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Air traffic in context: geopolitical and technical factors affecting its safety and security

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Abstract

Air traffic is integral part to modern air traffic management in aviation system. The available literature mainly focuses on commercial and operational aspects, and sees air traffic safety as taken for granted that can be applied regardless of the context. However, this view of air traffic safety and security is unsatisfactory when it comes to macro-level contextual factors that operate beyond the normative organizational level. The aims of this search was to explore the contextual factors that influence the safety and security of global air traffic and therefore the provision of air traffic services. This study followed a systematic literature review approach to address these factors. Nineteen papers were reviewed, evaluated and analysed in terms of their contexts, key characteristics, and their main findings. The search identified three factors: political, wars and unlawful activities, and state safety oversight. These range of factors can be categorized and operate at supra-organizational level to influence air traffic safety and security. This article draws particular attention to the impact of politics and macro-level contextual factors on the airspace safety and security especially in combated airspaces. The Practical implications of the findings adopted in this article provides a useful source for differentiating between various contextual factors and the extent to which they function. This could make it possible to manage these factors more effectively, to enhance the potential for different stakeholders mitigate local, regional, and international risks to airspace safety and security.

Keywords: Airspace management; Air traffic safety; Air traffic security; Contextual factors; Air transport geography.

الحركة الجوية فالسياق: العوامل الجيوسياسية والفنية المؤثرة علي سلامة وأمن الحركة الجوية.

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الملخص:

الحركة الجوية جزء لا يتجزأ من إدارة الحركة الجوية الحديثة في نظام الطيران. وتركز الأدبيات المتاحة بشكل رئيسي على الجوانب التجارية والتشغيلية، وترى أن سلامة الحركة الجوية أمر مفروغ منه ويمكن تطبيقه بغض النظر عن السياق. ومع ذلك، فإن هذه النظرة لسلامة وأمن الحركة الجوية غير مرضية عندما يتعلق الأمر بالعوامل السياقية على المستوى الكلي التي تعمل خارج المستوى التنظيمي. كانت أهداف هذا البحث هي استكشاف العوامل السياقية التي تؤثر على سلامة وأمن الحركة الجوية العالمية وبالتالي توفير خدمات الحركة الجوية. اتبعت هذه الدراسة منهج مراجعة الأدبيات المنهجية لمعالجة هذه العوامل. تمت مراجعة وتقييم وتحليل تسعة عشر ورقة بحثية من حيث سياقاتها وخصائصها ونتائجها الرئيسية. حدد البحث ثلاثة عوامل: السياسة، والحروب، والأنشطة غير القانونية، ومراقبة الدولة للسلامة الجوية. يمكن تصنيف هذه المجموعة من العوامل وتعمل على المستوى فوق التنظيمي للتأثير على سلامة وأمن الحركة الجوية. تلفت هذه المقالة اهتماما خاصا إلى تأثير السياسة والعوامل السياقية على المستوى الكلي على سلامة وأمن المجال الجوي وخاصة في المجالات الجوية التي تشهد حروب وصراعات. توفر النتائج المعتمدة في هذه المقالة مصدراً مفيداً للتمييز بين العوامل السياقية المختلفة ومدى عملها. وهذا يمكن أن يجعل من الممكن إدارة هذه العوامل بشكل أكثر فعالية، لتعزيز إمكانات مختلف أصحاب المصلحة لتخفيف المخاطر المحلية والإقليمية والدولية التي تهدد سلامة الأجواء وأمنها.

الكلمات المفتاحية: إدارة المجال الجوي، سلامة الحركة الجوية، أمن الحركة الجوية، العوامل السياقية، جغرافيا النقل الجوي.

1. Introduction

The international aviation industry plays a significant role in the international economy linking people, cultures and business entities

across the globe. The sector has grown significantly over the years. This growth can be attributed to multiple factors, including increasing disposable incomes, economical airfares, prosperous tourism, and globalization (Khairuddin et al., 2023). All these elements contribute to the growing economies and across continental international air travel which in return an increase in air traffic capacity.

Air traffic control is a pivotal element of air navigation services value chain to provide a safe, effective and seamless flow of air traffic (Stefanova, 2023). The International Civil Aviation Organization (ICAO) has approved the Global Air Navigation Plan (GNAP) to promote the implementation of global air navigation across regions and all contracting states (Batuwangala et al., 2018). The GNAP is a strategic plan covering 15 years (2013-2031) to utilize technologies and forthcoming developments in accordance with the ICAO's and contracting states operational objectives in order to mitigate to future challenges. The GNAP objective therefore is to prevent airplanes collisions and support a safe flow of air traffic (ICAO, 2001b, 2001a). Air traffic management services are largely provided by Air Navigation Service Providers (ANSP). International air traffic is regulated by ANSP, which are entities responsible for managing air traffic on behalf of an organization, area, or country, and may be either private or public institutions. ANSP provides different services to airspace users such as air traffic management, communication and navigation services, search and rescue to air navigation. However, the international air navigation in aviation like to other industries, encounters challenges and hazards, including restrictions to its operations. These restrictions might operate on different macro or micro levels, However, interestingly enough these restrictions have been largely overlooked in the existing literature. Neither these restrictions nor the factors are discussed in most of the available literature. In fact, to explore discussions on the elements that influence air traffic safety and security, one needs to review the existing studies of air navigation safety and security (see Dobruszkes, 2019). Since then, few studies such as Cong et al., (2024) and Ostroumov et al., (2025) have investigated this issue in limited contexts such as Russian and Ukrainian contexts.

In the context of this work, the aim of this article is to explore the extensive range of macro-level contextual factors that impact air traffic safety and security in civil aviation. And up to the authors

knowledge this work is one of the few studies that investigates the factors beyond the organizational level that could influence the air traffic management safety and security. This research examines the global view of the impact of these contextual elements and attempts to find out the regions and countries that experienced the most from these challenges. The lack of research examining the impact of macro-level contextual factors on air navigation safety particularly in non-Western contexts has been brought to light by this brief literature. This research addressed the listed below question:

- 1) How do external contextual factors influence operational safety of air traffic management?

This question is investigated through the existing published literature.

2. Methodology

2.1 Data collection

Studies were selected and compiled for this review using procedures outlined by [Siddaway et al., \(2019\)](#) for this study. The technique used for data collection process was applied in the following stages: searching, screening, and evaluating ([see Fig. 1](#)).

2.1.1 Search strategy

This stage involved firstly of developing a search query employing the terms “Air Traffic Safety”, “embargo”, “flight bans”, “travel sanctions” or “airspace safety” to “airspace security”. In addition to these keywords, the query (i.e. tile OR terms) used for searching included the following general criteria: publication period (between 2010 and 2024); kind of publication (the article must be peer-reviewed); and language (must be produced in English).

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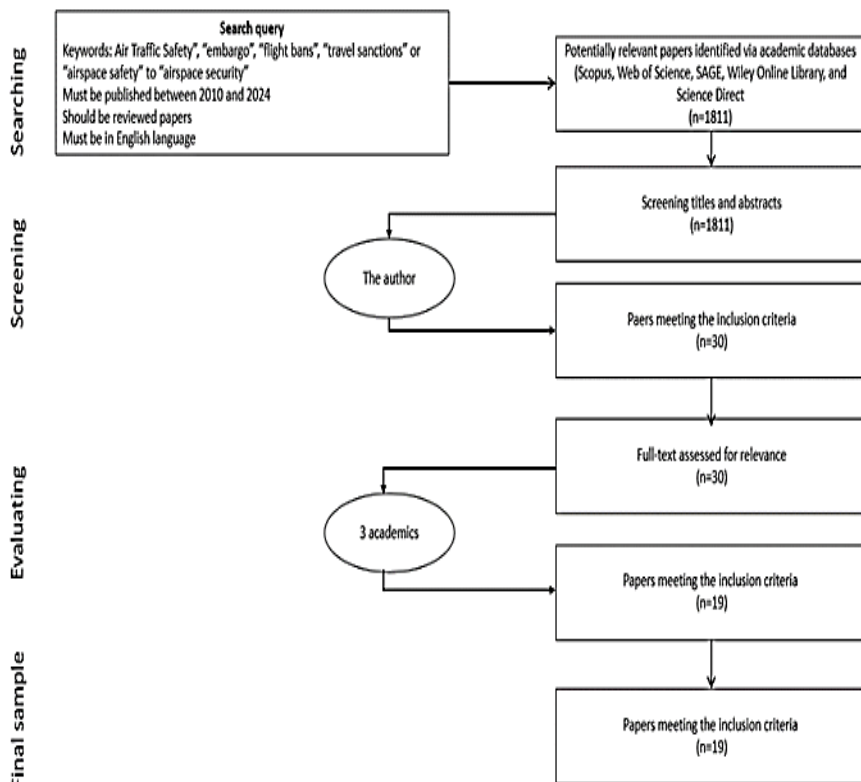


Figure. 1. Search and selection approach of articles, (created by authors).

Following that, the search query was entered into three different academic databases: SAGE, Science Direct, and Google Scholar. Some news websites like.

Reuters and BBC World Service were visited when necessary as supportive evidence-based tools. Eventually, 1811 relevant papers were found (Table 1). The identified papers were exported to Mendeley-Reference Management Software.

Table 1 Details of the papers search and selection.

Digital database	Number of retrieved articles by title	Number of retrieved articles by title	Total or retrieved articles
SAGE	156	747	903
Science Direct	273	597	908

2.1.2 Screening

This phase initially started by establishing inclusion and exclusion criteria (Table 2), and then matched these criteria to the abstracts. Furthermore, Relevant data was abstracted from each reviewed study, including research aim and objectives, methods, research results and conclusions. The selected studies are collated, the findings are grouped and analyzed and common themes were then identified. A reliable process of the inclusion and exclusion criteria was conducted to ensure a reliable systematic selection: these include primary studies focusing on direct or indirect factors of impact on air navigation safety and security, air traffic detour or redistribution, economic and travel sanctions and regional or civil wars. Despite the fact that every included study has its quality evaluated, the selection of studies is focused on their relevance to addressing the research question rather than any primary evaluation of their quality. In the next step, based on the identified criteria the researcher conducted the screening of the titles and research abstracts of the 1811 identified articles. This step led to keeping 19 articles to be exported to the evaluation phase.

2.1.3. Evaluating

Three academics not involved in this search, independently evaluated each of the 30 entire texts. Discussions were held with each of them until agreement was reached on any disagreements. In the end, 19 papers were included in this search.

Table 2. Inclusion and exclusion criteria.

Digital database	Inclusion criteria	Exclusion Criteria
General criteria	a. Published between 2010 and 2024 b. Must be peer reviewed c. Must be Written in English	a. Articles published before 2010 b. Articles not subject to peer-review process C. Written in language other than English
Study design	a. Articles used Quantitative, qualitative, mixed designs or observational studies b. Review studies	a. Studies used modeling procedures
Outcomes	a. Outcomes in terms of risks to airspace safety	a. Did not define factors affect air traffic safety b. Focused on economic perspective rather than safety

2.2 Data coding and analysis

This was executed in a systematic approach employing Microsoft Excel spreadsheet. This approach was used to develop a list of data

categories and sub-categories, outlined in Table 3, to methodically extract the key elements within the papers required to answer the questions they were investigating. Subsequently, all of the included 19 articles were coded by the author. To ensure credibility, the three academics involved in the evaluation process coded 9 of the articles to double code the entire data set. The first author and the evaluators held discussions to settle disagreements until they arrived into an agreement.

Table 3. data categories and sub-categories.

Categories	Subcategories
Article's key characteristics	Journal of publication, country, research aim and objectives, key research questions
Conceptualization of risks to air traffic	Level of risk (what is risk consequence), source of risks (air traffic in the face of external factors), nature of risk (what are external factors)
Study characteristics	Study design, data collection and analysis
Outcomes	Types and consequences of factors on air traffic safety

3. Results

This section outlines the key characteristics of the involved articles; then presents the main findings in way in which macro-level contextual factors contribute to the impact on air traffic safety.

3.1 Basic characteristics

This part highlights the key elements of the reviewed studies in order to answer the question of “what are the key characteristics of the involved articles?”

3.1.1. Geographical distribution

There were three (n = 3) studies conducted in the United Kingdom, Belgium (n = 2), Ireland (n = 1), Thailand (n = 1), Malaysia (n = 1), India (n = 1), China (n = 3), Iran (n = 1), Poland (n = 1). The rest of the studies were conducted in the USA, and Germany.

3.1.2. Journal of publication

Articles were published in different types of journals from the journal of safety research to the journal of applied geography. One study was published in journal of transport geography, Annual Review of Psychology (n=1), Journal of Air Transport Management (n = 1), Journal of Travel Research (n = 1). The remaining reviewed articles were published in other journals.

3.1.3. Objectives of studies

The articles aim and objectives varied. In some articles, authors offered more clear objectives such as exploring the main factors that lead to international sanctions over aviation industry in different parts of the world (Khairuddin et al., 2023). Other studies had the aim to investigate the impact of air traffic redistribution on the capacity and the distance flown of air traffic over war zones from a geopolitical perspective (see Dobruszkes, 2019; Dobruszkes & Peeters, 2019). A handful of authors attempted to examine, assess and evaluate the role of western sanctions and embargo on airline safety in developed countries (Ben-Saed & Pilbeam, 2022; Majidi et al., 2014). Some other authors reported a more specific aim to investigate the impact of Russian and Ukrainian war on the international air traffic from the perspective of political tensions to expand the body of current knowledge of regional events on air traffic management (Chu et al., 2024). The methodical techniques utilized in most of the reviewed studies like the work of Chu et al. (2024) on evaluating the Russian and Ukrainian conflict on the global aviation industry, use quantitative approaches to assess the consequences of this conflict from the perspective of mass flight routs using cost increment index. The remaining studies revolved around the commercial aspect of air traffic detour and redistribution in risky airspaces.

Research on air traffic safety is thus a complex field that includes the investigation of several interconnected factors, including political factors, geopolitical impact, regional events and their possible consequences. Typically, studies concentrate on particular cases (case studies) and are tackled from a range of disciplinary perspectives such as safety, air traffic management, cost and revenue. Because the air traffic safety and security are so contextually embedded, it is difficult to produce, comprehensive, and generalizable knowledge.

3.2 main findings

This section presents the main contextual factors that lead to challenging risks to air traffic safety. All studies that reviewed and identified in this search focused on the elements that introduce major risks to air traffic safety and the provision of air navigation services. These macro-level elements include political factors, wars and unlawful activities, and state's safety oversight.

3.2.1 Contextual factors

Countries having strong economic power and strong position on international stage possess the ability to apply this power to punish

their competitors in response to geopolitical, economic, and security concerns. Aviation industry usually used as a punishment tool in these political conflicts (Bunyavejchewin, 2024). Ben-Saed & Pilbeam (2022) described that political intervention aims to impose sanctions and embargo on aviation sector in general and inhibit air traffic in particular. Various political concerns can lead to restrictions such as sanctions and embargos on regional air traffic services ranging from no fly zones to restrictions on export of aviation related spare parts (Nephew, 2018). Table 4 provides examples of the studies and their findings that highlighted and discussed the role of political element on aviation domain.

Table 4. Selected examples of literature covering political impact on air traffic management.

Reference	Brief study description	Key category/factor
(Rowland, 2022)	Presents the European Unions sanctions against Russia following its invasion of Ukraine.	Institutional, legal, and judicial aspect of EU sanctions.
(Nwador, 2023)	Discusses Strategic deterrence through the use of sanctions in the international system in gaining support among major players.	The legal basis of UN sanctions and types of sanctions the impact of UN sanctions of Russia.
(Ben Saed & Pilbeam, 2022)	Investigates the role effect of sanctions, embargo and national culture on safety climate in airline industry.	Weak organizational safety attributed to the imposition of sanction and Embargos.
(Chu et al, 2024)	Assessing, analyzing the impact of Russian-Ukrainian Conflict on Global air traffic.	Russian air transport is suffering from western sanctions, air traffic completely stopped in Western Russia, air traffic between west and east affected by no fly zone act.
(Dobruszkes, 2019)	Investigate the factors lead to air traffic detour	Natural factors, technical factors, geopolitical factors, social factors.
(Dobruszkes and Peerters 2019)	Assessing the geography of air traffic detours in combated airspace.	Detours are imposed for political reasons, increase of greenhouse gas emissions.

4. Discussion

While the number of studies covered the impact of air traffic redistribution due to the effect of wars on airlines increment cost sees a little increase, a very little peer reviewed studies investigated the overall impact of external factors on air navigation activities. Highlighting the need to identify these elements and their related risks would enhance our understanding of the main causes that lead to their consequences. In this article, we explored the influence of these risks that have brought to the international air navigation industry. Compared to other forms of transport, air navigation services are vulnerable to the external hazards despite the technological advancement and regulatory approaches (Khairuddin

et al., 2023). Air navigation becomes fragile by the impact of factors like politics, wars, and poor state's safety oversight. These macro-level contextual factors suggest that air traffic services are extremely influenced by the elements beyond the intra-organizational level, and this is remarkable because the international air navigation industry promotes strong international safety standards (ICAO, 2019, 2018), as an indicator of adherence to the ICAO's Standard And Recommended Practices (SARP) (Ben-Saed & Pilbeam, 2022). Thus, the claims about the international adoption of ICAO's safety practices and the ICAO's legal authority over the international air traffic based on Chicago convention of 1944 and therefore countries sovereignty over their own airspaces, are perhaps warranted. This enables us to comment on the validity of the political sanctions and no-fly zones based on political tensions imposed by some global north countries over countries in the global south (Ben-Saed & Pilbeam, 2022).

4.1 Political factors

The effect of the political element is a mixture of effects vary from political tension to political sanctions. These sanctions used as a punishment tool against countries that challenge the interests of international community and international peace (Nwador et al., 2023). Political sanctions for example play a major restriction on the provision of air navigation services. Ben-Saed & Pilbeam (2022) stated that countries like Central African Republic, Guinea-Bissau, Iran, Libya, Mali, North Korea and Sudan are subject to sanctions from the United Nations. The US imposes sanctions over 30 countries such as Venezuela and Cuba whereas the UK puts sanctions against more than 70 states including Somalia and Syria (Ben-Saed & Pilbeam, 2022). The findings from this study are discussed from the perspective of the provision of air navigation services in order to ensure air traffic safety rather than from the commercial aspect. This is investigated from the lenses of diplomatic tensions and political sanctions.

4.1.1 Diplomatic tensions

In 1944 a small number of countries signed the International Air Services Transit Agreement, widely known as IASTA. Many countries have signed this agreement, however, still many countries like China, Canada, Libya, Saudi Arabia and more in continental Africa refused to be part of the signatories of this agreement (Dobruszkes, 2019). Dobruszkes, (2019) argues that, non-signatory states hold the right to refuse the provision of air traffic services to

airlines registered in signatory countries and vice versa from overflying their territorial airspace which frequently reflects geopolitical trends. As a result, this could endanger the safety of international aviation regime. For example, several airlines registered in Arab countries are not allowed to overfly the Occupied Palestine's airspace for safety and security concerns (Dobruszkes & Peeters, 2019). This is because of the Zionist Israeli terrorist militias threats against the safety of regional air traffic in the Middle East and North Africa. The best example of this threat was when the Israeli militias down a Libyan airliner in the Sinai Peninsula killing at least 108 souls back in February, 21, 1973 (Smith, 1973). According to Parker, (1982), a state's foreign diplomatic policy shapes geopolitical trends and conflicts. In the context of air traffic safety, Qatar diplomatic crisis represents the most recent events when air safety becomes at risk. The diplomatic conflict between Qatar and other Middle East countries (i.e. the Kingdom of Saudi Arabia (KSA), the Republic of Egypt, the United Arab Emirates (UAE) and the Kingdom of Bahrain) was a case when Qatar registered aircraft including Qatar airways barred from overflying the airspace of these countries (see Fig. 2). over a political tension between the leaders of these countries. This political conflict led Bahraini air forces to scramble four fighter jets and violate Qatari sovereignty and its airspace safety and security (Shafi, 2020), which was a breach of international aviation law and the Chicago Convention of 1944.



Fig. 2. Gulf countries blockade disrupts Qatar Airways flight safety and operations. Adopted from (Aljazeera.com).

Malaysia-Singapore airspace dispute, 2018-2019 was another political dispute in nature. The dispute was about the sovereignty over Malaysian Johor airspace (See Fig. 3). Under the commands of Malaysian Prime Minister Mahathir Mohamed', the Malaysian Authority closed its southern Johor airspace calling to regain control over its airspace (Bunyavejchewin, 2024). Malaysian airspace is managed by Singapore air navigation services authority. Bunyavejchewin, (2024) argues that when Mahathir came to power in mid-2018, brought the return of Mahathirism concept in Malaysia foreign policy and therefore the bilateral tensions with Singapore. I believe that the Mahathirism was a key element that led to the conflict between Malaysia and Singapore.



Fig. 3. Singapore Flight Information Region including Malaysian southern Johor airspace. Adopted from (Bunyavejchewin, 2024).

4.1.2 Political sanctions

Countries, unions and regional or international agencies might apply sanctions over competing countries or organizations in response to political conflicts driven by challenges like political disputes or dispute over geopolitical interests (UK Government, 2024). This also remains true for aviation industry, where sanctions are used as deterrent tool during global or regional conflict (Holub, 2023). Such disputes are shown by the political conflict between Libya and the USA back in 1982. The government of the USA put economic sanctions against the Libyan civil aviation sector in 1992, and this limited the Libyan air carriers to operate in normal status and access to spare parts for maintenance operations. Following that the United

Nations (UN) Security Council put a total air embargo over Libya through the security council resolution 748 (Directorate of Intelligence, 1986). This led to a full suspension of air traffic in the Libyan airspace for several years.

After the Gulf War of 1991, both the USA, the UK and France proclaimed a no-fly zones over Iraqi airspace in response to a political conflict with Iraqi government at that time. Iraqi airspace was controlled by the USA and UK air forces until 2003. The political and geopolitical conflict between the West and Russia forced the European Union and the USA and the UK to impose sever sanctions over Russian carriers including exporting spare parts especially after Russian invasion to Ukraine. The EU closed the European airspace ahead of all air traffic from the Ukrainian and Russian airspace to mitigate air traffic safety threats. The war in Ukraine closed the country's airspace and limited access to the airspace

of the Russian Federation and Belarus (see Fig. 4). This amounts to the biggest closure of airspace since the cold war, spanning 18 million km² (Ostroumov et al., 2025). Safety concerns and geopolitical sanctions have forced airlines to carefully navigate around restricted zones.

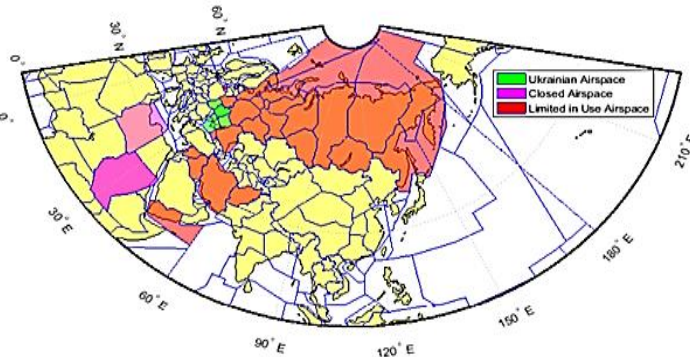


Fig. 4. European Union closed airspace to Ukrainian air traffic. Adopted from (Ostroumov et al., 2025).

4.2 Wars and unlawful activities

Factors such as wars and terrorist attacks have been known to play a significant threat to air traffic safety and security. These factors can lead to restriction and slow or halt to air traffic and access to its related air navigation services in certain airspaces. There is likely very little chance that an aircraft will be accidentally hit by a missile, however, it is possible for planes to be targeted, either on purpose

or accidentally, as happened with Malaysia Airlines Flight 17, which was shot down while flying over eastern Ukraine in 2014 by a ground to air missile at a level of more than 32000 feet (Dobruszkes & Peeters, 2019). Light weight missiles and anti-aviation weaponry that are easy to carry and launch can quickly target an aircraft during landings and take offs. These weapons and missiles are possessed and carried by militant organizations and rebels in different parts of several countries in the world. For example, on January 2020, the Ukrainian International Airlines flight PS752 was shot down minutes after take-off in Tehran, Iran by two Iranian surface to air missiles by Iranian Revolutionary Guard Corps (IRGC) due to a military conflict with the USA in the neighboring state of Iraq (Martin, 2020).

This suggests that some airspaces ought to be averted and air traffic should be transferred to a safe air traffic control, and there is a wide range of cases. At the point of writing, most of international air traffic do not utilize the air navigation services provided in Afghanistan, Haiti, Iran, Libya, Lebanon, Palestine, Sudan, Syria, Ukraine, and Yemen as the airspace under their sovereignty are considered unsafe due to the effect of civil and regional wars.

The Russian-Ukrainian war is also another example reveals that international air traffic is vulnerable for regional wars and global conflict. This war significantly influenced the international airspace safety regime. Over 17.879.000 km² of Russian and 674.000 km² of Ukrainian airspace were respectively affected by the consequences of this war (Chu et al., 2024). The consequence of this war is that 4.32% of international air traffic was completely stopped (Chu et al., 2024). To ensure air traffic safety, several international air traffic skirt around restricted war zones (see fig. 5).

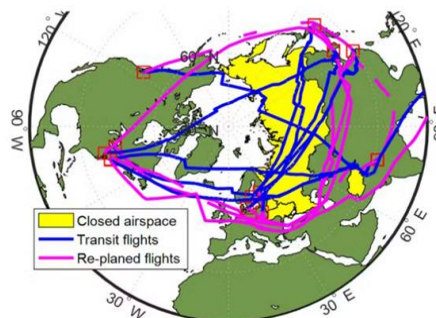


Fig. 5. International air traffic detour to avoid war zones. Adopted from (Ivannikova, 2025).

The ongoing military operations promptly barred civil air traffic from flying through the war zone for safety concerns. As a result, Russia, Belarus and Moldova have closed large sections of their own airspace near to their FIR boundaries with Ukraine. Ukraine was also closed its airspace to all civil air traffic on February 24, 2022. All the major countries who regularly issue airspace warnings (the US, UK, Canada, France, Germany, Italy) have since issued total flight bans for Ukraine due to risk from military activity at all levels ([Safe Airspace, 2022](#)).

The risk could be categorized into primary and secondary risks. The primary risk is an unintended targeting of civil aircraft by military, including misidentification (as with MAS17, UIA752), or confusion. The secondary risk is potential lack of Ukrainian Air Traffic Control Service at short notice (Cyber Attack), and other unforeseeable non-normal operating environments for civil aircraft. Prior to February 2022, there were two areas of concern in Ukraine - the conflict in the far east of the country (affecting UKDV/Dnipro FIR) and the double claim over ATC and airspace in Crimea (UKFV/URFV/Simferopol FIR) ([Safe Airspace, 2022](#)).

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The immediate sources of instability in Middle East remains a major risk for the safety of international and regional air traffic. Commercial flights in the Middle East severely disrupted after Iran carried out an unprecedented salvo of drone and ballistic missile strike on Occupied Palestine ([see fig. 6](#)), forcing many countries in the region to temporarily close their airspace due to security and safety concerns.



Fig. 6. Middle East airspace closure as Iran launched retaliatory attacks on Occupied Palestine. Adopted from Flightrader 24.

The air navigation services in the affected countries were suspended and air traffic was rerouted and the disruption continued for a few days and international airlines suspended their flights to the region in response to this war (Saskia O'Donoghue & Ruth Wrightm 2024). Saudi Arabia's airspace was not an exception of the disruption in Middle East. Surface to surface missile attacks launched by Houthi rebels in Yemen against Saudi airports located at Jeddah FIR and Damam FIR in Western and Eastern Saudi Arabia posed a latent threat to air traffic safety in the red sea and the Western part of Saudi airspace (see fig. 7). Moreover, back in 2014 when Tripoli international airport in Libya had been hit by several shells and heavy guns by rival armed groups that left the main airport in the country as a battlefield and left the airport navigational aids out of service including air traffic control tower to be completely destroyed (BBC, 2014). These attacks were resumed once again in 2018-2019 after Tripoli FIR and its main airport came under rocket fire that forced the air traffic to divert to alternate airport or adjacent FIR (BBC, 2018).

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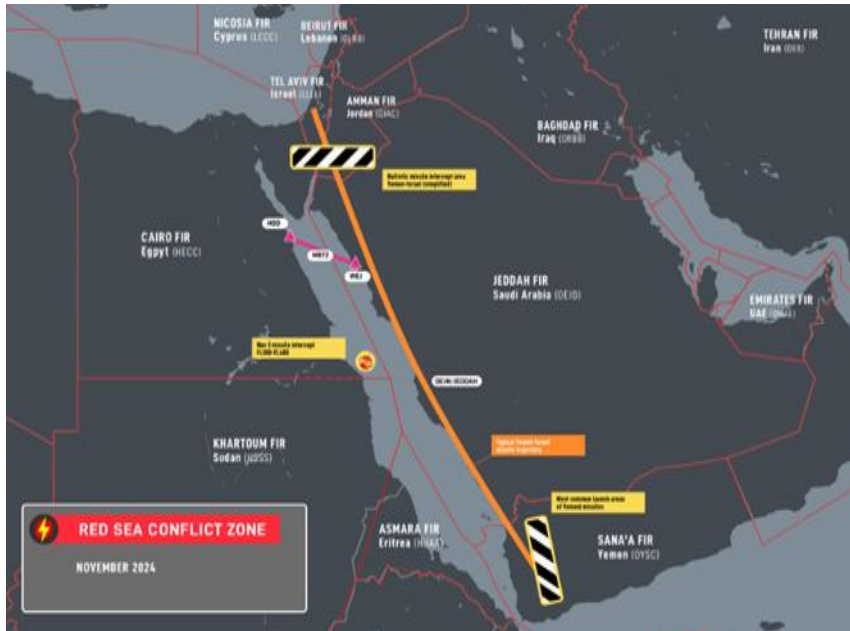


Fig. 7. Red sea conflict zone risk- Saudi-Yemen airspace. Adopted from (Safe Airspace).

Air traffic safety is impacted by three levels of risk; level 1 (red areas) indicates risk level is very high and no fly zone, level 2 (amber areas) danger exists but air traffic services are existed, and level 3 (yellow areas) indicates to caution and warnings (see fig. 8).

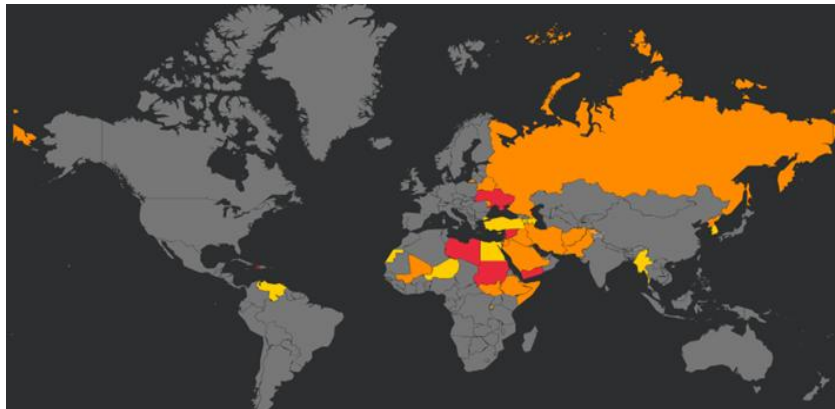


Fig. 8. Global airspace conflict zones and risk areas. Adopted from (Safe Airspace).

4.3 State's safety oversight.

Embargo on flights are commonly imposed in relation to safety issues relating to countries or airlines. European Union for example,

publishes a list of airlines that are prohibited from entering the European airspace or any of its member states usually for failing to meet the ICAO's international SARPS (European Commission, 2014). When a state civil aviation authority is categorized in Cat II (i.e. unsafe) for failure to adhere to the applicable international safety standards based on SARPS (Khairuddin et al., 2023), the European Aviation Safety Agency (EASA) takes decision through an advice of its EU Air Safety Committee to list the country and its national airlines to an operating ban from entering the EU airspace or its member states. Currently a total of 129 airlines are banned by EASA from EU single skies. For example, a 100 air carriers certified in 15 countries due to insufficient safety oversight of aviation authorities from these countries like Afghanistan, Angola, Democratic Republic of the Congo, Kyrgyzstan, Libya, and Sudan. Another 22 airlines certified in Russian and Belarus are banned since the 2022 Russian invasion of Ukraine, as well as 7 airlines from other countries like Tanzania, Zimbabwe, Venezuela, Suriname, Iran and Iraq based on their safety deficiencies (European Commission, 2024).

5. Conclusion

Air traffic industry plays a significant role in enhancing global air transport system by deploying standardized safety practices and interventions. Nevertheless, its safety is in question and the industry faces unprecedented safety challenges since the World War II, and surprisingly these challenges are not commonly investigated or assessed. Effective air traffic safety and security depends on the successful transfer of traffic from safe airspace to another. This process is influenced by a several contextual external factors. These factors are usually beyond the organizational level. This search investigates these factors using the approach of systematic literature review, enabling the author to explore and classify these factors according to their extent of influence: political factors (i.e. political tensions and political sanctions), Wars and unlawful activities, and state safety oversight.

For the first time, although not entirely thorough, list of contextual external factors determined from the previous literature shows, for the first time, the significance of the supra-organizational contextual factors on air traffic safety and security. The classification and identification of these factors draws attention directly to the geopolitical and technical nature of air transport industry and how

this shapes what is and is not acceptable to seamless provision air traffic service to ensure the international air traffic safety. Greater understanding of these supra-organizational factors and how they relate to one another, potentially would have important implications for regulators and policymakers so they can develop effective strategies to address the issues brought on by the negative consequence of these macro-level factors.

This review is a thorough and useful study that widens our understanding of the elements affecting air traffic safety, and provides policymakers helpful knowledge to assist their decision making process. In general, this article echoes scholarly discussions by contributing to the current knowledge in the area of air traffic management and holds practical implications for industry professionals.

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