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An Assessment of the Role of ISO 14001 Certified Environmental Management Systems (EMS) in Underpinning Environmentally Sustainable Airline Operations

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Abstract— *Based on an in-depth qualitative instrumental case study research approach, this study has examined the airlines that have implemented an ISO 14001 certified Environmental Management Systems (EMS). The study period was from 1990 to 2021. The qualitative data was analyzed by document analysis. The case study revealed that airlines located inBahrain, Canada, Ethiopia,Europe, Hong Kong, Japan, Singapore, South Korea, Taiwan, Thailand, Turkey,and the United States of America have implemented Environmental Management Systems (EMS) in accordance with the ISO 14001 based Environmental Management Systems (EMS) standard. The ISO 14001 Environmental Management System standard has been adopted by full-service network carriers, two leisure airlines, and by two major air cargo airlines. South Korea-based Asiana Airlines was the first airline to be ISO 14001 Environmental Management System (EMS) certified in 1996.Since the release of the ISO 14001:2015 Environmental Management System (EMS) standard, eight airlines have adopted this standard.The case study revealed that the use of an ISO 14001 certified Environmental Management Systems (EMS) underpins airlines environmentally sustainable operations. As part of their environmental management policies, airlines that have implemented an ISO 14001 Environmental Management System (EMS) have implemented a wide range of environmental conservation measures, which include the acquisition and deployment of the next generation, fuel efficient aircraft, the use of sustainable aviation fuel, energy efficient flight operations and air traffic management procedures optimization, aircraft weight reductions, aircraft engines washing, single engine aircraft taxying, sustainable waste management, electrification of ground service equipment (GSE) and vehicles, the use of photovoltaic (PV) solar systems, carbon offsetting programs, water conservation, and energy efficient offices and facilities.*

Keywords—Airlines, Case study, ISO 14001 Environmental Management System (EMS), Environmental conservation measures.

I. INTRODUCTION

At a world-wide level, the environmental sustainability of air transport is receiving greater attention because of its critical impact on climate change(Teoh & Koo, 2016).In the air transport industry, passenger services are provided by full-service network carriers (FSNCs), low-cost carriers (LCCs), regional airlines, leisure airlines, andcharter airlines (Whyte & Lohmann, 2017). The carriage of air cargo is another important market with air cargo services being provided by full-service network carriers (FSNCs), dedicated all-cargo airlines, for example. Cargolux International Airlines and Nippon Cargo Airlines (NCA),

and the integrated carriers, such as, DHL Express and FedEx (Baxter & Bardell, 2017; Baxter & Wild, 2021; Merkert & Alexander, 2018). As a byproduct of their passenger and air cargo services, air transport operations have a very substantial impact on the environment (Daley, 2016; Kumar et al., 2020; Schäfer & Waitz, 2014). These impacts include emissions, noise, wastes, and significant water consumption. To address their environmental impact, many airlines located around the world have recognized the importance of protecting the environment (Niu et al., 2016). Environmental issues in airline transport have grown in importance in recent times, and in response airlines have taken a proactive position by "greening" their operations (Hagmann et al., 2015; Mayer et al., 2012;Migdadi, 2020). Consequently, "greening" has become one of the most important emerging issues in the airline industry (Han et al., 2020).

The implementation of ISO 14001 certified Environmental Management Systems (EMS) has become one of the most important elements of corporate sustainability in recent times (Zobel, 2013). Environmental Management Systems (EMS) are now one of the principal tools used by firms to handle the environmental aspects and the impacts that their activities have on the environment (Campos et al., 2015; Ikram et al., 2019; MacDonald, 2005). Like many other industries, many airlines have now implemented ISO 14001 certified Environmental Management Systems (EMS)in recent times, and they use these systems as a tool to manage their environmental performance and to mitigate their environmental impact.

The key objective of this study is to empirically examine the airlines located around the world that have implemented an ISO 14001 certified Environmental Management System (EMS) as a tool to manage their operations in an environmentally sustainable manner. A second objective is to identify those airlines that have implemented an IS0 14001: 2015 Environmental Management System, which is the latest version of this ISO standard.A final objective is to examine the environmental mitigation measures implemented by the airlines that have adopted the use of an ISO 14001 certified Environmental Management System (EMS).

The remainder of the paper is organized as follows: The literature review is presented in Section 2. The research method that underpinned the study is outlined in Section 3. The case study is presented in Section 4. Section 5 presents the key findings of the study.

II. BACKGROUND

2.1 Environmental Impact of Airline Operations

Air transport has an environmental impact, particularly its impacts on climate change (Forsyth, 2011; Baumeister, 2020; Baumeister&Onkila, 2017). There is an environmental impact from its use of non-renewable resources (Forsyth, 2011).Air transport operations influence the environment at the local, regional, and global levels (Dileep, 2019; Marais et al., 2016).

A significant environmental impact of air transport operations are emissions (Graham, 2018). Indeed, the growth of commercial air transport has driven concerns over air quality around airports and their surrounding communities (Lobo et al., 2012). Aircraft operations are a growing source of greenhouse gas (GHG) emissions (Baer, 2020).Aircraft emissions produce air contaminants such as nitrogen oxides (NO_x), hydrocarbons (HC), and fine particulate matter (PM) (International Civil Aviation Organization, 2011). Aircraft emissions are contributing to climate change and to localized air pollution (Daley, 2016). Aircraft pollutant emissions may also directly or indirectly harmfully impact ecosystems and cultural heritage (Kurniawan &Khardi, 2011).Aircraft operating at subsonic speeds in flight have the following environmental impacts:

- Carbon dioxide (CO_2): CO_2 emissions are the most common and are acknowledged as a major contributor to climate change (Akpan & Akpan, 2012; Azarkamand et al., 2020;Sales, 2016).
- Oxides of nitrogen (NOx): at high altitudes NOx emissions help to form ozone in the upper troposphere.
- Water vapor (H2O): this is created through the burning of jet aircraft fuel. At altitude, condensation trails form, consisting of frozen ice crystals that deflect a small amount of sunlight away from the Earth's surface and reflect more radiation back towards the Earth. This results in an overall warming effect on the Earth's atmosphere (Sales, 2016, p.146).

Aircraft often travel long distances at a variety of altitudes, generating emissions that may potentially have an impact on air quality in not only local, but also regional and global environments (International Civil Aviation Organization, 2011).

Ground support equipment (GSE): for example, aircraft push-back tugs, aircraft loaders, and flight catering trucks,that are used to handle an aircraft whilst it is on the ground in between flightsare typically powered by diesel or petrol engines (Baxter et al., 2021), and hence,they also

produce exhaust emissions. Ground service equipment (GSE) refers to vehicles and equipment that are used in the airport precinct to service whilst they are at the gate in between flights (Hazel et al., 2011).Thus, gaseous emissions of carbon dioxide (CO_2), as well as carbon monoxide (CO) and nitrous oxide (NO_x) and particulates (PMs) from aircraft, ground access transport, such as buses and taxis, on-airport ground transport vehicles, all negatively impact local air quality (Budd, 2017).

In recent years, aircraft noise disturbance and its impact on communities surrounding airports has become one of the most significant concerns affecting airport operations and developments (Gorji-Bandpy& Azimi, 2013; Reynolds, 2016; Young & Wells, 2011). Noise from airport operations may have a negative impact on the quality of life and the property values of members of a surrounding community (Luther, 2007; Suksmith&Nitivattananon, 2015). The major source of noise at airports is from aircraft, and this occurs during aircrafttake-off, landing and when aircraft are taxiing to and from the terminal and airportapron area (de Neufville &Odoni, 2013).An airport's apron area is the location where aircraft stands interface with airport terminal buildings, and they are the location where aircraft are handled whilst on the ground in between flights (Budd & Ison, 2017). Another source of noise at an airport is from the operation of diesel generators or other mobile ground power units that are used to provide power to aircraft parked and which are being serviced (handled) on the apron at airport terminals. A further source of noise is from the use of aircraft auxiliary power units (APU's) (Bennett & James, 1999).Aircraft auxiliary power units APU's are small gas turbine engines that are typically mounted in the rear of the aircraft fuselage and supply the essential requirements of the aircraft whilst it is on the ground at the airport and without the main engines operating, or when no external power source is available (Smith, 2004). However, this source of noise can be eliminated from the installation and use of fixed electrical ground power (FEGP) stations (Bennett & James, 1999) as such systems eliminate the requirement for airlines to use APU's whilst the aircraft is being serviced at the gate (Elmer & Leigland, 2014).

Airlines also produce large volumes of wastes from their in-flight services and ground-based operations (Baxter, 2020).Each year the airline industry generates a substantial amount of comingle waste (Blanca-Alcubilla et al., 2019).Consequently, in recent times. waste management and waste disposal have become one of the most significant issues in the environmental management in the world airline industry (Baxter, 2020; Li et al., 2003). As a result, airlines are now making substantial efforts to improve their waste management and reduce theirwaste generation (Blanca-Alcubilla et al., 2019; Moynihan &Walków, 2019).

Airlines are also energy intensive. The largest energy source is aircraft jet fuel which, as previously noted, produces harmful pollutants. Airlines also consume large amounts of electricity to power their ground-based facilities and buildings. Diesel and petrol are commonly used to power ground service equipment (GSE) and vehicles (Baxter et al., 2021).Environmental sustainability related concerns over the past few decades have resulted in the dramatic progress in aviation fuel efficiency improvements (Singh et al., 2018). The next generation aircraft, such as the Airbus A350-900XWB and the Boeing 787-9/10 being operated by the world's airlines are more fuel efficient, and thus, have lower emissions levels.The Airbus A350-900XWB aircraft, for example, offers a 25% improvement in fuel efficiency and a 25% lower seat-mile (seat kilometre) cost when compared to its aluminum-based long-range competitors, such as the Boeing B777 aircraft (Otley, 2019).

Airlines also consume large volumes of water. Water is carried on flights and is used on the ground inflight catering, aircraft, and ground service equipment (GSE) maintenance, in buildings and facilities and for maintain grounds and gardens.Importantly, water utilization can have a detrimental impact upon the environment (Payán-Sánchez et al., 2021). Water quality around an airport's precinct can be adversely impacted by runoff from aircraft and airport winter de-icing operations, as well as fuel leaks, and solid and liquid waste treatment and disposal (Marais et al., 2016).

2.2 ISO 14001 Environmental Management Systems (EMS)

Many firms operating around the world have implementedEnvironmental Management Systems(EMS), and firms have taken the additional step and had their Environmental Management Systems (EMS)certified in accordance with the international standard ISO 14001 (Jiang & Bansal, 2003). Thus, energymanagement system standards, also referred to as meta-standards, have now been widely implemented by an increasing number of businesses around the world (Heras-Saizarbitoria&Boiral, 2013). The International Organization for Standardization (ISO) has developed a series of voluntary standards and guidelines in the field of environmental management. These are referred to as the EN ISO 14000 series. These standards have been designed to provide an internationally recognized framework for environmental management, measurement, evaluation, and auditing (Škurla et al., 2002). The most important standard is ISO 14001 which was introduced in 1996 (Bansal & Bogner, 2002; Chin et

al., 1999; Curkovic& Sroufe, 2011). The standard was slightly modified again in 2004 (de Vries et al., 2012). On September 15, 2015, the International Organization for Standardization (ISO) released the ISO 14001: 2015 standard, which had revised previous versions of the system (International Organization for Standardization, 2015).

According to Massoud et al. (2010), "the ISO 14000 series of international standards have been developed to integrate environmental aspects into processes and product standards". Accordingly, the ISO 14001 standard describes the requirements for a certifiable Environmental Management System (EMS) (Sartor et al., 2019). ISO 14001 is a global meta-standard for implementing Environmental Management Systems (EMS) (Heras-Saizarbitoria et al., 2011; Laskurain et al., 2017; Liu et al., 2020). The ISO 14001 Energy Management Systemstandard is based on the concept that more favorable environmental performance can be attained by a firm when environmental aspects are systematically identified and managed and are given a major contribution to sustainability, through pollution prevention, improved environmental performance, and from compliance with all applicable laws (Ciravegna& da Fonseca, 2015). The ISO standards are voluntary (Erauskin-Tolosa et al., 2020; Massoud et al., 2010).

Since its inception, the ISO 14001 Environmental Management System (EMS) standard has developed into one of the most widely used systems for managing corporate environmental aspects (Oliveira et al., 2011). Environmental Management Systems (EMSs) are intended to formalize procedures for managing and reducing environmental impacts of a firm's operations (Christini et al., 2004). Furthermore, the ISO 14001 Environmental Management System (EMS) standard has been designed to assist firms in the creation of structured mechanisms to enable the continuous improvement in their environmental performance (Kitazawa & Sarkis, 2000).

The basic elements of an environment management system (EMS) include the following:

- Reviewing the organization's environmental goals.
- Analyzing the firm's environmental impacts and compliance obligations (or legal and other requirements).
- Setting environmental objectives and targets to reduce environmental impacts and conform with compliance obligations.
- Establishing programs to meet these objectives and targets.
- Monitoring and measuring progress in achieving the objectives.
- Ensuring employees' environmental awareness and competence; and
- Reviewing progress of the EMS and achieving improvements (United States Environmental Protection Agency, 2021).

Firms can achieve very important environmental-related benefits from the use of an ISO 14001 EMS. These benefits include:

- Enhanced environmental awareness and accountability at all levels throughout the firm.
- Improved regulatory compliance.
- Enhanced operational procedures and controls.
- A reduced environmental footprint (lower emissions, discharges, and wastes).
- Continual system improvements resulting from the EMS objectives, goals, programs, periodic audits, and management reviews (Briggs, 2007, p. 67).
- Pollution prevention.
- Resource conservation
- New customers/markets
- Increased efficiency/reduced costs
- Enhanced employee morale
- Enhanced image with public, regulators, lenders, investors
- Employee awareness of environmental issues and responsibilities (United States Environmental Protection Agency, 2021)

The ISO 14001:2015 standard is applicable to any firm, regardless of type, size, and their nature of business. The ISO 14001 environmental management system (EMS) applies to the environmental aspects of its operations, products, and services that the firms sets and for which it can control and or influence (International Organization for Standardization, 2021; Shehabi, 2016).

III. RESEARCH METHODOLOGY

3.1 Research Approach

The present study used a qualitative instrumental case study research approach. An instrumental case study is the study of a case, for instance, a firm, that provides insights into a specific issue, redraws generalizations, or builds theory (Stake, 1995, 2005). The instrumental case study research approach provides researchers with a greater

understanding of a specific phenomenon. An instrumental case study is designed around established theory of the phenomenon under study (Grandy, 2010). The present study was designed around the established theory of ISO 14001 Environmental Management Systems (EMS) (Dentch, 2016; Grover & Grover, 2017; Imtiaz Haider, 2010; Whitelaw, 2004).

3.2 Data Collection

The data used in the study was obtained from a range of documents, airlineannual sustainability reports, company materials available on the internet and records as sources of case evidence. An extensive search of the leading air transport and airline journals and magazines was also conducted in the study.

This study used secondary data. This study followed the guidance of Yin (2018) during the data collection phases, that is, the study used multiple sources of case evidence, database on the subject was created, and therewas a chain of evidence.

3.3 Data Analysis

The data collected for the case study was examined using document analysis. Document analysis is quite commonly used in case studies. Document analysis focuses on the information and data from formal documents and a firm's records that are collected by a researcher(s) when conducting their study (Andrew et al., 2011; Yin, 2018). Following the guidance of Scott (2004, 2014) and Scott and Marshall (2009), the documents gathered in the present study were examined according to four criteria: authenticity, credibility, representativeness and meaning.

The document analysis was undertaken in six discrete stages:

- Stage 1: The first stage involved planning the types and required documentation and their availability for the study.
- Stage 2: The data collection phase involved sourcing the documents and developing and implementing a scheme for the document management.
- Stage 3: The collected documents were examined to assess their authenticity, credibility and to identify any potential bias.
- Stage 4: The content of the collected documents was carefully examined, and the key themes and issues were identified.
- Stage 5: This stage of the document analysis process involved the deliberation and refinement to identify any difficulties associated with the documents, reviewing sources, as well as exploring the documents content.
- Stage 6: In this stage the analysis of the data was completed (O'Leary, 2004, p. 179).

Following the guidance of Yin (2018), the study's documents were downloaded and stored in a case study database. All the documents gathered for the study were in English. Each document was carefully read, and key themes were coded and recorded in the case study (Baxter, 2021).

IV. RESULTS

Aegean Airlines, which is based in Greece,was awarded the ISO 14001:2004 certification by TUV AUSTRIA HELLAS for the airline's implementation of an Environmental Management System for Passenger Services – Aircraft Services and Aircraft Maintenance at its principal hub at Athens' International Airport in September 2008. The Environmental Management System (EMS)certification underpins the airline's efforts to reduce the impact of its activities on the environment. The introduction of the electronic (e-ticket) in 2003, is one of the company's environmental practices. Other environmental practices include solid waste separation, collection of used paper, collection oflubricants and aircraft tyres for recycling, procedures for leakage management, and the saving of natural resources.In addition, the airline's staff and its partner organizations are kept well informed on ecological issues such as waste recycling, and the sensible use of water (Aegean Airlines, 2008).

Air Dolomiti,an Italian regional airline, was awarded with its ISO 14001: 2015 certification by DNV GL in December 2020. The implementation of the ISO 14001 certified Environmental Management System (EMS)involved the review of internal management processes to keep under control the environmental impact of its operations (Macca, 2020).In accordance with its sustainability policy, the airline has implemented a range of environmental-related measures in recent times. These measures include the elimination of plastic in on-board services, the packaging of snacks with compostablepackaging, use of glass or paper cups, the use of stirrer and food covers made from ecologicalmaterial, the elimination of plastic at company sites,the replacement of plastic cups and cutlery atfood courts with paper and bamboo cups and cutlery, and the airline encourages its staff touse their own cup and bottle instead of disposable cups and bottles. The airline is also focusing on its waste management and has aimed to separate and reduce waste. It has also implemented measures to integrate containers

for glass collection withinthe company. Other environmental related practices adopted by the airline include aircraft flight plan optimization, the use of single engine taxi-in procedure, that is,closingdown of an engine after 2 minutes of cooldown following the landing of the aircraft at its destination airport, minimization of the use of aircraft auxiliary power units (APUs), the digitalization of manuals, navigation charts and other documents necessary forflights, and the use of electronic boarding passes, which saves printing and, therefore, paper consumption (Air Dolomiti, 2020).

Air France and KLM are ISO 14001 Environmental Management System (EMS)certified for all flights and for ground operations in France and The Netherlands. The two airlines social, societal, and environmental information is verified annually by an independent third party (Air France KLM Group, 2021).Air France KLMhave set a target to reduce their carbon dioxide (CO_2) emissions per passenger kilometreby50% by 2030 as compared to 2005 levels.To help achieve this target, the airlines have focused on their fleet renewal plans, with the order for 38 Airbus A350s and 60 Airbus A220s for Air France. These aircraft are quieter and more fuel efficient (Air France-KLM, 2020). Other environmental related measures implemented by the airlines are the use of sustainable aviation fuel (SAF)and achieving greater efficiency in the group's operations. These efficiency measures include designing more direct air routes, lightening the weight of aircraft, single-engine taxiing, and continuous descent air traffic management procedures (Poleri, 2021).

Air Transat, Canada's largest leisure airline, achieved ISO 14001:2015 Environmental Management System (EMS)certification for its Montreal-based head office in July 2019. The airline's ISO 14001 certified Environmental Management System (EMS) applies to its head office, comprising the administrative offices and maintenance centre, and includes building management as well as landscaping. The airline's environmental policy focuses on five primary areas: greenhouse gas (GHG) emissions, energy consumption, solid-waste production, hazardous materials, and wastewater. Mitigation targets have been defined for each of these areas, and all operations are standardized according to environmentally responsible practices supervised by the airline's Environmental Management System (EMS) team. The airline has implemented energy-optimization initiatives, which have included installation of a solar wall at the head office to lower energy consumption and greenhouse gas (GHG)emissions and banning of all single-use plastics in the cafeteria. Air Transat remains fully committed to continuing its many efforts to mitigate its environmental impact (Canadian Aviation News, 2019; Cision, 2019).

Asiana Airlines, which is based in South Korea,was the first airlines to receive ISO 14001 Environmental Management System (EMS)certification. The airline became ISO 14001 Environmental Management System (EMS)certified in 1996 (World Business Council for

Sustainable Development, 2009).To minimize environmental impactsfromits business activities, Asiana Airlines has selected four major environmental policies and related activities, from basic environmental pollution prevention activities such as air quality, water quality, and waste management to environment-friendly activities that it developsalong with its customers (Asiana Airlines, 2021).Asiana Airlines began its focus on its environmental efforts in 1994 when it developed and adopted a special emblem and the catchphrase "The one and only Earth, as precious as our customers".The airline has long focused on implementing environmental related protection measures. These measures include the introduction of environmentally friendly products and in-flight services. Asiana Airlineshas also focused on therecycling of waste so it can reduce consumption of resources.The airline has also made substantial efforts to reduce emissions by creating a roadmap and actively participating in global endeavors to prevent global warming. An example of this is the use ofground power units (GPU) at aircraft ramps instead of the aircraftauxiliary power unit(APU) power supply during ground maintenance and aircraft turnarounds.Jet fuel consumption and the associated gas emissions have also been reduced.Asiana Airlines has been carrying out various fuel reduction activities, which include improvements in flight procedures, flight plan optimization, and aircraft engine washing. In May 2008, Asiana Airlines started offsetting the carbon generated by all employees who travel on business trips on AsianaAirlines operated flights. The airline also introduced a passenger carbon offset scheme, where all funds raised from the carbon offset program are invested in offsets held by independent organizations (for example, government agencies) (World Business Council for

Sustainable Development, 2009).Other environmental related conservation measures implemented by the airline include the acquisition and deployment of the latest high fuel-efficient aircraft and engines, the continuous implementation of fuel saving policies, the implementation of environmentally friendly activities,

maintaining a green company, containing emissions within 50% of the legal standard, building voluntary reduction measures for emissions such as greenhouse gases (GHG), and a green campaign that is focused on its customers (Asiana Airlines, 2021). Announced in November 2020 and backed by the Korea Development Bank, Korean Air will formally acquire Asiana Airlines in 2022, with both

airlines to fully merge and integrate their operations by 2024 (Flynn, 2021).

China Airlines, which is based in Taiwan, received its International Organization for Standardization's (ISO) Expansion of ISO 14001 Environment Management System (EMS) certification on 17 January 2014. The ISO 14001 Environmental Management System (EMS) certification was awarded by the British Standards Institution. The implementation of its Environmental Management System (EMS) underpins China Airlines' commitment to promote environmental sustainability as well as adhere to international standards of environmental management.In 2012, China Airlines' maintenance facility first passed the ISO 14001 Environment Management System (EMS)audit and was subsequently awarded with its certification. In 2013, China Airlines expanded its ISO 14001 Environmental Management System (EMS) certification to also include areas of its corporate headquarters, Songshan Airport, Taipei branch office, Kaohsiung branch office, as well as itsair cargo services. During 2011, China Airlines established a dedicated unit for enterprise-level environmental risk management, and an inter-departmental "Corporate Environmental Committee." These bodies were established for the management of environmental indicators to further prevent pollution, conserve energy, and reduce carbon emissions. Areas of environmental-related management include aircraft fuel savings, ground operations fuel savings, and savings in energy and resources. Other environmental related measuresimplemented by the airlineinclude China Airlines' maintenance facility, which covers air, water, waste, and noise pollution, as well as toxic chemicals, greenhouse gases, and energy management (China Airlines, 2014). As part of its corporate sustainability policy. China Airlines has introduced a "green" flight initiative, which aims to reduce the carbon footprint of its services around the world (China Airlines, 2012b). The airline's aircraft maintenance department also pays close attention to the environment and focuses on energy savings and eco-friendliness in the areas of wastewater and gas treatment, reuse of old parts, efficient lighting systems, and floor designs (China Airlines, 2012a). China Airlines also aims to reduce the carbon footprint of its offices, and, as a result, focuses on energy saving and carbon reduction initiatives (China Airlines, 2012c).

Croatia Airlines was awarded ISO 14001: 2015 Environmental Management System (EMS) certification in 2016 (Croatia Airlines, 2016). In line with its Environmental and Energy Policy, Croatia Airlines focuses on environmental awareness and energy efficiency improvements as part of goal and risk management (Croatia Airlines, 2021a). Croatia Airlines sustainable development hasfocusedon two principal areas, which are airline fleet requirements and the application of certain procedures that reduce fuel consumption and the associated carbon dioxide (CO_2) emissions and noise (Croatia Airlines, 2021b).

Czech Airlines has been awarded ISO 14001 certification for its Environmental Management System (EMS) (Airline Marketing Australia, 2021). The airline has implemented a comprehensive environmental policy and in line with this policy it aims to reduce the direct and indirect impact of its activities on the environment,as such aircraft and equipment are carefully deployed to mitigate their impact on the environment, the company is focusing on reducing its fuel consumption and the associated greenhouse gas (GHG) emissions, andnoise reduction. The airline is also using technologies and procedures to prevent or continuously reduce environmental pollution during aircraft and equipment maintenance as well as in ground operations (Czech Airlines, 2015).

Ethiopian Airlines, the largest aviation group in Africa was awarded with its ISO 14001:2015. Environmental Management System (EMS) certification on 30 August 2018. The airline's Environmental Management System(EMS) covers Ethiopian Cargo and Logistics Services, the airline's Head Office, the airline's Maintenance Repair and Overhaul, flight catering services, Aviation Academy, Flight Operations, flight simulators and equipment facility maintenance.Ethiopian Airlines aims to be an eco-friendly airline and to achieve this aim, the airline has made a large investment in the state of the art, next generation aircraft, serving its customers organic food without extra packaging, employing waste-reduction programs and the elimination of paper. The airline has implemented a carbon offsetting program titled "Fly Greener Program" to reduce carbon dioxide (CO_2) emissions (Ethiopian Airlines, 2018).

Gulf Air, which is based in Bahrain, received its ISO 14001 Environmental Management System (EMS) certification from RINA Services in January 2016 (ITP Media Group, 2016).With commercial operations across four continents, Gulf Air is actively addressing environmental challenges individually and collectively. An example of this is Gulf Air's membership of the Sustainable Aviation Fuel Users Group, which is focusing on the commercialization, certification, and provision of a viable market to accelerate the development of alternative aviation fuels (Gulf Air, 2021).Airlines now view the use of aviation biofuels as being a key environmental sustainability measure (Baxter et al., 2020; Bittner et al., 2015; Cortez et al., 2015). Accordingly alternative jet fuel (AJF) technologies have gained considerable interest and are now regarded as a way for the airline industry to

achieve large, near-term emissions reductions (Staples et al., 2014).

Hong Kong-based Cathay Pacific Airways has been awarded ISO 14001:2015 Environmental Management System (EMS) certification. Positioned near Hong Kong International Airport, the airline's 134,000 square metres headquarters buildingscomprise Cathay Pacific City and CathayDragon House, airline stores, a hotel, and the flight training centre. The two premises are certified to the ISO 14001:2015 Environmental Management System (EMS) standard.To reduce its carbon footprint, Cathay Pacific Airways has invested in energy-saving measures such as low-impact lighting devices. Other reduction methods include sensors, chilled water system optimization andground fleet vehicle electrification (Cathay Pacific Airways, 2021). The flight catering division of Cathay Pacific Airways, Cathay Pacific Catering Services (H.K.) Ltd received its ISO 14001 Environmental Management System (EMS) certification in 1996 (Cathay Pacific Catering Services, 2007).

Jetairfly,a Belgian leisure and holiday airline, was awarded its ISO 14001 Environmental Management System (EMS) certification by the independent office Veritas in March 2015 (Orban, 2015). Jetairfly name has been changed to TUI fly, which is a brand name of TUI Airlines Belgium NV. TUI fly is a part of TUI Group(TUI fly, 2021a). The airline has implemented a wide range of environmental related measures, which include aircraft fleet modernization, the use of “winglets” on its Boeing 737 fleet, sustainable waste management practices, aircraft weight savings, optimal and dynamic flight planning, digitalization of flight manuals and other flight documentation, air traffic management optimization procedures, and single engine taxiing at the destination airport (TUI fly, 2021b).

Korean Airlines was awarded ISO 14001 Environmental Management System (EMS) certification on 25 November 2005. The airline subsequently obtained ISO 14001: 2015 Environmental Management System (EMS) certification on 10 December 2020 (Korean Airlines, 2020).Korean Air is optimizing fuel efficiency and reducing aircraft carbon emissions to achieve sustainable growth and minimize its environmental impact.The airline has also acquired and deploys the next generation environmentally friendly aircraft, such as, the Boeing 787-9 aircraft. The deployment of these next generation aircraft is enabling Korean Airlines to reduce its greenhouse gas (GHG) emissions. Korean Air has also taken steps to protect biodiversity and management of ozone-depleting substances to mitigate environmental pollution.Another environmental conservation measure is the planting of trees abroad, for instance, the “Korean Air Forest” in Baganuur, Mongolia, and the “Korea Air Green Garden” in Kubuqi Desert of Neimenggu, China (Korean Airlines, 2021).

LAN CARGO, an affiliate of LATAM Airlines Group, S.A., Environmental Management System (EMS) was awarded ISO 14001:2004 certification from Bureau Veritas for its air cargo ground operations and facilities at MiamiInternationalAirport on 5 January 2016. The ISO 14001:2004 Environmental Management System (EMS) certification covers both air cargo ground operations and the airline’s facilities at Miami InternationalAirport. By ensuring compliance with these standards the airline will be able to grow and develop its ground operation more efficiently, improve resource management and allocation, and reduce its operation’s environmental impact and carbon footprint.LAN CARGO ISO 14001:2004 Environmental Management System (EMS) certification coverscorporate and administrative activities, storage, warehousing and ground support for air cargo transportation and the repair station for maintenance of its aircraft in Miami. The certification was for three years and validated the impact of the development and implementation of policies by LAN CARGO to meet and comply with ISO 14001:2004 Environmental Management System (EMS)standards. The standards that govern LAN CARGO’s Environmental Management System (EMS), are based on a series of tools and initiatives that monitor key indicators to control and reduce environmental impact, whilst also promoting the continuous improvement of the airline’s operations.LAN CARGO’s Environmental Management System is designed to uphold a unified standard for all its ground operations. The objective of the EMS is to minimize environmental impact,comply with existing regulations and with the Company’s policy of security, quality, and environmental sustainability. The benefits of the Environmental Management System (EMS) include savings on costs and materials due to recycling, clear indicators to measure the development and progress of the different environmental protocols and programs, as well as the protection of natural resources (LAN CARGO, 2016).

Lufthansa Cargo AG was certified at its Frankfurt base to the international environmental management system standard ISO 14001 in February 2009 (Air Freight News, 2009).All of Lufthansa Cargo German stations have been ISO 14001 Environmental Management System (EMS)certified since 2010. This was extended to its subsidiary Jettainer GmbHin 2015 (Brice, 2018; Lufthansa Cargo, 2018).Lufthansa Cargo received its ISO 14001 environmental certification for its worldwide facilities in 2015 (Brice, 2018). The airline was once again recertified in accordance with the ISO 14001 environmental

management systemstandard in February 2018. This certification also included for the first its subsidiary time:matters GmbH (Air Freight News, 2018; Lufthansa Cargo, 2018). The airline had set a target to reduce its specific carbon dioxide (CO_2) emissions by 25% by 2020 (Air Cargo News, 2016). Lufthansa Cargo operated its final McDonnell Douglas MD-11F flight on 17 October 2021. The airline had previously operated the McDonnell Douglas MD-11F flight for 23 years.The carrier first commenced operating the tri-jet freighter in 1998 with its fleet of MD-11Fs eventually numbering 19 of the model. The McDonnell Douglas MD-11F flight have now been replaced by a fleet of more efficient Boeing B777-2OO freighter aircraft (Brett, 2021a).Lufthansa Cargo and DB Schenker partnered together on November 29, 2020, to operate the first ever carbon dioxide (CO_2)-neutral freighter flights, powered by sustainable aviation fuel (SAF). The flight operated from Frankfurt to Shanghai utilizing a Lufthansa Cargo Boeing 777 freighter aircraft (Harry, 2020). In April 2021, DB Schenker and Lufthansa Cargo launched a regular carbon dioxide (CO_2)-neutral freighter route, operating between Frankfurt and Shanghai. The use of sustainable aviation fuel has reduced conventional kerosene usage of 174 tonnes per week on this route (Harry, 2021b). In 2021, as part of its sustainability policy, Lufthansa Cargo began to offer all its customers the option of carbon dioxide (CO_2) neutral transportation on segments that are operated by freighter aircraft. Lufthansa Cargo will achieve the carbon dioxide (CO_2) neutrality by using sustainable aviation fuel (SAF) or through certified carbon offsetting projects which will avoid or compensate for the emissions generated during air cargo transportation (Brett, 2021b).

Lufthansa CityLine was the world's first airline to launch a structured and officially certified environmental environment protection plan. In 2018, the airline wasrecertified in accordance with the international environmental standard ISO 14001: 2015 for its comprehensive Environmental Management System (EMS). The ISO 14001: 2015Environmental Management System (EMS) certificationis valid for each of the three company locations Munich, Frankfurt, and Cologne airports (Lufthansa CityLine, 2021a). Importantly, the protection of the environment is one of Lufthansa CityLine's most important goals. The airline aims to avoid environmental damage such as pollution, noise, waste, and wastewater whenever possible and keeps these to a minimum if they cannot be fully avoided (Lufthansa CityLine, 2021b).

Scandinavian Airlines (SAS) ISO 14001 certifiedEnvironmental Management System (EMS) encompasses all activities performed within SAS. SAS was certified according to ISO 14001 Environmental Management System (EMS) standard in 2010 (Scandinavian Airlines, 2021). Scandinavian Airlines (SAS) ISO 14001 certified Environmental Management System (EMS)was recertified in accordance with the ISO 14001: 2015 standard on 14 September 2018 (Scandinavian Airlines, 2018). The airline's system focuses on activities around administrative functions at the headquarter Frösundavik and at the airline's main bases at Stockholm-Arlanda Airport, Copenhagen-Kastrup Airport and Oslo-Gardermoen Airport.The system also includes other geographical areas through follow-up programs and contracted services. The airline's Environmental Management System(EMS) is based on shared environmental and sustainability policies, the Code of Conduct, the UN Global Compact, airline operational standards and ISO 14001. In addition, the system provides guidelines for a continuing cycle of planning, implementation, and evaluation, together with the improvement of processes and activities to meet operational and environmental targets (Scandinavian Airlines, 2021a).Scandinavian Airlines (SAS)has implemented a wide range of initiatives to mitigate its environmental impact. These measures include the acquisition and deployment of the latest start of the Airbus A350-900 XWB aircraft, Increased energy efficiency, sustainable products,and services, optimizingits flight schedule and aircraft size to optimally meet demand (particularly on regional routes with relatively low levels of demand), air space procedures optimization, collaboration with aircraft and enginemanufacturers and the airline is working with these key stakeholders on future low emission aircraft (Scandinavian Airlines, 2021b). Scandinavian Airlines (SAS) is regularly using sustainable fuel sources and has established a target to have all its Scandinavian domestic flights powered solely by sustainable aviation fuels by 2030 (Ahlgren, 2020).

Singapore Airlines has in placean Environmental

Management System (EMS) which is certified to the ISO 14001:2015 standard. The airline's EnvironmentalManagement System (EMS) covers the Engineering Division and FlightOperations Division, for the provision and management of aviation and engineering support services. Furthermore, the EnvironmentalManagement System (EMS) ensures that the airline's operations comply with the relevant local and international environmental regulations. Internal and external auditsare performed annually to ensure compliance with the requirements (Singapore Airlines, 2021). Singapore Airlines has implemented a wide range of environmental mitigation measures in recent times. These measures include an aircraft weight reduction

program, the installation of extensive light emitting diode (LED) lighting, the installation of more energy efficient plant and equipment, the installation of more energy efficient heat exchange system at its Silver Kris Lounge at Changi Airport, the upgrading of lifts with a more efficient model that had a Variable Voltage Variable Frequency (VVVF) motor(Singapore Airlines, 2015), the installation of a large scale photovoltaic (PV) system, a computer system that optimizes the maximum zero fuel weight (MZFW) of its aircraft fleet, the use of lightweight catering items, and the use of fixed electrical ground power and preconditioned air units at airports where its aircraft have night layovers or long transits (Singapore Airlines, 2021).

Thai Airways International headquarters was awarded with its ISO 14001 Environmental Management System (EMS)certification by BVQI (Bureau Veritas QualityInternational) on 28 April 28, 2000. The airlines headquarters were recertified by BVQI (Bureau Veritas Quality International) on December 20, 2004. Thai Airways International Technical Department and the new Aircraft Maintenance Facility located at U-Tapao International Airport were awarded ISO 14001 Environmental Management System (EMS) certification from BVQI (Bureau Veritas Quality International) onMarch 16,2001. The airline's Customer Services Department has also been awarded ISO 14001 Environmental Management System (EMS) certificationfrom the Bureau Veritas Certification (Thai Airways International, 2021).Thai Airways International has established its environmental management policy in accordance with the Environmental Management System (EMS) ISO 14001:2015 standard, the airline's environmental policy comprises environmental protection, measures to prevent pollution,legal compliance, and constant improvement in its environmental performance. The airline has implemented a range of environmental related measures as part of its commitment to its environmental policy. These measures include carbon dioxide (CO_2) offsetting, the sustainable use of resources, energy efficient flight operations, flight route optimization, potable water uplift management, efficient fleet planning, energy, and water conservation its buildings and facilities, and sustainable waste management (Thai Airways International, 2020).

The Japan Airlines Group (JAL) has established Environmental Management Regulations based on the JAL Group Environmental Policy and is building and operating an Environmental Management System (EMS). Based on this Environmental Management System (EMS), the JAL Group aims to achieve its environmental goals, as well as complying with all applicable laws, regulations, and other rules related to the environmental activities of the company. A key goal of Japan Airlines is to reduce its environmental impact and prevent pollution. In addition, internal environmental audits are performed each year to confirm the conformity and legal compliance of the system and to verify the achievement status of the company's targets. Internal audits are conducted annually at each department in the airline's headquarters building, and over a three-year period at Group companies, and the results are linked to management reviews to ensure continuous improvement. In addition, JAL Royal Catering Co., Ltd. was awarded its ISO 14001 Environmental Management System certification in 2021 (Japan Airlines, 2021). As part of its sustainability policy, Japan Airlines has implemented environmental conservation measures that include a reduction in carbon dioxide (CO_2) emissions, operation of fuel-efficient aircraft, use of sustainable aviation fuels, reduction in the use of plastics, a reduction in the disposal of in-flight meal wastes, a reduction in industrial wastes, and the operation of low noise aircraft (Japan Airlines, 2020).

The Lufthansa Hub Munich received its ISO 14001 Environmental Management System (EMS) certification in May 2016 (Travel PR News, 2016). Munich is a key hub for Lufthansa and is also served by Lufthansa CityLine.

Turkish Airlines received its ISO 14001 Environmental Management System (EMS) certification in March 2013. The ISO 14001 Environmental Management System (EMS) certification coversallofTurkish Airline's activities and operations within the Republic of Turkey, and all of theactivities carried out onboard the airline's aircraft during flight operations even if they are not operated within the borders of theRepublic of Turkey. Within the airline's Environmental Management System (EMS), variousactivities are performedto increase environmental awareness of staff and to reduce the environmentalimpacts of its products, services, and activities. The airline focuses on its waste management within its offices and inflight activities. Turkish Airlines also promotes effective and efficient use of natural resources such as water,electricity, natural gas, and paper. As part of its sustainability policy, Turkish Airlines has implemented various environmental-related measures which include a fuel efficiency program, optimizing the use of APU (auxiliary power unit) while the aircraft is on ground, the introduction of anew optimized flight planning system, optimization of flight routes and aircraft speed, aircraft weight reduction, engine washing, investments in new technologies, and investments in infrastructure (Turkish Airlines, 2014).

V. CONCLUSION

Based on an in-depth qualitative instrumental case study research approach, this study has empirically examined the airlines that have implemented an ISO 14001 certified Environmental Management System (EMS) as a tool to manage their operations in an environmentally sustainable manner. The study period was from 1990 to 2021. The qualitative data was analyzed by document analysis. The case study revealed that airlines located Bahrain, Canada, Ethiopia,Europe, Hong Kong, Japan, Singapore, Thailand, South Korea,Taiwan, Turkey, and the United States of Americahave implemented the ISO 14001 based Environmental Management Systems (EMS). The ISO 14001 Environmental Management System standard has been adopted by full-service network carriers, two leisure airlines, and by two major air cargo airlines (LATAM Cargo and Lufthansa Cargo). South Korea-based Asiana Airlines was the first airline to receiveISO 14001 Environmental Management System(EMS) certification. The airline'sEnvironmental Management System was ISO 14001 certified in 1996.

The case study found that since the release of the ISO 14001:2015 Environmental Management System (EMS) standard, Air Transat, Cathay Pacific Airways, Croatia Airlines, Ethiopian Airlines, Korean Airlines, Scandinavian Airlines (SAS), Singapore Airlines, and Thai Airways International, have adopted this standard.

The case study revealed that the use of an ISO 14001 certified Environmental Management Systems(EMS) underpins airlines environmentally sustainable operations. The case study showed that as part of their environmental management policies, theairlines that have implemented anISO 14001 Environmental Management System(EMS) have defined and instigated a wide range of environmental conservation measures. Theseenvironmental conservation measures include the acquisition and deployment of the next generation, fuel efficient aircraft, such as, the Airbus A350 and Boeing 787, the use of sustainable aviation fuel, energy efficient flight operations and air traffic management procedures optimization, aircraft weight reductions, aircraft engines washing, single engine aircraft taxying, sustainable waste management, electrification of ground service equipment (GSE) and vehicle, the use of photovoltaic (PV) solar systems,carbon offsetting programs, water conservation, and energy efficient offices and facilities.

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