, P. (2010) Adopting proactive environmental strategy: The
618 influence of stakeholders and firm size. *Journal of Management Studies*, 47(6) 1072–1094.

619 Devault, T.L., Blackwell, B.F. and Belant, J.L. (2013) *Wildlife in airport environments: preventing
620 animal-aircraft collisions through science-based management*. The John Hopkins University
621 Press (ed.). JHU Press.

622 Devault, T.L., Kubel, J., Rhodes Jr, O.E., Dolbeer, R. and Jr, O.E. (2009) Habitat and Bird Communities
623 at Small Airports in the Midwestern USA. In: *13th Wildlife Damage Management Conference*.
624 2009 137–145.

625 Dimitriou, D.J. and Voskaki, A.J. (2010) Regional airports' environmental management: key messages
626 from the evaluation of ten European airports. *International Journal of Sustainable Development
627 and Planning*, 5(2) 150–162.

628 Donehue, P. and Baker, D. (2012) Remote, rural, and regional airports in Australia. *Transport Policy*,
629 24 232–239.

630 EASA (2019) *Executive Summary | European Aviation Environmental Report* Available from
631 <https://www.easa.europa.eu/eaer/executive-summary> [accessed 17 July 2019].

632 European Commission (2019) *International Aviation: ECAA*.

633 European Union (2002) EUR-Lex - 32002L0049 - EN - EUR-Lex. EUR-Lex.

634 FAA (2019) *Passenger Boarding (Enplanement) and All-Cargo Data for U.S. Airports* Available from
635 https://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/passenger/
636 [accessed 29 July 2019].

637 Gadenne, D.L., Kennedy, J. and Mckeiver, C. (2009) An Empirical Study of Environmental Awareness
638 and Practices in SMEs. *Journal of Business Ethics*, 84 45–63.

639 Graham, A. (2018) *Managing airports: an international perspective*. 5th edition. Routledge.

640 Graham, A. (2013) The Environmental Impact of Airports. In: *Managing Airports*. 4th edition London:
641 Routledge, 286–308.

642 Grampella, M., Martini, G., Scotti, D., Tassan, F. and Zambon, G. (2017) Determinants of airports’
643 environmental effects. *Transportation Research Part D: Transport and Environment*, 50 327–
644 344.

645 Gudmundsson, S.V. (2018) *European Air Transport Regulation: Achievements and Future Challenges*.
646 Toulouse: .

647 Gupta, H. and Barua, M.K. (2018) A framework to overcome barriers to green innovation in SMEs
648 using BWM and Fuzzy TOPSIS. *Science of The Total Environment*, 633 122–139.

649 Hansen, M., Ryerson, M. and Marchi, R. (2013) New Methodologies for Airport Environmental
650 Impact Analysis. In: K Zografos, G Andreatta, A Odoni (eds.) *Modelling and Managing Airport*
651 *Performance*. Chichester: , 145–169.

652 Hartsfield-Jackson Atlanta International Airport (2019) *GreeningATL* Available from
653 <https://www.atl.com/community/sustainability/> [accessed 29 July 2019].

654 Hillary, R. (2004) Environmental management systems and the smaller enterprise. *Journal of Cleaner*
655 *Production*, 12 561–569.

656 Hoogendoorn, B., Guerra, D. and van der Zwan, P. (2015) What drives environmental practices of
657 SMEs? *Small Business Economics*, 44(4) 759–781.

658 Hörisch, J., Johnson, M.P. and Schaltegger, S. (2015) Implementation of Sustainability Management
659 and Company Size: A Knowledge-Based View. *Business Strategy and the Environment*, 24(8)
660 765–779.

661 Hwang, B.-N., Huang, C.-Y. and Wu, C.-H. (2016) A TOE Approach to Establish a Green Supply Chain

662 Adoption Decision Model in the Semiconductor Industry. *Sustainability*, 8(2) 168.

663 Jaiyeola, A.T. (2017) The management and treatment of airport rainwater in a water-scarce
664 environment. *International Journal of Environmental Science and Technology*, 14(2).

665 Jayanti, R.K. and Rajeev Gowda, M.V. (2014) Sustainability dilemmas in emerging economies. *IIMB*
666 *Management Review*, 26(2) 130–142.

667 Koç, S. and Durmaz, V. (2015) Airport Corporate Sustainability: An Analysis of Indicators Reported in
668 the Sustainability Practices. *Procedia - Social and Behavioral Sciences*, 181 158–170.

669 Kousar, S., Sabri, P., Zafar, M. and Akhtar, A. (2017) Technological Factors and Adoption of Green
670 Innovation-Moderating Role of Government Intervention: A Case of SMEs in Pakistan. *Pakistan*
671 *Journal of Commerce and Social Sciences*, 11(3) 833–861.

672 Kuan, K.K.Y. and Chau, P.Y.K. (2001) A perception-based model for EDI adoption in small businesses
673 using a technology–organization–environment framework. *Information & Management*, 38(8)
674 507–521.

675 Kuan, K.K.Y.Y. and Chau, P.Y.K.K. (2001) A perception-based model for EDI adoption in small
676 businesses using a technology–organization–environment framework. *Information and*
677 *Management* , 38(8) 507–521.

678 Lee, K.-H. (2009) Why and how to adopt green management into business organizations?: The case
679 study of Korean SMEs in manufacturing industry. *Management Decision*, 47(7) 1101–1121.

680 Lin, C.-Y. and Ho, Y.-H. (2008) An Empirical Study on Logistics Service Providers' Intention to Adopt
681 Green Innovations. *Journal of Technology Management & Innovation*, 3(1) 17–26.

682 Lin, C.-Y. and Ho, Y.-H. (2011) Determinants of Green Practice Adoption for Logistics Companies in
683 China. *Journal of Business Ethics*, 98(1) 67–83.

684 Lippert, S.K. and Govindarajulu, C. (2006) Technological, Organizational, and Environmental

685 Antecedents to Web Services Adoption. *Communications of the IIMA*, 6(1) 147–160.

686 Luther, L. (2007) *Environmental Impacts of Airport Operations, Maintenance, and Expansion*.

687 Washington DC: .

688 Macpherson, A. and Wilson, A. (2003) Enhancing SMEs' capability: opportunities in supply chain

689 relationships? *Journal of Small Business and Enterprise Development*, 10(2) 167–179.

690 Martin, J.A., Conkling, T.J., Belant, J.L., Biondi, K.M., Blackwell, B.F., Devault, T.L., Fernandez -Juric, E.,

691 Schmidt, P.M. and Seamans, T.W. (2013) *Wildlife Conservation and Alternative Land Uses at*

692 *Airports*.

693 Monsalud, A., Ho, D. and Rakas, J. (2014) Greenhouse gas emissions mitigation strategies within the

694 airport sustainability evaluation process. *Sustainable Cities and Society*, 14 414–424.

695 Montabon, F., Sroufe, R. and Narasimhan, R. (2007) An examination of corporate reporting,

696 environmental management practices and firm performance. *Journal of Operations*

697 *Management*, 25 998–1014.

698 Netjasov, F. (2012) Contemporary measures for noise reduction in airport surroundings. *Applied*

699 *Acoustics*, 73(10) 1076–1085.

700 Piaralal, S.K., Nair, S.R., Yahya, N. and Karim, J.A. (2015) An Integrated Model of the Likelihood and

701 Extent of Adoption of Green Practices in Small and Medium Sized Logistics Firms. *American*

702 *Journal of Economics*, 5(2) 251–258.

703 Pitt, M., Brown, A. and Smith, A. (2002) Waste management at airports. *Facilities*, 20(5/6) 198–207.

704 Podsakoff, P.M., MacKenzie, S.B., Lee, J.-Y. and Podsakoff, N.P. (2003) Common method biases in

705 behavioral research: A critical review of the literature and recommended remedies. *Journal of*

706 *Applied Psychology*, 88(5) 879–903.

707 Ramakrishnan, P., Haron, H. and Goh, Y.-N. (2015) Factors Influencing Green Purchasing Adoption

708 For Small And Medium Enterprises (Smes) In MalaysiaFactors Influencing Green Purchasing
 709 Adoption For Small And Medium Enterprises (SMEs) In Malaysia. *International Journal of*
 710 *Business and Society*, 16(1) 39–56.

711 Ramdani, B., Chevers, D. and Williams, D.A. (2013) Predicting SMEs’ adoption of enterprise systems.
 712 *Journal of Small Business and Enterprise Development*, 20(4) 735–753.

713 Ratliff, G., Sequeira, C., Waitz, I., Ohsfeldt, M., Thrasher, T., Graham, M. and Thompson, T. (2009)
 714 Aircraft Impacts on Local and Regional Air Quality in the United States. Massachusetts: .

715 Revell, A. and Blackburn, R. (2007) The business case for sustainability? An examination of small
 716 firms in the UK’s construction and restaurant sectors. *Business Strategy and the Environment*,
 717 16(6) 404–420.

718 Roberts, P. and Priest, H. (2006) Reliability and validity in research. *Nursing Standard*, 20(44) 41–46.

719 Roberts-Hughes, R. (2014) *Sustainable Airports: Improving the environmental impact of the UK’s*
 720 *global gateways*.

721 Rodríguez-Díaz, A., Adenso-Díaz, B. and González-Torre, P.L. (2017) A review of the impact of noise
 722 restrictions at airports. *Transportation Research Part D: Transport and Environment*, 50 144–
 723 153.

724 Ruslan, M.F., Senin, A.A. and Soehod, K. (2014) Technological Determinants of Green Production
 725 Adoption by Malaysian Small and Medium Enterprises (SMEs): A Conceptual Framework. In:
 726 *International Conference on Business, Management & Corporate Social Responsibility*. 2014
 727 Batam, Indonesia: , 59–63.

728 Ryerson, M.S. (2016) Building Air Service Sustainability: Analytical Approach to Documenting Air
 729 Carrier Incentive Programs in Airport Sustainability Plans. *Transportation Research Record*:
 730 *Journal of the Transportation Research Board*, 2569(1) 1–15.

- 731 Sameh, M.M. and Scavuzzi, J. (2016) *Environmental Sustainability Measures for Airports*. Occasional
732 Paper Series.
- 733 Simpson, M., Taylor, N. and Barker, K. (2004) Environmental responsibility in SMEs: Does it deliver
734 competitive advantage? *Business Strategy and the Environment*, 13(3) 156–171.
- 735 Sroufe, R. (2009) Effects of Environmental Management Systems on Environmental Management
736 Practices and Operations. *Production and Operations Management*, 12(3) 416–431.
- 737 Tavakol, M. and Dennick, R. (2011) Making sense of Cronbach’s alpha. *International Journal of*
738 *Medical Education*, 2 53–55.
- 739 The World Bank (2017) *Population density (people per sq. km of land area)* Available from
740 <https://data.worldbank.org/indicator/EN.POP.DNST> [accessed 17 June 2019].
- 741 Tornatzky, L. and Fleischer, M. (1990) *The processes of technological innovation*. Vol. 16. Lexington
742 Mass.: Lexington Books.
- 743 UK Trade and Investment (2013) *Sustainable airports: Benefiting from the UK’s world-class expertise*.
- 744 United Nations (2020) *UNSD — Methodology* Available from
745 <https://unstats.un.org/unsd/methodology/m49/> [accessed 27 January 2020].
- 746 Wang, Y.-M., Wang, Y.-S. and Yang, Y.-F. (2010) Understanding the determinants of RFID adoption in
747 the manufacturing industry. *Technological Forecasting and Social Change*, 77(5) 803–815.
- 748 Weng, M.-H. and Lin, C.-Y. (2011) Determinants of green innovation adoption for small and medium-
749 size enterprises (SMES). *African Journal of Business Management*, 5(22) 9154–9163.
- 750 Williams, B., Onsman, A. and Brown, T. (2010) Exploratory factor analysis: A five-step guide for
751 novices. *Journal of Emergency Primary Health Care*, 8(3) 1–13.
- 752 Wolfe, P.J., Yim, S.H.L.L., Lee, G., Ashok, A., Barrett, S.R.H.H. and Waitz, I.A. (2014) Near-airport
753 distribution of the environmental costs of aviation. *Transport Policy journal*, 34 102–108.

754 Wright, K.B. (2005) Researching Internet-Based Populations: Advantages and Disadvantages of
755 Online Survey Research, Online Questionnaire Authoring Software Packages, and Web Survey
756 Services. *Journal of Computer-Mediated Communication*, 10(3).

757 Your Heathrow (2018) *Heathrow 2.0* Available from <https://your.heathrow.com/heathrow-2-0/>
758 [accessed 26 September 2018].

759

760 **Acknowledgements**

761 The authors would like to thank the Editor and the reviewers for their very helpful comments on an
762 earlier draft of this paper.