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Business sustainability in aviation industry in post-COVID era through information technology and triple bottom line perspective

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Abstract: The aviation industry has faced significant challenges in the wake of the COVID-19 pandemic. However, the industry has shown resilience and adaptability, and there are indications that it will emerge stronger and more sustainable in the post-COVID era. This study's objective is to comprehend and identify sustainability practices that are relevant for the aviation sector. Further, the study also explores information technology as an enabler of sustainability in the aviation sector. The study uses a systematic literature review, published in Scopus, SCI, and ESCI-indexed journals. The study examines the industry's complexity with regard to sustainability and analyses key indicators using complete and reliable data from various stakeholders. The study focuses on social, economic, and environmental sustainability independently and identifies sustainability indicators for each pillar based on the triple bottom line's viewpoints (TBL). By taking into account the three distinct pillars of sustainability, the study expands on previous efforts to identify sustainable practices, applications, and enablers in the aviation sector.

Keywords: business sustainability; aviation sustainability; triple bottom line; TBL; sustainability; aviation industry.

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1 Introduction

In late March and early April 2020, almost all air travel was suspended due to the coronavirus illness (COVID-19) pandemic, which had a severe effect on the aviation industry worldwide. Although the airline business was more severely impacted by the COVID-19 pandemic than any other area of the aviation industry, the sector was not doing very well prior to the epidemic. The epidemic inflicted financial havoc throughout the aviation value chain, particularly among carriers (Bouwer et al., 2022a). Except for freight forwarders and cargo airlines, who benefitted from an increase in demand for air cargo, every subsector recorded enormous losses in 2020. Even formerly dependable value generators, such as airports and factories, were not immune to the economic impact of the epidemic. The Russian-Ukraine crisis and the relevant sanctions will further increase complexity and operating costs. Global mobility is the norm in today's increasingly interconnected society (Bouwer et al., 2022b). However, huge global shocks will likely increase in frequency and when the global aviation sector is rebuilt, sustainability and adaptability must be two of the most important things to think about.

Aviation has faced the same issues ever since it was invented: provincial boundaries and restrictions, connected geographic impediments, divided airspace, high capital requirements, and ensuring that aircraft are safe to travel. Airlines are geared up in case there are any more COVID-19 pandemic waves after surviving several of them. Complexity and operating costs will continue to rise as a result of the Russian-Ukrainian situation and related sanctions. The rising cost of jet fuel is another threat that airlines must contend with. Oil prices in 2021 were driven by a combination of uncertain oil demand, global economic uncertainty, and variable oil production rates. The Russian invasion has inflated this value even further. As per Frost and Sullivan's analysis fuel costs are the highest contributor to the operating expenditure of an airline (~30% of

operating expenditure), and they have increased by almost 89% in the last three and a half years as per Energy Information Administration (Abraham, 2022). Together, these problems have made it very hard and risky to be in the aviation business (Singh et al., 2022).

The usage phase dominates the whole life cycle impact in the aviation industry; consequently, component weight dictates environmental impact and costs. As a result, the effect attributable to material production and component manufacture has a tiny relative contribution to the entire life cycle impact of a material or component. This fact hinders the use of recycled components for closed-loop aircraft applications, particularly high-performance ones (Markatos and Pantelakis, 2022). Aviation is a significant contributor to global greenhouse gas emissions, and the COVID-19 pandemic has significantly impacted the industry, leading to a reduction in air travel and emissions (Gossling, 2020). However, as the industry recovers, it is crucial to prioritise sustainability and explore ways to reduce emissions and environmental impact (Guan et al., 2022). Professionals in the aviation industry have always been interested in sustainability, but it seems to be becoming an even bigger concern for decision-makers as they try to restructure their business operations during the current renaissance of the industry (Connected Aviation Industry, 2021). A clear understanding of stakeholder roles is crucial though sometimes neglected part of aviation sustainability efforts (Singh et al., 2022). In addition, Song et al. (2020) study stated that further research is necessary on the aviation industry's sustainability from the comparative advantage viewpoint and the policy direction perspective. The study conducted by Suk and Kim (2021) recommended that observing sustainability indicators and best practices from the perspective of post-pandemic government policy designs would be an interesting research topic. Research in the field of aviation sustainability post-COVID-19 is essential for promoting a sustainable and environmentally responsible aviation industry that can continue to serve the needs of society while also protecting the planet (Gossling, 2020).

Considering these research directions in the field of aviation sustainability, the present study is carried out with the following objectives:

- To understand the sustainability issues and measures adopted by the aviation industry post COVID scenario.
- To analyse the applicability of triple-bottom-line measures adopted by the aviation industry.

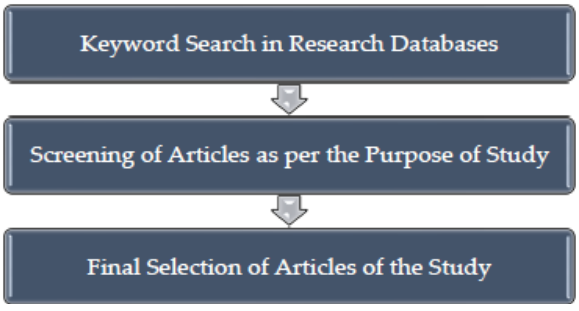
The remainder of this study is structured in the following way: Methodology is discussed in Section 2. The third section details the issues impacting aviation sustainability, measures to improve aviation business sustainability through the triple bottom line (TBL) approach, and the cases of sustainable measures in the aviation industry. Section 4 covers the conclusion of the study with the limitations and future research directions.

2 Methodology

This study employs uses an exploratory research methodology and applies a qualitative approach to research. This study's approach was determined to be a comprehensive literature review. Understanding the level of business sustainability in the aviation sector and identifying the application of sustainability metrics in the aviation industry were the

initial objectives of this study, which utilised a literature analysis. The literature review included the study and assessment of research papers, book chapters, conference papers, articles, reports, and other publications in the field of sustainability in aviation management. For the literature review, several combinations of complimentary search phrases are entered into online databases such as Scopus, Google Scholar, Science Direct, IEEE, Emerald insights, TandF, Wiley, MDPI, etc. For a focused and well-coordinated literature review (from 2006 to 2022), there is a three-stage review method. The review of digital databases and deliberate develop three stages entailing planning, conducting, and reporting the review (Sabharwal and Miah, 2022). The three-stage literature review is mentioned below:

Figure 1 Three-step literature review (see online version for colours)



3 Discussion

This section presents a detailed discussion on issues impacting sustainability in the aviation industry, sustainability through a TBL, and how overall aviation sustainability can be achieved by adopting the TBL approach focusing on economic sustainability, social sustainability, and environmental sustainability. Finally, some cases of sustainable measures in the aviation industry are presented.

3.1 Aviation industry: issues impacting sustainability

The growth prospects of an economy are positively correlated with the expansion of the aviation market. The global aviation sector is facing a dismal decline in revenue. According to the International Air Transport Association (IATA), the global airline industry's income is expected to decrease by around USD 113 billion. Every 100 instances of COVID-19 will result in a decline in passenger demand, which will cost global airlines roughly USD 113 billion. The aviation industry has increased commercial activity by permitting speedier commutes, opening up previously inaccessible regions, promoting tourism, providing jobs, bolstering other business sectors, and improving commerce. These aviation sector products enhance the quality of life and contribute to global economic expansion. Statistics demonstrate that aviation has become a vital component of the global economy because it facilitates increased access to labour, expertise, investment, and other economic activity (Singh et al., 2022). The aviation sector has terrible effects on the environment and human health as a result of its usage of

fossil fuels, toxic pollutants, and the employment of enormous and varied workforces. These problems have been exacerbated by the expansion of the aviation business, both in terms of passenger and freight transportation, because this demand growth entails an increase in fuel consumption, hazardous waste, and noise. Because the industry is global, these bad effects do not just happen in the countries where the companies are based. They also happen in other countries, which leads to global climate change (Karaman et al., 2018).

The COVID-19 pandemic has highlighted the urgent need for sustainability in the aviation industry, particularly in airport operations (Agrawal, 2021; Suk and Kim, 2021). Despite efforts by some companies to implement sustainable practices, the aviation industry continues to face significant economic, social, and environmental challenges that threaten its long-term viability. These challenges include rising greenhouse gas emissions, inefficient use of resources, noise pollution, and negative impacts on local communities and ecosystems (Guan et al., 2022; Gupta et al., 2022). As the aviation industry continues to recover from the pandemic and global demand for air travel grows, it is imperative to address these sustainability challenges to ensure a more sustainable and resilient aviation industry in the future.

3.2 Sustainability

The purpose of traditional business models is to increase shareholder wealth, occasionally at the expense of other stakeholders. By creating business models that benefit all stakeholders, including employees, shareholders, supply chains, civil society, and the environment, sustainable businesses are altering the corporate ecosystem. Embedded sustainability measures have a favourable effect on corporate success (Whelan and Fink, 2016). The continued existence and viability of airlines need a shift in their strategy and business models to bolster their financial resilience. Major variables impacting airline performance are overcapacity, severe competition, and high operating expenses. Optimal resource use, collaboration rather than rivalry, and cost minimisation appear to be realistic solutions for sustaining a financially successful take-off over hard terrain in the face of the current COVID dilemma (Agrawal, 2021).

3.3 Sustainability and triple bottom line

The origin of sustainability may date back over 130 years ago from an idea known as spaceship earth. Used interchangeably, TBL and sustainability are related constructs; however, there seems to be an inconsistent use of sustainability (Alhaddi, 2015). The TBL theory is a framework that evaluates an organisation's performance and success based on three pillars: economic, social, and environmental. It aims to measure an organisation's impact on people, the planet, and profit (Guan et al., 2022). John Elkington's TBL Theory has altered how corporations, organisations, and governments evaluate the sustainability and effectiveness of initiatives and programs. Beyond the cornerstone of assessing sustainability on three fronts – people, planet, and profits – the TBL's adaptability enables firms to implement the idea in a manner that meets their requirements (Slaper and Hall, 2011). The TBL is an approach focused on three crucial dimensions: environmental quality, social equality, and economic prosperity. Similar to more known marketing research, these dimensions may be seen as the foundation for market-focused resources, competencies, and a competitive advantage over market rivals.

Arowoshegbe and Emmanuel (2016) suggested that the social dimension includes the company's impact on its employees and the social system within its community. When looking at the environmental dimension, companies need to look at the qualitative and quantitative effects they are having on their local, national, and international resources. The last, but certainly not the least, economic dimension includes the company's financial performance, the flow of capital, and its economic involvement in society. As per the study by Miller (2020) beyond helping companies capitalise on a growing market for sustainable goods, embracing sustainable business strategies can be highly attractive to investors. According to Sustainable Business Strategy, evidence has increasingly shown that firms with promising environmental, social, and governance (ESG) metrics tend to produce superior financial returns. As a result, more investors have begun focusing on ESG metrics when making investment decisions. Correia (2019) found that for organisations it is important that they incorporate sustainability into their strategies and accesses the issues with their implementation. Willard (2012) demonstrated that sustainable behaviour can contribute to a company's profit by increasing revenue and employee productivity, reducing energy, water, and materials expenses, reducing turnover, and decreasing strategic and operational risks. Ali et al. (2022) with their study drew attention to green operations for energy and resource conservation and promotes the role of sustainable work culture, sustainable strategies, and policies for their role in encouraging sustainable performance outcomes. The TBL theory suggests that an organisation should strive to achieve success in all three pillars, rather than just focusing on financial performance. This approach recognises that a company's success is not only measured by its financial bottom line but also by its impact on people and the planet.

The TBL theory is often used as a framework for sustainability reporting, where organisations report on their economic, social, and environmental performance (Guan et al., 2022). It has become an important concept for businesses, policymakers, and investors who are looking to balance economic growth with social and environmental responsibility.

3.4 Improving aviation business sustainability through the TBL

Aviation sustainability refers to the ability of the aviation industry to meet the needs of the present without compromising the ability of future generations to meet their own needs. It involves balancing economic, social, and environmental factors to create a sustainable aviation system (Gemmer, 2019; Gossling, 2020; ICAO; 2011).

- Economic sustainability in aviation refers to the industry's ability to generate profits while maintaining safety, security, and reliability. This includes optimising operations, reducing costs, and managing risks to ensure financial stability.
- Social sustainability in aviation refers to the industry's ability to support local communities, create jobs, provide a positive passenger experience, and provide safe and affordable air transportation for all. This includes promoting diversity and inclusion, investing in employee training and development, and supporting community initiatives.
- Environmental sustainability in aviation refers to the industry's ability to reduce its environmental impact, including greenhouse gas emissions, noise pollution, and air and water pollution. This includes implementing sustainable practices such as using

renewable energy, investing in more efficient aircraft and engines, using sustainable aviation fuels, reducing waste and improving recycling, and promoting sustainable operational practices.

Aviation sustainability looks for ways to lessen the negative effects that air transportation has on both society and the environment. Its goal is to lessen aviation's impact on climate change through revolutionary innovation and new practices. Overall, aviation sustainability requires a multi-stakeholder approach, involving collaboration between airlines, airports, manufacturers, regulators, governments, and the public. The industry needs to work together to address the challenges of sustainability and to identify and implement solutions that will enable aviation to continue to grow and thrive sustainably.

To keep the aviation industry viable, future aircraft will need to be more efficient, have lower direct operating costs, carry larger payloads, and continue to operate from existing airports. These rules will make the aviation industry more economically and environmentally sustainable. Southwest Airlines' use of TBL distinguished it from competitors and catapulted it to the top of the American airline market. Southwest Airlines is implementing a fresh system for controlling its ability to differentiate itself from the competition in response to the COVID-19 outbreak. The company's capacity reductions will be less severe than those of its competitors in the coming weeks, a decision supported by the fact that it is easier to withdraw resources from the system than to restore supply to its customers. The airline is attempting to keep as many destinations as possible, and the majority of these destinations remain unaltered at this time. However, Southwest insists that if demand remains low, it will allocate additional resources to its operations. Southwest is also cooperating with other airlines to ensure that passengers feel comfortable traveling in the next weeks and months, including limiting airplane reservations so that passengers can exercise social distancing (Gupta et al., 2020). But at some point, airlines will have to find a balance between being cut off from society and making sure that the cost of flying stays the same.

3.4.1 Environmental sustainability

The aviation sector can improve its sustainability by employing various effective substitute technologies that have a lower environmental impact (Bertoni et al., 2015). Numerous studies indicate that superior aircraft engines, alternative fuels, air-to-air refuelling, well-organised flight routes, ecologically friendly impulsion systems, and fuel savings can all contribute to aviation sustainability (Agarwal, 2010; Elhmoud and Kutty, 2020; ICAO, 2012; Warwick and Norris, 2011).

The research conducted by Somerville et al. (2016) showed the multiple benefits of box-wing technology, including the fact that its deployment will result in considerable fuel savings for aircraft. Reduced aircraft emissions are a by product of reduced fuel consumption; as a result, environmental sustainability in the aviation sector will be enhanced. The multiple benefits of box-wing technology, including the fact that its deployment will result in considerable fuel savings for aircraft (Ragbir et al., 2016). Reduced aircraft emissions are a by product of reduced fuel consumption; as a result, environmental sustainability in the aviation sector will be enhanced. The research by Ragbir et al. (2021) supported prior studies on environmental sustainability that indicated consumers' willingness to pay more for planes powered by biofuels and constructed with sustainable materials.

To be sustainable, firms must adopt new approaches and methods for routine tasks such as designing and sourcing aircraft and necessary components. The industry must be ready for the transition in procurement by moving away from buying decisions from the lowest pricing suppliers to those producing items fulfilling longer-term sustainability standards. A CO2-friendly component may cost more upfront, but it offers possibilities for recycling that cut down on carbon emissions (Galer, 2022). Additionally, designers will need to engage much more strongly with their suppliers, sharing information to acquire the finest quality items that will reduce rework and subsequent CO2 emissions, while airplane makers explore sustainable fuel choices and materials. Moreover, the question is not only how to build a more environmentally friendly system for new aircraft fleets, but also how to improve the efficiency of the 'existing fleets'. It has been evident that aviation sustainability and efficiency can be greatly improved with changes to the design of an aircraft, fuel efficiency, engines, and materials.

Hence, aircraft manufacturers must look for ways to improve their current processes while transferring more data up and down the value chain to develop and build the next generation of aircraft. This will help them operate their businesses in a carbon-neutral manner. Moreover, it is important to note that a sustainable aviation business connects data from each aspect of engineering, sourcing, logistics, manufacturing, sales, and funds (Galer, 2022). Finally, to meet the sustainable goals, the aviation sector will need to consider a variety of strategies, including improved efficiency, technological innovation, and the use of sustainable aviation fuel (SAF).

Following are some of the environmental measures that can be taken for improving airport sustainability:

- Reducing greenhouse gas emissions with sustainable aviation fuels, energy-efficient technologies, and carbon offset programs.
- Minimising waste and promoting recycling and composting programs.
- Implementing sustainable land use practices to protect natural habitats and wildlife.
- Reducing noise pollution through the use of noise-reducing technologies and flight path optimisation.

3.4.2 Social sustainability

The aviation industry has created millions of jobs worldwide and contributed significantly to improving human life. All countries can now travel freely thanks to air travel. It provides access to international marketplaces while bridging cultures, nations, and people. Air travel provides a means of inclusion for isolated communities when it is the only mode of transportation, connecting developing nations to wealthier nations. Most people on the globe can enjoy the cultural and recreational opportunities that come with international travel because of the low cost of air travel. In turn, this makes the world more accessible to tourism, which greatly raises living standards and reduces poverty in many countries (Elhmoud and Kutty, 2020). In addition to serving as a means of travel for tourists, aviation also serves the crucial purpose of enabling the quick transportation of medical supplies, emergency aid relief, and organs for transplantation.

The airline sector also makes use of its operations to support charitable groups and give back to the community at large. Each year, every major airline has made significant financial contributions to philanthropic endeavours and charity. The main carriers

typically support both national organisations and local charities in the hub cities where they operate. Additionally, most airlines that provide a mile incentive program permit the donation of miles for free travel to charitable organisations (Elhmoud and Kutty, 2020).

The 'social life cycle assessment' is a frequently employed instrument for evaluating sustainability in the social domain (Thies et al., 2019). The stakeholder implications resulting from their actions throughout the life cycle are accounted for by the social impacts that exist.

Reporting on corporate social responsibility (CSR) is another well-known assessment technique. By taking appropriate legal, moral, and charitable measures, the airline sector is required by the CSR to protect and advance the welfare of both the passenger community and the industry as a whole (Anttila and Kretzschmar, 2010). The findings of the study (Ragbir et al. 2021) indicated that affect and emotions, especially the amount of happiness and concern for sustainability in aviation, explain why an individual would be prepared to pay extra to support sustainable practices. As more sustainable projects are implemented globally, the aviation industry must incorporate sustainable practices into airports, planes, and their complete operations. Furthermore, customers are growing more interested about human resource policies that encourage social sustainability. With more options, disruptive technological advances, and changes in consumption and lifestyles that accompany them, the airline sector will need to be flexible and receptive to new trends and changing dynamics in order to remain competitive. Following are some of the social measures that can be taken for improving airport sustainability:

- Promoting diversity and inclusion in the workplace and providing opportunities for employee training and development.
- Engaging with local communities to understand their needs and concerns and working together to develop sustainable solutions.
- Providing a safe and inclusive environment for passengers, including accessible facilities and services.
- Supporting local culture and art initiatives to enhance the airport's social impact and sense of place.

3.4.3 Economic sustainability

Economic competence, economic growth, and financial viability comprise economic sustainability. In addition, methodologies for the estimation of costs and performance can be used to evaluate economic viability (Elhmoud and Kutty, 2020). For achieving economic sustainability in the aviation industry, the usage of SAF is one of the most significant ways. Amounting to the goals of the aviation sector to meet passenger needs and make a profit, the use of SAFs is influenced by the price of aviation fuel and regulatory incentives. A sizable return on investment may encourage bio-refineries to establish SAF production facilities to meet the expanding demand (Kutty et al., 2020; Elhmoud and Kutty, 2020).

On the other side, the development of more fuel-efficient aircraft is a promising way to increase the aviation sector's economic sustainability. The latest models from leading airline manufacturers have been released, and they have the potential to cut current fuel use by 20%. Even if the new airplanes have a little high price tag, the economic benefits for all parties concerned are substantial in both the short and long terms. Finally, modern

fuel-efficient aircrafts save money on fuel costs, operating expenditures, maintenance costs, and taxes. This cost savings will be seen by both customers and airlines. More fuel-efficient planes and cheaper costs will offset the recent increase in ticket prices. Fuel price increases are directly responsible for rising ticket prices. Furthermore, as demand for crude oil reduces internationally as a result of the aircraft industry's reduced fuel use, the price per barrel will fall as well. New fuel-efficient aircraft will have a significant financial impact on the entire global population. Households, small enterprises, and aircraft manufacturers will benefit financially.

Understanding the links between manufacturing, operations, and decommissioning in the airline industry necessitated the development of a decision-support model based on the LCC strategy (Thokala et al., 2010). The worldwide standard for the integration of financial reports with corporate sustainability reporting as a single report will contribute to speeding up the process (Koç and Durmaz, 2015). Following are some of the economic measures that can be taken for improving airport sustainability:

- Implementing energy-efficient technologies and renewable energy sources to reduce energy consumption and costs.
- Developing sustainable transportation systems, such as public transit and sharing programs, to reduce vehicle emissions and congestion.
- Partnering with local businesses to promote economic growth and job creation in the surrounding community.
- Investing in airport infrastructure, such as runways, terminals, and parking facilities, to improve safety, efficiency, and passenger experience.

Airport operators, airlines, regulatory agencies, and other stakeholders must work together to integrate sustainable practices into all parts of airport operations in order to achieve aviation and airport sustainability. This encompasses the creation of sustainable infrastructure, the use of environmentally friendly materials and technology, and the adoption of environmentally friendly policies and practices throughout all airport activities. Ultimately, airport sustainability is a complicated and diverse subject that necessitates the incorporation of economic, social, and environmental factors into airport operations and development. Airports can contribute to a more sustainable future for the aviation industry and the globe by working together to emphasise sustainability.

Overall, a TBL approach to airport sustainability requires a commitment to balancing economic, social, and environmental considerations in all aspects of airport operations and development. By taking these measures, airports can contribute to a more sustainable future for the aviation industry and the planet.

3.5 Cases of sustainable measures in the aviation industry

This section discusses some examples of aviation-related companies that have demonstrated a commitment to sustainability in aviation and have taken significant measures to reduce their environmental impact while also promoting social and economic sustainability:

1 Airport Authority Hong Kong (AAHK) has set a target of achieving net zero carbon for the Hong Kong International Airport (HKIA) by 2050 (Newswire, 2021). To achieve this goal, they have implemented a range of measures including the use of renewable energy, energy-efficient technologies, and sustainable transport options.

2 Qantas Airways, Australia has implemented a sustainable aviation fuel program and has committed to net-zero emissions by 2050 (Qantas, 2023). They have also invested in renewable energy sources and have implemented sustainable policies and practices across their operations.

3 The Emirates Group has developed a comprehensive sustainability strategy that includes measures such as fuel efficiency programs, waste reduction, and the use of eco-friendly materials in their operations. They have also invested in sustainable technologies, such as electric ground service equipment, and have implemented sustainable policies across their operations (The Emirates Group, 2022).

4 Amsterdam Airport Schiphol in the Netherlands has developed a sustainable aviation fuel program that uses waste and residues as feedstock (Neste, 2023). Neste's press release stated that

> "Schiphol is one of the airports in Europe in which Neste MY Sustainable Aviation Fuel™, a more sustainable alternative to fossil jet fuel, is available. The use of Neste-produced SAF reduces greenhouse gas emissions by up to 80% over the fuel's life cycle, compared to using fossil jet fuel. The program aims to reduce carbon emissions and promote sustainable aviation".

Also, it has confirmed that 'from January 2023 onwards, all diesel-powered ground handling vehicles and machinery at Amsterdam Airport Schiphol in the Netherlands are using Neste MY renewable diesel (also known as 'HVO100' produced from 100% renewable raw materials)'.

5 Gatwick Airport in the UK has implemented a range of sustainable initiatives, including the use of electric vehicles, sustainable construction practices, and the promotion of public transport options. They have also set targets to support people and communities, and reduce their carbon emissions, waste, and water consumption by 2030. The aim is to minimise emissions from the aircraft and the transportation used to turn up to the airport. Further, 60% of trips to and from the airport will have negligible or extremely low emissions by 2030 (Sustainability Policy, 2021).

3.6 Information technology as an enabler for business sustainability in aviation industry

The aviation industry faces several challenges related to sustainability, including reducing carbon emissions, managing resources, and improving efficiency. Information technology (IT) can be a key enabler for business sustainability in this industry, as it can help airlines and related businesses to optimise their operations and reduce their environmental impact. IT innovations drive operational efficiency, service quality, environmental responsibility and corporate sustainability (Grant et al., 2013). Another significant trend that has emerged in the aviation industry is the digital transformation of the sector. The pandemic has accelerated the adoption of digital technologies across all industries, including aviation. Airlines have been investing in digital technologies such as

mobile apps, self-service kiosks, and artificial intelligence to improve the customer experience, reduce costs, and increase efficiency. Growing requirements are challenging maintenance, repair and operations (MRO) organisations as well, where larger organisations can cope with by facilitating comprehensive quality systems, airworthiness and life cycle management systems based on IT (Uclera and Gok, 2015). Based on 'sustainable growth and environment' value creation, Ryley et al. (2013) proposed adopting telepresence systems for communication to reduce drop-off/pick-up trips as sustainable development in airports. Rather than travel to an airport to drop-off and pick-up a passenger, relatives or friends could order an on-demand event to say goodbye to the traveler where telepresence can offer a realistic experience. Medvedev et al. (2017) highlighted the role of the NextGen air transportation system (NextGen) in transferring the air traffic control system from the current ground-based system to a satellite-based system with a GPS technology feature. Better understanding of IT may have systemic benefits to public bodies aiming to efficiently conduct a digital procurement ecosystem. This innovation benefits aircraft operators through enhanced safety, higher efficiency, and increased capacity by deploying precision navigation and network-enabled information access (Raya and González-Sánchez, 2020). Also, the emerging technology known as blockchain technology can enhance aviation operation management, increasing spare parts traceability. Effective use of the blockchain technology in aviation industry of developing countries with focused improvements will not only strengthen the economic aspects of the supply chain but will also improve its performance to comply with the environmental regulations and social aspects (Munir et al., 2022). As per Jankowska et al. (2021), in comparison with other industries, the aviation industry is very much infiltrated by IT and industry 4.0 solutions and aviation industry stakeholders are still eager.

In connection to the TBL, a study conducted by Bamidele et al. (2023) suggested that younger employees with better access to IT and awareness about environmental sustainability aspects of climate change, global warming, and other environmental phenomenon are more well-disposed to change towards pro-environmental behaviour at work and thus information flow can be used to strengthen environmental component of TBL perspective.

Also, digital technologies are enabling airlines to operate more sustainably by reducing paper use, optimising flight routes, and reducing fuel consumption. By collecting and analysing data on everything from fuel usage to passenger preferences, airlines can make more informed decisions that minimise waste and reduce their carbon footprint. For example, airlines can use data to optimise flight routes, adjust fuel consumption, and reduce the amount of time planes spend on the ground, all of which can lead to significant reductions in emissions.

The introduction of self-service kiosks and mobile check-in can reduce the need for printed boarding passes and other paper-based documents, reducing the industry's carbon footprint (European Union, 2023). One example of the use of IT for sustainability is the implementation of the Single European Sky (SES) initiative. The initiative aims to create a more efficient and sustainable air traffic management system in Europe through the integration of IT systems. The SES initiative is expected to reduce emissions by 10%, improve safety, and save costs for airlines. Another way that IT can enable business sustainability in aviation is using automation and robotics. For example, airports can use automated baggage handling systems to reduce the amount of fuel used by ground vehicles, and airlines can use robots to perform maintenance tasks more efficiently and with greater precision, reducing the need for repeated repairs and replacements. Finally,

IT can also enable business sustainability in aviation by facilitating communication and collaboration between different stakeholders. By using cloud-based platforms and other collaboration tools, airlines can work more closely with suppliers, customers, and regulatory bodies to share information, coordinate efforts, and find new solutions to sustainability challenges.

4 Conclusions

The aviation sector has played a significant role in the global development process. The necessity for sustainability in this industry has been completely acknowledged by industry leaders in a more integrated way. The purpose of this article was to undertake a review of the literature covering the need for sustainability and incorporating methods for all aspects of sustainability (economic, social, and environmental) for sustainability in the aviation industry. Post-COVID-19, the airlines must define and prioritise their responses to the current situation and commercial objectives. Inventiveness in technology is already pushing past limits in several areas, which is good for the whole world. The finest illustration of this is the fact that social distancing measures have sparked a technological revolution; virtual connections and gatherings now aim to expand internationally.

The present study focuses on achieving sustainability in the aviation business post-COVID era through a TBL approach. The study discusses the factors for achieving overall business sustainability such as economic sustainability, social sustainability, and environmental sustainability. The study shows that there is a high requirement for sustainability in the aviation sector especially post-COVID era as the industry has already been highly affected by the pandemic. Several interventions are required at different facets of the aviation supply chain to overcome the challenges faced by the current aviation industry. The study suggests that the aviation sector must adapt to more fuel-efficient aircraft for its operations. This would help to sustainably improve the environment by drastically reducing carbon emissions. Similarly, fuel-efficient airplanes use less fuel and have a positive economic impact on sustainability. Also, the airline sector needs to be more socially conscious, and CSR is crucial to achieving sustainability in all areas.

To meet sustainable goals, the aviation sector will need to consider a variety of strategies, including improved efficiency, technological innovation, and the use of sustainable aviation fuel. The study also suggests that by adopting a TBL approach, the aviation industry not only can minimise the cost but also minimise the environmental burden through their sustainable operations, which will lead to improved performance and a better future for the aviation industry. As aviation is a robust business that has recovered from past shocks, the road to the TBL would accelerate necessary reform. Governments, businesses, and global institutions should work together to make sure that innovative solutions can be put into place quickly. This will help the world recover from the pandemic more quickly and effectively, while also leaving a legacy of sustainability for future generations to enjoy. The methods discussed in this study encourage decision-making to promote sustainable operations in the aviation sector, thus enabling mitigate the existing issues and challenges. The study also suggests that IT can play a critical role in enabling business sustainability in the aviation industry. By leveraging data analytics, automation, and collaboration tools, airlines and related businesses can optimise their operations, reduce their environmental impact, and work more closely with stakeholders

to find innovative solutions to sustainability challenges. As the aviation industry faces increasing pressure to reduce its carbon footprint and become more sustainable, the use of IT will likely become increasingly important in helping businesses achieve their sustainability goals while remaining competitive in a rapidly changing market. The TBL approach to airport sustainability, which considers economic, social, and environmental factors, provides a framework for creating a more sustainable airport system. To achieve airport sustainability, airport operators, airlines, regulatory agencies, and other stakeholders need to work together to integrate sustainable practices into all aspects of airport operations. This includes the development of sustainable infrastructure, the use of eco-friendly materials and technology, and the implementation of sustainable policies and practices across all airport operations. By prioritising airport sustainability, airports can contribute to a more sustainable future for the aviation industry and the planet. This requires a commitment to balancing economic, social, and environmental considerations and a willingness to collaborate and innovate to develop sustainable solutions. The present study will provide important insights into the environmental, social, and economic impacts of aviation and inform policy and decision-making at the local, national, and international levels. Moreover, this study will have a significant implication for the future of the aviation industry, particularly as the industry faces growing pressure to address its environmental and social impacts and ensure long-term sustainability.

5 Limitations and future scope of the study

The present study is based on secondary literature and is limited to the analysis of available literature in the field of aviation sustainability. This study offers several research avenues in the field of aviation sustainability where the present study can be used as a guide to conduct an empirical study covering the primary data. Moreover, individual sustainability aspects such as economic aspects, social aspects, or environmental aspects can also be studied about a particular nation. As new technologies such as sustainable aviation fuels, and advanced air traffic management systems continue to emerge, there is a need for research to assess their potential environmental, social, and economic impacts. Also, the research could explore sustainable design practices for airports, including renewable energy systems, energy-efficient buildings, and green infrastructure.

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