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

Grace Harley\textsuperscript{a}, Andrew Timmis\textsuperscript{a}, Lucy Budd\textsuperscript{b,*}

\textsuperscript{a} Transport Studies Group, School of Architecture, Building and Civil Engineering, Loughborough University, Loughborough, Leicestershire LE11 3TU, UK
\textsuperscript{b} Leicester Castle Business School, De Montfort University, Leicester LE1 9BH, UK

\textbf{ABSTRACT}

The majority of the world’s 3759 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\textsubscript{x} and CO\textsubscript{2} 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

* Corresponding author.

\textit{E-mail address: lucy.budd@dmu.ac.uk} (L. Budd).

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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 Area (ECAA), over 80% of airports, equivalent to over 400 separate facilities, fall into this category (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 fulfill 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, 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, p. 41, 2016; Boiral et al., p. 7, 2017). 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 organisations’. 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. Water use and quality degradation
2. Air quality and air pollution emissions
3. Energy consumption
4. Noise pollution
5. Biodiversity impacts

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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).
6. Waste production
7. Land use
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 panels, 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 structure. 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 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, 2014; Baker, 2011). 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

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.)
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.

3. Method

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

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, 2013). 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).

The survey was pilot tested between March 6th and March 17th, 2019, on a sample of 54 airports (13% of the total population).

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). |
| Organisational  | Relative advantage | The perception that a new practice is better than what is already in place (Wang et al., 2010; Weng and Lin, 2011). |
|                 | 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. 9). |
|                 | 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). |
Results from the pilot survey indicated that some of the statements in the fourth part of the survey were not (based on Cronbach’s Alpha and factor analysis) reliable indicators for the factors they intended to measure. These statements were subsequently modified to improve the construct validity of the final survey instrument. Additionally, the phrasing of certain questions and statements was modified to improve their clarity and prevent confusion among respondents for whom English was not their first language.

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

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

4. Discussion and analysis

The survey received 109 valid responses from airports across Europe. Table 3 shows the geographical location, ownership and number of staff members employed at the airports who responded to the survey. The average number of passengers at the respondent airport ownership report (see ACI-Europe, 2016, p. 2)

4 Ownership is defined in accordance with the definitions used in ACI-E’s airport ownership report (see ACI-Europe, 2016, p. 2)
The number of passengers at airports was 403,465 in 2017.

4.1. Target areas

Within the study, respondents were asked to identify which practice types, if any, their airport had adopted. Fig. 2 shows the percentage of airports addressing\(^5\) each of the 8 target areas, by geographic region and the overall percentage. The figure also shows the mean\(^6\) number of practice types employed to address each target.

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/km\(^2\) respectively) than in Northern Europe (where the population densities in Norway and Sweden are 14.5 and 24.7 people/km\(^2\) respectively) (The 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.

Figs. 3 and 4 show EP employment by airport ownership type. The results show that, on average, privately owned airports employ more EPs in total and across all environmental target areas, with the exception of waste reduction and land use management. This suggests that commercial involvement has a positive impact on EP adoption as EP adoption could impart potentially important reputational benefits as being a responsible company and thus attracting/retaining custom. This 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.

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\(^5\) 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.
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. Fig. 5 displays the % of airports employing each practice type and whether the practice involves the airport modifying third party operators’ operations (demarked by an asterisk.)

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

Footnote: 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.
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., p. 166, 2013; 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).

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

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

Fig. 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.

The identification of size subgroups led to an additional difference being noted between the engagement groups identified in Fig. 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

Fig. 7 presents the mean responses to individual statements in the survey relating to the technological context.

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 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, p. 1, 2016).

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

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

Fig. 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

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

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

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 unpolicied. 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.

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9 Using independent samples t-tests.
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 dependent 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 dependent 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.

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.

The environmental and technological contexts, which were identified thorough the TOE framework, have a greater effect than the organisational context on EP adoption. Therefore, it is recommended that airlines, passengers and regulatory bodies continue to demand environmental behaviour from airports and that exceptions and exclusions are not be made based on size alone. This should be coupled with increased networking and showcasing opportunities and support where required, specifically in the form of specialist staff training. With this being said, however, it is now also important to consider the impact of the COVID-19 pandemic on future small airport engagement with EPs. Although great uncertainty surrounds the realistic impact on the aviation industry and how industry recovery will look, it is likely that airports, particularly smaller airports, will see decreased revenues and compounded financial challenges. This will likely exacerbate resource issues at small airports, limiting their ability to engage with EPs. Furthermore, with decreased demand for air travel, the environmental impact of airports will also decrease, lessening the imminent need to address environmental externalities.
This paper makes several important contributions by adding to the limited field of study focusing on small airports, specifically focusing on their environmental behaviours and the factors affecting this behaviour. The research has revealed that some of the claims in the existing literature regarding EP adoption at airports do not necessarily hold true in the context of small European airports. This, therefore, has the potential to more effectively inform policy. Existing aviation environmental policies, guided by existing literature, have been primarily based on information relevant to larger airports; this study’s contribution will allow more appropriate and effective environmental policies to be designed for small airports.

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

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