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SUSTAINABLE DEVELOPMENT PRINCIPLES IMPLEMENTATION IN RIGA
INTERNATIONAL AIRPORT

Bachelor Thesis

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This paper conforms to the requirements for a Bachelor Thesis

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I have written this Bachelor Thesis independently. Any ideas or data taken from other authors or other sources have been fully referenced

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(signature of the author and date)

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Introduction

Aviation industry is one of the fastest growing industries in the world and it brings so many benefits to all of us, even if we do not realize it. According to Air Transport Action Group (ATAG, 2018), jobs in aviation industry contribute to global economy 4,4 times more than other jobs and with more than 65 million employees working in aviation industry worldwide, the contribution to global Gross Domestic Product (GDP) reached a total of \$2,7 trillion in 2016. Aviation connects continents, countries and people, businesses and knowledge. In 2017, airlines carried 4,1 billion passengers globally (ATAG, 2018), which is more than half of the world population.

However, there are some aspects, that are not so positive and requires serious attention. To provide us with all the good benefits mentioned before, airplanes must fly, therefore, by doing so, airplanes emit noise, heat and all kinds of gases with the most harmful one being carbon dioxide (CO₂). Noise problem is more related to environment around airports, especially ones, that are close to living areas. Heat and gases on the other hand, affect the whole world – nature and people living in it. Airplanes warm up the air, contaminate it and destroy the ozone layer, which protects us from the ultraviolet radiation, therefore climate is changing in unfavourable direction.

Some years ago, the biggest concern for aviation was the reducing of CO₂ emissions, but now, when the industry is so significant and can have impact on the whole world in almost any field of interest, the tasks for both airlines and airports have changed above all. Reduction of CO₂ emissions in aviation took a huge step forward few years ago. According to European Aviation Environmental Report (2016), in the period 2014-2015, in European airports CO₂ emissions have been reduced from 3,7 kg per passenger to 1,9 kg per passenger. Serious attention is being put on airports and their surrounding areas, because big part of aviation impacts comes also from on-land activities, therefore airports are in the centre of

sustainable development. To be more efficient in achieving sustainability, aviation industry requires partnerships within and outside the sector to develop infrastructure, management and provide innovative solutions to environmental challenges (IATA, 2017).

Since 2015, a new plan for a better future was developed by United Nations. The plan includes 17 goals, known as Sustainable Development Goals (SDGs), with a systematic framework for each of them, describing the aims and problems. The project is set to achieve all goals by 2030 and it covers all major worldwide problematic topics from poverty and gender equality to clean oceans and affordable energy etc. (United Nations, 2015)

According to the International Civil Aviation Organization (ICAO), 15 out of 17 sustainable development goals relate to aviation industry, therefore airlines and airports around the world are now facing the task of fulfilling these goals as efficient as possible (International Civil Aviation Organization, n.d.).

The aim of this research is to find out, whether the largest passenger airport of Baltic states, Riga International airport, is developing its business by implementing sustainable development principles. Riga airport is selected for research, because it is the busiest airport in Baltic states, which has major effect in this region and is undergoing drastic infrastructural changes. Riga airport is continuing to expand its passenger terminals with the main goal to connect with “Rail Baltica” railway station and developing infrastructure for more efficient cargo handling.

To achieve the aim of the research paper, the following tasks are set up:

- To give an overview about sustainable development principles and assign them to airport operations,
- To bring out the main results of previous empirical studies about sustainable development principles implementation in airports,
- To give an overview of environmental impact by Riga airport,

- To conduct interviews and surveys, to find out how sustainable development principles are implemented in Riga Airport,
- To draw conclusions about sustainable development policies implementation of Riga Airport based on data analysis.

Structure of the paper will include theoretical and empirical parts. First part of this work will focus on explaining the concept of sustainable development and assigning its principles to airport operations. Previously done studies will be analysed to gather data about specific measures that can be implemented in airports. Author of this paper will, based on various literature, choose specific sustainable development goals, that can be best affected by airport activities and combining them will create an original approach for airport sustainability measuring. Empirical part will include analysis of environmental reports and three interviews with experts from different environmental fields of Riga airport. In addition, author was interested in what measures do employees perceive as important and applicable thus constructed a online survey.

Keywords: Sustainable development, Riga airport, airport sustainability, survey, interview

1. Theoretical framework for evaluating sustainable development implementation in airports

1.1. Concept of sustainable development and its relevance to airport operations

Sustainable development has been a widely discussed topic for the last few decades and as time passes, still a no clear definition has been introduced (see Table 1). The first modern definitions for sustainable development were introduced by World Commission on Environment and Development (WCED) in report *Our common future*. Since then, the main concept of sustainable development has not changed.

Table 1

Sustainable development definitions

Author(s)	Year	Definition
World Commission on Environment and Development (WCED)	1987	“At a minimum, sustainable development must not endanger the natural systems that support life on Earth: the atmosphere, the waters, the soils, and the living beings.” (p. 42).
Elkington	2000	“Business is sustainable when it lives up to the “triple bottom line” of economic prosperity, environmental quality and social justice.” (p. 229).
Hopwood, Mellor & O’Brien	2005	“It embraces the key issue for humanity of how to ensure lives worth living and our relation with the planet and our relation with each other.” (p. 49).
Byrch, Kearins, Milne & Morgan	2007	“Individual’s definition of sustainable development describes how they consider things should be.” (p. 29).
Pesqueux	2009	“Sustainable development is a multi-faceted issue which concerns the state, a given industry, consumers and citizens alike.” (p. 233).
Arias-Maldonado	2013	“Sustainability is an inherently open principle for guiding social action. It is a principle insofar as it signals a general orientation for society: being ecologically sustainable.” (p. 12).

Source: compiled by author

WCED (1987) put emphasis on understanding of the concept of needs and highlight the idea, that sustainable development starts with providing with basic needs the world’s poor. Few decades ago social aspect was the main problem to deal with and it is still one of the most problematic, however, rapid industrialization with chemical production plants and other forms of toxic pollution, which deliver significant harm to planet, force environmental issues to be on top of everything. WCED (1987) identified environmental protection as number one priority and made it a difficult, but very important task for the society. Meaning that any action performed corresponding to sustainable development, under no circumstances, can harm the natural environment.

From the society’s perspective, sustainability is important concept related mostly to natural environment protection, that provides with guidelines on how to perform different actions (Arias-Maldonado, 2013) and is a supplement to WCED (1987) vision of making

people perform daily activities without leaving destructive footprints behind for the future generations. Sustainable development principles need to be introduced into public and from there the road to sustainability can be expected. The fact, that people view things differently, will have effect on fulfilling sustainability tasks. Based on Byrch, Kearins, Milne & Morgan (2007), society has its own perception of the concept and tasks introduced a while ago might be perceived variously and realized based on one's opinion.

A popular model known as "triple bottom line", introduced by Elkington (2000), provides the existing SD concept with more specific rules for achieving sustainability. General idea of protecting environment (WCED, 1987) has been replaced with three-dimension (economical, environmental, social) model (Elkington, 2000), which is more sophisticated, but presents better results and is more convenient for SD. Therefore, development can only be considered sustainable, if dimensions are in balance, meaning that economy can achieve sustainability, if is socially responsible and environment friendly.

Hopwood, Mellor & O'Brien (2005) & Pesqueux (2009) claim, that sustainable development concerns any individual, industry or state, while proposing principles for mutual relationships and how to comply with the natural world. Importance of sustainable development has made cities focus more on infrastructure, so the natural surroundings are preserved, and city can become "greener". Term "greener" relates not only to nature, but also creating conditions more appropriate for public transportation and other means of transport, so local citizens would not have the need for a private car (Banister, 2008). Cities with large populations are beginning to implement sustainable principles to make them environmentally attractive, healthy for its citizens and economically powerful. Appropriate example for this study would be city of Riga, which has introduced a sustainable development plan, with all three dimensions receiving considerable attention (The City Development Department, 2014). With such strategy plans, also local airport must consider their sustainability.

Definitions of sustainable development vary and so it is complicated to find exact meaning of the concept. Some authors talk about individual interpretation (Byrch, Kearins, Milne & Morgan, 2007) and open principle (Arias-Maldonado, 2013), which means, that the concept is open for change and everyone can contribute. Others are more emotional and include topics of meaning of life (Hopwood, Mellor & O'Brien, 2005) to raise awareness. However, the main idea concerns protection of natural environment and all authors agree with it in some way.

Sustainable development has generated significant interest globally and has been put into a measurable form by proposing achievable goals to several topics. SDGs were introduced by United Nations in 2015, when all UN member states agreed on their implementation and collective realization. SDGs are measurable targets also known as 2030 Agenda. All countries participating have obligation to support these goals through global partnerships and achieve them in 15 years. (United Nations, 2015)

ICAO, as mentioned previously, has linked SDGs to their strategic objectives and explained how these goals would be implemented into daily activities of all aviation industry participants. Author of this paper has organized 15 SDGs into three sustainable development dimensions to differentiate goals from each other (see Table 2). ICAO tends to apply each goal to as many dimensions as possible, however, in this table, focus is more on aspects, that could directly affect each of the goal. For instance, SDGs No. 1 to 5 can also be assigned to environmental or economical dimension in some way, but the focus is on direct effect, therefore, social dimension is more appropriate for these goals. According to ICAO, only two goals could not be associated with aviation – *Clean water and sanitation* and *Life below water* (International Civil Aviation Organization, n.d.). These goals are mostly concerned about ocean and sea protection, as well as clean water availability for daily consumption, therefore, have been excluded from Table 2.

Table 2

Sustainable development goals

Number of the SDG*	Sustainable development goal	Environmental dimension	Economical dimension	Social dimension
No. 1	No poverty			X
No. 2	Zero hunger			X
No. 3	Good health and well-being			X
No. 4	Quality education			X
No. 5	Gender equality			X
No. 7	Affordable and clean energy	X		
No. 8	Decent work and Economic growth		X	
No. 9	Industry, innovation and infrastructure		X	
No. 10	Reduced inequalities			X
No. 11	Sustainable cities and communities			X
No. 12	Responsible consumption and production	X		
No. 13	Climate change	X		
No. 15	Life on land	X		
No. 16	Peace, justice and strong institutions	X	X	X
No. 17	Partnerships for the goals	X	X	X

Note. *List does not include 2 SDGs – *Clean water and sanitation* and *Life below water*

Source: compiled by author, based on United Nations (2015) SDG list

Airports need to contribute to sustainable development by supporting all three aspects of it – economic, social and environmental, hence, airports need to take sustainable development under consideration and manage it effectively to keep all things in a balance for successful future (Knudsen, 2002). *The Future of Air Transport* (2003) discusses, how balanced development strategy should be implemented – based on airport activities, the rights and interests of the ones affected by development should be met. Airports in United Kingdom have developed sustainable development systems, that include operational development, efficient use of technological advancements and solutions to climate change, as well as air pollution in local areas and noise (Sustainable aviation, 2005). Walker and Cook (2009) in their study of aviation and climate change brought out the major aspects of sustainable

development, which should be addressed by aviation industry. The analysis found, that environmental criteria receives higher support than economic or social spheres. According to findings in Walker's and Cook's (2009) study, aviation relates sustainability to mostly environmental issues, because those are the ones most often discussed in public. Social aspects of aviation sustainability receive dual opinions, some are sceptical about it and doubt, that aviation has much affect in global equality issues. However, others are more positive and claim, that aviation can help deal with worldwide social issues, such as offer fair prices, so that everyone besides their economic status can use the services (Knudsen, 2002). Department for Transport (DfT, 2003) analysed the economic aspect of sustainable development and found that aviation contributes significantly to economic growth and provides employment both directly and indirectly. Hence, there are economical benefits, but mostly aviation and airports focus on environment. Therefore, research in this study will focus on environmental dimension.

Another important aspect to take in consideration, when discussing SD in airports, is to investigate, why this development is needed in the first place and how important it is for the society. A well-known concept of external costs could fit in this discussion perfectly (see Figure 1). A definition used by Steven C. Hackett (2006, p. 66): "Externalities are positive or negative impacts on society that occur as a by-product of production or exchange" explains the idea, that any business, including aviation and precisely, airports, can have a good impact on economy, but with that also comes the negative aspect, which, in this case, is environmental effects.

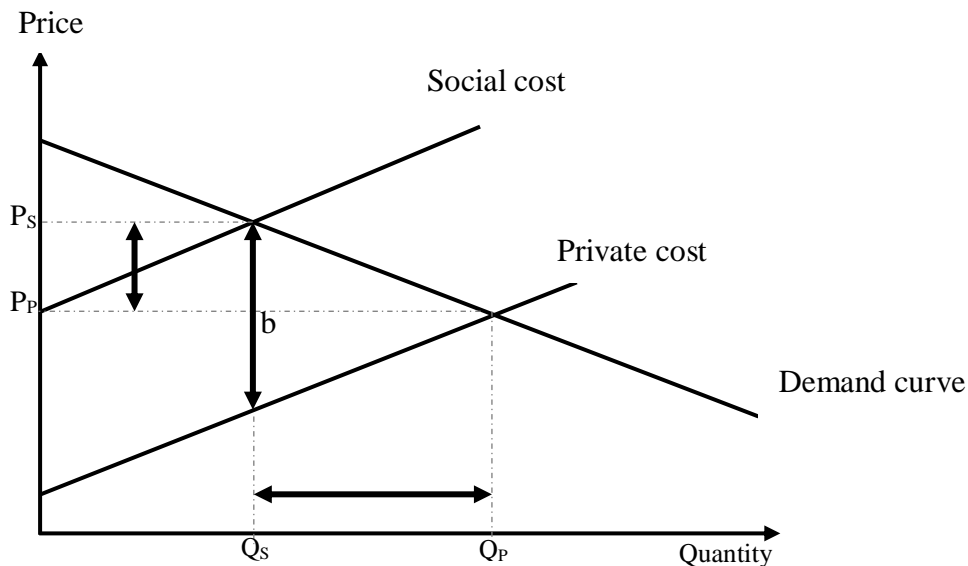


Figure 1. Negative externalities of airport operations

Source: Compiled based on Hackett (2006)

We can distinguish between private and social cost curves. For example, airline offered services, that customers purchase, affect the private cost curve, but there is also the social cost, which represents the environmental aspect. Emissions and noise are the social cost, that is paid by the society, whether they travel by air or not. The point, where private cost crosses demand curve, is the equilibrium, in which airlines can pollute without worrying about side effects, indicated by Q_P . Q_S on the other hand, shows the point, at which airports need to introduce ways to reduce societal cost, either by taxes, subsidies to airlines etc. “b” shows the total external cost, which is harming the society.

To better understand the concept of negative externalities, we must find out, what are the exact reasons for society’s concerns and for that few previous studies and reports have been analysed to answer this question.

The first reason society and government are being concerned about airport activities, is the air pollution and contamination in local land and water areas. Air pollution costs are produced by emissions emerging from aircraft. These costs include health, building damage, crop loss and casualties for the whole ecosystem, such as soil and water. Regarding buildings, the main damage is corrosion arising from acid air pollutants. Similarly goes for crops and forests, which are damaged by chemicals. Soil and water can be contaminated by airport water waste. (Maibach et al., 2008) Although SDGs dealing with water issues have been excluded from the list, it seems, that airports do have some connection with water related problems, but they are not mentioned as goals for ICAO.

The second reason is noise pollution - the most familiar is simple annoyance, which can create undesirable disturbances, but in the long term, this can cause serious health issues, problems with quality of life and wellbeing. People become stressful eventually, their heart rate and blood pressure may change, as well as hearing problems may occur. Flights during night time can decrease sleep quality. Increasing impact is on vulnerable groups, like children and elderly. (Lawton and Fujiwara, 2016) In the study of Maibach et al. (2008) it is found, that negative impacts of continuous noise can appear in medical costs, productivity loss and increased mortality.

Besides health issues, the urban development around airports is also affected – it can have negative impact on value of property and land use planning (Ferreira, 2016). It may not be permitted to build new houses, therefore preventing new settlements from being established (Trojanek and Glapska, 2018). People might not be informed fully about airport activities and purchasing property close to the source of noise can afterwards create disappointment and decrease in property value. Lack of cooperation between airport authorities and local municipalities can interfere with airport development plans and so

increase the number of people, who are experiencing negative effects (Trojanek and Glapska, 2018).

Global annual damages in monetary value are enormous and noise problem alone adds up to over one billion US\$ in damage and at least ten times more for climate change (Schäfer and Waitz, 2014). Damage from climate change is much more substantial, but aircraft noise is a very location specific. For people living closer to airports, costs related to noise will be much higher, while climate change related costs will affect also those, who live further away from airports (Schäfer and Waitz, 2014).

It has become clear, that SD has three pillars, but because environmental dimension is something that airport has direct impact on, focus in this paper will be on environment. Airport concerns about environmental aspects are followed by social and economical. Social aspect has a more indirect link to airport operations, but noise from airport is one aspect, that will be investigated in this paper as well, because it has a direct impact on local communities and affects people living near airports. Economic aspect, of course, is an integral part of business model of airports, but it is not considered as a troublesome issue and therefore is reported far less and will not be included in this research.

1.2. Overview of empirical literature about sustainable development principles implementation in airports

To draw conclusions for methods and results used on empirical analysis, few previously done research papers were chosen, covering mostly different airports and various topics. The studies were found using scientific databases ScienceDirect and EBSCO Discovery. Most common keywords used were “sustainable development in airports” and “airport sustainability”. Criteria for choosing the specific studies were year of the paper, accordance to the keywords and with content related to specific measures implemented. The number of studies were enough however, author of this paper did expect a higher number. When searching by keywords “airport sustainability” on EBSCO Discovery, the number of studies found were 846. Results varied between different databases. Findings were narrowed down to academic journals and year starting from 2010. Remaining findings were briefly evaluated and in case of potentially valuable information, were saved and analysed closer afterwards. Large part of studies was written after year 2011, which shows, that the topic is receiving increasing interest lately. Most studies analysed European airports, mostly the busiest ones, such as London, Amsterdam, Copenhagen and Barcelona. Other papers were found to be written about American countries, such as Colombia, Brazil and United States, as well as airports in Asian countries. Most common methods (see Table 3) include surveys, document analysis and using of existing sustainable development principles or indicators. In this part author will analyse each of the mentioned studies from the table and point out the relevant aspects, that will be used in empirical part of this research paper. Studies in the table have been selected based on relevance to the topic. Reports and articles of international organizations have not been added to the table.

Table 3

Overview of empirical literature

Author(s)	Year	Target airports	Data and Method	Main topics
Alonso, Benito & Boto	2016	European airports – Zurich, Madrid, Malaga and other	Data gathered from Euro control database, method - document analysis	Noise measures
Baxter, Srisaeng & Wild	2018	Copenhagen airport in Denmark	Data obtained from company materials, airport's annual reports, environmental reports, method - document analysis	Responsible energy consumption practices
Bezerra & Gomes	2018	Airports in Brazil with a full rescue-and-firefighting system	Data gathered from publications and other professional-related literature. Method – document analysis, online survey	Availability and importance of specific measures for airports
Chao, Lirn & Lin	2017	Narita airport in Japan, Incheon airport in South Korea and other.	Data gathered from literature. Method - questionnaire for experts in airport environmental protection	Measures in airports for environmental issues
Ferrulli	2016	European and international airports	Data was gathered from case studies with existing sustainability indexes. Methods - interviews, workshops, focus groups and questionnaires	Sustainability strategies for energy, water use and other
Ganic, Netjasov & Babic	2015	European airports	Noise abatement measures gathered from Boeing database and other sources. Method – statistical analysis (correlation, linear regression, cluster analysis)	Noise abatement measures in European airports
González-Ruiz, Duque & Restrepo	2017	El Dorado Airport in Colombia	Data gathered from literature and other sources about El Dorado airport. Method – document analysis	Mechanisms to promote sustainable infrastructure
Kilkis & Kilkis	2016	Biggest airports in Europe (London, Amsterdam, etc.)	Data gathered from CSR/ Annual reports. Method – SRA index, surveys	Sustainability measures in airports for different SD dimensions
Koc & Durmaz	2015	Few of world's best airports in Europe	Data gathered from sustainability reports. Method – document analysis	Best airports according to SD dimensions
Schneider	2017	Geneva Airport in Switzerland	Data from within the airport. Method – Key Performance Indicators	Importance of SD in airports, specific measures used

Source: composed by the author

The selected studies include diverse methods of analysis, however, for this research, most essential part is data gathering and exact measures used in building sustainable development in airports. For gathering information, authors have used available airport performance reports, such as Corporate Social Responsibility reports, Sustainability reports, annual reports and other written sources. Other component of gathering data include questionnaires and interviews with specialists of the industry or airports. Answers to surveys and interviews were given by experts from industry and government, who have knowledge in airport environmental protection - airport executives, airport design experts, researchers and academics (Bezerra & Gomes, 2018; Ferrulli, 2016; Chao, Lirn & Lin, 2017).

The following part of this subchapter will point out, what are the main measures found for each sustainable development dimension and which SDGs are more likely to be directly supported by airports across the globe. SDGs will be grouped the same way as in table 2, under three dimensions and will be described by each dimension separately. The SDGs found to be the most relevant for measuring airport sustainability, will be selected for further analysis in empirical part. SDGs No. 16 and No. 17 will not be included into research, because of complexity to measure these goals and they are strongly connected to all dimensions.

The first dimension analysed will be the economical. SDG No. 8 *Decent work and Economic growth* could potentially be affected directly by airport operations, however, is being reported less and not mentioned that often. Gatwick Airport Limited (2016), however, analysed employment tendencies in airport and found evidence, that for local communities' jobs in airport are highly beneficial – higher salaries, opportunities for people without any specific skillset and a good chance to progress in any field of interest. Jobs in aviation are also more productive than other sectors and contribute much more to global GDP (Benefits

Beyond Borders, 2018). Hence, in average terms, employees can earn more in airports and usually salaries increase based on increasing airport capacity. Studies show, that airports worldwide use various types of measures for economic growth, such as rate of return, profitability ratios, revenue for the local economy, management of people and skills, investments and revenues from non-aeronautical activities (Bezerra & Gomes, 2018; Kilkis & Kilkis 2016; Schneider, 2018). Specifically, Geneva airport in Switzerland analyses management of people and their skills to evaluate employment and work environment (Schneider, 2018).

Social dimension has the most SDGs however airports focus more on actions, that can bring direct impact. Goals, such as zero hunger, good health, education and other are hard to measure in airports, because they are more associated with indirect activities. After reviewing the literature, there was found only one SDG, that can be directly affected by airport activities – No. 11 Sustainable cities and communities. Local communities are often bothered by airport activities and their health damaging effects from noise and air pollution. In response, airports are implementing set of rules for airlines and cooperating with public citizens to ensure best possible solutions are introduced for both communities and even bigger cities. One of the most useful rules in airports is to limit or completely ban flights at night, usually after 22:00, which is used in most places around the globe (Schneider, 2018; Kilkis & Kilkis, Alonso, Benito & Boto, 2016). Other effective practices include re-routing airplanes to avoid living areas, regulate landing and take-off trajectories, operating quotas and additional charges for loud airplanes, physical mitigation barriers and design infrastructure to have the least possible noise influence (Ganic, Netjasov & Banic, 2015; Kilkis & Kilkis, Ferrulli, Alonso, Benito & Boto, 2016). Besides noise issue, airports also try to be open to public, perform social activities and inform local communities about expansion plans and possible side-effects of it (Bezerra, Gomes & Schneider, 2018).

Environmental dimension is much often discussed in airports and is the key-point of sustainable development. Main issues for airports are energy consumption and air pollution. Many of the energy sources have negative effect on environment, so airports are taking part in changing the existing system and think of sustainable solutions. Copenhagen airport in Denmark is making important progress towards renewable energy – airport installs solar panel systems on land and buildings, which are suitable for that cause (Baxter, Srisaeng & Wild, 2018). Some airports in the study of Kilkis & Kilkis (2016) produce their own electricity and thermal energy by burning biomass. Airports in Japan, South Korea and other neighbouring countries use green energies – solar, wind and biomass (Chao, Lirn & Lin, 2017). Ferrulli (2016) made a study about methods for airport infrastructure planning and some European and international airports reported, that they use renewable energy as well. Renewable energy can contribute to airport's energy consumption needs and CO₂ emissions can be reduced by generating solar power (Baxter, Srisaeng & Wild, 2018). These solutions are direct contribution to SDG No. 7 - Green and affordable energy.

Responsible consumption and production (SDG No. 12) is connected with the previous mentioned goal and they have similarities. Consumption of energy and water are one of the most analysed elements in airports. Bezerra & Gomes (2018) in their study of performance measurement practices in airports found, that highly used measures in airports are energy consumption, occurrence of spills and water consumption. For practical use, airports install variety of technologies and systems to reduce consumption and even reproduce on site to put in use again. Airports use efficient electrical motors for baggage claim areas to reduce electricity consumption and even develop their own waste management systems to collect waste, recycle, sell and re-use (Kilkis & Kilkis, 2016; González-Ruiz, Duque & Restrepo, 2017). Airport buildings are designed and built in order to reduce energy consumption, surrounding landscape is designed and used efficiently to save water, maximize

rain water harvest and recycling, moreover, waste is sorted to find useful materials or recyclables (Ferrulli, 2016). Copenhagen airport has a modern ventilation system, which efficiently manages heat temperature and keeps indoor climate in optimal level (Baxter, Srisaeng & Wild, 2018). Use of the system results in heating and power consumption savings. Water is collected and re-used in toilets, plant watering and cleaning (Gonzalez-Ruiz, Chao et al., 2017) as well as for cooling server rooms (Baxter, Srisaeng & Wild, 2018). Most used utility in airports is electricity and for that specific initiatives have been introduced. Airports replace old lighting with modern light-emitting diodes (LED) across terminals, runway signs, toilets and shops, low emission or electric vehicles are introduced for both energies saving and emission reduction (Baxter, Chao et al., 2017). Additional feature in Copenhagen airport includes monitoring of energy consumption (electricity, heat, water) – if any part of building shows an unusual consumption, airport can apply specific actions to deal with it (Baxter, Srisaeng & Wild, 2018).

Another very important issue is the CO₂ pollution (SDG No.13 – Climate change). Reduction of aircraft pollution has always been the first goal for airports and airlines, however, the situation for reducing pollution and measuring it is still problematic in some cases. Some of the best airports in the world, mostly in Europe, had not achieved a neutral level of CO₂ at the time of the study (Kilkis & Kilkis, 2016). CO₂ neutrality means, that airports compensate the amount of emissions produced by implementing projects, that can reduce these emissions (Airport Carbon Accreditation, n.d.). Despite difficulties, there are also good practices found in airports, for instance, replacing diesel powered stairs with electric ones, introducing eco vehicles, that run on electricity and designing apron infrastructure, so that aircrafts reduce turnaround times and distances driven on land (Ferrulli, 2016; Baxter, Srisaeng & Wild, 2018). Interesting findings were revealed about Amsterdam airport in Netherlands – only 10% of air pollution around airport was registered to come from

aircraft, hence, it is essential to provide public transportation in airport surrounding areas and reduce vehicle pollution inside airport restricted areas (Kilkis & Kilkis, 2016). Airports also take care of life on land (SDG No. 15). One of the most dangerous aspects in any airport are birds and animals on land, mostly for aircraft during take-off. Brazil airport executives agree, that dealing with wildlife in manoeuvring areas is a very important safety issue (Bezerra & Gomes, 2018). For this reason, airports are very careful about this issue and implement wildlife preventive measures. Airports around the world use special sound systems to keep birds away and design airport facilities so that they are not attractive to animals (Kilkis, Kilkis & Ferrulli, 2016). Other on-land activities include measuring water quality, amount of waste generated, preserving soil and water and design infrastructure to reduce land use (Kilkis, Kilkis & Ferrulli, 2016; González-Ruiz, Duque & Restrepo, 2017). Many, if not all of the goals discussed in environmental dimension, are related to infrastructure development in some way. Airports have implemented innovative and sophisticated solutions to crucial problems mostly because of modern infrastructure. Far-reaching infrastructure planning can help airports in future expansion projects. Sustainable infrastructure (SDG No. 9) requires architectural assistance and both environmental and social aspects need to be included into design and construction (Ferrulli, 2016). Chao, Lirn & Lin (2017) in their study suggest, that airports have to build based on local climate and geographical environment, as well as use materials, that can be recycled after and are easy to maintain.

After reviewing the studies, it has become clear, that airports now face with various environmental and social issues, that need to be addressed to achieve sustainability, however, economical dimension is less mentioned as a problematic issue. Some airports, such as the ones in Brazil, find it difficult to fight against pollution or other related issues. Airports in Europe are more advanced towards SD and the issues regarding it are handled better. Study of Koc and Durmaz (2015) show, that European airports, such as Zurich, Amsterdam or

Munich, present high-quality reports on all sustainability dimensions and provide transparent information on energy, water, biodiversity and emissions. Author of this paper has found evidence, that airports, which are located near water sources, such as rivers, measure its water quality and prevent it from being contaminated. Water protection, as mentioned before, is not included into ICAO's action plans, but in this study will be added to SDGs related with consumption and life on land. For further analysis few SDGs have been selected (see Table 4) and measures planned to analyse are added to have a better understanding of the empirical part of this paper. SDGs are selected based on findings of previous empirical studies. Environmental SDGs are primary focus and these goals have the most respective measures found. SDG No. 12 was added as additional element to environmental SDGs, because airports have direct impact on noise pollution, and this is a much-discussed topic.

Table 4

SDGs selected for further analysis

Number of SDG	Name of SDG	Respective measures
No. 7	Clean and affordable energy	Renewable energy options (solar, wind, biomass)
No. 11	Sustainable cities and communities	Reduction of noise pollution (ban flights at night, re-route airplanes, physical barriers etc), cooperation and communication with local communities
No. 12	Responsible consumption and production	Energy and water consumption, occurrence of spills, waste management systems, rainwater harvest and re-use, modern lighting inside and outside airport buildings
No. 13	Climate change	Exclude diesel powered vehicles, reduce aircraft turnaround times, time spent on land and distances driven
No. 15	Life on land	Dealing with wildlife, quality of local water sources, reduction of waste generated

Source: compiled by author

Overall, sustainability issues are in the interests of airports and the requirements will keep increasing, especially environment related. Environmental dimension will be in the focus of empirical analysis, including water related issues and noise disturbance.

2. Empirical analysis of sustainable development principles implementation at Riga International airport

2.1 Methodology for empirical analysis and environmental impact of Riga airport

Author of this paper has created methodology for further analysis of Riga International airport based on SDGs selected in the previous chapter. Empirical part will consist of three main aspects – document analysis of Riga airport environmental reports, online questionnaire for airport employees and interviews with Riga airport experts from environmental departments.

Firstly, basic data and numbers about airport's impact on environment were gathered from airport's environmental report. Data expected to be received from the report would give basic insight about airport's performance on CO₂ emissions, energy consumption, amount of waste generated, water consumption and other data found useful. Airport's environmental report is a publicly available report on airport's website and so far, reports from year 2017 and 2018 are available. Both reports were analysed and major changes in numbers are noted. Results from report analysis has provided with additional questions for interviewees to answer and comment on specific data.

Secondly, an online questionnaire was conducted (see Appendix A), aimed for airport employees from various departments to analyse overall knowledge and importance of SD's environmental dimension in airport. Survey questions were put together based on findings from the literature overview. Idea of Likert-scale and questions evaluating importance of SD measures were taken from Bezerra & Gomes (2018) study and adjusted to better suit analysis of Riga airport. Some specific measures were also included from that study, such as energy consumption. Other measures were found in studies of Chao, Lirn & Lin (2017), Ferrulli (2016) and Kilkis & Kilkis (2016). Survey also asked questions about social aspects, such as noise and communication with local communities. Employees live in various places around

the airport and further, therefore employees can answer based on their experience. Survey began with introductory questions to separate respondents by their genders, age groups, years worked in airport and field of employment. There were two open questions to shortly explain specific topic. Other questions were Likert scale with maximum 5 values. Value “1” account for “strongly disagree” and value “5” for “strongly agree”. One question had Likert scale with 3 values. “1” accounting for “not important at all” and “3” for “very important”. The expected sample for survey was at least 100 respondents. Riga airport employs more than 1000 employees therefore the expected sample was reasonable. The number of employees to whom the survey was distributed, is unknown. Survey was open for 6 days, because of shortage of time and lack of activity for the last few days. In total, 63 answers were gathered (see Table 5). Results have been evaluated and major key points are brought out into this paper. Questionnaire accounts for quantitative research method and has provided good insight into employee knowledge about SD principles. SPSS statistics software was used to compare results and create graphs. Questionnaire was conducted in Latvian and afterwards translated to English.

Table 5

Sample characteristics

Variable	Number of respondents	Percentage of sample (%)
Gender		
Male	33	52,4
Female	30	47,6
Age		
16-20	1	1,6
21-30	27	42,9
31-40	23	36,5
41-50	9	14,3
51+	3	4,8
Years worked in airport		
Less than a year	11	17,5
1-3 years	23	36,5
4-9 years	16	25,4
10-19 years	10	15,9
20+ years	3	4,8
Field of work		
Security department	15	23,8
Quality department	3	4,8
Ground Handling Department	19	30,2
Apron safety and management department	12	19
Other	14	22,2
Knowledge about SD		
Have knowledge	45	71,4
Do not have knowledge	18	28,6

Source: author's calculations based on survey results

From all respondents, 52,4% accounted for men and remaining 47,6% for women. There are specific types of jobs, that are mostly for men and similarly goes with jobs for women, therefore gender proportions are quite decent at Riga airport. Most of the respondents, or 42,9%, were in the age from 21-30 years, followed by 31- 40 years old with 36,5%. Riga airport employees are relatively young and especially for the last few years airport is rapidly employing new people and because of highly dynamic job, it is more suitable to younger people. Usually work at Riga airport does not require years of experience, therefore being beneficial for job seekers.

The least represented department is the quality department, which is responsible for environmental protection. Whole department employs over 100 employees and according to survey results, only 3 employees are from this department, which is not a positive sign, however, analysing another department knowledge is probably more useful. Hence, most respondents come from departments, in which the knowledge about sustainable development could potentially be lower. Years worked at airport also vary, but majority of respondents have been working for less than 10 years in airport. This shows, that airport has increased significantly number of employees in period of the last 10 years, especially last 4 years, because the share of employees working in airport for less than 4 years, is little above 50%.

Questionnaire was then followed by a question whether SD or SDGs are a topic that employees have ever heard about. Results show, that most employees do have some knowledge about SD or SDGs. Individual statistics show, that there is no specific tendency of knowledge in particular department or age groups. Also, those who have worked in airport for less than one year, still mostly report positive answer to this question.

Lastly, 3 interviews were conducted, which cover all SDGs selected for further research. Interview plan is added into appendix (see Appendix B). The experts for interviews are from different sectors and specific questions were asked from each of them (see Table 6). Experts cover topics of energy, wildlife protection, noise pollution and social issues, as well as other environmental aspects at Riga airport. Interviews correspond to qualitative research to receive specific answers and opinions. Interview plan was unstructured to discuss topics as widely as possible and questions depend on field of expertise of the respondent. Coding method was used for analysing interview results to find the most important information needed for further analysis. Interviews were conducted in Latvian to ease the communication for interviewees and translated afterwards to English.

Table 6

Interview characteristics

Interviewees	Occupation/department	Topics covered	Length of interview
Interviewee A	Noise impact specialist/ responsible for people complaints	Noise impact, noise reducing measures, communication with local communities	45 minutes
Interviewee B	Environmental management specialist	Energy consumption, water protection, energy production, waste management, climate change	42 minutes
Interviewee C	Bird and animal control specialist	Airport protection against animals and birds	16 minutes

Source: compiled by author based on interview results

In order to get allowance to conduct interviews and surveys, representative of environmental department of the Riga airport was contacted through email to introduce with the research topic and discuss potential cooperation. Contact with the responsible person was made in the beginning of April 2019 and it was agreed to meet in person to discuss details. One week after the meeting the online questionnaire was sent to the responsible person to forward it to airport employees. Interviews could only be conducted at the end of April 2019, because of tight schedule for the interviewees. Two interviews were more than 40 minutes long and the topics were discussed in detail. Third interview was shorter however the topic was narrow, and all the required answers were gathered. It was agreed with interviewees, that their names will not be revealed in this paper.

In the next section, author will bring out the main findings found in airport's environmental reports, which cover majority of airport's sustainability actions. Together there were two reports publicly found on airport's website and both were analysed. After reviewing of the reports, some interesting data has been found about Riga airport's sustainability actions and impacts on environment. The first thing, that was found, are the CO₂ emissions coming from airport's-controlled emission sources. There are three sources of CO₂ and those include providing electricity for airport, airport's heating and fuel consumption (see Figure 2). Airport buys energy from external company and has on-site power generator, which uses fuel to provide electricity. Other sources, such as aircraft emissions from landing, taking off and aircraft ground movements are classified as uncontrolled emissions sources.

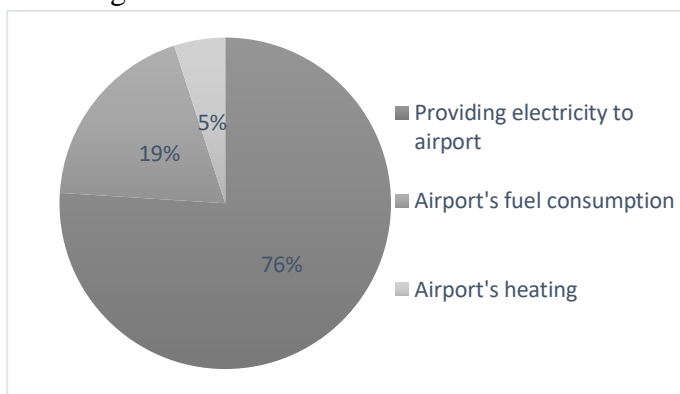


Figure 2. Airport's controlled sources of CO₂ emissions (%)

Source: compiled by author based on Environment review, 2017

Significant part of total CO₂ come from providing electricity, which accounts for 76%, followed by fuel consumption and heating. In 2017, airport registered for almost 4000 tonnes of controlled CO₂ emissions, followed by a slight decrease in CO₂ emissions the year after (2018), average uncontrolled emissions account for 6000 tonnes of CO₂ annually (Environment review, 2018).

Interesting findings about water consumption and production opposes the ICAO sustainability plans, which stated, that water related SDGs are not in aviation industry's competencies. However, Riga airport obtain water from its three artesian wells, that are in

airport's territory. Water from wells is then transformed into drinking water, used for watering plants and for cooling terminal building roofs. Because of hot summer in 2018, airport's obtained water amount increased by 46% or 53214m³ in comparison to 2017, when total amount of water obtained was 114469 m³ (see Figure 3). Water consumption has no restrictions and it is highly dependent on passenger amount and weather conditions.

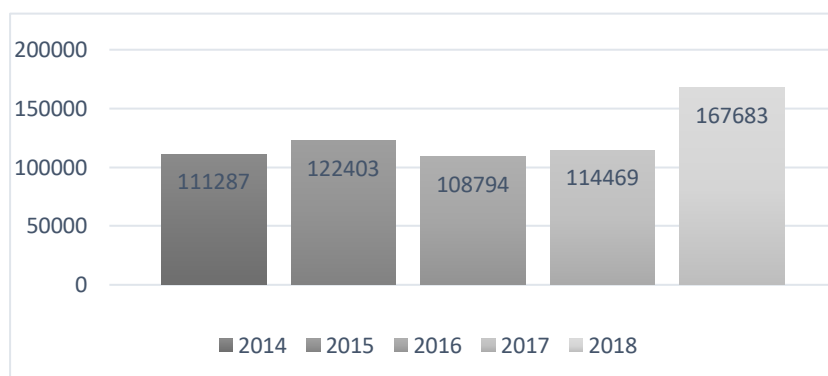


Figure 3. Water gathered from airport's artesian wells (m³)

Source: compiled by author based on Environment review, 2018

The amount of water obtained from wells is expected to rise, because of increasing number of passengers and upcoming construction work. Airport also has a rain water harvesting system, in which the water is cleaned from chemicals and afterwards released in the local river (Environment review, 2018). Rain water needs to be cleaned before releasing into river, because it is mixed with other liquids coming from the apron.

Third important aspect is the noise pollution. Airport has a laboratory, which analyses the noise results from three noise monitoring stations around the airport. In 2017, all stations recorded an increase in noise impact in comparison to 2016 (Environment review, 2017). In 2018, on the other hand, was registered a decrease in noise impact in all stations (Environment review, 2018). Most important factor, which affected the changes, was the introducing of new aircraft for Air Baltic, which are much quiet. Results show, that level of noise increase is lower than the actual volume of activities in airport, therefore it is clear, that

airlines with modernized aircraft have a positive impact on noise reduction (Environment review, 2018).

Last, but not least, important is the waste management system. Total household waste in 2018 was 4383,86 tonnes, which was around 400 tonnes more than in 2017. The increase of waste is explained by rapidly increased number of passengers. Besides household waste, there is also hazardous waste, which is mainly produced on the apron of airport. In 2017, hazardous waste accounted for 308 tonnes and saw a slight decrease in 2018, reaching 274 tonnes. (Environment review, 2018) Decrease in waste amount is not expected because of airport's growth tendencies and therefore it is required to increase amount of waste being recycled.

To conclude this section, a brief and positive insight has been gathered about sustainability actions in Riga airport. Environmental reports emphasize, that Riga airport is working on sustainable development and keep improving ways to protect the natural environment, which is the main field of sustainability for the airport in Riga. Regarding more specific aspects of sustainability, airport's SD mostly concerns electricity and water consumption, noise, CO₂ emissions, quality of local water sources, household and hazardous waste and other environment aspects, which are not mentioned specifically (Environment review, 2018). The environmental management system in Riga airport is implemented and maintained in accordance with the requirements of ISO 14001 standards. Overall statistics seem good and numbers for CO₂ emissions, noise and hazardous waste tend to decrease in the last two years. All relevant data could be found from the reports, except for wildlife effects. Airport's impact on wildlife is not being measured.

2.2 Quantitative and qualitative analysis of sustainable development principles in Riga International airport

This subchapter will talk about main results from survey and interviews linking together with findings from literature review. Subchapter will start with analysis of questionnaire and will be followed by interview results.

First aspect analysed based on the survey results, are measures, that should be implemented in Riga airport, based on employee thoughts (see Table 7). For determining how much employees know about sustainability in Riga airport and where did they first found out about SD, two open type questions were asked. Answers were very diverse and well explained, providing also very detailed information. Most of the respondents said that Riga airport had informed them about SD – in meetings, daily job activities, airport newspaper, information found on airport's website and development plans. Other popular answers included studies in university and even in high school, personal interest, media, business journals and sources, which were not specified. This leads to think, that people aged 21-30 do mostly know about SD and the sources are diverse, which means, that the topic is quite popular outside the airport and especially important in the airport. Employees from all departments have reported knowledge about SD, therefore it seems, that this topic covers all fields of activities in Riga airport.

Second open type question results show that people think differently, and their interpretation of SD is very diversified. This was also reflected in the theory of Byrch, Kearins, Milne & Morgan (2007), that people interpret the concept differently and it is the case in Riga airport. Main findings show, that only few employees think that SD is about energy consumption and innovation in airport, but few more are certain, that it includes airport's business development taking in account protection of natural environment. Other small groups of employees consider SD as a tool for airport's positive reputation and that it

has something to do with the fact, that Riga airport is a highly important strategic object in the region. Most answers were concerning infrastructural development, employee and passenger satisfaction, increase in passengers and thought-out action plans. Findings in literature revealed that infrastructure is one of cornerstones for environmental dimension, as said by Ferrulli (2016) and that every climate requires specific infrastructure (Chao, Lirn & Lin, 2017). Environment reports of Riga airport also mentioned infrastructure to reduce energy consumption and apparently employees are well informed about this aspect in airport. As the SD is a very broad topic, none of the answers provided are incorrect and it means, that when talking about SD, it is very important to explain the details for people involved in the process of sustainability planning.

Table 7

Average values of sustainability measures applicability in Riga airport

Measure	Measures already in place	Mean	Standard deviation
Electricity production from renewables	X	3,78	1,17
Waste management system	X	4,38	0,99
Rain water harvest and reuse	X	3,79	1,08
Make all airport vehicles electric		3,79	1,31
Sound systems to scare away animals and birds	X	4,33	0,82
Measure quality of local water sources	X	4,24	0,78
Restrict flights at night-time		2,75	1,43
Close cooperation with local communities	X	4,29	0,77

Source: Author's calculations based on survey results

As it can be seen in the table, employees do not agree with restricting flights and do not consider this as a measure, that should be implemented. One reason for negative answers could be that the question was not asked clearly enough, which created misunderstandings and explains the high standard deviation of 1,43. For better comparison of mean and standard deviation values, see Figure 4. However, employees do not see a problem for aircraft operations during night-time. Authors of other empirical literature explain the need to restrict

flights after 22:00 (Schneider, 2018; Kilkis & Kilkis, Alonso, Benito & Boto, 2016) and if this was emphasized in the survey, the results might have been different. Findings from interviews reveal, that flights are not restricted at any time of the day and during night airplanes can operate as usual. People during night are more sensitive to noise, however there are not that many flights at night, therefore this measure is not useful at this moment. Authors of theory of negative externalities consider noise as the most harmful one for local communities (Maibach et al., 2008) and employees of airport work in increased noise environment, therefore the negative impacts should be known. More and more people are moving to living areas closer to Riga airport, so the amount of people being affected by noise is basically increasing, but number of complaints is not changing significantly. Hence, it is difficult to determine, whether flights should be restricted during night or not.

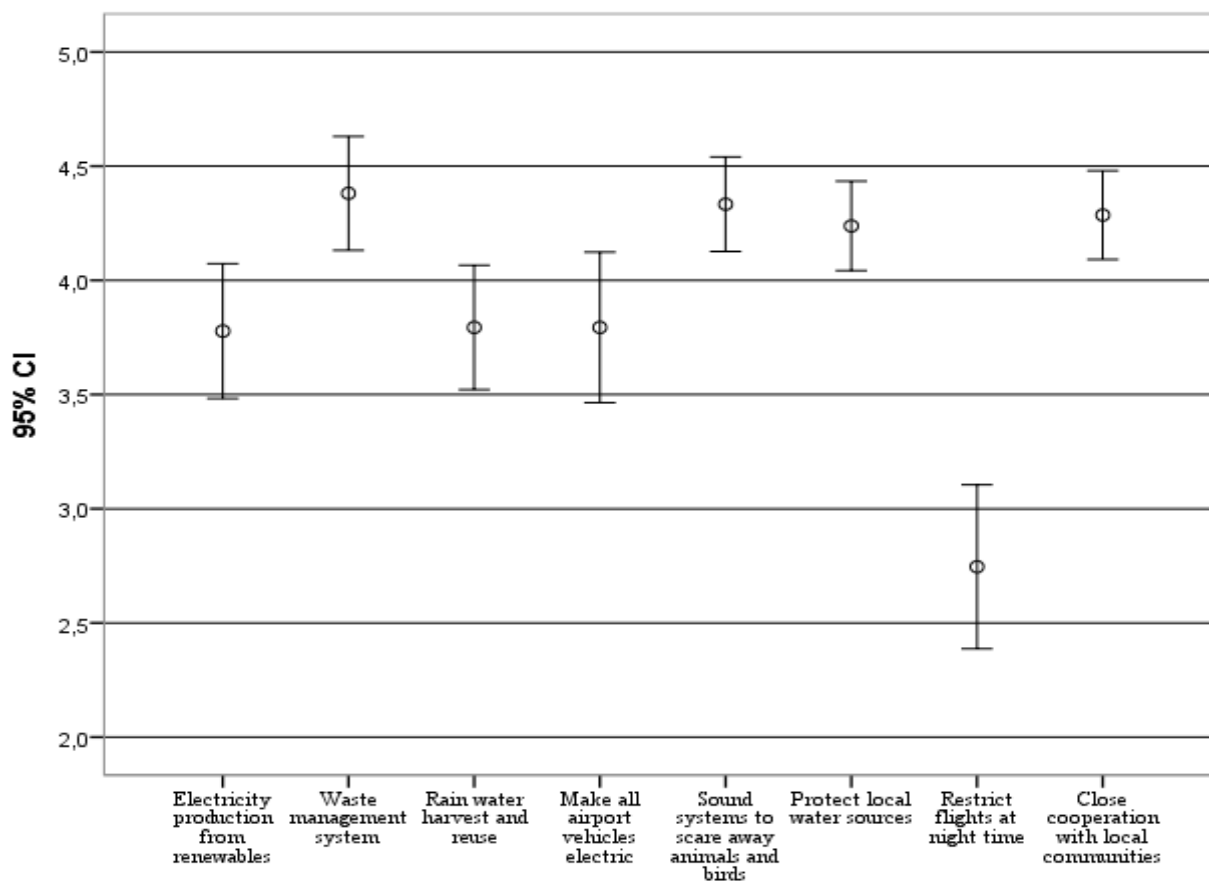


Figure 4. Error bar for measures applicable at Riga airport.

Source: Compiled by author based on survey results.

Employees were the most agreeing about waste management system, which showed the highest mean value of all. However, from all the means, which are over “4”, waste management system measure has the highest standard deviation score, therefore it shows, that there have been quite diverse answers. Waste issues were also mentioned often in other literature as an important aspect in every airport (Kilkis & Kilkis, 2016; González-Ruiz, Duque & Restrepo, 2017), because waste is being generated in huge volumes and it may contain hazardous waste.

Employees were also positive on producing electricity from renewable resources, rainwater harvesting, sound systems for scaring away animals and birds, protecting local water sources, cooperating with local communities and making all airport transport electric. Figure 4 perfectly shows, that four measures stand out as the highest valued. As seen from the table mentioned before, there are two measures, which are not completely implemented. Airport cannot make all vehicles electric, because they need to operate all day and do not have time to recharge. Flights are not restricted during night and that will not be done in future as understood from interviews, which will be analysed in this paper.

Second aspect, that was analysed from survey results, is the importance of specific sustainability measures for airport employees (see Table 8). This part of the questionnaire presented very similar results and all measures, except for noise impact reduction, were evaluated as important or close to “very important”.

Table 8

Respondents rating of sustainability measure importance

Measure	Mean	Standard deviation
Use of clean energy (renewable)	4,08	0,89
Waste collecting and recycling	4,48	0,84
Efficient use of electricity and water	4,49	0,72
CO ₂ emissions reduction	4,14	0,91
Protection of local water sources	4,30	0,82
Protection of surrounding nature	4,43	0,80
Cooperation and communication with local communities	4,03	0,78
Noise impact reduction	3,81	0,96

Source: Author's calculations based on survey results

Some measures and their importance to airport's sustainability can easily be compared with study of Bezerra & Gomes (2018), hence with the situation in airports in Brazil. Efficient use of energy and water score high on both studies therefore this seems as very important aspect for employees of Riga airport. Environment reports emphasize the importance of responsible consumption, waste management and as employees are part of airport's sustainability strategy, everyone should be concerned about these issues. Similarly, as for previous table about measures, noise impact scored the lowest average score again and standard deviation remained the highest. This result makes to think, that employees apparently are not enough familiar with the noise impacts and do not consider it a problem. Employees themselves could be used to the loud environment and thus do not feel the negative side effects. To better see the differences in importance of measures, an error bar graph was made, similarly as before (see Figure 5).

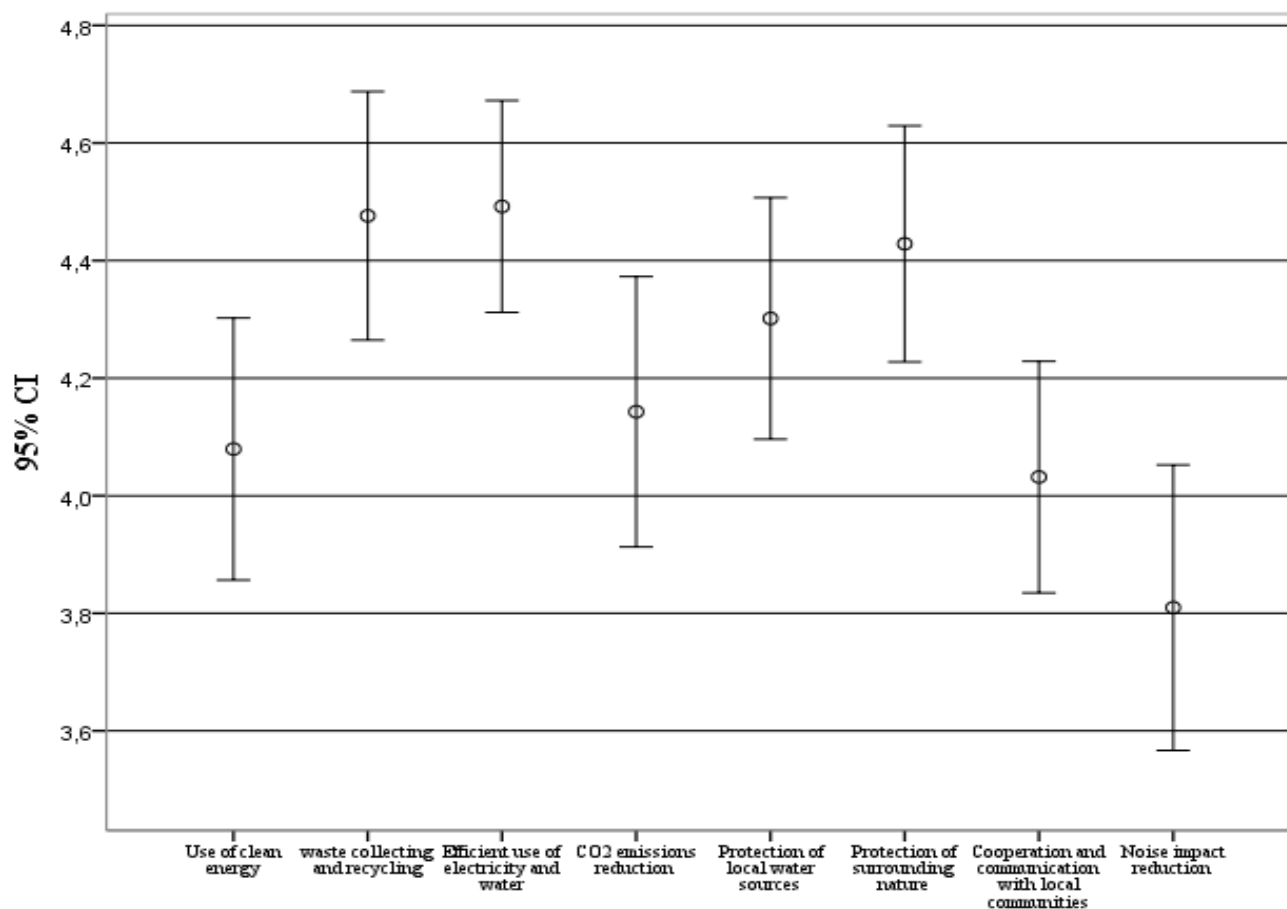


Figure 5. Error bar representing specific measure importance to airport employees.

Source: Compiled by author based on survey results.

From the figure we see, that 3 measures – waste recycling, electricity/water use and nature’ protection are the most important to airport employees. However, there are four other measures, that are valued as important, hence, leaving the noise reduction measure as the least important. Social activities are evaluated as important in study of Bezerra & Gomes (2018) and similarly goes for Riga airport. Airport is trying to be open to public and inform (Schneider, 2018) local communities about its development plans and potential side effects of airport operations. Another measure being improved is to change times and location for aircraft engine testing. It was being done in area, which is close to residential buildings. Also, testing during summer is problematic, because people tend to keep their windows open, so they are more affected by noise. Study of Ganic, Netjasov & Banic (2015) offer to introduce

operating quotas, but this in no way can be a beneficial action for Riga airport, because it is focusing on passenger growth and any quotas would slow down development.

Efficient use of electricity and water is slightly the most important measure and one reason could be that people are motivated to use these utilities responsibly, so that the price for them would be lower. In general, the tendency shows, that all measures offered are quite essential to employees and they do care about natural environment.

Respondents of the survey were also asked to evaluate different aspects related to airport's attitude towards SD and providing information to employees (see Appendix C). Employees were confident, that airport does include SD in their activities, but were more neutral towards received information about it. There might be some departments, which receive less information about SD issues, because they are not related with it. Some employees might also not be interested in news sent by the management, hence not reading them and saying that he or she is not being informed. Employees have answered, that it is important for them, that employer (Riga airport) is sustainable. Lastly, employees were asked to give answer on whether they would like to receive more information from the airport, to which in a scale from 1 to 3, answer gathered a total score of 2,33. Overall results show, that employees are interested in the topic, they are well informed about the activities in Riga airport and based on answers found in open type questions, employees are quite creative towards SD and think of various fields, that can be associated with it.

The following sections are more focused on interview results and specific measures for each SDG selected for research, will be brought out. From the more advanced measures, that are being used to reduce noise impacts, the most attention is being put on aircraft landing and take-off trajectories (Kilkis & Kilkis, 2016). Information from interviews tells, that airport is working on implementing advanced GPS systems, which would provide each flight with the best possible trajectories in order to avoid living areas as much as possible. Riga

airport does not have any specific barriers (Ferrulli, 2016), that would decrease noise impacts, but the design of apron does in some way protect local citizens from noise. Airplanes must pay additional fees for taking off and landing. Fee is based on aircraft type and weight, but this feature needs to be analysed more and improvements to this measure could be introduced in the following years. Fees for airplanes were mentioned in the study of Alonso, Benito & Boto (2016) and are used all around the world, however at Riga airport this measure still has some issues – some aircraft, though having the same weight, pay the same price, but noise impact coming from them is dissimilar.

Riga airport does not receive many complaints, but they do not cause significant problems and usually are dealt with. Most discussed issue, however, is aircraft taking off, known as J-type take-off procedure. It means, that aircraft has special trajectory for taking off and point when to turn to its required direction. This “J” shaped line covers some living areas and people living beneath it have concerns. This is an important procedure for aircraft, which cannot be easily changed. However, airport does not have the power to restrict from building residential buildings. Local municipalities have full control over this, so they decide, whether they want to allow construction of residential buildings or not. Though, airport can affect construction in areas, which are too close to airport’s territory and forbid it in order to protect people from potential noise impacts.

One of priorities at Riga airport right now is to reduce energy consumption and think of ways how to produce electricity more efficiently and cheaper. Kilkis & Kilkis (2016) proposed to burn biomass as a renewable resource and Riga airport uses it for heating purposes, however, the effect is very small and decrease in CO₂ accounts for very little. Bigger airports, such as Copenhagen, use solar panels to produce electricity (Baxter, Srisaeng & Wild, 2018), but Riga airport considers implementing them in future. Airport is lacking financial support for this kind of innovation and there are too many old buildings, which are

not suitable for solar panel instalment. Another option is using wind power (Chao, Lirn & Lin, 2017), however interviewee is not considering this choice.

With electricity also comes responsible consumption and Riga airport is quite of an expert in this field. Bezerra & Gomes (2018) found, that energy and water consumption are undoubtedly important measures and Riga airport is closely following how these utilities are being used. Airport successfully introduced advanced LED lighting (Baxter, Srisaeng & Wild, 2018) across airport territory except some parts of apron, that has specific rules for lighting. Kilkis & Kilkis (2016) proposed to implement electric baggage claim belts, which Riga airport has done. When asked about any ventilation systems, such as the one in Copenhagen airport (Baxter, Srisaeng & Wild, 2018), interviewee told, that Riga airport has a similar system, which turned out to be very efficient and has helped to significantly reduce in-door temperatures and overall energy consumption. Although a new terminal was opened few year ago, energy consumption has not increased that much, if viewing as energy consumed on one m². Airport is monitoring both electricity and water consumption by airport tenants and every month data is prepared with information on unusual consumption. When this occurs, tenants are informed about increased consumption and are asked to explain the reasons.

For the last few years, Riga airport has seen considerable increase in waste produced. For this reason, a waste management system (González-Ruiz, Duque & Restrepo, 2017) is required to be able to sort, recycle (Ferrulli, 2016) and afterwards give the waste away to waste companies. Riga airport is having major problems with achieving these measures, as interviewee explained: *“situation with waste is a tough topic for us – people do not pay attention to recycling and so it is harder for us to manage waste properly”* (Interview B). There are separate waste containers for each type of household waste – plastic, paper and glass, but people are not keen on sorting and therefore airport is having problems with sorting

and recycling waste. Expert explains, that hazardous waste, which are mostly liquids, can differ year from year – it depends on weather, liquids used and amount of that gathered from the apron. Not everything can be collected and therefore the amounts are changing. Riga airport has special “oil catchers” installed in the sewage system, that clean the hazardous water.

One of most problematic world environmental problems – CO₂ emissions, are also analysed and dealt with at Riga airport. As mentioned previously in empirical part, airport produces around 4000 tonnes of CO₂ annually and couple of methods, such as the one with renewable resources, are being implemented to reduce CO₂. Chao, Lirn & Lin (2017) propose airports to introduce low emission or electric vehicles, while others talk about design of the apron (Ferrulli, 2016). Interviewee explained reasons, why fully electric vehicles cannot be implemented, but Riga airport has future plans for hybrid light vehicles. Large machineries most likely will remain diesel powered. Apron is built in a way, that aircraft spends the least possible time on land and new projects are incoming in following years to make it more efficient.

Riga airport is also concerned about life on land and measures for this include protecting local water sources (González-Ruiz, Duque & Restrepo, 2017) and wildlife protection, that will be discussed in further section. Airport collects and purifies rain water and cleans water from hazardous waste before releasing it into local river. In addition, water quality in the river is being measured to make sure, that no chemicals have gotten in. Another action, that Riga airport performs, is to monitor local forests around the airport territory and determine airport’s activity impact on forest health. In the next following years, a new project will be introduced within which new trees will be planted around airport territory.

Topic of life on land is followed by wildlife in airport’s territory and its respective measures. Animal control at Riga airport monitors migration of birds, follows their

movement both inside and outside airport's territory and scares the animals away so that threat to aircraft is reduced. Similarly, as in the study of Bezerra & Gomes (2018), also at Riga airport dealing with wildlife is one of priorities for ensuring safe aircraft landing and taking off. *"Birds are one of the biggest threats for aircraft – situations may vary from harmless to even lethal"* (Interview C). Daily used measure for this includes special sound systems (Kilkis & Kilkis, 2016), that have many different predator bird sounds, which helps to scare away specific species of birds. Sound towers are in few places of the apron, there are speakers on building roofs and on cars to cover as much area as possible. Some species do not respond to sounds, so for them flare guns are mostly used. Airport has a radar system to register bird movements in the area and the information is further sent to air traffic control tower, which can then adjust aircraft movement. This system requires improvements and work on it is expected to begin in near future. Work with birds is a non-stopping process throughout the whole year to keep as many birds outside the airport as possible.

Another threat are the land animals, but a newly designed fence around the airport is doing the job very well to keep them away. If any animal manages to get in restricted area, they are caught and released back in the wild. Ferrulli (2016) mentioned the need to design buildings specifically unattractive to animals, however, Riga airport has majority of old buildings, therefore this action can only be thought of in the future. One aspect, that Riga airport is working on, is to transform the grass fields in airport territory, so that lawn would not be attractive to animals and birds. To implement this method, experts are highly wanted, but are hard to find in this region of Baltics.

After analysing all three aspects of empirical part, it has become clear, that Riga airport is actively participating in sustainability implementation and for more successful development, airport employees, local municipalities and companies are working together to achieve SD. Appropriate measures have been found for each of the SDG selected before and

main findings are summed up to clearly see, which SDGs are supported by Riga airport (see Table 9). Interviewees believe that SD is the way, how airport should develop further, but for that financial aid and advanced technologies are required. Airport has huge potential, but it cannot fully achieve it alone, because there are many sides involved in the development process of Riga airport. However, airport is eager to implement new measures and is working hard to gradually achieve sustainability. To ease the implementation and discovery of potential sustainability measures, a new SD committee is being introduced at Riga airport, which will be directly responsible for airport's sustainability implementation.

It was emphasized in interviews, that airport is aware of all the negative social costs, that people may encounter, but without advanced technologies, further drastic developments, for instance, in noise impact reduction cannot be expected. Noise cannot be fully cut down, therefore communication with people and working closely with local municipalities is very important, as said by one of the interviewees: *"it is important to achieve win-win situations, because we cannot benefit everyone"* (Interview A).

Table 9

Main measures found for each SDG

Number of SDG	Name of SDG	Main results from survey	Main results from interviews
No. 7	Clean and affordable energy	Is not considered as essential part of SD	Clean energy from biomass
No. 11	Sustainable cities and communities	Communication is important, but noise is not problematic	Noise reduction measures, good communication and cooperation; appropriate living conditions for people
No. 12	Responsible consumption and production	Electricity and water need to be used efficiently; waste recycling receives dual thoughts	Limited use of electricity, modern lighting, waste management system
No. 13	Climate change	CO ₂ reduction compared to other measures, is not that important	Fuel powered mechanics and vehicles are being replaced with electrical, special apron design
No. 15	Life on land	Water, animals and nature in general is important to employees	Animal and water protection, forest monitoring and tree planting

Source: Compiled by author

SDGs “Life on land”, “Responsible consumption and production” and “Climate change” are strongly supported at Riga airport and new measures are being implemented gradually. Water and local forests are healthy; animals and birds are also treated well. Airport is strictly following energy consumption and is implementing new measures to reduce it even more. Water consumption, on the other hand, does not have consumption restrictions, but unusual use of water needs to be explained. Regarding climate change, Riga airport is still relatively small and compared to bigger European airports, the CO₂ impact on nature is very slight. However, diesel powered vehicles and machinery is slowly being replaced with nature friendlier technologies. In addition, modernized fleet is being introduced for Air Baltic airline and because this airline covers the most flights operated at Riga airport, CO₂ impact is expected to decrease even more.

Idea of “Clean and affordable energy” is to provide people with affordable energy and produce it using renewables. Specifically, the second aspect was analysed at Riga airport and results show, that this goal is not receiving enough support yet from the airport. Airport produces energy using biomass, but the benefit offered is too small to draw proper conclusions. Future plans, as mentioned before, include solar panels, but at this moment, airport does not offer considerable support for this SDG.

SDG “Sustainable cities and communities” is well supported by Riga airport. Local communities are well informed about airport activities and potential side effects. It seems, that noise does not significantly affect neither land prices in the area, neither local citizens, because demand for residential property remains high in the area.

Conclusion

The concept of sustainable development is quite sophisticated and different authors have slightly different interpretation of it. It is generally agreed that it consists of three dimensions – economical, social, environmental and that anyone and anywhere can contribute to SD. In world's current situation in field of any of the dimensions, SD concept is more important than ever. Ideas presented by various authors are similar and as time goes on, new ideas are presented to supplement the previous ones. Since time, when first definitions were introduced and present day, the concept has become more ambitious, as it covers more topics, is open to changes and in today's rapidly changing environment the tasks for SD will continue to change. Findings show, that SD is also applicable to airports.

Amount of literature about SD implementation in airports is rapidly increasing in the last decade. A bigger increase in literature is seen after 2015, when SDGs were introduced. Literature about SD in airports concern mostly environmental dimension. Most popular measures include efficient use of energy and water, waste management systems and recycling, CO₂ reduction, noise impact reduction and being socially responsible. Although ICAO's framework for SD in aviation did not include water issues, these are highly important for some airports and are included into SD plans. Most studies found describe European airports, for the reason probably being strict regulations and so these airports are more actively participating in environmental protection and are more interesting as a subject of research. Social and economical dimensions receive considerable attention, however compared to environmental one, these are only a fraction of the amount of sustainability actions performed in airports.

Empirical analysis was based on three methods – document analysis, online questionnaire and interviews. Document analysis consisted of two documents created by Riga airport. According to environment reports, Riga airport is putting emphasis on energy

consumption, noise impact reduction and waste management. Airport has quality guidelines, that need to be met regarding natural environment and airport is putting in a lot of work to fulfil these requirements. Main issues of Riga airport's sustainability, as reflected in environmental reports, are CO₂ emissions, noise, waste and energy consumption. All of these are managed quite well, except for waste reduction and recycling. Riga airport also takes care of local water sources and water quality is essential aspect of airport's sustainability.

Online questionnaire was used to determine employee knowledge about SD in airport and results have been very diverse and intriguing. Sample of 100 respondents was not met, with reasons probably being lack of interest in taking surveys. Main results show, that employees are positive about implementation of various sustainability measures and these actions are important for employees. Employees are engaged in airport's development and are important factor in fulfilling these goals.

Interviews with experts of Riga airport have provided with answers needed to determine, whether Riga International airport develop its business by implementing SD principles. Analysis give clear answer, that Riga airport does include SD in its business model, and it is an essential factor of airport's further development.

Overall, the growth at Riga airport for the last five years has been outstanding. Such rapid growth was not expected and therefore it forces Riga airport executives to think much faster about SD implementation. As a response, participation in global aviation events and seminars to gather information on sustainability measures, that could potentially be implemented, is a consistent activity for airport executives. However, SD principles implementation is not an easy task for Riga airport. According to interview results, Riga airport has three main factors, that slow down SD. These are technological, financial and social aspects. Advanced technologies are considered as primary reason why some sustainability measures cannot be implemented in Riga airport. Airport executives are

hopeful, that technologies will develop quickly, so that future ideas can be introduced into reality. Second aspect is the lack of funding for some measures. Riga airport often has to ask for financial aid, so that environmental projects could be carried out. Last aspect is the social one. Interviewees discussed, that Latvian society and government are not ready yet for significant changes and more educating is needed on topic of SD.

This paper is a contribution to increasing number of studies about SD actions performed in airports and provides detailed information about sustainability measures carried out at Riga airport, the largest passenger airport of Baltic States. Study brings out the main aspects which are essential for SD implementation in airports and what measures can small airport potentially implement.

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Appendices

Appendix A

Questionnaire of the survey as displayed to the respondent

Airport employee knowledge about sustainable development in Riga Int. airport

This survey was created to analyze the overall knowledge and importance of Sustainable Development for employees of Riga International airport. This survey is part of research conducted by Bachelor student of University of Tartu. The aim of this research is to find out how sustainable is Riga airport and what specific measures does the airport implement to promote Sustainable Development. In case of questions, please contact the author of the survey by email mezaraups.rihards@gmail.com

PART 1 (Introductory questions)

Question 1: Gender:

Female
Male

Question 2: Age:

16-20
21-30
31-40
41-50
51+

Question 3: Field of work:

Security department
Quality department
Ground Handling Department
Apron safety and management department
Other

Question 4: Years of employment at Riga airport:

Less than a year
1-3 years
4-9 years
10-19 years
20+ years

Question 5: Have you ever heard about sustainable development or sustainable development goals before?

Yes/No

Information on the concept: Sustainable development is increasingly discussed topic for the last few decades and is being implemented by balancing three dimensions – economical, environmental and social. All dimensions need to be in balance to achieve sustainability. Meaning, that a company can be strong financially, but must take in account natural environment protection and local communities.

Sustainable Development Goals (SDGs) are set of goals introduced by United Nations describing world problems such as global warming, poverty, renewable energy etc. and provides with guidelines how to achieve these goals. Together there are 17 goals to achieve in 15 years.

If yes, was it during working at airport? Please explain briefly, where you heard about it.

Question 6: What do You think Sustainable development is mostly about in case of airport? Please explain shortly.

Question 7: In your opinion, Riga airport develop itself according to sustainable development principles.

Strongly disagree Strongly agree

Question 8: In your opinion, Riga airport provide you with information on sustainability actions.

Strongly disagree Strongly agree

PART 2 This part of survey will ask you to rate specific sustainability measures on a scale from 1 to 5.

Question 9: To what degree, do you think the following measures could be applied in Riga International airport?

Electricity production (wind, solar):

Strongly disagree Strongly agree

Waste management system for collecting, recycling waste:

Strongly disagree Strongly agree

Rainwater harvest for its re-use:

Strongly disagree Strongly agree

Make all airport vehicles eco-friendly (electric)

Strongly disagree Strongly agree

Special sound systems to protect airport from wildlife:

Strongly disagree Strongly agree

Preserve surrounding water sources and measure their quality:

Strongly disagree Strongly agree

Impose flight restrictions at night:

Strongly disagree Strongly agree

Airport's close cooperation with local communities:

Strongly disagree Strongly agree

PART 3 This part will ask you to evaluate how important to you are specific measures, that could be applied in Riga airport.

Use of clean energy (renewable energy):

Not important Very important

Waste collecting and recycling:

Not important Very important

Efficient consumption of electricity and water:

Not important Very important

CO2 emissions reduction:

Not important Very important

Protection of the local water sources:

Not important Very important

Protection of wildlife:

Not important Very important

Cooperation and communication with local communities:

Not important Very important

Noise impact reduction in local areas:

Not important Very important

How important it is for you, that your employer (Riga airport) is sustainable?

Not important Very important

How important it is for you, that airport focuses more on natural environment?

Not important Very important

Would you be interested in receiving more information about sustainable development actions in airport?

Not interested Very interested

Thank you for your cooperation!

Appendix B

Interview plan as presented to interviewees

PART 1 (introduction)

What are your work duties at the airport?

Do you think airport should be concerned with SD? What are the main reasons?

Does Riga airport have sustainable development plan? Have you thought about making one?

Which of sustainable development dimensions is the airport the most concerned about?

PART 2 (energy, consumption, production)

Are there any forms of electricity production implemented at Riga airport? If no, are there plans for electricity production in future?

Are there other forms of renewable energy, that the airport uses (such as biomass, geothermal, water etc.)?

What are the measures Riga airport implements to reduce energy consumption?

What are the measures Riga airport implements to reduce waste amount?

What are the concerns about energy consumption, when designing new buildings/terminals?

Copenhagen airport has a modern ventilation system, which efficiently manages heat temperature and keeps indoor climate in optimal level. Are there any measures implemented to keep inside temperature balanced?

What are the measures Riga airport implements to harvest rain water, if any, and what is being done with it after?

PART 3 (climate change, life on land)

What are the measures Riga airport implements to reduce CO₂ emissions?

Is the apron designed in any way, that can reduce aircraft time on land and distances driven?

Are there any vehicles or machinery at Riga airport, that are still diesel powered?

Is there a project, which the airport has implemented, that has considerably reduced the carbon emissions?

Are there any actions, that Riga airport takes to protect local water sources?

Does wildlife create any problems for airport's operations?

What are the measures Riga airport implements to protect the restricted area from animals or birds?

Does Riga airport monitor the migration of birds/animals?

In what season are the birds found in airport the most?

Have there been any incidents with birds or animals?

Are there any species of birds arrived, that require some other measures than usual sound systems?

Is the design of airport buildings designed in some way, that they are not attractive to animals?

Are there any plans for future measures for keeping wildlife away?

PART 4 (noise, social issues)

What are the measures Riga airport implement to reduce noise impact?

Are there any special rules or fees for airlines that use loud airplanes?

Do airlines have rules on how to take off, land etc?

Are there any future plans for noise reduction?

Are there any complaints coming from citizens or local communities and what are the most common ones?

How does Riga airport include local communities in its development plans?

Have there been any projects, that have not been implemented because of local community's protests?

PART 5 (Final questions)

What are the biggest challenges, when implementing a new sustainability project?

Do you consider sustainable development as a way for airport's further development?

What are the biggest challenges for the upcoming Rail Baltic railway station construction at Riga airport? Does it generate any environmental threats?

Does Riga airport have any goals for sustainable development?

Appendix C

Employee thoughts on other Likert-scale questions

Question/topic	Mean	Standard deviation
Does Riga airport include SD in their development plans	3,84	0,83
Riga airport provides employees with enough information on SD actions	3,52	0,91
Is it important, that employer (Riga airport) is sustainable	4,63	0,58
Is it important, that Riga airport focuses on environment protection	4,37	0,75
Interest in receiving information from airport on SD	2,33*	0,57*

Note. * Likert-scale question with values from 1 to 3.

Source: Author's calculations based on survey results

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