UNIVERSITY OF TARTU

Faculty of Social Sciences

School of Economics and Business Administration

Ali Kurbanov

Georgian Airspace: A Strategic Geoeconomic Asset

Bachelor Thesis

Supervisor: Associate Professor in Economic Policy Diana Eerma

Tartu 2025

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

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Introduction

Airspace plays a pivotal role in the 21st-century global economy and geopolitics, serving as an indispensable resource for facilitating trade, diplomatic relations, and military logistics. With over 41 million annual flights worldwide, efficient airspace management is crucial for ensuring both economic sustainability and operational safety in aviation (Majka et al., 2022). Recent geopolitical conflicts, such as the Russo-Ukrainian War, have disrupted traditional air routes, significantly increasing operational costs for airlines as they reroute flights to avoid conflict zones (Ennen & Wozny, 2024). Similarly, air corridor closures over the Middle East due to escalating tensions, including the Israel-Iran conflict, underscore the urgent need for alternative, secure routes. Georgian airspace, positioned as a low-risk alternative, offers stability and continuity for global air travel, mitigating economic and geopolitical risks (EUROCONTROL, 2023; Majka et al., 2022). In this context, the concept of strategic sustainability becomes increasingly relevant. It refers not only to operational and environmental performance but also to an airspace's ability to offer reliability, geopolitical resilience, and continuity of service during periods of regional or global disruption. Georgian airspace exemplifies this dual sustainability framework—strategic and economic—by maintaining high operational efficiency while also serving as a secure transit route amidst instability.

Situated at the crossroads of Europe and Asia, Georgian airspace has emerged as a critical corridor for global aviation, offering a stable alternative to conflict-affected routes. The integration of Georgia into the European Single Sky initiative has bolstered its role as a transit hub, enabling smoother connections between major markets and mitigating risks associated with geopolitical instability (EUROCONTROL, 2023). This strategic importance is further highlighted by a 62% increase in air traffic in 2023 compared to 2022, with a recovery rate at 169% of 2019 levels. While this surge underscores Georgia’s growing role in global air traffic networks, it also presents significant challenges for airspace management, necessitating rapid modernization to maintain efficiency and sustainability (EUROCONTROL, 2023). During the Russo-Ukrainian war, Georgian airspace became a vital route for airlines travelling from Europe to Asia, bypassing restricted zones and contributing to a significant increase in overflights and associated revenues (Majka et al., 2022.).

Additionally, ongoing tensions in the Middle East have further underscored the need for secure alternatives, with Georgian airspace serving as a reliable and safe transit corridor, thereby

ensuring continuity of trade and passenger travel (Ennen & Wozny, 2024). As US Army General Jones once stated, “Georgia stands as a beacon of stability in an increasingly unstable region, offering a crucial link in the global transportation network” (Lynch, 2006, p. 51). These factors reinforce Georgia’s strategic importance in maintaining regional connectivity and resilience within global air traffic networks.

Despite the increasing reliance on Georgian airspace as a transit corridor, research into its economic sustainability remains limited. Economic sustainability, in this context, refers to Georgia's ability to efficiently manage increased air traffic, modernize its airspace infrastructure, and maximize revenue generation while maintaining operational stability amid geopolitical challenges (Barnhart et al., 2012). Existing literature primarily focuses on broader themes, such as airspace sovereignty, security cooperation, and the economic consequences of closures in politically sensitive regions (Baumgartner & Finger, 2014; Ennen & Wozny, 2024). However, the unique dynamics of Georgian airspace—its integration into European air traffic systems, its strategic value amid regional instability, and its potential for revenue generation—are often overlooked. For instance, while studies like Ennen & Wozny (2024) analyze the economic effects of airspace closures during geopolitical crises, they rarely consider the specific contributions of alternative corridors, such as those in Georgia.

The central aim of this thesis is to explore the role of Georgian airspace as a strategically and economically sustainable geoeconomic asset. This means evaluating how it performs under pressure, sustains operations during crises, and contributes to regional and global connectivity. To achieve this aim, the following research tasks are pursued:

- To define and explain key concepts related to airspace management, sustainability, and sustainability measurement, as well as geopolitical resilience, thereby establishing the theoretical foundation for the study.
- To critically review previous empirical studies on airspace governance, identifying insights relevant to Georgia’s context and revealing current research limitations.
- To benchmark Georgian airspace against other strategically important corridors (Poland, Turkey, Azerbaijan), identifying both comparative advantages and areas for improvement.
- To conduct a structured SWOT analysis that evaluates Georgian airspace’s strengths, weaknesses, opportunities, and threats from an operational and economic standpoint.

- To formulate targeted, data-driven strategies aimed at enhancing Georgia's performance, sustainability, and long-term role as a competitive aviation corridor.

By addressing these objectives, this paper aims to bridge the gap in the current discourse on Georgian airspace, highlighting both its vulnerabilities and its capacity to maintain efficient operations, generate revenue, and manage risks related to geopolitics and sustainability. The structure of this bachelor's thesis reflects its comprehensive aim. Chapter 1 lays the theoretical foundation, defining key terms and concepts related to airspace and examining sustainability measurements. It further reviews existing literature to identify gaps and establish a framework for analysis. Chapter 2 applies a SWOT analysis and comparative methodology to evaluate the strengths, weaknesses, opportunities, and threats of Georgian airspace, situating it within the context of other strategically significant airspaces. Finally, the conclusion synthesizes the findings, offering actionable strategies to enhance the role of Georgian airspace as a strategic geoeconomic asset.

Keywords: Georgian airspace, sustainability metrics, geoeconomics, conflict resilience, airspace management.

1. The Economic Importance and Sustainability Measurements for Airspace

1.1 Key Terms, Concepts, and Sustainability Measurements for Airspace

Airspace, as a finite and strategically valuable resource, is managed through structured systems to ensure the safety, efficiency, and sustainability of aviation. It is categorized into several types: controlled, uncontrolled, and restricted airspace, each with specific implications for air traffic management. Controlled airspace refers to zones where air traffic controllers monitor and direct aircraft movements to prevent collisions and maintain optimal separation standards. In contrast, uncontrolled airspace grants pilots greater autonomy, with navigation carried out using either visual flight rules (VFR) or instrument flight rules (IFR), depending on the conditions. Restricted airspace, often allocated for military use or national security operations, prohibits or limits civilian aircraft access to protect sensitive areas (Loukianova, 2011).

Airspace management is grounded in the principle of balancing traffic demand with available capacity, particularly in high-density corridors. As global air traffic continues to

increase, congestion in major flight paths leads to delays, economic losses, and environmental inefficiencies. Barnhart et al. (2012) emphasize that strategic airspace design and real-time flow interventions—such as capacity modeling, performance simulations, and route optimization—are essential in ensuring that airspace infrastructure keeps pace with demand. Such interventions are critical for countries like Georgia, where the sudden increase in rerouted traffic due to regional conflicts has highlighted the limitations of existing systems and underscored the need for modernization.

General aviation also plays a critical role in shaping airspace dynamics, particularly in regions with mixed-use airspace. This segment includes non-commercial flights such as private aviation, business jets, agricultural operations, and emergency services. Delgado et al. (2021) note that general aviation makes a significant contribution to national economies and public service delivery. However, its integration with commercial traffic in controlled airspace presents coordination and safety challenges. Technologies such as Automatic Dependent Surveillance–Broadcast (ADS-B) systems have become vital in managing these complexities. ADS-B allows aircraft to broadcast their position, speed, and altitude in real-time, greatly enhancing situational awareness and reducing the risk of mid-air collisions (EUROCONTROL, 2023). For Georgia, where general aviation supports remote medical access and disaster relief in mountainous regions, these technologies are particularly valuable in improving airspace safety and accessibility.

Sustainability in airspace management is increasingly multidimensional, encompassing environmental, economic, operational, and governance concerns. Payán-Sánchez et al. (2018) argue that achieving sustainability requires collaboration among public institutions, private service providers, and international regulatory bodies. Delgado et al. (2021) emphasize that performance-based navigation (PBN), reduced vertical separation minima (RVSM), and optimized routing can lower fuel consumption and CO_2 emissions, thus enhancing environmental performance while maintaining economic efficiency. For instance, Continuous Climb Operations (CCO) and Continuous Descent Operations (CDO) are now widely promoted in Europe and parts of Asia as ways to reduce noise pollution and fuel burn. Georgia’s partial adoption of these procedures—particularly at Tbilisi and Batumi airports—represents a significant step forward; however, further implementation is necessary to achieve comprehensive sustainability gains.

Airspace also functions as a strategic tool for national security, foreign policy, and regional influence. As Jaffe (2016) highlights, the control and governance of airspace enables countries to facilitate trade, project power, and influence international logistics. This is especially relevant in volatile regions, where geopolitical risks often result in airspace closures, rerouting, and significant losses of overflight revenue. Majka et al. (2022) note that sustainable airspace practices help mitigate the fallout of such disruptions. In Georgia's case, maintaining open, efficient, and secure airspace during periods of regional tension, such as the Russo-Ukrainian war, has been critical not only for revenue stability but also for strengthening its international reputation as a reliable transit partner.

Sustainability in airspace is typically assessed through a range of key performance indicators (KPIs). These include metrics such as fuel burn per kilometer, average delay per flight, capacity utilization ratios, cost efficiency (e.g., ANS unit cost per service unit), and compliance with environmental targets. The European Union's Single European Sky (SES) initiative provides a standardized approach for benchmarking these indicators across member and partner states (EUROCONTROL, 2023). In addition to technical metrics, broader governance indicators—such as institutional capacity, legal harmonization, and stakeholder coordination—are increasingly used to measure progress. Georgia's participation in EUROCONTROL's Local Single Sky Implementation Plans (LSSIP) is a promising sign; however, gaps remain in aligning national practices with SES performance goals.

Governance approaches such as reflexive regulation are also gaining traction in aviation. As described by Mölders (2014), reflexive governance prioritizes adaptability, enabling policymakers to adjust their strategies in response to real-time conditions, feedback loops, and stakeholder input. This is particularly relevant in aviation, where changes in political, environmental, or economic conditions can quickly alter airspace dynamics. For Georgia, building such adaptive governance capacity—through digital monitoring systems, flexible legal frameworks, and inter-agency cooperation—will be crucial for long-term sustainability.

European modernization efforts offer instructive lessons. The SES initiative, which aims to unify and streamline air traffic management across the continent, has led to significant improvements in route optimization, delay reduction, and cost efficiency. The integration of digital systems—such as satellite-based navigation, dynamic airspace reconfiguration, and network management tools—has allowed countries to manage growing traffic loads without

compromising safety or environmental targets (Baumgartner & Finger, 2014). EUROCONTROL (2023) highlights several successful implementations of performance-based airspace designs and collaborative decision-making processes. Georgia, currently a non-EU state but an active participant in European aviation frameworks, stands to benefit greatly by adopting similar strategies, particularly in collaboration with neighboring countries through cross-border FRA initiatives.

Cross-border cooperation is essential in modern airspace management, especially for countries with limited size or fragmented terrain. Studies by Payán-Sánchez et al. (2018) and Delgado et al. (2021) emphasize the benefits of regional coordination in addressing environmental challenges and traffic complexity. For Georgia, collaborative efforts such as the Free Route Airspace South Caucasus (FRASC) project with Armenia are a positive example of this trend. Further expansion of these initiatives to include Azerbaijan or Turkey could unlock greater efficiency and help distribute modernization costs across the region.

In conclusion, airspace is a critical, multidimensional resource that encompasses operational, environmental, economic, and strategic dimensions. Its management requires both technological innovation and institutional adaptability, especially in smaller transit states like Georgia. This chapter has reviewed the most relevant concepts, including airspace classification, general aviation integration, sustainability frameworks, and the role of governance in shaping outcomes. Together, these concepts provide the theoretical foundation for evaluating Georgia’s airspace within a broader comparative and strategic framework, as explored in the next chapter.

1.2 Overview of Previous Studies on Airspace and Their Economic Sustainability

Understanding the economic sustainability of Georgian airspace requires a comprehensive analysis of operational efficiency, governance, and the economic implications of geopolitical disruptions. Economic sustainability in this context refers to Georgia's ability to manage air traffic efficiently, generate revenue, and maintain stability in the face of regional and global challenges. This section synthesizes insights from four key studies, providing a foundation for evaluating the strengths, weaknesses, opportunities, and threats of Georgian airspace.

The following table provides a concise summary of the key methodologies, findings, and relevance of the selected studies to this research.

Table 1

Overview of Key Literature on Airspace Governance and Sustainability Studies

Authors/Year	Focus	Methodology	Relevance to Research
(Barnhart et al., 2012)	Balancing capacity and demand to improve operational efficiency and reduce costs.	Capacity modeling and performance simulations to test strategic and tactical interventions.	Provides strategies for managing increased air traffic and reducing costs in Georgian airspace.
Mölders (2014)	Governance frameworks and sustainability in European airspace regulation.	Case studies on reflexive governance and regulatory practices.	Suggests governance strategies adaptable to Georgia's dynamic geopolitical and operational landscape.
Baumgartner & Finger (2014)	The reform process and operational inefficiencies of the Single European Sky (SES) initiative.	Case studies and policy analysis examining institutional and technical gridlocks in SES reform.	Offers solutions for overcoming systemic inefficiencies, critical for aligning Georgian airspace with SES.
Payán-Sánchez et al. (2018)	Sustainability in aviation through stakeholder engagement.	Qualitative analysis of sustainability practices in the aviation sector.	Highlights the role of stakeholder collaboration in achieving sustainability.
Rogošić et al. (2022)	Environmental and operational benefits of flexible airspace use in Croatia.	Simulation modeling, performance benchmarking.	Offers a directly comparable methodology for airspace sustainability metrics.

Source: Compiled by the author based on theoretical studies reviewed

As summarized in the table, these studies explore critical aspects of airspace management, including operational efficiency, systemic inefficiencies, collaborative sustainability frameworks, and regulatory governance. Each study contributes a unique perspective, addressing challenges and opportunities in airspace management from distinct academic angles. The following analysis provides a detailed overview of these studies, emphasizing their methodologies, core findings, and specific relevance to evaluating the economic sustainability of Georgian airspace.

The first study by Barnhart et al. (2012) focuses on the challenges of balancing capacity and demand in air transportation systems. Using capacity modeling and performance simulations, the authors explore both tactical and strategic interventions to address delays, congestion, and inefficiencies. Tactical measures, such as real-time flow management, are designed to mitigate immediate operational bottlenecks, while strategic interventions, like route redesign and advanced navigational technologies, aim for long-term sustainability. These findings demonstrate how optimized airspace operations can minimize delays, reduce costs, and enhance economic efficiency. For Georgian airspace, applying such interventions could reduce bottlenecks caused by increased overflight traffic during regional conflicts, enhancing both efficiency and revenue potential. As traffic demand surges due to rerouting from conflict-affected regions, the ability to manage short-term disruptions while planning for future growth becomes increasingly vital.

The second study by Baumgartner and Finger (2014) examines systemic inefficiencies and reform barriers within the Single European Sky (SES) initiative. Using case studies and policy analysis, the authors identify institutional gridlocks, conflicting national priorities, and technical challenges as significant obstacles to achieving the SES's objectives of seamless and efficient air traffic management. These systemic barriers highlight the need for collaborative governance and modernized infrastructure to overcome fragmentation. These findings are particularly relevant to Georgian airspace as it navigates challenges in aligning its management with SES standards, requiring significant institutional reforms and cross-border cooperation. The study further emphasizes that SES alignment involves more than technical compliance; it demands deep integration into shared regulatory mechanisms—an important consideration for Georgia as it develops towards closer cooperation with EU systems.

The third study by Payán-Sánchez et al. (2018) investigates sustainability in aviation through stakeholder collaboration and engagement. The authors employ qualitative analysis to explore how cooperation among governments, private entities, and international organizations contributes to the operational and economic sustainability of these entities. Their findings emphasize the need for knowledge co-creation and collaborative frameworks to address environmental and operational challenges in aviation. In the context of Georgian airspace, fostering stakeholder engagement could facilitate modernization efforts, address regional security risks, and enhance decision-making to achieve operational sustainability. This is particularly important in Georgia's geopolitical context, where regional tensions require flexibility, proactive planning, and transparency in aviation governance.

The fourth study by Mölders (2014) focuses on governance frameworks and their role in achieving sustainability in airspace management. The study emphasizes the concept of reflexive governance, which prioritizes adaptability in regulatory practices to balance economic, operational, and environmental goals. By analyzing case studies on European airspace regulation, the findings underscore the importance of responsive governance strategies in maintaining long-term operational stability and economic viability. For Georgia, adopting reflexive governance principles can help adapt to rapidly shifting geopolitical dynamics, thereby ensuring long-term economic and operational stability. The ability to react quickly to airspace rerouting needs or conflict-induced changes is a key element of competitiveness and safety.

The fifth study by Rogošić et al. (2022) offers a simulation-based analysis of the environmental and operational benefits of flexible airspace structures in Croatia. The authors assess the impact of flexible use of airspace (FUA) on route optimization, fuel consumption, and CO_2 emissions. Their method involves the construction of a sustainability performance framework based on key performance indicators (KPIs) similar to those used in this thesis, including route distance, fuel burn, emissions, and temporal efficiency. For Georgian airspace, their findings provide a valuable model for dynamic FRA design and empirical benchmarking.

These studies collectively offer a multidimensional framework for evaluating the economic sustainability of Georgian airspace, highlighting critical intersections of operational efficiency, governance, collaboration, and adaptability. Each study contributes distinct yet complementary insights that are vital for understanding the challenges and opportunities faced by Georgian airspace. While some focus on internal technical reforms, others prioritize institutional

coordination and intergovernmental mechanisms—an essential combination for a country like Georgia, navigating regional uncertainty and airspace modernization simultaneously.

Barnhart et al. (2012) emphasize the importance of balancing capacity and demand through tactical and strategic interventions, offering practical solutions to optimize operational efficiency and mitigate bottlenecks. These insights are instrumental in addressing the immediate challenges posed by increased overflight traffic, which is a pressing issue for Georgian airspace during regional conflicts. In contrast, Baumgartner and Finger (2014) delve into systemic inefficiencies, focusing on the institutional and technical barriers within the SES initiative. The study's emphasis on collaborative governance and overcoming fragmentation aligns with Georgia's strategic need to integrate into European air traffic systems, addressing broader structural reforms necessary for long-term sustainability.

Payán-Sánchez et al. (2018) bring attention to the role of stakeholder collaboration in achieving sustainability, highlighting how cooperative frameworks can enhance decision-making and operational resilience. For Georgian airspace, this highlights the importance of engaging diverse stakeholders to navigate complex regional security risks and drive modernization efforts effectively. In times of geopolitical uncertainty, coordinated responses can ensure service continuity and support Georgia's image as a stable transit corridor.

Mölders (2014) offers a governance-oriented perspective, advocating for reflexive governance to balance economic, operational, and environmental objectives. This adaptability is particularly relevant for Georgian airspace, where rapid responses to evolving geopolitical dynamics are crucial for maintaining stability and generating revenue. Rogošić et al. (2022) complement these studies by offering quantitative validation and simulation-based support for benchmarking sustainability performance in a smaller national airspace context, akin to Georgia. While Barnhart et al. (2012) focus on operational efficiencies, Baumgartner and Finger (2014) and Mölders (2014) prioritize governance and structural reforms, and Payán-Sánchez et al. (2018) bridge these approaches with an emphasis on collaboration. Together, these studies present a cohesive understanding of how operational strategies, institutional reforms, and stakeholder engagement can collectively enhance the economic sustainability of Georgian airspace.

To visualize the intersections between operational strategies, governance frameworks, and stakeholder collaboration, Figure 1 presents a conceptual Venn diagram summarizing the contributions of these key studies.

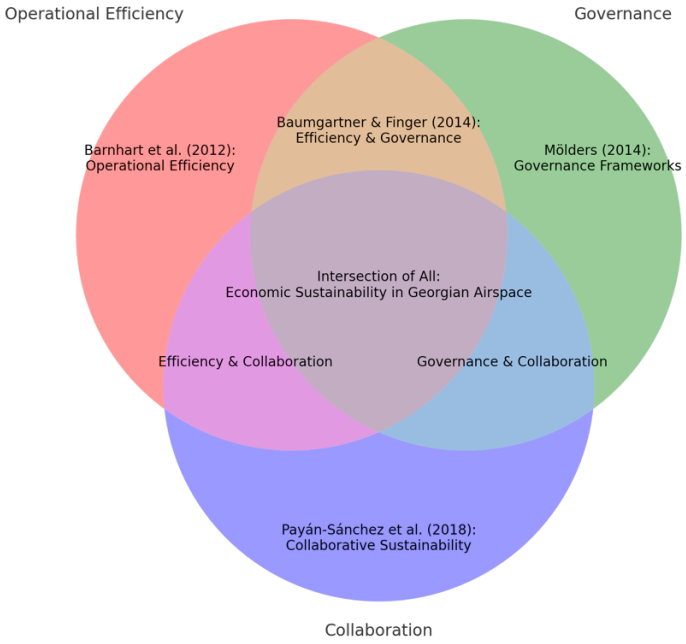

Figure 1. Contributions of Literature to Georgian Airspace Sustainability
Source: Compiled by the author

The empirical study draws on a focused set of secondary, publicly available quantitative data. The air traffic record, the reports of EUROCONTROL, and civil aviation statistics of Georgia will support the quantification of key performance indicators regarding traffic flow efficiency, traffic flow efficiency with delays, and fuel consumption. In this instance, a purely quantitative approach would be suitable for developing a comprehensive picture of the dynamics within the Georgian airspace. Given the political sensitivity and regulatory complexity involved in regional airspace governance, a data-driven analysis provides the most objective basis for policy conclusions.

Insights from these studies will directly inform the SWOT analysis, highlighting strategic opportunities, potential weaknesses, and recommendations for actions to be taken. In particular, the reviewed literature underlines the need for reflexive governance frameworks, increased stakeholder cooperation, and enhanced operational efficiency within Georgian airspace. Such frameworks are crucial for mitigating significant risks associated with geopolitical instability, efficiently managing growth in air traffic, and aligning with international sustainability

objectives. This paper integrates these findings into the foundation for policy development, positioning Georgian airspace as a resilient and competitive transit corridor amidst regional challenges.

To address the identified gaps in the literature and achieve the research objectives, this study employs a quantitative empirical methodology combined with a SWOT analysis framework. Quantitative analysis provides measurable insights into Georgian airspace's economic and operational performance, allowing for objective evaluation of sustainability metrics, including air traffic volumes, delays, fuel consumption, and revenue generation. Using a comparative lens enhances the significance of findings by situating Georgia within a broader regional context.

Data collection will rely primarily on recent and authoritative sources. Specifically, Georgia's 2023 Local Single Sky Implementation (LSSIP) report, compiled by EUROCONTROL, will serve as the primary data source, providing essential quantitative data on air traffic trends, capacity management indicators, delays, and progress in infrastructure modernization. Additional data on global airspace disruptions, geopolitical threats, and operational efficiency benchmarks will be gathered from SafeAirspace's Conflict Zone and Risk Database, ensuring comprehensive coverage of external conditions influencing Georgian airspace sustainability.

The SWOT analysis framework systematically evaluates both internal strengths and weaknesses, as well as external opportunities and threats. Internal indicators, such as infrastructure readiness, traffic flow capacity, modernization status, and governance efficiency, will define the strengths and weaknesses. This structured approach is supported by Barnhart et al. (2012), who emphasize that sustainable airspace planning must be grounded in quantitative indicators of demand, capacity, and system bottlenecks, especially when evaluating operational constraints and long-term strategic resilience. External opportunities and threats will be assessed through an examination of current geopolitical dynamics, focusing on Georgia's position relative to other strategic airspaces and its potential integration into broader European and global networks. By combining quantitative data with a structured SWOT analysis, this methodological approach provides a robust basis for assessing the economic sustainability of Georgian airspace, identifying actionable strategies for enhancement, and addressing operational and geopolitical challenges effectively.

In summary, this chapter has provided a comprehensive overview of the key theoretical concepts and empirical insights essential for understanding airspace management and economic sustainability. It established foundational terms and concepts, highlighting their importance for airspace efficiency, governance, and sustainability. It also presented a detailed synthesis of previous studies, identifying operational efficiency, governance flexibility, and stakeholder collaboration as crucial themes. The methodological framework integrates quantitative benchmarking, key performance indicators (KPIs), and a composite sustainability index, followed by a structured SWOT analysis. This approach enables a data-driven evaluation of the economic sustainability, operational performance, and strategic positioning of Georgian airspace. Addressing these areas ensures a solid theoretical foundation for exploring how Georgia can sustainably manage operational demands, geopolitical risks, and strategic opportunities, reinforcing its effective positioning in global aviation networks.

2.1 Methodology and Descriptive Data on Georgian Airspace

Building on the theoretical foundations laid out in Chapter 1, this section presents a comprehensive empirical analysis of the strategic and economic significance of Georgian airspace. In an era marked by geopolitical turbulence, including the ongoing Russo-Ukrainian war and escalating tensions in the Middle East, the global aviation landscape has undergone profound shifts. Airspace closures in conflict zones have forced airlines to reroute flights, elevating the importance of stable, efficient corridors like Georgia's. This analysis leverages a rich dataset to evaluate Georgia's performance, drawing on descriptive statistics from EUROCONTROL's 2023 Local Single Sky Implementation (LSSIP) reports, sustainability metrics from the Aviation Sustainability Briefing (Edition 10, December 2024), and Rogosić et al. (2022), who provide a comparable benchmarking framework for evaluating flexible airspace use. These sources inform a comparative benchmark of key performance indicators (KPIs) across Georgia, Poland, Turkey, and Azerbaijan, focusing on five critical dimensions: traffic recovery, operational efficiency, airspace modernization, cost efficiency, and environmental sustainability.

The purpose of this empirical section is to evaluate the sustainability and competitiveness of Georgian airspace by combining quantitative performance metrics with comparative and strategic analysis. Unlike qualitative studies, this research relies on measurable indicators

derived from EUROCONTROL and sustainability reports to construct a benchmark-based evaluation framework.

The empirical methodology is divided into five stages: a literature review to define concepts and establish the theoretical foundation; quantitative selection of key performance indicators (KPIs); construction of a composite sustainability index; benchmarking Georgian airspace against peer countries; and finally, a SWOT analysis based on the evaluated data. Figure 1 outlines the full methodology structure applied in this research. The literature review informed the selection of key performance indicators (KPIs) relevant to the airspace sector, including IFR traffic recovery, ATFM delay per flight, FRA coverage, ANS unit cost, and CO_2 emissions per flight. These indicators are drawn from EUROCONTROL's LSSIP 2023 reports, the Aviation Sustainability Briefing (2024), SafeAirspace risk databases, and sustainability reports from TAV Airports.

Their integration forms the empirical foundation for evaluating Georgia's airspace governance, efficiency, and environmental performance. The composite sustainability index is then calculated using a weighted model, with governance (30%), operational efficiency (40%), and environmental impact (30%) as the key components, and scores normalized between 0 and 100. Benchmarking Georgia against Poland, Turkey, and Azerbaijan enables meaningful cross-country comparison, identifying relative strengths and performance gaps. These results are then mapped into a SWOT analysis, using a threshold method (±20% from the peer median) to identify strong and weak indicators. This strategic mapping links empirical findings to actionable recommendations discussed in Section 2.4.

Figure 2. Methodology of the study

Source: compiled by the author

The empirical analysis uses a quantitative approach, combining descriptive statistics with a SWOT framework to evaluate the economic and strategic sustainability of Georgian airspace. Five key performance indicators (KPIs) are used to measure capacity, efficiency, and sustainability: IFR flights compared to 2019 levels, ATFM delay per flight, FRA coverage, ANS unit cost, and CO_2 emissions per flight. These KPIs correspond to the five strategic dimensions outlined above: traffic recovery, operational efficiency, airspace modernization, cost efficiency, and environmental sustainability.

To guide the empirical assessment, these indicators provide a multidimensional basis for evaluating each country. They are later used to structure the SWOT analysis and inform the composite sustainability index introduced in Section 2.4. The KPIs serve as the backbone for a SWOT analysis in Section 2.3, where strengths are rigorously defined as performance at least 20% better than the peer median, and weaknesses are defined as performance at least 20% worse. This methodological approach, grounded in quantitative rigor, ensures a robust assessment of Georgian airspace's role as a geoeconomic asset, navigating both regional complexities and global aviation demands. By integrating these data-driven insights, the section aims to illuminate Georgia's competitive positioning and propose actionable strategies to enhance its sustainability and resilience in an increasingly interconnected world.

A significant contextual distinction lies in airport governance: Tbilisi and Batumi Airports are operated by TAV Airports Holding, a Turkish-based international airport operator owned by Groupe ADP (Aéroports de Paris), which manages over 30 airports worldwide, including Paris Charles de Gaulle Airport. As a result, these airports adhere to Groupe ADP's global environmental and sustainability standards, which include carbon reduction initiatives, digital monitoring systems, and renewable energy targets. In contrast, Kutaisi Airport is operated by the state-owned United Airports of Georgia, reflecting national-level aviation and infrastructure strategies. Due to this divergence, Georgian airports exhibit differentiated sustainability practices depending on the operating authority. Given this operational structure, the analysis incorporates official TAV Airports sustainability reports to gain a better understanding of environmental and efficiency progress at Tbilisi and Batumi. These reports provide detailed metrics on renewable energy adoption, emissions reduction, and green infrastructure investments, all of which influence Georgia's national sustainability profile.

To bring these indicators together, a composite sustainability index is constructed. It is based on three dimensions—governance (30%, reflecting regulatory adaptability), efficiency (40%, focusing on delays), and environmental performance (30%, based on CO_2 emissions). The index is normalized on a 0–100 scale using data from 2023. Although the full comparative application of this index appears in Section 2.4, Georgia's inputs for each dimension are presented descriptively here to frame later analysis. The SWOT analysis applies a threshold of 20% or more above or below the median of peer countries to identify strengths and weaknesses, ensuring a rigorous and meaningful comparison.

The geopolitical upheavals of recent years have thrust Georgian airspace into the spotlight as a vital transit corridor, offering a stable alternative to conflict-disrupted routes. According to EUROCONTROL's Aviation Sustainability Briefing (2024), Georgia recorded an extraordinary 180,120 overflights in 2023, marking a 103% increase from the 88,648 overflights in 2019. This dramatic surge is largely attributable to airlines rerouting flights to avoid Ukrainian airspace and conflict zones in the Middle East, underscoring Georgia's strategic importance at the crossroads of Europe and Asia. In terms of estimated economic value, assuming a conservative average en-route charge of €500 per overflight, Georgia may have generated approximately €90 million in overflight revenue in 2023—a substantial contribution to the country's aviation sector. A closer examination of Georgia's primary airports reveals a nuanced aviation landscape shaped by diverse economic and tourism-driven factors. Tbilisi Airport, the nation's busiest hub, experienced a modest 5% decline in traffic from 36,047 flights in 2019 to 34,343 in 2023, reflecting capacity constraints during peak periods. However, a robust 19% recovery from 2022 to 2023 signals resilience and growing demand. In contrast, Kutaisi Airport experienced a remarkable 70% increase in traffic, rising from 5,519 flights in 2019 to 9,850 in 2023, driven by Georgia's burgeoning tourism sector and partnerships with low-cost carriers. Similarly, Batumi Airport recorded a steady 10% growth, reaching 6,115 flights, further highlighting the coastal city's appeal as a tourist destination. These divergent trends illustrate the complexity of Georgia's aviation market, where geopolitical rerouting, economic activity, and tourism converge to shape traffic patterns.

Georgia's commitment to sustainability has significantly enhanced its airspace performance, aligning with global aviation trends toward environmental responsibility and operational efficiency. The implementation of Free Route Airspace (FRA) within the Tbilisi Flight Information Region, managed by SAKAERONAVIGATSIA Ltd., has revolutionized flight planning by enabling airlines to optimize routes, resulting in a 7–10% reduction in fuel consumption per flight segment. This efficiency translates into a notable decrease in CO_2 emissions, with Georgia achieving an average of 9.8 kg per flight in 2023, compared to a regional benchmark of 11.4 kg (EUROCONTROL, 2024). These values refer to en-route phase emissions per IFR flight, as reported in the 2024 Aviation Sustainability Briefing. The adoption of Continuous Climb Operations (CCO) and Continuous Descent Operations (CDO) at major airports has further enhanced sustainability, resulting in a 5–8% reduction in fuel burn through

optimized ascent and descent profiles. These measures not only align with the European Union's ambitious sustainability targets but also position Georgia as a forward-thinking player in the global aviation community. The Free Route Airspace South Caucasus (FRASC) project, a collaborative initiative with Armenia, exemplifies Georgia's regional leadership, reducing flight durations by approximately 3% across shared routes and enhancing both operational resilience and environmental performance. Georgia's governance efforts extend beyond bilateral projects; its active participation in the EUROCONTROL Local Single Sky Implementation (LSSIP) framework and its support for SESAR-aligned digital upgrades illustrate strong institutional alignment with EU and ICAO standards.

To provide a clearer picture of these advancements, Table 2 presents key sustainability metrics for Georgian airspace by comparing 2023 performance against 2019 baselines. The table highlights a 22% reduction in CO_2 emissions per flight, a 225% increase in CDO (Continuous Descent Operations) uptake, and a 150% rise in the use of renewable energy within air navigation services. The renewable energy share data are based on EUROCONTROL briefing estimates cross-referenced with SAKAERONAVIGATSIA's sustainability disclosures. The decline in CO_2 emissions per flight, from 12.5 kg in 2019 to 9.8 kg in 2023, coincides with two pivotal milestones: the implementation of Free Route Airspace (FRA) in 2021 and the rollout of CCO/CDO procedures in 2022. These measures contributed directly to improved environmental outcomes and are key contributors to Georgia's strong sustainability performance.

Table 2

Sustainability Metrics for Georgian Airspace (2019 vs. 2023)

Metric	Unit	2019	2023	% Change
CO_2 per flight	kg	12.5	9.8	-22%
CDO uptake	%	20	65	+225%
Energy mix (renewable)	%	10	25	+150%

Source: Compiled by the author using EUROCONTROL (2023) and TAV Georgia (2022)

These empirical findings, rooted in authoritative data, align with academic insights from Barnhart et al. (2012), who emphasize the importance of balancing capacity and demand, and Payán-Sánchez et al. (2018), who highlight stakeholder collaboration as a cornerstone of sustainable aviation. By integrating advanced technologies and regional partnerships, Georgia has not only addressed the immediate challenges of increased traffic but also positioned itself as a model for sustainable airspace management. Rogosić et al. (2022) further validate the significance of flexible airspace use and its environmental benefits in the South-Eastern European context, reinforcing the validity of Georgia's FRA implementation and its inclusion in composite benchmarking models. Moreover, from the governance dimension of the sustainability index, Georgia scores highly due to its participation in FRA harmonization, digital modernization (including VoIP and SWIM preparation), and structured collaboration through regional and international aviation frameworks. These data provide a robust foundation for the comparative and SWOT analyses, illuminating Georgia's evolving role in global aviation networks.

2.2 Comparative Analysis with Other Strategically Important Airspaces

To contextualize the performance of Georgian airspace within the broader regional aviation landscape, this section undertakes a comparative analysis with the airspaces of Poland, Turkey, and Azerbaijan. These countries were selected due to their geopolitical relevance, substantial overflight volumes, and parallel modernization trajectories. Poland's integration into the Single European Sky (SES) reflects advanced regulatory alignment, Turkey's strategic location amplifies its role as a global transit hub, and Azerbaijan's proximity and shared regional dynamics with Georgia offer insights into South Caucasus-specific challenges. Together, these cases serve as suitable reference points for benchmarking Georgia's performance.

The comparison is grounded in the five key performance indicators (KPIs) introduced at the beginning of this chapter: traffic recovery, operational efficiency, airspace modernization, cost efficiency, and environmental sustainability. These metrics are derived from EUROCONTROL's 2023 LSSIP reports and the 2024 Aviation Sustainability Briefing. For each KPI, performance is evaluated relative to the peer median, with differences of 20% or more flagged as potential strengths or weaknesses. This approach offers a rigorous and data-driven framework for analysis.

Georgia leads in several key areas. Its traffic recovery is the strongest among peers, with IFR flights in 2023 reaching 169% of 2019 levels, +37% above the peer median of 123%. In terms of operational efficiency, Georgia recorded zero ATFM delay per flight, compared to a median of 0.18 minutes, representing a 100% improvement over its peer baseline. These numbers highlight Georgia's ability to absorb rerouted traffic from conflict zones while maintaining smooth airspace operations.

In terms of modernization, Georgia and Azerbaijan both report 100% coverage of Free Route Airspace (FRA), while Turkey and Poland fall slightly behind at 85% and 70%, respectively. FRA coverage refers to the full vertical and horizontal implementation across national Flight Information Regions (FIRs), as reported by EUROCONTROL. This positions Georgia as a regional frontrunner in airspace flexibility and fuel-saving route structures. This is further supported by empirical simulations over Croatian airspace, where the implementation of FRA has been shown to significantly reduce flight length, fuel use, and CO_2/NO_x emissions (Rogošić et al., 2022), underscoring the environmental and operational advantages Georgia now enjoys.

However, Georgia faces challenges in cost efficiency. Its air navigation service (ANS) unit cost is €55 per service unit, compared to a peer median of €46, 20% higher. While this may partly reflect the scale and structural constraints of a smaller system, it highlights an area where efficiency gains could strengthen competitiveness. On the environmental front, Georgia performs strongly, recording an average CO_2 emission rate of 9.8 kg per flight, 14% below the median of 11.4 kg. This is attributed to the adoption of CCO/CDO procedures and optimized route planning under the FRA regime.

The benchmark values used in this assessment are summarized in Table 3, which evaluates Georgia's performance across key dimensions relative to its peers:

Table 3:

KPI Benchmark for Georgian Airspace and Peer Countries (2023)

KPI	UNIT	Georgia	Poland	Turkey	Azerbaijan	Peer Median	GE vs. Median
IFR flights vs. 2019	%	169	77	106	140	123	+37%
ATFM delay/flight	min	0.00	0.31	0.00	0.05	0.18	-100%
FRA coverage	%	100	70	85	100	92	+9%
ANS unit cost	€/SU	55	43	39	50	46	+20%
CO_2/flight	kg	9.8	12.4	11.2	10.6	11.4	-14%

Source: Compiled by the author using EUROCONTROL (2023 and TAV Georgia (2022)

Turkey's airspace, handling 1.2 million overflights in 2023, underscores its role as a linchpin in global aviation, connecting Europe, Asia, and the Middle East. The adoption of Free

Route Airspace and Performance-Based Navigation has resulted in fuel savings of 5–8%, thereby enhancing efficiency (EUROCONTROL, 2023). However, geopolitical tensions near Syria and Iraq introduce periodic route disruptions, a challenge less pronounced in Georgia's relatively stable environment (SafeAirspace, 2024). Additionally, Turkey's main aviation operators have implemented ISO 14001-certified environmental management systems and introduced energy-saving and waste management programs, thereby reinforcing their sustainability credentials in airport operations (TAV Airports, 2018). While these efforts place Turkey ahead in infrastructure and procedural modernization, its sheer scale can delay agile adaptation compared to Georgia's more compact system.

Poland, fully integrated into the Single European Sky, managed 850,000 overflights in 2023, a 77% recovery from 2019, aided in part by rerouting from Ukrainian airspace. SESAR technologies and FRA implementation have achieved fuel efficiency gains of 6–9%, but delays averaging 0.31 minutes per flight reflect continued operational strain (EUROCONTROL, 2023). As Baumgartner and Finger (2014) argue, Poland's success in aligning with the SES provides a valuable regulatory template for Georgia, even as the two countries navigate different regional complexities.

Azerbaijan saw 150,000 overflights in 2023, an 80% increase from 2019. Full FRA coverage places it on par with Georgia, yielding fuel savings of 4–7%. However, minor ATFM delays (0.05 minutes per flight) suggest modernization is still in progress. Azerbaijan's collaboration with Georgia via the FRASC project, which reduced shared route flight durations by 3%, underscores the potential of coordinated regional initiatives. Still, ongoing tensions with Armenia introduce geopolitical risks that, while less acute than Turkey's, remain a shared concern for the South Caucasus region (SafeAirspace, 2024). Taken together, Georgia's performance stands out. It leads all peers in traffic recovery and operational efficiency, with 100% FRA coverage and the lowest CO_2 emissions per flight. These outcomes reflect a strong convergence of modernization and sustainability goals. However, its ANS unit cost of €55 per service unit, 20% higher than the peer median, remains a competitiveness challenge.

To deepen this analysis, a composite sustainability index was calculated using the same framework introduced in Chapter 1.2. This index combines three weighted dimensions: governance quality (30%), operational efficiency (40%), and environmental performance (30%). Georgia's governance score reflects its efforts in regional cooperation and digital modernization,

although it remains only partially aligned with EU SES standards. These index categories also reflect emerging sustainability frameworks that emphasize the knowledge, behavioral shifts, and environmental commitment of aviation stakeholders (Sustainability, 2022), aligning with Georgia's regulatory, operational, and ecological profile. The resulting index scores are as follows: Georgia (82), Poland (78), Turkey (75), and Azerbaijan (80). Zero delays and low emissions drive Georgia's high overall score. Poland scores well on governance but loses points due to delays; Türkiye's complex structure reduces efficiency despite modernization efforts; and Azerbaijan, while strong regionally, still faces limited delays and safety oversight gaps.

In conclusion, this comparative analysis highlights Georgia's competitive edge in operational resilience and environmental leadership, while identifying cost efficiency as a key area for strategic improvement. These insights provide the empirical foundation for the SWOT analysis presented in the following section, where strengths and weaknesses are more explicitly mapped against the country's regional positioning.

2.3 SWOT Analysis of Georgian Airspace

The SWOT analysis provides a structured evaluation of Georgian airspace's internal strengths and weaknesses, alongside external opportunities and threats, drawing on the KPI benchmark data and composite sustainability index results presented in Section 2.2. To ensure analytical rigor, strengths are defined as performance at least 20% better than the peer median, and weaknesses as at least 20% worse, aligning with the quantitative framework established earlier. This approach, grounded in empirical data and reinforced by comparative benchmarking, sheds light on Georgia's strategic positioning and provides actionable recommendations for policymakers and aviation stakeholders. Figure 3 presents the SWOT matrix, which synthesizes key insights from the empirical analysis of Georgian airspace:

Strengths	**Weaknesses**
169% traffic recovery (37% above peer median) 0.00 ATFM delay per flight (100% better than peer median) 100% FRA coverage (9% above peer median) CO_2 emissions per flight: 9.8 kg (14% below peer median)	ANS unit cost €55 (20% above peer median) Infrastructure constraints at Tbilisi Airport Partial integration with SES limits access to EU-wide technological and governance benefits High dependence on overflight revenue (vulnerable to route changes)
Opportunities	**Threats**
SES integration by 2027 (mirroring Poland's success) FRA expansion through regional projects (Armenia, Azerbaijan) Rapid traffic growth at Kutaisi (+70%) and Batumi (+10%) diversifying tourism-driven revenue streams Sustainability leadership TAV Airports' green infrastructure model	Geopolitical instability (Ukraine, Middle East) affecting routing reliability Competitive ANS pricing in Turkey and Azerbaijan Future EU environmental compliance costs may strain national budgets Global fuel price volatility and reduced demand in recession scenarios

Figure 3. *SWOT Summary based on descriptive data*

Source: Compiled by the author

Georgia's strategic location at the crossroads of Europe and Asia has catalyzed a remarkable 169% traffic recovery in 2023, 37% above the peer median, establishing it as an indispensable transit corridor for airlines navigating conflict-disrupted routes (EUROCONTROL, 2024). This geographic advantage, coupled with zero ATFM delays—100% better than the median—reflects exceptional operational efficiency, a testament to SAKAERONAVIGATSIA Ltd.'s adept management. Full Free Route Airspace coverage, at 100% and 9% above the median, underscores Georgia's leadership in airspace modernization, enabling optimized flight paths that enhance efficiency and reduce environmental impact. The

composite sustainability index score of 82, driven by a CO_2 emission rate of 9.8 kg per flight (14% below the median), positions Georgia as a regional pioneer in sustainable aviation, aligning with global priorities outlined by Payán-Sánchez et al. (2018). These trends align with the environmental efficiency gains observed in Croatia, where the flexible use of airspace has significantly reduced both fuel consumption and CO_2 emissions, suggesting that Georgia is following a proven model for small-to-medium airspaces (Rogosic et al., 2021). Relative to Turkey's exposure to Middle Eastern conflicts and Azerbaijan's regional tensions, Georgia's geopolitical stability, as noted by SafeAirspace (2024), enhances its reliability as a safe and dependable corridor—a critical asset in an era of uncertainty and rerouting.

Despite these strengths, internal challenges persist, posing a threat to Georgia's long-term competitiveness. Tbilisi Airport's 5% decline in traffic from 2019 to 2023, despite a 19% recovery from 2022, signals infrastructure constraints that limit capacity during peak traffic periods (EUROCONTROL, 2024). These bottlenecks, as highlighted by Barnhart et al. (2012), underscore the need for targeted investments in air traffic management systems to accommodate growing demand. The ANS unit cost of €55 per service unit, 20% above the peer median, represents a significant weakness, potentially deterring cost-sensitive airlines and undermining Georgia's attractiveness as a transit hub. Although Georgia's performance on emissions and delays is exemplary, this cost inefficiency can offset its competitive appeal unless addressed through regional cost-sharing or technological optimization. Heavy reliance on overflight revenue, as noted by Ennen and Wozny (2024), introduces economic vulnerability, as shifts in global routing patterns—driven by geopolitical or economic factors—could erode this income stream. Furthermore, Georgia's partial integration with the Single European Sky initiative, as discussed by Baumgartner and Finger (2014), restricts access to advanced European air traffic management frameworks, limiting interoperability and technological advancements that could further enhance efficiency. This incomplete integration also impacts the governance component of sustainability, where full alignment could improve both policy coherence and funding efficiency.

Externally, Georgia faces a landscape rich with opportunities to solidify its position as a global aviation hub. Full integration with the Single European Sky by 2027 could mirror Poland's success, reducing delays and attracting additional overflights through seamless regulatory and technological alignment (Baumgartner & Finger, 2014). The Free Route Airspace

South Caucasus project, which has already reduced flight durations by 3% through collaboration with Armenia, presents a model for expanded regional cooperation, potentially including Azerbaijan, to optimize cross-border routes (EUROCONTROL, 2024). Empirical findings from Croatian FRA reforms (Rogosic et al., 2021) confirm that these kinds of regional harmonization efforts yield measurable improvements in fuel efficiency and delay reduction, reinforcing Georgia's current direction. The burgeoning tourism sector, evidenced by Kutaisi's 70% traffic increase and Batumi's 10% growth, offers a pathway to diversify revenue beyond overflights, mitigating economic risks (EUROCONTROL, 2024). By scaling up Continuous Climb and Descent Operations, Georgia could position itself as a leader in green aviation in the South Caucasus, aligning with stringent EU sustainability goals and attracting environmentally conscious airlines, as advocated by Payán-Sánchez et al. (2018). Public communication efforts, as emphasized by Gile et al. (2022), will be crucial to sustaining this leadership by fostering a culture of stakeholder buy-in and sustainability awareness among both operators and decision-makers.

This SWOT analysis, grounded in quantitative metrics and academic insights, reveals a dynamic interplay of strengths and opportunities that position Georgia as a rising star in global aviation, tempered by weaknesses and threats that demand strategic foresight. The findings provide a robust foundation for the recommendations that follow, which aim to maximize Georgia's geoeconomic potential. By leveraging its leadership in operational and environmental metrics while addressing cost and integration gaps, Georgia can transform these insights into long-term sustainability advantages.

2.4 Recommendations and strategies for improvement for Georgian Airspace Management

Drawing on the SWOT analysis and comparative insights, this section proposes a comprehensive set of strategies to enhance the strategic and economic sustainability, operational efficiency, and global competitiveness of Georgian airspace. These recommendations address internal weaknesses, such as infrastructure constraints and high unit costs, while capitalizing on external opportunities, including the integration of SES and tourism growth. The goal is to ensure that Georgia not only remains a resilient transit hub but also evolves into a forward-looking aviation leader in the South Caucasus and beyond. By framing airspace as a strategic

enabler of regional connectivity and sustainability, these measures align with global aviation priorities and EU policy frameworks (Gile et al., 2022).

Achieving full integration with the Single European Sky by 2027, leveraging Georgia's ongoing EU Common Aviation Area Agreement negotiations, represents a transformative opportunity. Despite hurdles such as EU acquis adoption and funding needs, this alignment is expected to mirror Poland's success in reducing delays and attracting overflights (Baumgartner & Finger, 2014). Collaboration with EUROCONTROL to adopt SESAR technologies, such as advanced Performance-Based Navigation (PBN) and System-Wide Information Management (SWIM), will enhance interoperability and address Tbilisi Airport's capacity constraints. Public-private cooperation and institutional capacity-building must accompany technical upgrades to ensure the sustainable implementation of these initiatives. This strategic alignment will position Georgia as a seamless extension of the European aviation network, fostering both operational and economic benefits.

Expanding the Free Route Airspace South Caucasus (FRASC) project by 2025, potentially incorporating Azerbaijan alongside Armenia, will further optimize regional routes, building on the project's demonstrated 3% reduction in flight durations (EUROCONTROL, 2024). Establishing joint task forces to harmonize FRA implementation and share modernization costs will mitigate Georgia's financial constraints, as highlighted by Baumgartner and Finger (2014). Croatia's experience demonstrates that flexible airspace use can significantly reduce emissions and delays in smaller states (Rogosic et al., 2021), underscoring the urgency of collaborative integration in the South Caucasus. These initiatives also serve as platforms for stakeholder engagement, as emphasized by Payán-Sánchez et al. (2018), ensuring that both governments and operators are involved in shaping modernization efforts.

Addressing Tbilisi Airport's infrastructure limitations requires targeted investments in air traffic management systems, with a goal of completion by 2026. Securing EU funding or establishing public-private partnerships will alleviate budgetary pressures, enabling upgrades that reverse the 5% decline in traffic observed from 2019 to 2023 (EUROCONTROL, 2024). These investments, aligned with Barnhart et al.'s (2012) emphasis on capacity enhancements, will ensure Tbilisi can accommodate growing overflight and passenger traffic. Improved infrastructure will also enable Georgia to diversify its services, potentially facilitating new cargo, charter, or regional airline partnerships, thereby boosting its geoeconomic relevance.

Scaling up Continuous Climb and Descent Operations (CCO/CDO) across all major airports—supported by EU green aviation grants—will solidify Georgia's position as a leader in sustainability. With a 225% increase in CDO uptake since 2019 and CO_2 emissions at 9.8 kg per flight, Georgia is well-positioned to meet EU targets and attract environmentally conscious airlines (EUROCONTROL, 2024). Awareness campaigns and sustainability dashboards, as suggested by Gile et al. (2022), could improve transparency and increase public, regulatory, and commercial support. These efforts will also align with the Airport Carbon Accreditation program, enabling Georgia to benchmark its progress against regional peers.

Leveraging tourism-driven growth at Kutaisi (a 70% traffic increase) and Batumi (a 10% increase) airports presents a strategic opportunity to diversify revenue streams, thereby reducing reliance on overflight income (EUROCONTROL, 2024). Partnerships with low-cost carriers, targeting a 20% passenger increase by 2027, will capitalize on Georgia's natural and cultural appeal. Promotional collaboration between airports and national tourism authorities could yield high returns while encouraging regional development. These efforts mitigate risks associated with global rerouting shifts, as noted by Ennen and Wozny (2024), and foster long-term economic resilience.

Adopting reflexive governance, as advocated by Mölders (2014), will equip Georgia to navigate the dynamic geopolitical and economic landscape. Training regulators in adaptive governance principles by 2025, supported by real-time data analytics and stakeholder monitoring tools, will enable them to respond rapidly to emerging challenges, such as conflict-related disruptions or regulatory shifts. This approach acknowledges the necessity for flexibility and responsiveness in airspace management, particularly for countries with high geopolitical exposure, such as Georgia.

Finally, Georgia must develop an Airspace Sustainability Strategy (ASS)—a consolidated roadmap that integrates environmental goals, technological modernization, cost-efficiency targets, and crisis protocols. This initiative would demonstrate Georgia's commitment to long-term geoeconomic sustainability and serve as a model for similar states. Its implementation could be supported by ICAO and EUROCONTROL's technical assistance and monitored through annual progress reports, which would help maintain momentum and transparency.

These strategies, informed by the SWOT analysis and comparative data, provide a roadmap for Georgian policymakers to address immediate challenges while capitalizing on long-

term opportunities. By prioritizing SES integration, regional collaboration, infrastructure upgrades, sustainability leadership, revenue diversification, and adaptive governance, Georgia can solidify its role not only as a strategic corridor but as a forward-thinking regional aviation leader, capable of thriving in both stable and crisis-driven global contexts.

Conclusion

This thesis has demonstrated that Georgian airspace is a pivotal strategic and geoeconomic asset, leveraging its location and operational strengths to thrive amidst global aviation challenges. Building on the theoretical foundation laid in Chapter 1, the empirical section demonstrates that Georgia's aviation system is not only resilient but also uniquely positioned as a transit corridor for rerouted flights during times of geopolitical instability. The 169% traffic recovery in 2023—37% above the peer median—underscores Georgia's critical role in Europe–Asia connectivity (EUROCONTROL, 2024). Zero ATFM delays and full Free Route Airspace (FRA) coverage reflect Georgia's operational efficiency, while a composite sustainability index score of 82 and low average CO_2 emissions (9.8 kg per flight, 14% below the peer median) confirm its leadership in environmentally conscious airspace management.

However, this success is tempered by internal constraints. High ANS unit costs (€55 per service unit, 20% above the peer median) and infrastructure bottlenecks at Tbilisi Airport limit competitiveness and capacity. Economic vulnerability from overreliance on overflight revenue remains a pressing concern, particularly amid global route shifts and rising compliance costs. Georgia's partial integration into the Single European Sky (SES) also limits its access to more advanced traffic management systems and digital infrastructure. That said, significant strategic opportunities—such as full SES alignment, expansion of the FRA South Caucasus project, and tourism-driven traffic growth in Kutaisi and Batumi—offer clear avenues for improving both resilience and long-term sustainability.

The analysis draws from recent and authoritative sources, including EUROCONTROL's 2023 LSSIP reports and the Aviation Sustainability Briefing (2024). Key performance indicators (KPIs)—encompassing traffic recovery, delays, FRA coverage, emissions, and costs—were benchmarked to construct a customized sustainability index. This framework, reinforced by Rogosic et al. (2021), who employed a similar KPI methodology in assessing Croatian airspace,

added quantitative depth and comparability. The SWOT analysis, aligned with 20% thresholds, identified specific performance outliers, transforming raw metrics into strategic insights.

While the triangulated data ensures high validity, limitations remain: CO_2 and ANS cost estimates vary slightly across sources, and the regional scope (Georgia, Poland, Turkey, Azerbaijan) limits broader generalizability. Furthermore, geopolitical volatility remains a variable that can unpredictably shift performance trends over time. Additionally, the study is limited by its reliance on publicly available secondary data, which may not capture the full complexity of behind-the-scenes regulatory decisions, cost structures, or infrastructure constraints. The absence of stakeholder interviews restricts the depth of institutional analysis and excludes potentially valuable qualitative insights from policy implementers, airspace regulators, or airlines. The methodology also assumes static weightings for the sustainability index, which may not fully reflect evolving policy priorities across different regions. Finally, as the study focuses only on a snapshot year (2023), it does not account for longitudinal changes or cyclical fluctuations in traffic, policy, or sustainability performance.

Despite these constraints, the methodological framework has proven robust, and the results offer significant relevance for aviation policymakers, regional planners, and regulatory authorities. The findings lay out a concrete policy roadmap to enhance Georgian airspace governance and sustainability. Prioritized strategies include full integration with the Single European Sky (SES) by 2027 to improve interoperability and alignment with EU traffic management systems; targeted infrastructure upgrades at Tbilisi Airport to resolve capacity bottlenecks; expanded regional collaboration through FRA harmonization with Armenia and potentially Azerbaijan; and the national rollout of green operations like Continuous Climb and Descent (CCO/CDO) procedures. Additionally, revenue diversification through expanded low-cost carrier traffic in Kutaisi and Batumi is essential to buffer Georgia against declining overflight revenues in future geopolitical crises.

To build on this research, several targeted directions are recommended. A longitudinal study quantifying the effects of SES integration on traffic delays and overflight revenue would provide compelling evidence for decision-makers. Econometric modeling focused on passenger demand at Georgia's secondary airports could better inform tourism and route development strategies. Comparative studies involving similarly positioned countries in the Baltic and Central Asia may yield transferable best practices for small-to-medium-sized aviation economies.

Moreover, exploring emerging technologies, such as AI-enabled traffic flow optimization, satellite-based air traffic management, and digital infrastructure, could position Georgia at the forefront of next-generation aviation governance. In addition, incorporating qualitative methods, such as stakeholder interviews with regulators, airport authorities, or airline executives, could reveal context-specific barriers and drivers that are not captured through quantitative benchmarking alone. These insights would complement the present study and help refine both policy recommendations and institutional reform paths. Finally, as global aviation increasingly aligns with climate and ESG standards, Georgia's role in fostering public sustainability awareness at the airport level (Gile et al., 2022) represents a promising avenue for strengthening its soft power and environmental leadership in the region.

Overall, this empirical section has shown that Georgia is well-positioned to lead in sustainable, strategically resilient airspace governance. With the right mix of modernization, regulatory alignment, and diversification, Georgia's airspace can evolve from a passive transit corridor into a proactive, stabilizing, and globally competitive aviation hub for decades to come.

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Resümee - Gruusia õhuruum: strateegiline geomajanduslik vara

Õhuruum muutub üha olulisemaks ressursiks rahvusvahelises lennunduses, eriti nende riikide jaoks, mis paiknevad geopoliitilistes sõlmpunktides. Gruusia õhuruum, mis ühendab Euroopat ja Aasiat, on viimasel ajal pälvinud suuremat tähelepanu tänu piirkondlikele konfliktidele ja vajadusele turvaliste lennukoridoride järele. Kuigi varasemad uuringud on käsitlenud Euroopa õhuruumide reguleerimist ja võimekuse juhtimist, on Gruusia õhuruumi strateegilise ja majandusliku väärtuse kohta olnud vähe uurimusi. Käesolev töö täidab selle uurimislünga.

Töö eesmärk on hinnata Gruusia õhuruumi kui strateegilist geomajanduslikku vara ja analüüsida selle majanduslikku jätkusuutlikkust. Täpsemalt uuritakse, kas Gruusia õhuruumi toimimine on vastupidav, tõhus ja keskkonnasäästlik võrreldes piirkondlike naabritega ning milliseid geopoliitilisi ja majanduslikke eeliseid pakub selle asukoht. Samuti käsitletakse töö käigus Gruusiat ähvardavaid riske ja võimalusi muutuvas lennunduskeskkonnas.

Eesmärkide saavutamiseks kasutati ametlikel EUROCONTROL andmetel ja jätkusuutlikkuse näitajatel põhinevat kvantitatiivset võrdlusanalüüsi. Analüüsitud võtmetegurid olid lennuliikluse taastumine, operatiivsed hilinemised, Free Route Airspace (FRA) katvus, lennunavigatsiooni teenuste ühikukulud ja CO_2 heitkogused lennu kohta. Gruusia tulemusi võrreldi Poola, Türgi, Aserbaidžaani ja teiste sarnastes tingimustes olevate riikidega. Tulemused näitasid, et 2023. aastaks oli Gruusia lennuliiklus taastunud 169% tasemele võrreldes 2019. aastaga—37% üle piirkondliku keskmise. Tõhusus oli kõrge: kogu õhuruum oli kaetud FRA-ga ja ATFM hilinemised puudusid. Keskkonnasäästlikkus avaldus 14% madalamates CO_2 heitmetes võrreldes võrdlusriikidega. Samas tõi analüüs esile ka probleeme nagu kõrged ANS ühikukulud ja kitsaskohad Tbilisi lennujaamas, samuti sõltuvus ülelennutasudest.

SWOT-analüüsis tuvastati sisemised tugevused ja nõrkused ning välised võimalused ja ohud. Tugevustena toodi esile paindlik õhuruumi disain, kõrge ohutustase ja strateegiline asukoht. Nõrkusteks olid piiratud lennujaamainfrastruktuur ja sõltuvus transiitliiklusest. Võimalused seisnevad EL-i lennundusraamistikega integreerumises ja piirkondlikus koostöös näiteks Armeeniaga. Ohtudeks on geopoliitiline ebastabiilsus ja konkurents alternatiivsete marsruutidega.

Töö lõppjäreldustes esitatakse praktilised soovitused: täielik ühtlustumine Single European Sky (SES) raamistikuga, Tbilisi lennujaama moderniseerimine, keskkonnasäästlike

lennuprotseduuride rakendamine ning odavlennufirmade osakaalu suurendamine Batumi ja Kutaisi lennujaamades. Töö järeldab, et Gruusia õhuruumil on potentsiaal olla stabiilne ja tõhus sillaehitaja Ida ja Lääne vahel, juhul kui moderniseerimine ja piirkondlik koostöö jätkuvad.

Töö pakub uusi teadmisi Gruusia õhuruumi strateegiliste ja majanduslike aspektide kohta ning näitab, kuidas väike riik saab oma õhuruumi kasutada majanduskasvu ja geopoliitilise kaalu suurendamiseks. Tulevased uurimused võiksid laiendada empiirilist ulatust näiteks intervjuude või stsenaariumipõhiste prognoosidega.

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Ali Kurbanov

13/05/2025