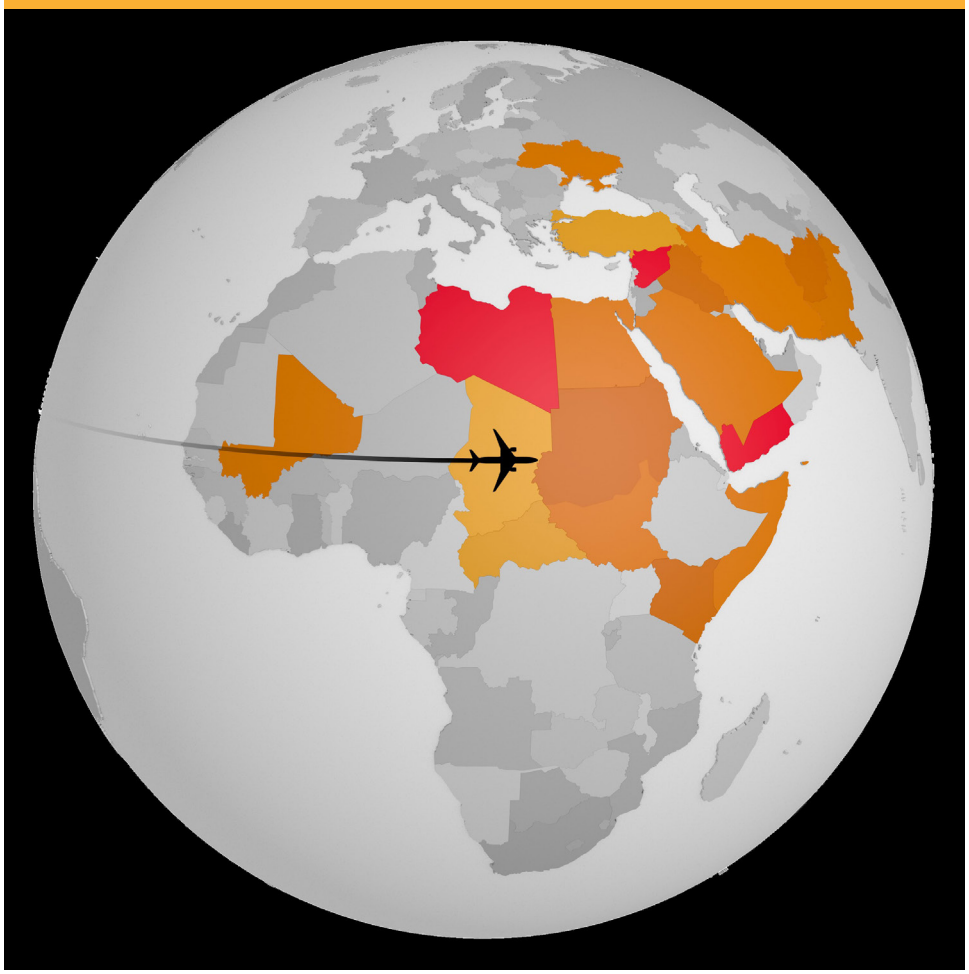
DUTCH
SAFETY BOARD

Safe flight routes

Responses to escalating conflicts

2021 report



Safe flight routes

Responses to escalating conflicts

2021 report

The Hague, June 2021

The reports issued by the Dutch Safety Board are publicly available on www.safetyboard.nl.

Cover photo: Dutch Safety Board

The Dutch Safety Board

When accidents or disasters happen, the Dutch Safety Board investigates how it was possible for these to occur, with the aim of learning lessons for the future and, ultimately, improving safety in the Netherlands. The Safety Board is independent and is free to decide which incidents to investigate. In particular, it focuses on situations in which people's personal safety is dependent on third parties, such as the government or companies. In certain cases the Board is under an obligation to carry out an investigation. Its investigations do not address issues of blame or liability.

Dutch Safety Board

Chairman: J.R.V.A. Dijsselbloem
M.B.A. van Asselt (until 14 June 2021)
S. Zouridis

Secretary Director: C.A.J.F. Verheij

Visiting address: Lange Voorhout 9
2514 EA The Hague
The Netherlands

Postal address: PO Box 95404
2509 CK The Hague
The Netherlands

Telephone: +31 (0)70 333 7000

Website: safetyboard.nl
E-mail: info@safetyboard.nl

N.B. This report is published in the Dutch and English languages. If there is a difference in interpretation between the Dutch and English versions, the English text will prevail.

CONTENTS

SUMMARY

On 17 July 2014, flight MH17 crashed in Ukraine, following the detonation of a surface-to-air missile outside the aircraft's cockpit. All 298 persons on board lost their lives in the crash. The Dutch Safety Board investigated the crash and published a final report (in 2015) and a follow-up report (in 2019) about the risks of flying over conflict zones.

Less than six years later, on 8 January 2020, flight PS752 was also shot down by a surface-to-air missile, shortly after taking off from Teheran Airport in Iran. All 176 persons on board were killed. This crash once again raised concerns about the decisions taken in respect of flying over or near conflict zones.

Despite the fact that there was no Dutch involvement in the crash of flight PS752, the Dutch Minister of Infrastructure and Water Management requested the Dutch Safety Board to reflect further on the implementation of the recommendations from the *MH17 Crash* report. This request was focused on possible improvements to the national, European and global system for better managing the risks involved in flying over conflict zones. In response to this request, the Dutch Safety Board decided to start an additional follow-up investigation into the safety of flight routes. The aim of this investigation is to provide insight into what airlines and states do in practice to manage the risks of flying over conflict zones. Based on these insights, the Dutch Safety Board identified any shortcomings and possibilities for improvement. The cause of the crash of flight PS752 was not part of this investigation as the accident investigation into the cause of the crash was led in accordance with international standards by the Aircraft Accident Investigation Board of the Civil Aviation Organization of Iran. In its investigation, the Dutch Safety Board reconstructed the information available to Dutch airlines and the Dutch government in the period leading up to the crash of flight PS752, and the decisions they took in respect of overflying Iran and Iraq. The report integrates relevant findings from previous investigations by the Dutch Safety Board (2015 and 2019) with new findings about current practice in airspace management, the sharing of information and decision-making on flight routes.

Until the crash of flight MH17, the risks to civil aviation of overflying conflict zones were insufficiently recognized. Until that moment, within civil aviation, it was assumed that whenever airspace was open, it was safe to fly there. Since that time, important steps have been taken within civil aviation to improve the management of risks of flying over and near conflict zones. In the follow-up report published in 2019, the Dutch Safety Board concluded that airlines have become more aware of the risks above and near conflict zones. Awareness has also increased among states and international organizations, which is reflected amongst others in new ICAO standards and the EU Integrated Aviation Security Risk Assessment process. At national level, the sharing of threat information between government and airlines has improved, as a result of a covenant between the Dutch state and airlines.

Airspace management by states with a conflict in or near their territory is of the utmost importance, as a crucial step in protecting civil aviation. As in its follow-up investigation in 2019, the Dutch Safety Board once again concludes that the majority of states with a conflict on or near their territory still do not close or restrict their airspace, and that they do not share information about the conflict relevant to airlines. Although closure of the airspace as a precaution would offer the best protection, this means is rarely employed. Even when the conflict between Iran and the United States escalated rapidly in January 2020, the Iranian airspace remained open, and Iran did not to publish a NOTAM (an aeronautical publication) about the ongoing conflict.

Although in theory airspace management in conflict zones is an effective safety barrier, in practice this is not the case. As a consequence, airlines cannot assume that open airspace over a conflict zone is safe.

To identify the measures needed to ensure a safe flight, airlines carry out risk assessments in respect of conflict zones. In order to carry out a risk assessment, airlines need relevant threat information, that they obtain from a variety of sources. For their information, they are partially dependent on the state in which they are established, because states have access to other sources of information than airlines. For Dutch airlines, as part of the covenant between the Dutch state and the airlines, the Expert Group is an important source of information, for example for threat information provided by the Dutch intelligence services. The investigation into the process of information sharing within the Expert Group prior to the crash of flight PS752 revealed that information was available within the Dutch aviation network about the presence of surface-to-air missiles, the growing tensions in the region, the possibility of retaliatory attacks by Iran on a variety of targets, and the resultant uncertainty about further escalation of the conflict. This information was shared in time, and the parties were satisfied with the information exchange.

The reconstruction of public flight data in the Iran-Iraq region reveals that at the time of the escalation of the conflict, civil aircraft continued to fly in Iran, in airspace in which threats had been identified. The increased tensions in the region following the attack on an Iranian general on 2 January 2020 and the presence of surface-to-air missiles were identified as risk-increasing factors but were no reason for airlines to stop flying in the area. KLM and Transavia, at the time the only Dutch airlines flying in the region (for Iran and Iraq only overflights), concluded in the period between 2 and 7 January that on the basis of their own risk assessment, the measures already taken were sufficient; in response, they decided to continue flying over Iraq and the eastern part of Iran. Based on the assessment of the situation, KLM considered the scenario of an unintentional attack by a surface-to-air missile on a civil aircraft at cruising altitude unlikely. The conflict escalated further when late in the evening of 7 January, in response to the attack on the Iranian general, Iran launched ballistic missiles in the direction of two American airbases in Iraq. The launch of ballistic missiles prompted the Dutch airlines to reassess the situation. In response, they decided to stop flying over the area. Shortly after this decision, flight PS752 was hit by an Iranian missile, and crashed.

Risk assessments based on assessing likelihood and consequences is a well-established practice for safety management in civil aviation. However, this traditional risk assessment method has limitations in assessing the risks of flying over or near conflict zones. A catastrophic scenario whereby a civil aircraft is intentionally or unintentionally hit by a surface-to-air missile is a scenario that may be associated with uncertainties. These uncertainties should serve as sufficient reason to give more weight to such scenarios with catastrophic consequences when assessing the risks.

Dutch airlines have all implemented a risk assessment process related to flying over or near conflict zones, whereby they use risk qualification schemes that combine the likelihood and the consequences. In their risk assessments, Dutch airlines include scenarios with uncertain intentions or capacities. Uncertainties about the development of the conflict are also included in the risk assessment by opting for a limited period of validity or short review cycle, or are used as a trigger to initiate a new risk assessment. Nonetheless, no greater weight is given to uncertain but catastrophic scenarios, in the current risk approaches.

As well as the airlines, the states where these airlines are based play a role in the risk assessment of overflying conflict zones. States can share threat information with airlines, but can also take greater responsibility by issuing recommendations on foreign airspaces in relation to conflict zones, or by imposing a flight prohibition. The policy choice taken by the Dutch government in this respect is to issue neither recommendations nor to impose flight prohibitions. Moreover, no legal basis has been created in the Netherlands to impose a flight prohibition on Dutch airlines in foreign airspace. A number of other states follow a different approach. The United States, Canada, the United Kingdom, Germany and France, for example not only inform all airlines established in their state about the threats arising from conflict zones; they also offer advice and recommendations. The United States, the United Kingdom, Germany and Canada can also impose flight prohibitions for their operators, and do so regularly. Because the recommendations and flight prohibitions from these states are published, their outreach is not limited to the airlines in their own state. Airlines in other states can also benefit from the recommendations and prohibitions, in their own risk assessment and decision-making process. Although various states were in a position to advise against overflying Iran when the conflict in that state escalated, until the moment when Iran launched the ballistic missiles, not a single state had issued either a recommendation to avoid overflying Iran, or a flight prohibition for Iranian airspace.

At European level, advice on conflict zones is published by EASA, the European Union Aviation Safety Agency. EASA bases its recommendations on the EU Integrated Aviation Security Risk Assessment process for conflict zones. This process compiles (threat) information at European level, and contributes to an equal level of information for EU airlines and member states. Although the recommendations from EASA are generally perceived as valuable and reliable, the process of reaching a decision on issuing a recommendation in practice takes a great deal of time, since it requires consultation with the European Commission and Member States. EU decisions and notices about conflict zones are therefore not issued quickly enough, if conflicts escalate within a short time span.

In conclusion, this investigation shows that in the event of an escalating conflict, the majority of states do not close or restrict their airspace, nor do they publish any aeronautical information. Iran too did not close its airspace. In addition, the investigation shows that prior to the ballistic missile attack on 7 January 2020, not a single state had issued a recommendation or flight prohibition for the airspace of Iran for its airlines. Analysis of flight data shows that airlines also decided not to stop flying to and over the conflict zone. Information about increased military tensions in combination with the presence of surface-to-air missiles that can reach cruising altitude was available within the Dutch aviation sector. The scenario of an unintentional attack on a passenger aircraft was also discussed in the information networks in which the Netherlands participates. However, due to the uncertainties and unpredictability of the conflict, this scenario was assessed as unlikely. As a consequence, despite indications of growing military tensions and the presence of missiles, neither states nor airlines took the decision to stop flying. The Dutch Safety Board concludes that it is desirable to further develop the risk assessment method for flying over and near conflict zones, in which, based on the precautionary principle, greater weight should be given to uncertain but catastrophic scenarios.

CONSIDERATION

The crash of flight PS752 on 8 January 2020 marked the second occasion in just six years when a passenger aircraft was shot down in a conflict zone. Just as at the time of the crash of flight MH17 in 2014, states involved in armed conflict rarely close their airspace. As a consequence, passengers, crew, airlines and states are unable to be confident of the airspace management of the state they are overflying. In other words, open airspace is not by definition safe. This means that airlines are primarily reliant on the information they collect and share between them. Airlines are required to assess the risks on that basis, and decide whether to continue to overfly conflict zones or to (temporarily) stop the overflying of those zones.

The investigation shows that in the years following the crash of flight MH17, steps forward have been taken in the Netherlands, in particular with regard to the sharing of threat-related information about (escalating) conflicts abroad. At the same time, the investigation clearly also shows that the scenario of a passenger aircraft being shot down in practice still remains a scenario that although taken into account in the risk assessment, is still often assessed unlikely, such that continued overflying of conflict zones seems a possibility. Only when a conflict actually escalates and the risks are demonstrated do airlines stop overflying the area in question. Because the overflying of conflict zones is continued until the risks become apparent, the decision to stop flying can come too late. By granting more weight to the uncertainties of a scenario with catastrophic consequences in a conflict that is inherently unpredictable, a precautionary decision to stop flying will be taken at an earlier stage.

The fact that a catastrophic but uncertain scenario is assessed as unlikely within the context of an escalating conflict also becomes clear from the reconstruction of the information sharing and decision-making about whether or not to overfly Iran and Iraq. At the start of 2020, within just a short time frame, a long-running conflict with the United States escalated in that region. This escalation resulted in the shooting down of passenger flight PS752 by an Iranian missile. During this period, Dutch airlines, intelligence services and the government were actively and rapidly involved in gathering and sharing relevant information within the Expert Group established specifically for this purpose. Based on the information received, Dutch airlines then prepared a risk assessment: was it safe to continue overflying Iran? Although the risk assessment did include the scenario that a passenger aircraft could be hit by a surface-to-air missile present in Iran, while flying at cruising altitude, this scenario was assessed as unlikely. As a consequence, just like many other European airlines, Dutch airlines were still flying above Iran at the moment when the conflict suddenly escalated further, following the launch of ballistic missiles by Iran aimed at two American airbases in Iraq. A few hours later, shortly following takeoff from Tehran Airport, flight PS752 was hit by an Iranian missile, and crashed.

The crash of flight PS752 made it painfully clear that the uncertain situation that emerges in any escalating conflict is still underestimated by all parties involved. This can be explained by the fact that the likelihood of a threat occurring is given a considerable weighting in the risk assessment method employed. As long as there is uncertainty about the further course of the conflict, the likelihood that a passenger aircraft will be shot down is assessed as low. As a result, airlines remain convinced that it is safe to continue flying. A decision to stop flying over a particular area must also be viewed in a context in which the cancellation or the rerouting of flights has financial and logistic consequences and can affect the competitivity of the airline in question. As long as the likelihood of the catastrophic scenario cannot be clearly demonstrated, the scenario is qualified as not real, and as such represents no reason to avoid a particular airspace. As a result, airlines continue to overfly the area.

The risk assessment methods currently in use are insufficient in situations characterized by unpredictable conflict, because in a conflict with an uncertain course, it is not possible to predict the likelihood of catastrophic scenarios for civil aviation. Escalating conflicts between and within states are inherently unpredictable. The heavily weighted factor of likelihood employed in these methods loses its meaning in unpredictable conflicts. Specifically for scenarios with catastrophic consequences, this is a problem. To better estimate the risks for civil aviation above areas experiencing (escalating) conflicts, those risks must be assessed according to a different method. Instead of the likelihood, the impact of the scenario based on the precautionary principle should be leading. At the point when a catastrophic scenario becomes conceivable, while the further course of the conflict remains uncertain, there is ground to act as a precaution. According to this method of risk assessment, a temporary stop of flying over a conflict zone far sooner emerges as a serious option: instead of waiting until the risk has emerged, for example following the actual firing of missiles, intervening as a precaution, at an earlier stage. If airlines operating flight routes over conflict zones were to act according to the precautionary principle, this would mean accepting that at certain times, they are unable, temporarily, to overfly (parts of) those areas, because at that time, the course of the escalation was uncertain. To bring this situation about, risk assessment methods by airlines worldwide must be further developed.

To drastically reduce the likelihood of future tragedies as a consequence of missile impact, the first barrier, namely the closing of airspace by the state over or nearby whose territory a conflict is occurring, must be reinforced. After all, practice has revealed that these states in most cases do not close their airspace. There is no internationally shared consensus on the situations in which airspace should be closed. By developing international criteria for airspace management, the responsibility will become clearer, and that in turn is expected to result in the earlier closing of the airspace.

At European level, too, steps can be taken to improve the safety of passengers and crew. EASA, the European Union Aviation Safety Agency, as a key information hub, occupies a crucial position. Information and recommendations issued by the EASA reinforce the information position of member states and their airlines, so that better decisions can be taken on flying over or near conflict zones. The effectiveness of recommendations issued by EASA is however itself under pressure, due to the lengthy process which involves the necessary consultation of all EU member states. Economic, diplomatic and other

considerations of individual member states can also start to play a role in the decision-making process, thereby muddying the view of the safety of civil aviation. In particular with regard to rapidly escalating conflicts, the decision-making process takes too much time. Illustrative for this situation is that the first European information note on Iranian airspace was not released until fourteen hours after the crash of flight PS752, while the first public notice was not published until a further eight days later. As a consequence, there was no possible preventive effect. In order to make better use of the hub function that the EASA has acquired over the past few years, further development will be necessary, focusing specifically on speeding up the process and expanding the mandate of EASA.

Within the system of safety barriers, the focus of protecting passengers and crew lies with the airlines and the states they overfly. The crashes of flight MH17 and flight PS752 show that this system of safety barriers is not watertight, despite all the efforts made. Where other barriers fail, the state in which the airline is based can allocate itself a role in protecting civil aviation, by issuing a recommendation or issuing a flight prohibition for a conflict zone. Now that a number of states, and the European Union have taken steps towards (compulsory) recommendations, the Dutch government could also start to consider whether a more active role with (wherever necessary) relevant statutory possibilities could be appropriate. Creating possibilities for this further-reaching form of protection of citizens and passengers is by no means a decision to be taken lightly. It also engenders further responsibilities than the Dutch state has adopted to date, or is able to live up to. Following on from other states and in line with the EU recommendations, for the Netherlands, too, the time would appear ripe for reconsidering its role and responsibilities.

Passengers and crew must be able to rely on enjoying a safe flight, irrespective of the airline, the point of departure and the destination they choose. Air safety in relation to conflict zones is a complex, shared and international problem, that can only be tackled through joint efforts. Against that background, the Dutch Safety Board has issued recommendations at various levels. By assessing risks based on the precautionary principle, both states and airlines are able to take measures sooner, thereby preventing civil aircraft still overflying the area, in a situation of rapidly escalating conflict. Moreover, international consensus regarding the situations in which airspace should be closed can contribute to a necessary improvement in the field of airspace management. Thirdly, decision-making at European level must be accelerated so that information and recommendations can have a preventive effect. Finally, an enhanced set of instruments in states where airlines are based can contribute to the protection of passengers and crew. For that reason, the Dutch Safety Board recommends that the Dutch government reconsiders its role and responsibility in advising on and regulating Dutch airlines overflying conflict zones. Efforts are needed at all four levels in order to better manage the risks of overflying conflict zones, so that passengers and crew can be confident of enjoying a safe flight.

RECOMMENDATIONS

To the Minister of Infrastructure and Water Management and the Minister of Justice and Security:

National: advice and regulation

1. Consider expanding the possibilities for the Dutch state, in addition to the provision of information to airlines, to also issue advice, and as the ultimate remedy, to impose a flight prohibition for Dutch operators in foreign airspace.

To the Minister of Infrastructure and Water Management:

International: innovation of the risk assessment methods

2. Encourage the development and application of risk assessment methods based on the precautionary principle for civil aviation operations over or near conflict zones. Take the initiative on international level to further develop the risk assessment methods as described in ICAO Doc 10084. Closely involve airlines and work out how possible catastrophic scenarios can be identified in the event of an escalating conflict, and how uncertainties must be taken into account in the analysis and decision-making.

International: criteria for airspace closures

3. Take the initiative at international level to develop a specific proposal for a stricter definition of the responsibility of states with regard to airspace management, so that it is clear in which cases the airspace should be closed. Urge the inclusion of this proposal in the Chicago Convention and the underlying Standards and Recommended Practices.

To the European Union Aviation Safety Agency (EASA):

European: effectiveness of European guidance

4. Further develop the European Information Sharing and Cooperation Platform on Conflict Zones by expanding the available information without losing rapidity, including analysis and recommendations to member states, airlines and other stakeholders.

To the Commissioner for Home Affairs and the Commissioner for Transport of the European Commission:

European: effectiveness of European guidance

5. Enhance the efficiency and the effectiveness of the European Integrated Aviation Security Risk Assessment process, so that Conflict Zone Information Bulletins are published faster and include information and recommendations that are tailored to the operational needs of airlines.

J.R.V.A. Dijsselbloem
Chairman Dutch Safety Board

C.A.J.F. Verheij
Secretary Director

ABBREVIATIONS

AIC	Aeronautical Information Circular
AIP	Aeronautical Information Publication
ATS	Air Traffic Services
AIVD	Netherlands General Intelligence and Security Service (*Dutch: Algemene Inlichtingen- en Veiligheidsdienst*)
CANSO	Civil Air Navigation Services Organisation
CAO	Civil Aviation Organization of the Islamic Republic of Iran
CCT	Contingency Coordination Team
CZIB	Conflict Zone Information Bulletin
DG HOME	Directorate-General for Migration and Home Affairs of the European Commission
DG MOVE	Directorate-General for Mobility and Transport of the European Commission
EASA	European Union Aviation Safety Agency
EC	European Commission
EEAS	European Union External Action Service
EGRICZ	Expert Group on Risk Information overflying Conflict Zones
ERP	Emergency Response Plan
EU	European Union
EU INTCEN	European Union Intelligence and Situation Centre
FAA	Federal Aviation Administration (United States)
FIR	Flight Information Region
FL	Flight Level
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IFALPA	International Federation of Air Line Pilots' Associations
IFATCA	International Federation of Air Traffic Controllers' Associations
ILT	Human Environment and Transport Inspectorate (Dutch: *Inspectie Leefomgeving en Transport)*
KFSSB	KLM Flight Safety & Security Briefing
KLM	Royal Dutch Airlines (Dutch: *Koninklijke Luchtvaart Maatschappij*)
MIVD	Netherlands Defence Intelligence and Security Service (Dutch: *Militaire Inlichtingen- en Veiligheidsdienst*)

NCTV	National Coordinator for Security and Counterterrorism (Dutch: *Nationaal Coordinator Terrorismebestrijding en Veiligheid*)
NOTAM	Notice to Airmen
OAB	Overflight Assessment Board
OCC	Operations Control Centre
OSA	Overflight Security Assessment
SAM	Surface-to-air missile
SFAR	Special Federal Aviation Regulation (United States)
SRB	Safety Review Board
SSCC	Safer Skies Consultative Committee
TSB	Transportation Safety Board of Canada
UK	United Kingdom
UN	United Nations
US	United States (of America)
VNV	Dutch Airline Pilots Association (Dutch: *Vereniging Nederlandse Verkeersvliegers)*

1 INTRODUCTION

1.1 Background

On 17 July 2014, 298 people lost their lives when Malaysia Airlines flight MH17 crashed due to a missile launched from a Buk surface-to-air missile system. The Dutch Safety Board investigated this crash, publishing a final report in 2015[1] and a follow-up report in 2019[2]. The crash of flight MH17 and the recommendations of the investigation have put the issue of flying over or near conflict zones firmly on the agenda, both in the Netherlands and internationally.

On 8 January 2020, Ukraine International Airlines flight PS752 was shot down in Iran. All 176 people on board the aircraft lost their lives. As this flight, like MH17, was also shot down by a missile, this event once more raised concerns about the decisions made regarding flying over or near conflict zones. With reference to this recent event, the Dutch Minister of Infrastructure and Water Management requested the Dutch Safety Board to reflect again on the implementation of the *MH17 Crash* report recommendations and on possible new lessons. The Dutch Safety Board decided to respond to the Minister's request by starting an additional follow-up investigation into the safety of flight routes. This report synthesizes the findings of the Dutch Safety Boards' previous investigations (2015 and 2019), complemented with new findings on the current practice of airspace management, information sharing and decision-making in the context of flying over or near[3] conflict zones.

For the purpose of this report, the following definition of *conflict zone*[4] is used:
Airspace over areas where armed conflict is occurring or is likely to occur between militarized parties, and is also taken to include airspace over areas where such parties are in a heightened state of military alert or tension, which might endanger civil aircraft (ICAO Doc 10084 Risk Assessment Manual for Civil Aircraft Operations over Conflict Zones).

1 Dutch Safety Board, *MH17 Crash*, 13 October 2015.
2 Dutch Safety Board, *Flying over conflict zones - Follow-up recommendations MH17 Crash*, 21 February 2019.
3 There is no clear definition for near in relation to flying near a conflict zone. This depends on the development of the conflict and the weapons present.
4 A wide variety in terminology is used in relation to conflict zones, as this is a sensitive topic for states involved. The ICAO definition is used in this relation to conflict zones, because this conclusion includes not only areas with an armed conflict, but also areas with increased tension and areas where the use of arms may occur.

1.1.1 MH17

Flight MH17 crashed over the eastern part of Ukraine, where an armed conflict had broken out in April 2014. During the period between the conflict breaking out in the eastern part of Ukraine and the day of the crash of flight MH17 on 17 July 2014, Ukrainian armed forces' helicopters, transport aeroplanes and fighters were shot down. On 6 June 2014, the airspace above the eastern part of Ukraine was closed to civil aviation below an altitude of 26,000 feet (FL260). On 14 July 2014, the upper limit of the restricted airspace imposed on civil aviation was increased to 32,000 feet (FL320). Operators assumed that the unrestricted airspace above FL320 over the eastern part of Ukraine was safe. Flight MH17 was flying at 33,000 feet (FL330) when it was shot down.

MH17 was not the only flight passing over the eastern part of Ukraine. This airspace was a frequently used route. Between 14 and 17 July 2014, 61 operators from 32 countries routed their flights through this airspace. On the day of the crash, 160 flights flew over the area before the airspace was closed. The question that arose was: why were those aircraft flying over the eastern part of Ukraine?

Investigation by the Dutch Safety Board

Following the crash of flight MH17, the Ukrainian authorities initiated an investigation, in accordance with the international standards on accident investigation ICAO Annex 13. On 23 July 2014, following a request from the Ukrainian authorities, Ukraine delegated the investigation to the Netherlands, the state with the largest number of nationals on the aeroplane. As the safety investigation authority of the Netherlands, the Dutch Safety Board was tasked with conducting the investigation.

Besides the investigation into the cause of the crash, one of the key questions of the investigation concerned the decision-making process related to flying over conflict zones. The MH17 crash investigation revealed that the structure and functioning of the system of civil aviation responsibilities did not always lead to an adequate assessment of the risks associated with flying over conflict zones. The Dutch Safety Board issued its final report in October 2015. It included eleven recommendations aimed at improving the risk management process globally. The Board concluded that improvements were necessary in airspace management, risk assessment, and operator accountability.

Follow-up investigation by the Dutch Safety Board

Considering the impact of the crash and the importance the Dutch Safety Board attaches to the recommendations, in 2018 the Board started an investigation into the follow-up to the recommendations with regard to flying over conflict zones.

In its follow-up report, the Dutch Safety Board concluded that since the crash of flight MH17 states and operators around the world are more active in gathering and exchanging information, and are more aware of the risks posed by flight routes passing over or near to conflict zones. Moreover, with amendments to the international aviation standards in ICAO Annexes, the International Civil Aviation Organization (ICAO, see paragraph 1.6 for an overview of the organizations involved) has incorporated the importance of sharing information about conflict zones and the associated risk assessments in the global regulatory framework. In conclusion, civil aviation operations over conflict zones have been firmly on the international agenda since 17 July 2014. Nonetheless, the follow-up

investigation also highlighted the difficulties of actual implementation in practice, for example in relation to airspace management and the sharing of classified threat information.

1.1.2 PS752

Concerns about safety of flying over or near conflict zones were reiterated by the crash of flight PS752. Flight PS752 was a scheduled passenger flight from Tehran to Kiev, which was shot down in a region with increased military tension. This flight, which was operated by Ukraine International Airlines, crashed a few minutes after take-off from Tehran Imam Khomeini International Airport, Iran on 8 January 2020. All 176 occupants were killed in the crash. On 11 January, Iran reported that the aircraft had been hit by a missile fired from an Iranian missile defence installation. At the time of the crash several other civil aircraft were also flying in the airspace of Iran.

1.1.3 Request of the Dutch Minister of Infrastructure and Water Management

As Dutch civil aircraft were among those that were flying in the airspace of Iran and Iraq shortly before the crash of flight PS752, additional questions were raised: What are parties doing in practice to select safe flight routes? What lessons can be learned to further reduce the risks associated with flying over and in conflict zones? The Minister of Infrastructure and Water Management asked the Dutch Safety Board to reflect on the desired adjustments to the global, European and national system – relating to the Dutch government's role as State of the Operator - to better manage the risks associated with flying over conflict zones. The Dutch Safety Board decided to respond to the Minister's request by starting an additional follow-up investigation into the safety of flight routes.

1.2 Focus of the present investigation

The scope of this additional follow-up investigation is complementary to the previous follow-up investigation, as it builds on the findings of the previous investigations and takes the context of Dutch airlines and the Netherlands as State of the Operator as the starting point.

This report provides an update regarding various aspects that emerged from the previous investigations. The following five aspects that contribute to the safety of flight routes are central to the investigation:

I. the management of airspace in states with a conflict zone on their territory or near to their territory;
II. the sharing of (threat) information by states and airlines[5];
III. providing guidance to airlines by the state of the operator in the form of advice or regulation;
IV. the airlines' own risk assessment processes and how these feed into their decisions about flying over or near conflict zones;

5 For the purpose of this investigation the focus is on airlines. ICAO Annex 6 defines an operator as a person, organization or enterprise engaged in or offering to engage in an aircraft operation. An airline is considered an operator offering public transport of passengers and/or cargo.

V. accountability by airlines for their decisions, distinguishing between public accountability and transparency about chosen routes on the one hand, and accountability towards the relevant state authority about their risk assessment process on the other.

The investigation focuses on what parties do in practice for each of these five aspects in general, and in particular on their response to the heightened military tension in Iran and Iraq at the time of the crash of flight PS752. In its follow-up report, the Dutch Safety Board concluded that the manner and swiftness of sharing threat information in rapidly emerging conflicts are a point of attention. The crash of flight PS752 occurred during a rapid escalation of the conflict in an already volatile region, which emphasizes the necessity to further investigate the timeliness of information-sharing and decision-making and to draw lessons to further improve safety. Timeliness is therefore emphasized in the elaboration of aspects II and IV.

The investigation focuses on the parties that, from the perspective of Dutch airlines, have or may have a major contribution in the decision-making process regarding the safety of flight routes. These parties are Dutch airlines, the Dutch government, foreign airlines, foreign states, and the European Union, EASA in particular. The focus on the Dutch context allows consideration of possible lessons for the broader international context as well. These broader lessons may improve the safety of civil aviation globally, which is relevant for all states as citizens also take flights with airlines based outside their own country.

1.3 Investigation questions

The aims of the investigation are to provide insight into the current practice of the selection of safe flight routes by Dutch airlines, and to determine whether new lessons can be learned to further reduce the risks associated with flying over or near conflict zones. The key question of this follow-up investigation is as follows:

> How is the safety of flight routes in relation to conflict zones organized for Dutch airlines, and what further improvements are possible?

This key question is divided into the following sub-questions:

a. How do states with a conflict zone on their territory or near to their territory manage their airspace?
b. What is the practice of information-sharing and decision-making for Dutch airlines?
c. What was the process of information-sharing and decision-making for Dutch airlines with regard to the escalating conflict in Iran and Iraq before and at the time of the flight PS752 crash?
d. How do Dutch airlines account for the routes they fly?

1.4 Demarcation

The response of parties to the heightened tension in the period before the time of the crash of flight PS752 is part of this investigation by the Dutch Safety Board. Neither the cause of the crash of flight PS752, nor the management of Iranian airspace is part of this investigation, as the accident investigation into the cause of the crash of flight PS752 is led by the Aircraft Accident Investigation Board of the Civil Aviation Organization of the Islamic Republic of Iran (CAO).[6] The final investigation report[7], released by Iran in March 2021, indicates that due to the incorrect calibration of the missile system's radar and subsequent human actions, flight PS752 was mistaken for a target by an air defense unit.

The present investigation by the Dutch Safety Board is chosen to be limited in scope. The practice of information sharing and decision-making by Dutch airlines was investigated through interviews and assessment of relevant documents. Flight behaviour was analysed using publicly available flight data.

The process of collection, analysis and dissemination of intelligence, other than the shared information in the current civil aviation context, was not assessed by the Dutch Safety Board.

1.5 Other investigations and initiatives

The crash of flight PS752 gave rise to several other investigations and initiatives, focusing on improving aviation safety in relation to conflict zones.

In February 2020 the Safer Skies Initiative was established, building on the efforts and work done following the crash of flight MH17. The aim of this international initiative is to enhance the level of safety and security for commercial airlines travelling in higher risk areas and to prevent future tragedies. Canada has taken a key role in the Safer Skies Initiative, as 55 Canadian citizens and 30 permanent residents[8] were among the 176 people killed in the crash of flight PS752. So far, the commitment statement of the Safer Skies Initiative has been endorsed by 17 states.[9] One key outcome from the Safer Skies Initiative was the establishment of the Safer Skies Consultative Committee (SSCC)[10] to propose and advance initiatives to mitigating conflict zone risks. SSCC initiatives include seeking improvements to information sharing and developing training and mentoring

6 The investigation is led by Iran as State of Occurrence (Annex 13 of the Chicago Convention). The following countries are participating in the accident investigation: Ukraine (State of the Operator), United States (State of the aircraft's Design and Manufacture) and France (State of the engine's Design and Manufacture). The Transportation Safety Board of Canada (TSB) is also involved and has appointed an expert. The Netherlands is not participating in this investigation; this is in accordance with international standards.

7 Aircraft Accident Investigation Board of the Islamic Republic of Iran, *Flight PS752 Accident Investigation, Final report,* 15 March 2021.

8 Source: Ralph Goodale, Special Advisor for Canada's ongoing response to the Ukraine International Airlines tragedy, *Flight PS752; The long road to transparency, accountability and justice*, 15 December 2020.

9 Status 1 February 2021.

10 The Safer Skies Consultative Committee (SSCC) was established in July 2020 as an international collaborative forum to address the objectives in the Safer Skies Initiative. The following government and industry partners take part in the SSCC: Canada (chair), CANSO, EGRICZ, France, IATA, IFALPA, IFATCA, Netherlands (co-chair), New Zealand, Spain, Ukraine, United Kingdom and United States.

opportunities to develop states' capacity in assessing conflict zone risks, communicating with their respective operators, and establishing mitigation measures.

Early 2020 the Prime Minister of Canada appointed a special advisor to examine the Canadian government's response to the crash and the chronology of events, and to propose recommendations. On 15 December 2020, the special advisor published his report.[11]

The United Nations (UN) Special Rapporteur on extrajudicial, summary or arbitrary executions - an independent human rights expert - examined the downing of the flight from a human rights perspective. In this investigation the UN Special Rapporteur focused on whether the states had fulfilled their obligations to respect and protect the right to life of the passengers on board. Exactly one year after the crash of flight PS752, the UN Special Rapporteur published a statement[12] calling for urgent measures to protect civilian aircraft flying in conflict zones or areas of high military tension.

1.6 Overview of responsibilities in the selection of safe routes

The decision-making regarding flight routes used by airlines is multi-layered and involves the interaction of several stakeholders. Three groups of organizations contribute to the selection of safe flight routes:

1. States in the context of airspace management: states with a conflict zone on their territory or near to their territory have to manage the safety of their airspace.
2. Airlines (Operators): airlines are responsible for the decisions they make about flying over or in a specific area;
3. States in the context of state of the operator: states in which the airlines are based have to assist those airlines in making decisions about flying over or in a specific area by sharing information in a timely manner. More guidance in the form of recommended actions or regulation is provided by a limited number of states (see Chapter 3).

Flying over and in conflict zones is an international issue with complex interactions. Each of the three groups of organizations should act as a crucial barrier in the system that aims to prevent tragedies such as the crash of flight MH17 and flight PS752. As is shown in Figure 1, each group of organizations can decide that flying in a certain airspace is not safe. Furthermore, each group of organizations has a role in the sharing of threat information.

11 Ralph Goodale, Special Advisor for Canada's ongoing response to the Ukraine International Airlines tragedy, *Flight PS752; The long road to transparency, accountability and justice*, 15 December 2020.

12 United Nations Special Rapporteur on extrajudicial, summary or arbitrary executions, *Statement, Commercial Airlines and conflict zones: Recommendations to strengthen air safety and prevent of unlawful deaths*, 7 January 2021.

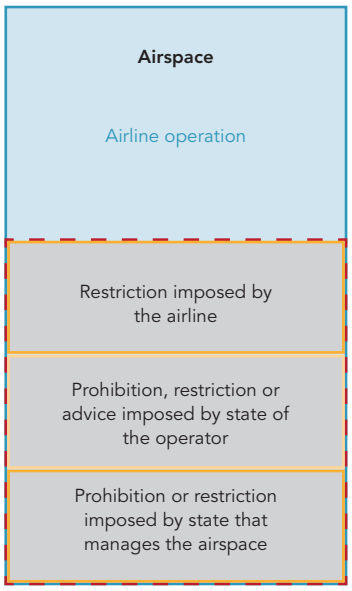


Figure 1: The airspace that is available for airline operation is limited by decisions of the state that manages the airspace, the state of the operator and the airline itself.

The responsibilities of the various organizations are laid down in aviation regulations to which states and airlines have to conform. The international framework for civil aviation is established by the International Civil Aviation Organization (ICAO), an agency of the United Nations. The principles on which ICAO's work is based are defined in the Chicago Convention, which has been ratified by all of its 193 member states, and are elaborated in Annexes, documents (Docs) and Manuals. The Annexes contain standards, which must be followed by member states, and recommended practices. There are nineteen Annexes addressing various topics, including aviation safety and security.

In the European Union (EU), legislation related to aviation safety is established in European regulations which are directly binding for EU member states. Since EU member states are also ICAO member states, European requirements must be consistent with ICAO standards. The European Commission is the executive body of the European Union. The European Commission is responsible for proposing legislation, managing the EU budget, enforcing EU law and representing the EU at an international level. The European Union Aviation Safety Agency (EASA) is a specialized EU agency that acts as the aviation safety authority. The tasks of EASA include preparing proposals for European legislation; certifying aviation products such as aircraft, engines and parts; providing oversight and support to EASA member states; and approving aviation organizations. A more extensive description of these international organizations can be found in the report on the follow-up to the recommendations from the MH17 crash.[13]

13 Dutch Safety Board, *Flying over conflict zones - Follow-up recommendations MH17 Crash*, 21 February 2019.

1.7 Reading guide

In the report, the five aspects mentioned in paragraph 1.2 are discussed as follows: Chapter 2 describes airspace management (aspect I). Sharing information and providing guidance to airlines by the states in which those operators are based (aspects II and III) are discussed in Chapter 3. Chapter 4 describes the risk assessment process performed by airlines, as well as the accountability of airlines (aspects IV and V). Each chapter follows the same structure, starting with a paragraph about the significance of the aspect(s). The next paragraph describes the responsibilities and obligations of parties regarding the aspect(s) concerned. The practice of the aspect(s) for Dutch airlines is then described (except in Chapter 2). Finally, the actual response of parties to the escalation of the conflict at the time of the crash of flight PS752 is described in each chapter. The conclusions and recommendations are set out in Chapters 5 and 6 of this report.

Note that this report synthesizes the findings of the Dutch Safety Boards' previous investigations (2015 and 2019) complemented with new findings. Readers with a professional background in the topic are recommended to start with the conclusions and the paragraphs describing the actual response of parties to the escalation of the conflict at the time of the crash of flight PS752 (paragraphs 2.4, 3.5 and 4.4).

2 AIRSPACE MANAGEMENT

2.1 Significance

All states have sovereignty over the airspace above their own territory.[14] This means that the relevant state exercises complete and exclusive control over its own airspace and bears responsibility for managing the airspace above its territory. For reasons of safety, a state has the possibility, but also the responsibility, to restrict or prohibit access to its airspace. This may be necessary when military tension increases or when the state is facing a conflict with (potential) use of arms on its territory. Airspace management by states with a conflict zone on their territory or near to their territory is of the utmost importance, as it is the first step in the protection of civil aviation.

2.2 Responsibilities and obligations

States' responsibilities and obligations with regard to airspace management and conflict zone threats are laid down in different ICAO standards. First of all, states have the obligation to monitor the level and nature of threats to civil aviation within their territory and the airspace above it.[15] Furthermore, coordination with the authorities that provide Air Traffic Services (ATS) is required at the state level for activities potentially hazardous to civil aircraft.[16]

Air Traffic Services (ATS)
Air Traffic Services is a generic term which includes air traffic control service (area control service, approach control service or aerodrome control service), flight information service, alerting service, and air traffic advisory service. The appropriate air traffic service authority is the relevant authority designated by the state responsible for providing air traffic services in the airspace concerned.

Activities potentially hazardous to civil aviation include military activities. These activities range from training exercises, practice firing, and weapons testing, to operations in conflict zones and (the potential for) armed conflict. ICAO guidance material discusses

14 Convention on Civil Aviation (Chicago Convention), 7 December 1944, 15 U.N.T.S. 295, ICAO Doc. 7300/9.
15 ICAO Annex 17 Security, standard 3.1.3, applicable as of 3 August 2017.
16 ICAO Annex 11 Air Traffic Services, standard 2.19.1.

aspects that affect the risks over or near conflict zones.[17,18,19] These documents offer states guidelines for airspace management.

Collaborative decision-making processes involving both ATS and military authorities is advised when military activities are potentially hazardous to civil aircraft operations. A key element in this process is that civil and military stakeholders share all information relevant to the operation of aircraft in a timely manner. International standards have been amended to ensure that, based on all relevant information, the appropriate ATS authority conducts a safety risk assessment for these potentially hazardous activities, so that appropriate risk mitigation measures for the protection of civil aircraft are implemented.[20] These measures may include closure of all or part of the airspace; restrictions on, for example, the flight altitudes or ATS routes to be used; or the publication of warnings and information notices.

No clear criteria have been established, however, as to when states should close or restrict their airspace. In 2015 this finding led the Dutch Safety Board to issue a recommendation addressed to the ICAO member states.

Recommendation to ICAO member states (*MH17 Crash report*, 2015):
Ensure that States' responsibilities related to the safety of their airspace are stricter defined in the Chicago Convention and the underlying Standards and Recommended Practices, so that it is clear in which cases the airspace should be closed.

In 2019, the Board concluded that although initiatives had been taken at the ICAO level to better define a state's responsibility in relation to conflict zones, no further steps have been taken to make clear in which cases the airspace should be closed. This aspect was also highlighted in the recent statement of the United Nations (UN) Special Rapporteur on extrajudicial, summary or arbitrary executions.[21] This statement emphasized that state authorities are expected to take all reasonable measures to avoid a real and immediate risk to life, and that the closure of airspace is a reasonable and evident measure to be taken to protect lives. The UN Special Rapporteur also stressed that the international community must establish clear and explicit standards on when states should close the airspace under their jurisdiction.

After the crash of flight MH17, a new ICAO standard was adopted that requires states to implement procedures to give timely information to relevant parties, such as airlines, and

17 ICAO Doc 10084, *Risk Assessment Manual for Civil Aircraft Operations Over or Near Conflict Zones, Second Edition*, 2018.
18 ICAO Doc 9554, *Manual concerning Safety Measures Relating to Military Activities Potentially Hazardous to Civil Aircraft Operations, First Edition*, 1990.
19 ICAO Doc 10088, *Manual on Civil/Military Cooperation in Air Traffic Management, First Edition*, 2020.
20 ICAO Annex 11 Air Traffic Services Amendment 52, standard 2.19.3, applicable as of 5 November 2020.
21 United Nations Special Rapporteur on extrajudicial, summary or arbitrary executions, *Statement, Commercial Airlines and conflict zones: Recommendations to strengthen air safety and prevent of unlawful deaths*, 8 January 2021.

by doing so shall assist in the conduct of effective security risk assessment.[22] Coordination between military and civil stakeholders on activities, threats and mitigation measures allows for the early promulgation of information regarding activities that are potentially hazardous to civil aviation. The ICAO standards have been amended to specifically indicate that in order to inform operators of civil aircraft about conflict zones, a state is obliged to issue a Notice to Airmen (NOTAM).[23] The NOTAM must include information that is as specific as possible regarding the nature and extent of threats posed by that conflict and its consequences for civil aviation. Besides a NOTAM, a state has other means to officially publish aeronautical information of a lasting character, namely as part of the Aeronautical Information Publication (AIP) or by the issuance of an Aeronautical Information Circular (AIC).

Aeronautical publications[24]

An Aeronautical Information Publication (AIP) is a publication issued by or with the authority of a State and containing information of a lasting character essential to air navigation.

Aeronautical Information Circulars (AICs) are notices containing information that do not qualify for the origination of a NOTAM or for inclusion in the AIP, but relate to flight safety, air navigation, technical, administrative or legislative matters.

A Notice to Airmen or NOTAM is a notice distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.

The crash of flight MH17 initiated the development and amendment of ICAO standards and guidance material on airspace management in relation to conflict zones. Most of the standards became applicable only recently, on 30 July 2020[25] and 5 November 2020[26]. To support their member states in the implementation of the standards and available guidance material, ICAO is planning to organize workshops.[27] No information is publicly available on the current level of implementation of the standards by states.

22 ICAO Annex 17 Security, standard 3.1.5, applicable as of 16 November 2018, updated standard applicable as of 30 July 2020.
23 ICAO Annex 15 Aeronautical Information Services Amendment 41, standard 6.3.2.3, applicable as of 5 November 2020.
24 Source: ICAO Annex 15 Aeronautical Information Services.
25 Annex 17 (update of standard 3.1.5 on procedures for information sharing with relevant stakeholders).
26 Annex 11 (standard 2.19.3 on safety risk assessments by the ATS authority), Annex 15 (standard 6.3.2 on NOTAMs).
27 ICAO State Letter SMM1/4-20/110, *subject: Risk management in conflict zones*, 23 October 2020.

Sub-conclusions
States bear the responsibility for managing the airspace above their territories. States with a conflict zone on their territory or near to their territory explicitly remain fully responsible to manage the safety of their airspace.

Following the crash of flight MH17, the ICAO standards and guidelines related to airspace management have been amended to specify the responsibilities of states in case of a (potential) conflict in or near their territory. Nevertheless, most of the standards became applicable only recently, in July and November 2020. Three of the most relevant new standards are the following: First, states shall monitor threats to civil aviation within their territory and in the airspace above it. Second, states shall coordinate this information with their Air Traffic Service provider(s). Finally, states with a conflict on their territory shall inform other states and airlines about the conflict and the extent of threats by means of a NOTAM.

Although the new standards lay the foundation of states' responsibilities with regard to airspace management, the standards lack clear criteria on when states should close or restrict access to their airspace.

2.3 Airspace management worldwide

At the time of the crash of flight MH17, most states that were facing a conflict on or near to their territory did not close or restrict their airspace; nor did those states publish information about the conflict through aeronautical publications. Of the eleven conflict zones examined by the Dutch Safety Board in July 2015, three states had restricted or partly closed their airspace to civil aviation, and one state had issued a warning. In 2019, the Board concluded that the situation regarding airspace management in relation to conflict zones had not been improved. Of the fifteen states that were known to have faced a conflict in September 2018, only one state had prohibited a part of its airspace and two states had warned of the risks caused by the conflict on their territory.

Figure 2 presents the status of airspace management in relation to conflict zones on 5 January 2021. The map shows nineteen areas for which at least either Canada, France, Germany, the United Kingdom (UK), the United States (US) or EASA have published information; see paragraph 3.4. Only four of the nineteen sovereign states concerned have implemented restrictions or a prohibition of all or part of their airspace: Libya and Saudi Arabia have implemented restrictions, and Azerbaijan and Ukraine have issued a prohibition to fly in part of their airspace. Most of the states concerned have not issued any restrictions or prohibitions. Pakistan has contradicted the publications of foreign states in an AIC, stating that Karachi and Lahore Flight Information Regions (FIRs) are safe for all types of aircraft operations.

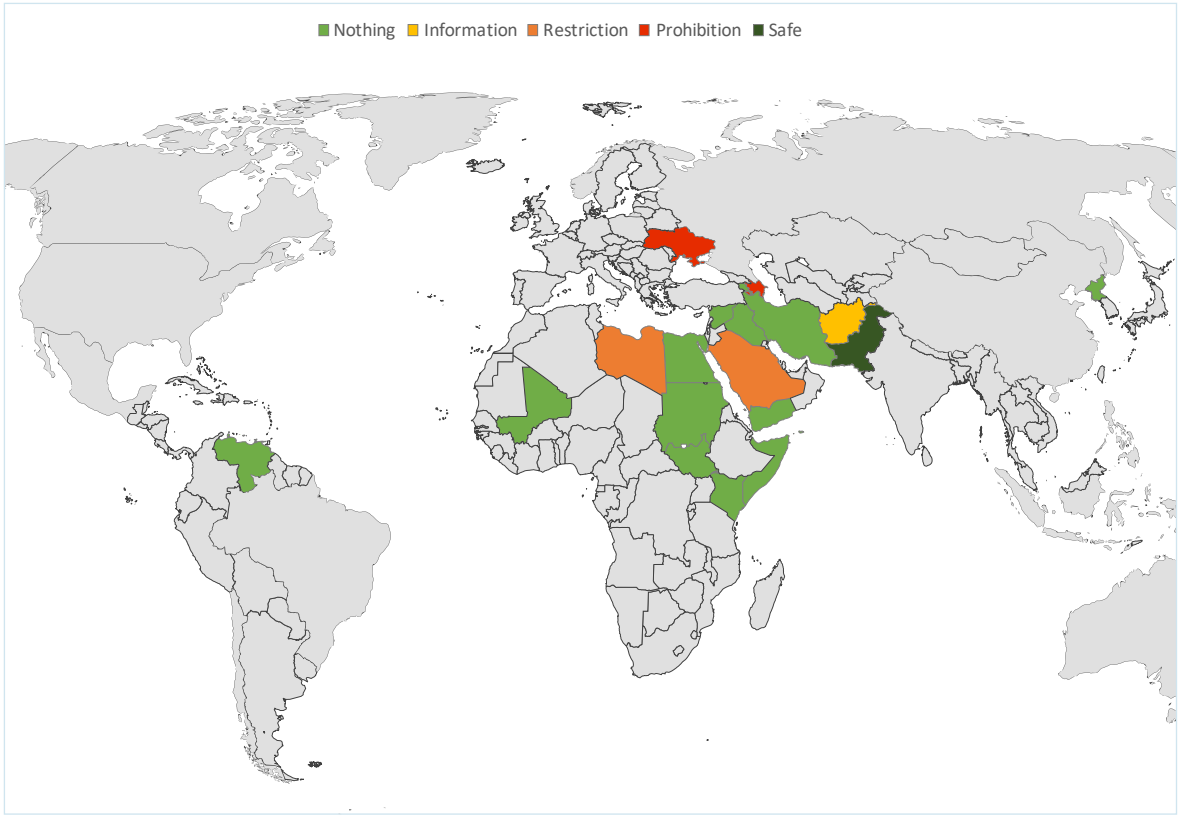


Figure 2: Aeronautical publications on conflict zones by states having a conflict on their territory, applicable on 5 January 2021.

Most conflict zones are at great distance from the Netherlands, except from Venezuela that borders the Kingdom of the Netherlands. Although a military conflict with the Kingdom of the Netherlands seems unlikely, there is a risk of inadvertent escalation due to possible misinterpretation and incidents as a result of the decline in military professionalism within Venezuela.[28] The situation is considered unstable and the crisis in Venezuela may affect the entire region. This may also affect airspace safety in Aruba, Bonaire and Curacao. In order to illustrate the practice of airspace management into more detail, the box below discusses two recent conflicts in relation to airspace management.

28 Dutch state, in Dutch: *Dreigingsbeeld statelijke actoren*, (Threat assessment of state actors), 3 February 2021.

The situation in practice - two conflict zones detailed

The conflict between **Armenia and Azerbaijan** concerning the region of Nagorno-Karabakh escalated towards the end of September 2020 and lasted until mid-November 2020. There have been no new reports of fighting since then. Apart from the long-lasting NOTAM regarding Nagorno-Karabakh (NOTAM UBBA A0024/11, 11 February 2011), Azerbaijan established a Temporary Restricted Area along the border with Armenia, which meant that all east-west airways between the two countries were effectively closed (UBBA A0084/20, 21 July 2020). This airspace was reopened on 10 November 2020. In addition, Azerbaijan issued a NOTAM closing specific ATS routes in FIR Baku (UBBA A0083/20, 21 July 2020). Azerbaijan also issued a NOTAM advising caution across the UBBA/Baku FIR due to the spill over of the conflict, with the specific warning of the threat posed by long-range missiles which it claimed Armenia had been using to target locations throughout Azerbaijan (NOTAM UBBA A0148/20, 5-14 November 2020). During the conflict Armenia did not close any part of its airspace. Instead it issued a NOTAM advising operators to expect tactical rerouting and short-notice closures in the airspace along the border, and recommended that aircraft carry additional fuel (UDDD NOTAM A0113/20). This NOTAM was cancelled on 30 September 2020.

The conflict in the Tigray region along the border between **Ethiopia and Eritrea** escalated rapidly in early November 2020. In this conflict Tigray regional forces fought against the Ethiopian government in the Tigray region. The conflict spread to Eritrea. There was heavy fighting, there were multiple airstrikes, and missiles were fired across the border into Eritrea, targeting the airport of Asmara. Within Ethiopia, Bahir Dar and Gondar were also targeted. Ethiopia closed two airways (UM308 and UT124, NOTAM HAAA A376/20 and A377/20, 5 November – 5 December 2020) and aircraft transiting between the Addis Ababa and Asmara FIRs had to do so via BOPSA (NOTAM HAAA A0378/20, 5 November – 5 December 2020). These NOTAMs did not specify the reasons for the airways to be closed, nor did they point to the conflict. Flight crews and aircraft operators were therefore not alerted to any conflict in the area by a NOTAM. The airways that remained open were still close to the conflict zone. Eritrea did not issue a NOTAM.
NB: As there were no restrictions or recommended actions applicable on 5 January 2021, the conflict zone is not mapped in Figure 2.

Source: Safeairspace.net (status: January 2021)

The *MH17 Crash* report concluded that states facing a conflict on their territory might find it difficult to guarantee the safety of their airspace by closing airspace, setting restrictions, and providing information about the conflict. Based on the results presented above, it can be concluded that this finding still applies. Multiple factors, which include safety as well as the political context and economic circumstances, play a role in a state's consideration of whether to close or restrict its airspace. Instead of closing or restricting airspace, some states choose to share information about the conflict on their territory in a NOTAM or in the state's AIP. This can also be helpful, as it is potentially useful information for airlines that perform risk assessments related to flying over these areas.

Nonetheless, even when states do publicize information or restrict access to their airspace, the content of the information provided in the publications often lacks relevant detail on the actual hazards present. For example, information about the conflict and the weapon systems being used is often absent. In addition, a NOTAM about a conflict zone does not have a specific template or reference, which means that it is not immediately recognizable as a NOTAM concerning a conflict zone. In NOTAMs the relevant areas are identified through geographical coordinates instead of area visualizations. As such the NOTAM system has limitations in terms of raising awareness of conflict zones or making a comprehensive survey for a specific region.

Sub-conclusion
Most states with a conflict zone on their territory or near to their territory do not impose restrictions on their airspace for civil aviation, nor do they publish aeronautical information about the conflict. Even when states do publicize information or restrict their airspace, the content of the information provided in the publications often lacks relevant detail on the actual threats present. This situation has not changed since 2015.

2.4 Airspace management at the time of the crash of flight PS752

2.4.1 Escalation of the conflict situation in Iran and Iraq

For many years, there have been political tensions between Iran, states in the region and the US. Since the US stepped down from the Joint Comprehensive Plan of Action (also known as the "Iran Deal") in 2018 and imposed sanctions on Iran, tension between Iran and the US increased.[29] In May and June 2019, the situation escalated when several oil tankers were attacked and Iran shot down a US drone on 19 June 2019.

29 Dutch state, in Dutch: *Dreigingsbeeld statelijke actoren* (Threat assessment of state actors), 3 February 2021.

Figure 3: Tehran FIR (Iranian airspace) and Baghdad FIR (Iraqi airspace) (Source map: ICAO Geographic Information System gis.icao.int).

On 2 January 2020 around 21:45[30], the Iranian general Soleimani was killed near Baghdad International Airport, Iraq, by a drone strike directed by the US. This event triggered a rapidly escalating conflict between Iran and the US. In reaction to this event, Iran launched eleven to fourteen ballistic missiles in the direction of two American air bases in Iraq on 7 January 2020, between 22:30 and 23:48. Fearing reprisals, Iran then raised the alertness level of its air defence.

According to the Iranian accident investigation[31], Ukraine International Airlines flight PS752 received take-off clearance from Tehran Imam Khomeini International Airport at 02:40 on 8 January 2020. At 2:45, two missiles were fired towards flight PS752. At 02:48, just eight minutes after departure, flight PS752 crashed after being hit by a missile, causing all 176 occupants to be killed. Note that flight PS752 crashed close to Tehran, which is more than 400 km from Iraq.

On 11 January 2020, the general staff of the Iranian armed forces publicly announced that the Iranian air defence forces had shot down flight PS752 unintentionally from a missile defence installation. This was a surface-to-air missile system (SAM, more information on the particular SAM system can be found in the box below). The Iranian

30 All times in the report are indicated in UTC (Coordinated Universal Time), unless mentioned otherwise.
31 Aircraft Accident Investigation Board of the Islamic Republic of Iran, *Flight PS752 Accident Investigation, Final report*, 15 March 2021.

defense organization set up the SAM system as part of a defense system for Tehran in case of a retaliation attack.[32]

Weapon system[33]
Flight PS752 was shot down with a missile from a surface-to-air missile system called SA-15 Gauntlet (Tor-M1). This system is designed to destroy aerial targets, such as aircraft or other missiles, by launching missiles from the ground. These missiles have a maximum horizontal range of 14 kilometres and a maximum vertical range of 11 kilometres (the cruising altitude of civil aircraft). The missile system is mobile, as it is mounted on a vehicle. It can be used autonomously because the system has its own radar. These characteristics limit foreign intelligence services from knowing exactly where the systems are deployed and whether they are on high alert. The launch of the missiles requires human action, which makes this type of system prone to human mistakes.

In the final investigation report of the Iranian accident investigation, it is concluded that the human operator of the weapon system had identified the civil aircraft as a hostile target.

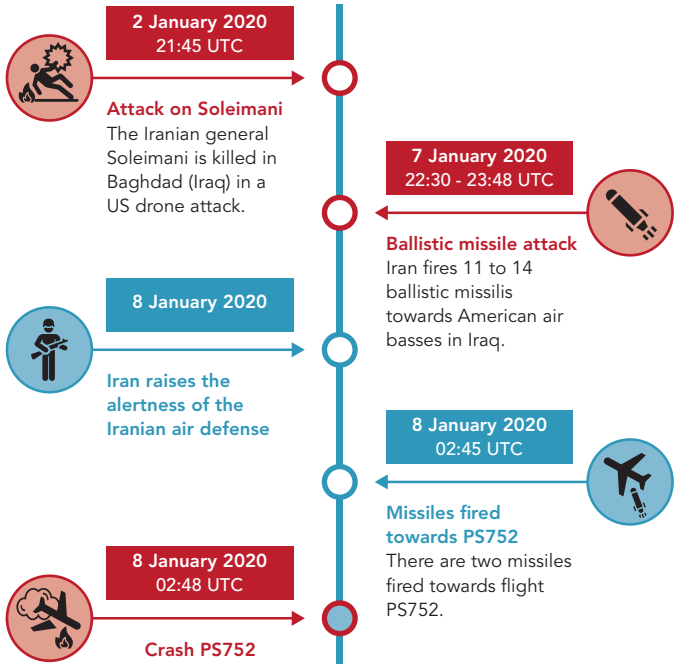


Figure 4: Timeline of the rapid escalation of the conflict that led to the crash of flight PS752.

32 Source: Dutch Ministry of Defence.
33 Source: Dutch Ministry of Defence.

2.4.2 Airspace management in Iran and Iraq

The final investigation report[34], released by Iran in March 2021, states that shortly after the ballistic missile attacks, following a risk assessment three measures were implemented by Iran's military sector and communicated to the civil sector of the state's airspace control.[35] First, the exchange of air traffic between the Baghdad FIR and Tehran FIR and vice versa was stopped. Second, the four parallel air traffic routes in the western part of Iran were cleared of air traffic. And third, coordination with the military sector would be required for civil aviation departure flights.

The underlying factual report states[36] that on 8 January 2020 at around 00:30 the Iranian military sector informed the civil sector of the state's airspace control that coordination would be required for civil flight operations. From that moment on, only those flights detected and cleared for flight operations by the Iranian defence network could be permitted to start up. This change in procedures, emphasizing that a go-ahead from the defence sector was needed prior to initiating a flight, was implemented with the aim of informing the Iranian air defence network that a civil aircraft would fly a specified route. This procedure was supposed to ensure the correct identification of civil flights by the defence network and avoiding targeting them by mistake. Shortly after 02:23, following the request by the Area Control Center, the Air Defence Coordination Center issued the clearance for flight PS752.

Although reportedly some operational airspace management measures were implemented, no prohibitions, restrictions or warnings had been issued by the Iranian authorities through aeronautical publications prior to or after the launch of the ballistic missiles, nor prior to the crash of flight PS752. Hours after the crash, on 8 January 2020 at 05:49 and 06:53, Iran issued two NOTAMs on respectively the implemented air traffic route restrictions on the Iran-Iraq border and the closure of the airways in the western part of Iran.[37] The NOTAMs did not contain any information about the conflict situation.

Iraq issued a NOTAM for its territory on 8 January 2020 at 14:35, twelve hours after the crash of flight PS752.[38] This NOTAM advised operators to exercise caution as missiles were reportedly being launched with unknown altitude and trajectory.

34 Aircraft Accident Investigation Board of the Islamic Republic of Iran, *Flight PS752 Accident Investigation, Final report,* 15 March 2021.

35 The risk assessments conducted by the relevant Iranian authorities in relation to the decisions made and measures taken with regard to the management of the airspace were not part of this investigation, see paragraph 1.4.

36 Iranian Civil Aviation Organization, *PS752 Accident investigation, Factual report,* July 2020.

37 NOTAM A0086/20, OIIX Tehran FIR, valid from 8 January 2020 05:49 until 8 January 2020 12:00, NOTAM A0087/20, OIIX Tehran FIR, valid from 8 January 2020 06:53 until 8 January 2020 13:00.

38 NOTAM A0018/20, ORBB Baghdad FIR, valid from 8 January 2020 14:35 until 15 January 2020 23:59.

Sub-conclusions

Prior to the ballistic missile attacks and the subsequent crash of flight PS752, the relevant airspace in Iran and Iraq had not been closed by the relevant Iranian and Iraqi authorities, and civil aviation operations were being permitted.

According to the Iranian investigation, Iran implemented restrictions for part of its civil air traffic routes close to the Iraqi border after the ballistic missile attacks. NOTAMs on these changes were issued three and four hours after the crash of flight PS752. These NOTAMs did not contain information about the conflict situation. Iraq issued a NOTAM regarding the ballistic missile attacks twelve hours after the crash of flight PS752.

According to the final investigation report published by the Iranian authorities, a few hours before the crash of flight PS752, a permission from the defence sector before initiating a civil flight had been implemented with the aim of preventing the misidentification of civil aircraft. This change of procedures was not communicated through an aeronautical publication.

2.4.3 Similarities and differences between MH17 and PS752

The crash of flight PS752 shows both similarities and differences with the MH17 crash. In order to put the previous reports and recommendations from the Dutch Safety Board into the perspective of the recent PS752 crash, it is necessary to compare both events to identify relevant similarities and differences.

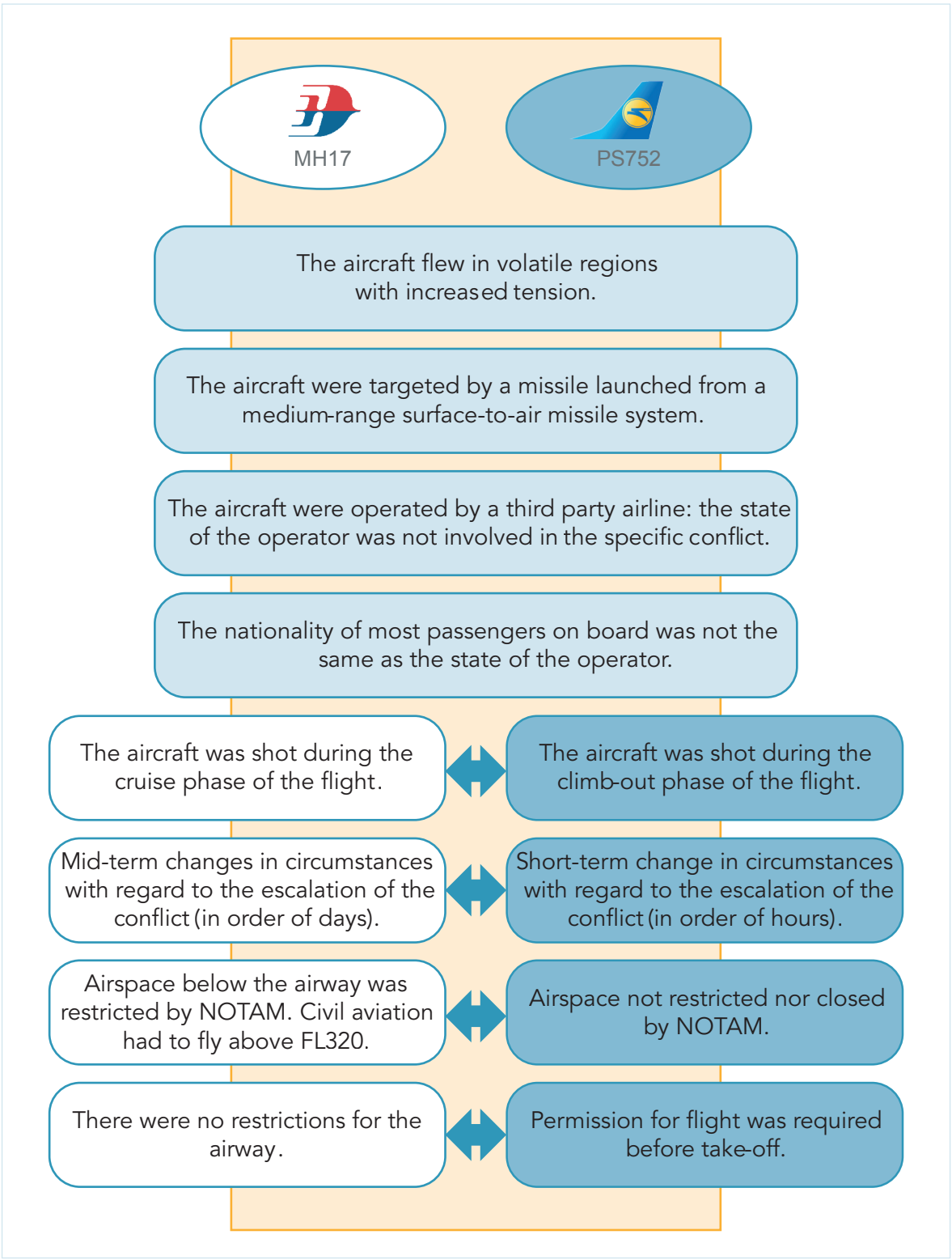


Figure 5: Similarities and differences between the crash of flight MH17 and flight PS752.

The most striking similarity between the tragedies of flight MH17 and flight PS752 is that both aircraft were shot at in a volatile region with increasing tension. Based on the Iranian final investigation report, it appears that flight PS752 was being operated in accordance with applicable airspace and air traffic procedures, as was flight MH17. Both Ukraine at the time of the MH17 crash and Iran at the time of the PS752 crash had implemented airspace management measures, namely the closure of airspace below FL320 and a permission requirement before flight, respectively. However, the relevant airspaces had not been closed to civil aviation. The airspace management measures that had been implemented proved to be inadequate.

Flight MH17 was shot down during the cruise phase of the flight, whereas flight PS752 was shot down during climb-out. Nevertheless, both aircraft were hit by a missile that could reach cruising altitude. The weapon systems used in both cases are comparable surface-to-air missile systems (SAM systems). Five aircraft were shot down by a SAM system from 1985 to the present day (including flight MH17 and flight PS752).[39] Statistically this seems a low probability. However, it is estimated that there could be more than 70 states around the world that have acquired SAMs as part of their military capability and this number is likely to continue to increase over time.[40] More importantly, when a civil aircraft is hit by such a weapon system, the outcome is catastrophic, as the tragedies with flight MH17 and flight PS752 evince.

Both SAM systems were mobile systems, that can be relocated and brought back into operation within hours. The location of these systems is therefore a matter of uncertainty for other states and their airlines. Both systems fire homing missiles, i.e. missiles that follow their target by radar. Target identification and allocation needs human interaction. Therewith, the possibility of human error exists. When military tension increases, the probability of human and organizational error increases.[41]

Sub-conclusion
There are several similarities between the crashes of flight PS752 and flight MH17. Both aircraft were shot down by a mobile surface-to-air missile system that could reach cruising altitude. Both states had implemented airspace management measures which proved to be inadequate.

39 Flight Safety Foundation, *Factual inquiry into the airspace closure above and around eastern Ukraine in relation to the downing of Flight MH17*, 2021.
40 ICAO Doc 10084. *Risk Assessment Manual for Civil Aircraft Operations Over or Near Conflict Zones, Second Edition*, 2018.
41 Source: Dutch Ministry of Defence.

2.5 Conclusions

States with a conflict zone on their territory or near to their territory explicitly remain fully responsible to manage the safety of their airspace. Adequate airspace management by states facing a conflict is a strong barrier against the risk of civil aircraft being shot down. Following the crash of flight MH17, ICAO standards and guidelines related to airspace management have been amended to specify the responsibilities of states with a conflict zone on their territory or near to their territory. First of all, states shall monitor threats to civil aviation within their territory and in the airspace above it. States shall also coordinate this information with their Air Traffic Service authorities. These authorities shall ensure that a safety risk assessment is conducted for activities potentially hazardous to civil aviation. Furthermore, states with a conflict on their territory shall inform other states and airlines about the conflict and the extent of threats by NOTAM. Most of these standards only have become applicable in 2020.

In its *MH17 Crash* report, the Dutch Safety Board recommended clarifying the responsibilities of states in ICAO standards so that the cases in which airspace must be closed are clear. However, there are still no criteria for the instances in which a state should close or restrict its airspace. In practice, most states with a conflict zone on their territory or near to their territory do not close or restrict their airspace, nor do they share aeronautical information about the conflict. This was also the case in Iran at the time of the crash of flight PS752. At the time of the ballistic missile attacks and the subsequent crash of flight PS752, the relevant airspace in Iran had not been closed and civil aviation operations were being permitted.

Even when states do publicize information about the conflict, and even when they restrict access to their airspace as a result of the conflict, the content of the information provided in these aeronautical publications lacks relevant detail about the actual threats present, such as the nature of the conflict, the weapon systems being used, and the possible consequences for civil aviation. This makes it difficult for airlines and states to gather relevant threat information directly from states with a conflict zone on their territory or near to their territory in order to perform a proper risk assessment.

In conclusion, airspace management in conflict zone situations is an effective safety barrier in theory, but not in practice. Hence, airlines cannot take it for granted that the open airspace above a conflict zone is safe.

3 INFORMATION SHARING AND STATE GUIDANCE

3.1 Significance

The previous chapter has highlighted the difficulties encountered in airspace management by states with a conflict zone on their territory or near to their territory. Therefore airlines, states where airlines are established and other aviation stakeholders cannot assume that the airspace over or near a conflict zone is safe. This means that airlines and/or the states of the operators have to assess the risks of flying over or near conflict zones. In order to carry out a risk assessment, relevant information about threats is needed.

Both states and airlines have an important function in gathering threat information because they have access to different information sources. Airlines can use their own networks to gather threat information, for example at destinations or with other airlines. States have access to, for example, classified intelligence information. Hence, it is necessary that parties holding relevant threat information also share it. In addition, a good relationship between airlines and their states is essential in order to obtain access to intelligence information.

It is important that states make this type of information accessible to the airlines based in their country. However, citizens also take flights with airlines based in other countries than their own. In order to increase the safety of all passengers, crew and aircraft, it is also of importance for states to share information with other states and with airlines that are not based in their own country. Mutual information sharing between states and airlines is crucial to guarantee adequate information about threats arising from conflict zones for all airlines flying in that area.

Apart from information sharing, the state of the operator can provide guidance to airlines: States can, if their national legal framework allows, prohibit their airlines to fly above a certain area or below a certain height (flight restrictions or prohibitions), or they can issue advice (recommended actions). In order to issue recommended actions, flight restrictions or prohibitions, states first carry out a risk assessment. The publication of this information, recommended actions, restrictions and/or prohibitions is considered useful for other states and airlines as well.

3.2 Responsibilities and obligations

Information-sharing
Airlines are obliged to carry out a risk assessment when flying over or near conflict zones (see paragraph 4.2.1). Airlines then need to set up a process for gathering information as part of this risk assessment process. Such a process should allow them to gather sufficient, high-quality information in a timely manner. How airlines are to gather threat information is not specified. The ICAO risk assessment manual[42] lists various sources that can be consulted, namely aeronautical information, information provided by the state of the operator, operator alliance networks and other membership networks, commercial providers, local sources at destination airports, and open source information (newspapers, magazines, television and social media). The manual also emphasizes the benefit of cross-validating the available information.

A standard in ICAO Annex 17 that became applicable in November 2018 prescribes that a state shall establish and implement procedures for sharing relevant information in a timely manner with end users (such as airport operators, aircraft operators and air traffic service providers) for the purpose of risk assessments.[43] Thus, states that possess relevant threat information should promptly share this with airlines and other relevant stakeholders through a robust and structured process. With this standard, ICAO took an important step in following up on a recommendation in the *MH17 Crash* report of the Dutch Safety Board on the decision-making process related to flying over or near conflict zones. The importance of this recommendation and the urgency of the need to further improve matters was recently emphasized in a UN Human Rights Statement about Conflict Zones.[44]

Within a state, several national authorities are usually involved in the process of gathering and sharing threat information for civil aviation, such as the civil aviation authority, the intelligence services dealing with domestic and/or foreign security, the military authorities, and their related ministries. The organization and structure of a state's procedures for information gathering and sharing differ from state to state. Threat information is often shared in a confidential context because of its sensitivity or classification.

Roughly, three models for the provision of information by states of the operator can be distinguished (see Figure 6), with rising efforts on the part of the state:
1. Help desk: airlines can question their state about conflict zones.
2. Sideline support: the state proactively informs airlines about information collected by intelligence services in the context of other state tasks.

42 ICAO Doc 10084, *Risk Assessment Manual for Civil Aircraft Operations Over or Near Conflict Zones, Second Edition*, 2018.
43 ICAO Annex 17, standard 3.1.5: Each contracting State shall establish and implement procedures to share, with relevant airport operators, aircraft operators, air traffic service providers or other entities concerned, in a practical and timely manner, relevant information to assist them to conduct effective security risk assessments relating to their operations. This standard has been included under the general provision for airport security in European Implementing Regulation (EU) 2015/1998 through Commission Implementing Regulation (EU) 2019/1583, entering into force on 31 December 2020.
44 United Nations Special Rapporteur on extrajudicial, summary or arbitrary executions, *Statement, Commercial Airlines and conflict zones: Recommendations to strengthen air safety and prevent of unlawful deaths*, 8 January 2021.

3. Active support: the state proactively requests independent investigations into the security of foreign airspace and the security of flight routes for civil aviation in that airspace by intelligence services and informs airlines about the information collected.

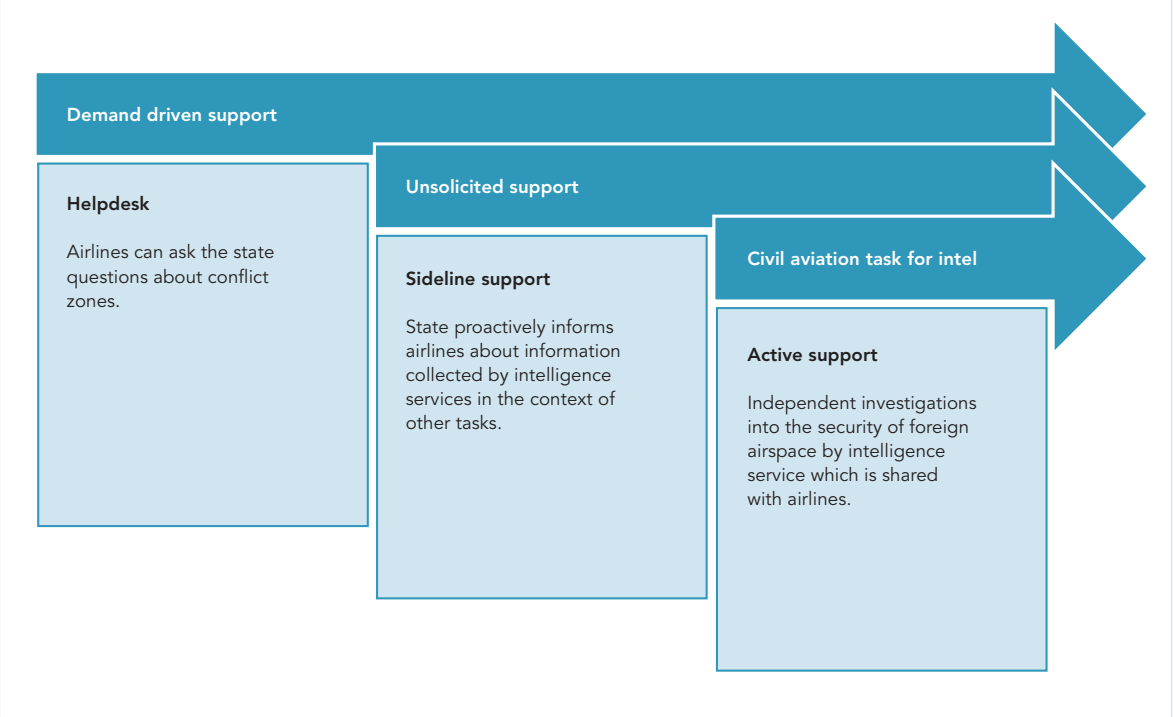


Figure 6: Models for provision of (threat) information by the state.

Additional state guidance

Besides information sharing, states can guide their operators through recommended actions (advice) or regulations. As there are no international standards for states to provide state guidance other than information, differences exist between the degree of guidance that is actually provided by different states to their airlines. A simplified representation is illustrated in Figure 7; a combination of these activities is also possible. At one extreme are the states whose authorities do not provide any guidance. At the other extreme are the states whose authorities play a regulatory role, which means that states prohibit or restrict their airlines from flying in certain airspaces. In between these two extremes there are states that issue recommendations or advice.

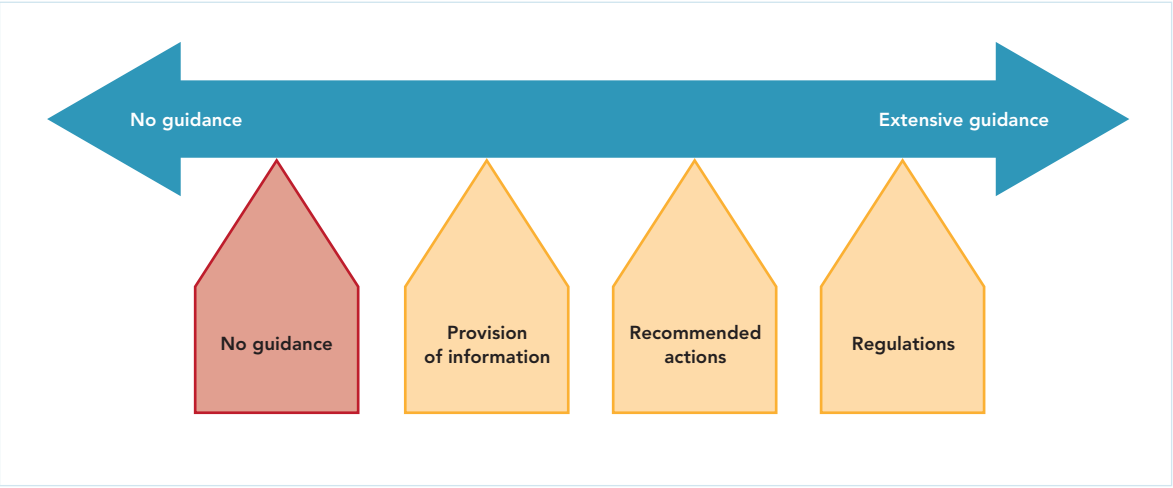


Figure 7: The degree of guidance provided to airlines by states.

Sub-conclusions

Airlines are obliged to carry out a risk assessment when flying over or near conflict zones. In order to be able to make a proper risk assessment, airlines need to gather sufficient, high-quality information in a timely manner. How airlines should set up a process for gathering and sharing this threat information is not prescribed in international standards.

States that possess relevant threat information should promptly share this with airlines and other relevant stakeholders through a robust and structured process. In addition to the provision of information, states may provide guidance to their airlines in the form of recommended actions (advice) or regulations (restrictions and prohibitions).

3.3 Information sharing and state guidance for Dutch airlines

3.3.1 Dutch airlines

Airlines use a variety of information sources. Figure 8 gives an overview of the information sources generally used by Dutch airlines.

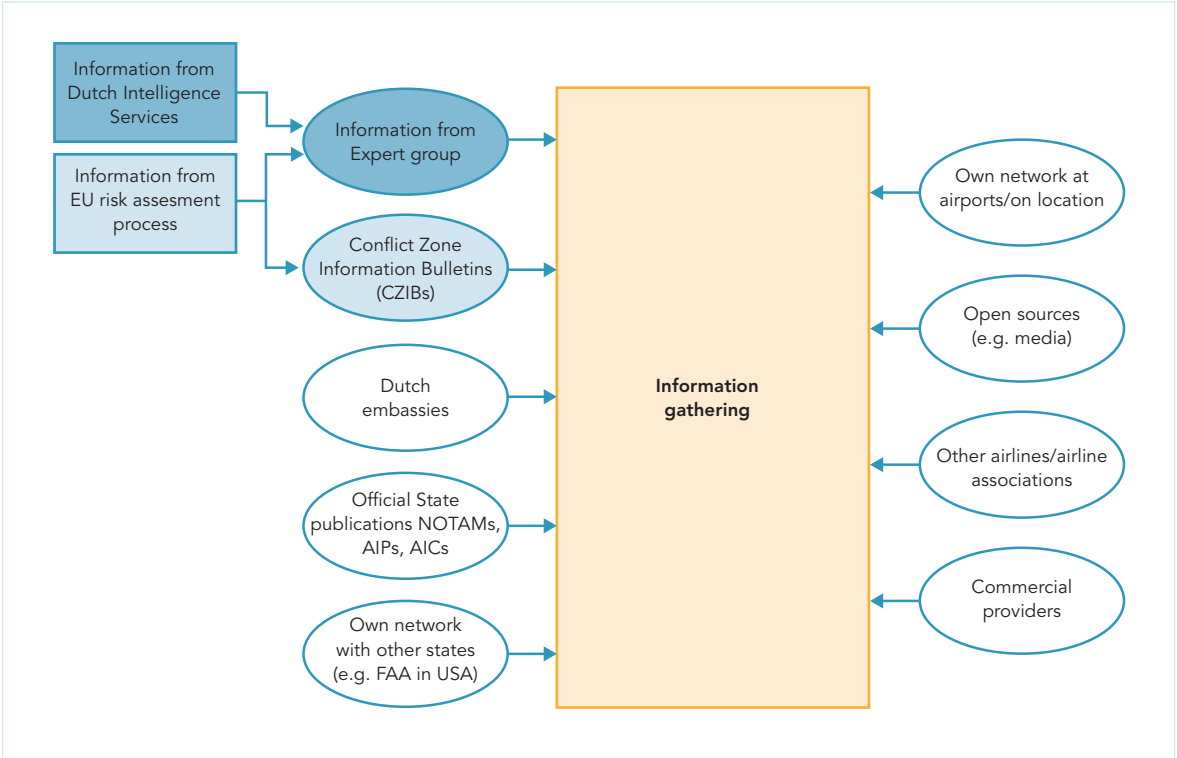


Figure 8: General overview of the information sources used by Dutch airlines. The dark blue areas represent information originating from the process at the Expert group, described in paragraph 3.3.2. The light blue areas represent information originating from processes in the European Union (see paragraph 3.3.3).

Some of the information is publicly available, such as aeronautical publications, European publications (Conflict Zone Information Bulletins, CZIBs), news items and social media. Other information is provided through commercial contracts with specialised companies that gather and analyse security information, or via their own network with other airlines, informal contacts or embassy contacts in destination countries. The information received from intelligence services is often classified. Dutch airlines receive this information via their contacts in the Expert group, see paragraph 3.3.2. For Dutch airlines, the Dutch intelligence services are considered the most important means to cross-check and validate information received from other sources. The Dutch intelligence services' knowledge of the activity level, possible intentions, and the presence and capabilities of weapon systems is considered essential for the conduct of risk assessments, as airlines do not have this knowledge. In the case of acute threats, information from sources on location is rapidly available, but intelligence is considered the most important source both for verification of information from local sources and for details about the involved weapon systems.

The information sources used by Dutch airlines depend on the practical implementation of the information gathering process and differ per airline, see box below. The information gathering process depends on the airlines' flight network, organisational structure, business model, code sharing agreements, but also on size of the airline and resources available.

Information gathering at the Dutch Airlines
An overview is provided of the main information sources (in arbitrary order) used by the Dutch airlines to illustrate similarities and differences.

KLM Royal Dutch Airlines (KLM) is part of the Air France-KLM group. KLM operates scheduled flights worldwide, both passengers and cargo. The main information sources are the Expert group (see paragraph 3.3.2), own network at location/on airports, contacts with other airlines, NOTAMs, CZIBs, the US Federal Aviation Administration (FAA), Dutch embassies, commercial providers and open sources, such as news media and internet (social media). Being part of the Air France-KLM group, KLM and Air France exchange information, whilst ensuring protection of the information sources. KLM and Air France cannot not share classified information which they receive from their state.

Transavia is part of the Air France-KLM group and conducts both scheduled and charter passengers flights, mostly in Europe, but also to North-Africa and Dubai. Transavia makes use of KLM's security monitoring of the route network and destinations. Transavia regularly receives risk assessment updates from KLM, covering all Transavia's flights.

TUI fly Netherlands is part of the TUI Group. The main information sources are the Expert group, airlines from the TUI Group, other airlines, NOTAMs, CZIBs, a commercial provider and open sources, such as news media. The advantage of having airlines from multiple states in the TUI Group is that every state has its own unique information position. The airlines can therefore warn each other. However, classified information cannot be shared within the TUI Group. TUI fly Netherlands gathers information broader than its current route network, as the airline also often performs ad hoc charter flights.

Corendon Dutch Airlines is fully owned by the Corendon Holding B.V., which also owns the various Corendon tour operator companies. Corendon Dutch Airlines offers mostly holiday flights. Destinations include Mediterranean countries, such as Turkey, Greece, Portugal, Spain, Bulgaria, Egypt, and Macedonia. As Corendon Dutch Airlines also offers charter flights, requests may come to fly to other destinations as well. The main information sources include the Expert group, NOTAMs, a commercial provider, CZIBs and open sources, such as news media.

Sub-conclusion
Dutch airlines use various information sources in order to be provided with relevant information regarding conflict zones. Dutch airlines regard the Dutch intelligence services as the most important means to cross-check and validate information received from other sources. Dutch airlines receive this information via the Expert group.

3.3.2 The Dutch Expert group

Information sharing

In the aftermath of MH17, a network (the Expert group) and process for sharing threat information was set up in the Netherlands, to ensure that Dutch airlines have access to good, accurate and relevant threat information. Threat information is often sensitive or even classified, and only shared in a secure context of mutual trust. The sharing of threat information between the Dutch airlines and the Dutch government has now been formalized.[45] Since 30 June 2016, a covenant between the Dutch government, the Dutch airlines and the Dutch Airline Pilots Association (VNV) addresses the sharing of threat information for civil aviation. Five ministries are involved, illustrating the variety of domains and responsibilities involved in sharing information about conflict zones. The aim of the agreement is to ensure the sharing of threat information between the government and the Dutch airlines so that the airlines can conduct an effective risk assessment for safe flight operations outside Dutch airspace.

Based on the covenant, two groups have been established: 1) the Steering group, which oversees the implementation of the agreement, and, if necessary, can make adjustments, and 2) the Expert group. It is the task of the Expert group, in which the various government authorities and airlines hold a seat (see box), to share and discuss in a confidential setting non-public and even classified threat information that is relevant for civil aviation.

Participants in the Dutch Expert group

Relevant representatives of intelligence services, ministries and airlines hold a seat in the Expert group:

- National Coordinator for Security and Counterterrorism (NCTV) of the Ministry of Justice and Security;
- Ministry of Infrastructure and Water Management;
- General Intelligence and Security Service (AIVD) of the Ministry of the Interior and Kingdom Relations;
- Defence Intelligence and Security Service (MIVD) of the Ministry of Defence;
- Ministry of Foreign Affairs;
- the airlines KLM[46], Corendon Dutch Airlines and TUI fly Netherlands.[47]

Expert group meetings discuss cases that are brought to its attention by either the government authorities or the Dutch airlines. As sensitive information is shared within the group, all participating organizations are obliged to observe confidentiality. There is also interaction outside the scheduled meetings. Specific threat information is passed directly from the Dutch intelligence services to the airlines. Airlines can put questions to the

45 Information sharing with third parties, including airlines, was already regulated in the law on the Intelligence services (Dutch: Wet op de inlichtingen- en veiligheidsdiensten). Source: Dutch House of Representative, meeting year 2015-2016, Motion of member Servaes C.S., 33 997 nr. 80, submitted 1 March 2016.

46 On behalf of KLM, KLM Cityhopper, Martinair and Transavia.

47 There are also Dutch operators (holders of an Air Operators Certificate, AOC) that have not signed the covenant and are therefore not part of the Expert group. These are charter/business aircraft and helicopter operators. As a result, these operators do not have access to the information coming from the Expert group.

intelligence services, for example in order to cross-check and validate information coming from other sources, or to gain information on areas lying outside the standard flight route network. Also technical and operational information on the actors involved in the conflict and their weapon systems are discussed within the Expert group. Moreover, the Expert group discusses contributions to and feedback from international consultations and meetings on flying over or near conflict zones, such as from the European Integrated Aviation Security Risk Assessment process, further explained in paragraph 3.3.3.

According to the airlines involved, since the launch of the Expert group in 2016 more useful unsolicited information is being exchanged, while the understanding of the airlines' needs has also improved. According to their third evaluation[48], the Expert group focusses on monitoring the political situation and developments in certain states more proactively. Through embassies, information is obtained about possible tensions. This monitoring is relevant, as this allows to better anticipate developments in a state or region and possible escalations.

In the Expert group, the Dutch government supports the Dutch airlines by gathering and sharing threat information, both on an unsolicited and demand-driven basis, following the sideline support model, see Figure 9. The Dutch intelligence services do not advice the Expert group, but only outline a specific situation, based on which the airlines can make their own risk assessment. The Dutch intelligence services acquire, among others, information and assessments from allied states. However, the services always make their own threat assessment. The legal security and intelligence tasks of the Dutch intelligence services do not include conducting independent investigations into the security of foreign airspace and the security of flight routes in that airspace specifically for civil aviation purposes. The information shared mostly involves information obtained in serving the current government intelligence requirements in support of national security and the democratic legal order. This implies limitations to the extent to which the Dutch intelligence services possess and provide information about the airspace above a certain state or region. Furthermore, the structural capacity of the Dutch intelligence services devoted to activities regarding security risks to civil aviation operations worldwide is currently limited.

48 Letter from the Minister of Justice and Security and the Minister of Infrastructure and Water management to the Dutch House of Representatives, meeting year 2018-2019, 24804 nr. 100.

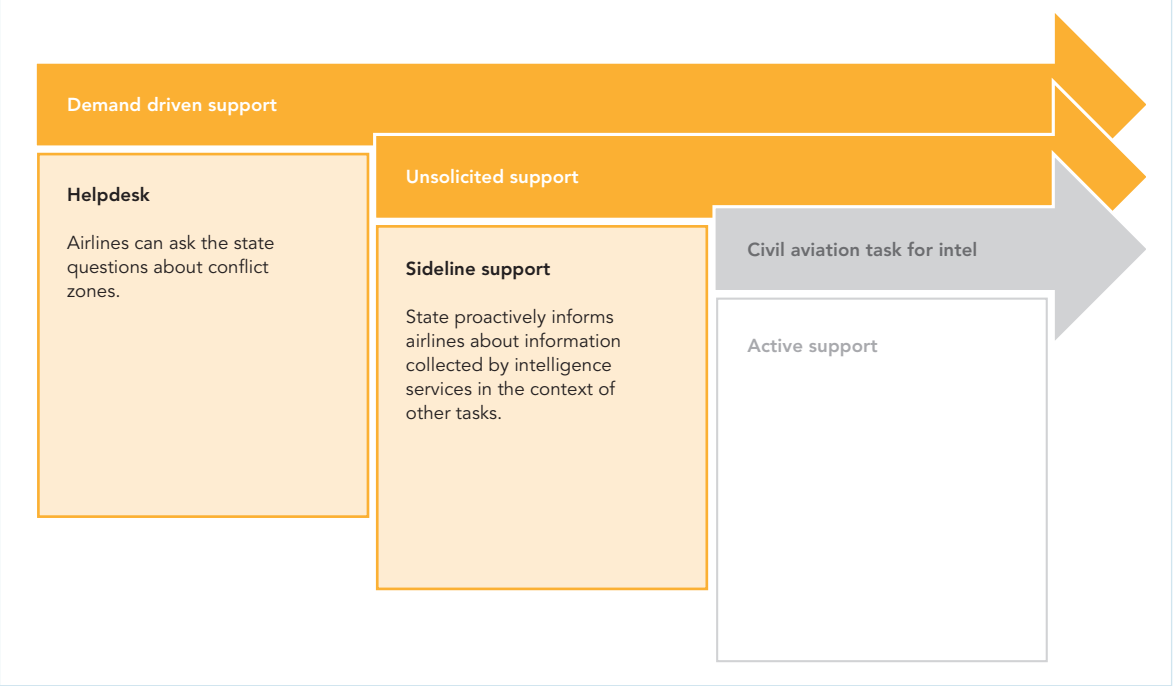


Figure 9: Dutch state involvement in threat information sharing for the purpose of civil aviation.

State guidance

The Dutch government does not provide guidance in the form of advice (recommended actions) or regulations (prohibition or restriction) (see Figure 10). Nor does the Dutch government conduct aviation-specific risk analyses with respect to the overflight of conflict zones. Currently, there is no legal basis in Dutch law (Act on Aviation, in Dutch '*Wet Luchtvaart*') to impose a flight prohibition or restrictions on Dutch aircraft in connection with flying in foreign airspace.[49]

The government's choice to provide no such guidance was motivated along the following lines: firstly, on the principle that sovereign states are primarily responsible for ensuring safety in their own airspace, and secondly, because the airlines themselves are responsible for ensuring safe flight operations, in line with the international regulatory framework for aviation. Besides this, the current information position of the Dutch state is not sufficient to cover all regions worldwide. So, there are also practical issues.

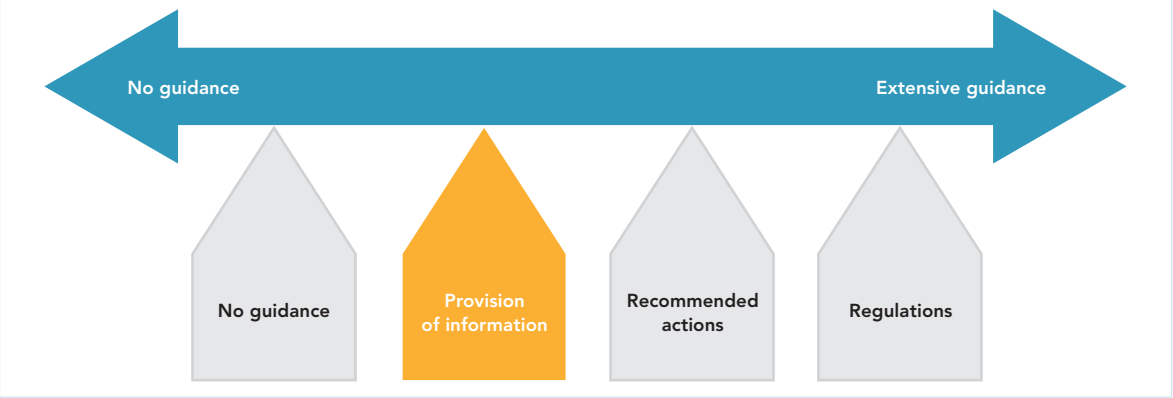


Figure 10: The degree of guidance given to airlines by the Dutch government.

49 Letter from the Minister of Infrastructure and Water management to the Dutch House of Representatives, meeting year 2018-2019, 33997 nr. 142.

Sub-conclusions

The Dutch government supports Dutch airlines in gathering threat information, both on an unsolicited and a demand-driven basis. The Expert group was established for this purpose. The legal security and intelligence tasks of the Dutch intelligence services do not include conducting independent investigations into the security of foreign airspace and the security of flight routes in that airspace specifically for the purpose of safety of civil aviation.

Apart from sharing threat information, currently the Dutch state has chosen not to provide airlines with additional guidance in the form of recommended actions or regulations.

3.3.3 The European Union

Following the crash of MH17, a European task force was created to evaluate the processes and responsibilities related to risk assessments of flight routes over or near conflict zones. In March 2016, this task force issued its final report to the EU Commissioner for Transport. This report contained a proposal for a European warning system for conflict zones (Conflict Zone Alerting System): a cooperative partnership between EU member states, the European Commission, EEAS (EU INTCEN), EASA, and other relevant parties. The main objectives of such a system were to link intelligence sources and risk analysis capacities and to perform joint risk assessments of conflict zones. This culminated in the establishment of a common EU Integrated Aviation Security Risk Assessment process (hereafter referred to as EU Risk Assessment process) and the publication by EASA of Conflict Zone Information Bulletins (public) and information notes (non-public). The EU Risk Assessment group is led by the European Commission (Directorates-General DG HOME, DG MOVE[50]) and EU INTCEN[51]. Quarterly meetings involving EU member states, Schengen associated countries and EASA are held, complemented by extraordinary meetings when necessary. The participation of states is based on voluntary partnership and cooperation, as there is no legal framework for this initiative.

At the level of the European Union, the EU Risk Assessment process forms the basis for guidance to EU airlines regarding the security of flight routes. A secondary aim is to inform passengers, other states and airlines worldwide. The EU risk assessment focuses on intelligence information. The process depends on the intelligence provided by states, as the European Commission and EU INTCEN do not possess their own intelligence data. Any member state can bring information to the EU risk assessment meeting, but not all states have the same knowledge on conflict zones worldwide as this depends on their intelligence capabilities. Before each meeting, all available information is collected from EU INTCEN in the form of classified security updates and from open sources, and is distributed to all participants. Although it is technically possible to share classified information digitally, physical meetings are required for the process, as classified

50 Directorate-General Migration and Home Affairs (DG HOME) and Directorate-General Mobility and Transport (DG MOVE).

51 EU Intelligence and Situation Centre, a directorate of the European External Action Service (EEAS) that is the exclusive civilian intelligence function of the European Union, providing in-depth analysis for EU decision-makers.

information is being easier shared and discussed amongst a large number of states. Hence, a meeting must be planned several days in advance in order to allow participants to plan ahead their travel to Brussels.

Threat information is shared between representatives of the EU member states during the EU Risk Assessment meetings. These meetings are classified as intelligence information is shared and discussed.

Guidance is provided to airlines in the form of information and recommended actions (see Figure 11). Information is shared with EU member states, who may subsequently share this information with their own airlines. In this way, information is provided indirectly to the airlines. Airlines therefore depend on their states for the receipt of this information.

At the EU level, information and recommended actions are distributed by EASA using two types of communication means: Conflict Zone Information Bulletins (CZIBs) and EASA information notes.

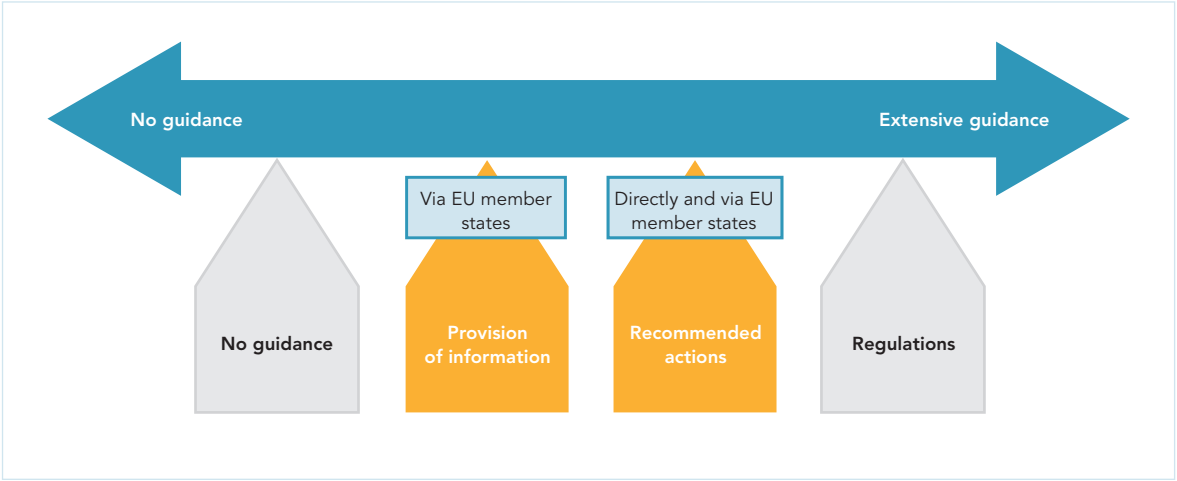


Figure 11: The degree of guidance to airlines at EU level.

The outcome of the EU risk assessment is an indication of the risk levels for four scenarios[52] in each assessed conflict zone and the related EU recommended actions. After the EU Risk Assessment meeting, and before EASA can disseminate relevant information to the aviation network, the agreement of the European Commission and the member states on the information to be published is required.[53] For urgent situations, at minimum prior approval from the European Commission is required. It may be difficult to reach consensus on the decisions to be taken in EU risk assessments. Divergences are caused by economic, diplomatic and other interests, including the fact that not all member states may have the same perception about flying to a specific region or state.

52 The scenarios for which risk levels are assessed are parking/taxiing, take-off/landing, medium altitude and high altitude.

53 See Article 88 of Regulation (EU) 2018/1139 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency.

The risk level and recommended action are published on the EASA website through CZIBs and are directly accessible by airlines (and states) globally.[54] A CZIB indicates the risk level for a conflict zone (an outcome of the EU Risk Assessment process) and contains a recommendation for operators to take the information from the CZIB into account in their own risk assessments. Overall, CZIBs are used and considered useful by airlines worldwide.

Contrary to CZIBs, EASA information notes on conflict zones are non-public and distributed by EASA to their network of member states. For the Netherlands the information notes are sent to the Ministry of Infrastructure and Water Management. The member states are requested to share the information in the notes with their airlines on a need-to-know basis. The information notes are also used to issue preliminary recommendations before an EU risk assessment has been conducted. The process for dissemination of non-public EASA information notes is considered easier than public CZIBs, because the terminology used is less sensitive as the notes are directed at aviation experts. In addition, updates can be published more easily. However, like the issuing of CZIBs, before EASA can disseminate information notes to its network of civil aviation authorities, at least the agreement of the European Commission is required.

In a rapidly escalating conflict, the time needed for publication of a recommendation through a CZIB or information note is long, due to factors related to the sharing of information, the meetings needed to discuss the risk assessment, and the consultation and necessary agreement required before publication.[55] Also, information notes are not directly disseminated to airlines, and therefore the duration of the process depends on the swiftness of the states to further distribute the information as well. In paragraph 3.5, the duration of the process at the time of the crash of flight PS752 is illustrated.

For the Netherlands, both the Ministry of Justice and Security and the Ministry of Defence participate in the EU meetings. The involvement of the Dutch government in the EU Risk Assessment process has multiple objectives:

- as the content of the EU meetings depends on the input provided by states, to bring all relevant intelligence information and knowledge from the Dutch intelligence services to the EU meeting;
- to ensure that input and questions from Dutch airlines are brought to the meeting, and to provide feedback to the airlines afterwards about the meeting's outcomes. The Dutch Expert group serves as the intermediary between the EU Risk Assessment group and the airlines;
- to share the threat information that was discussed during the EU meetings with the Dutch airlines;
- to provide information and arguments and to take a position in the discussion between member states.

54 https://www.easa.europa.eu/domains/air-operations/czibs.
55 See also chapter 3.5 for publication of the EASA CZIB in relation to risk assessment for the Iran and Iraq region.

Since this process was first established, the working methods employed in EU risk assessment have gradually improved. At the start, only the European Commission, EU INTCEN, EU member states and Schengen associated countries participated in the meetings. As of November 2018, EASA has been allowed to participate in the group meetings. Since 2018, the airlines, too, have been gradually more involved in the process. Prior to every group meeting, a pre-meeting is organized with airline associations and some major airlines, including KLM, at which airlines can share their information and queries. No feedback is given to the airlines in these pre-meetings as no classified information is directly provided to the airlines.

During the COVID-19 pandemic, since physical meetings were no longer possible, more use was made of virtual meetings (video and teleconferencing). This experience exposed the challenges surrounding the exchange of classified information (EU Restricted or Confidential). The circulation of classified information requires a time-consuming encryption/decryption process. Tools are available for this, but the process is cumbersome. Less restricted, and therefore less granular information was therefore sometimes circulated instead, thereby also restricting the level of detail of the discussions.

In order to improve information sharing at the EU level, EASA launched the first version of a European Information Sharing and Cooperation Platform on Conflict Zones on 25 February 2021. The aim of the platform is to support the existing EU Risk Assessment process by improving the availability and swiftness of the exchange of relevant information. To this end, the platform is focusing on the sharing of non-classified, and therefore less sensitive, threat information.

Sub-conclusions

The EU Integrated Aviation Security Risk Assessment process (hereafter referred to as EU Risk Assessment process) was set up in the aftermath of the MH17 crash. The aim of the process is to combine intelligence from EU member states and to provide EU member states and airlines with an equal level of information on conflict zone risks for civil aviation. A secondary aim is to inform passengers, other states and airlines worldwide. The Dutch state is involved in the EU Risk Assessment process, providing information and arguments and taking a position in the discussion between member states.

EASA's publicly available Conflict Zone Information Bulletins (CZIBs) contain information and recommended action, and are based on the outcome of the EU Risk Assessment process. Information notes by EASA contain information and recommended actions as well, including for situations where no EU risk assessment has taken place (yet). These notes, that are not publicly available, are distributed to member states but not directly to airlines. As agreement needs to be reached and coordination with the European Commission and EU member states is required, the time needed for publication of a recommendation through a CZIB, and to a lesser extent of an information note, is long in case of rapidly escalating conflicts. The physical meetings, required for the EU Risk Assessment process to share and discuss classified information amongst a large number of states, delay the process. In addition, it might be difficult to reach consensus between member states on the decisions to be taken in EU risk assessments.

The lack of mandate to disseminate relevant information to airlines directly, limits EASA's effectiveness. Because the agreement of the European Commission and the member states on the information to be published is required, neither EU decisions nor EU communications to airlines are fast enough in the case of rapidly escalating conflicts.

Complementary to the current procedures, EASA is working on creating an information sharing platform on conflict zones focusing on non-classified information in order to improve the availability and swiftness of the exchange of relevant information.

3.4 State guidance globally

Several states provide active guidance in the form of recommended actions or regulations to their airlines.[56] Following MH17, France, Germany, the United Kingdom (UK) and the United States (US) became increasingly active in issuing recommendations or regulations

56 States may also provide guidance in the form of information provision. Usually this information is not public as it is often confidential or even classified. The Dutch Safety Board did not investigate to what extent other states share information with their airlines, because the focus of this investigation is on Dutch airlines and the information available to them.

related to flying over or near conflict zones to airlines from their own countries. As a response to the crash of flight PS752, Canada has established its own Conflict Zone Information Office to monitor foreign conflict zones and to warn airlines of new or emerging risks. These five states promulgate the outcome of their risk assessments and advisories or restrictions (see Table 1) through aeronautical publications, such as a Notice to Airmen (NOTAM) or an Aeronautical Information Circular (AIC), by inclusion in the Aeronautical Information Publication (AIP), or through specific regulations such as the Special Federal Aviation Regulations (SFAR) in the US. Roughly, three types of guidance can be distinguished: a prohibition to fly, an advice not to fly, or an advice to take the potential risks into account.

Unlike Canada, Germany, the UK and the US, France does not have a legal basis in the national regulatory framework to issue prohibitions. Despite being non-mandatory, an advice issued by a state is considered a forceful measure, as deviating from it usually requires thorough justification by airlines. Many other states also provide incidental guidance to their airlines, for instance Italy, South Africa, Ukraine, and the United Arab Emirates.

Table 1: The way in which Canada, France, Germany, the United Kingdom, and the United States communicate the outcome of their risk assessments and the corresponding advice or restriction.[57] The public Conflict Zone Information Bulletins of EASA, based on EU risk assessments, are added as a comparison.

State	Publication	Risk levels	Legal basis for flight prohibition
Canada	NOTAM AIC	Two risk levels: • advice not to enter • prohibition	Yes
France	NOTAM AIC	Two risk levels: • request to ensure that • request not to authorize/ penetrate	No
Germany	NOTAM AIC	Three risk levels: • advice to take potential risk into account • advice not to plan and conduct • prohibition	Yes
United Kingdom	NOTAM AIP	Three risk levels: • advice to take potential risk into account • advice not to enter • shall not enter	Yes
United States	NOTAM SFAR	Three risk levels: • advisory - exercise caution • advisory - exercise extreme caution • prohibition	Yes
EU (EASA)	CZIB	One risk level: • advice to take potential risk into account	No

57 Source: Luftfahrt Bundesambt (LBA) presentation, Safer Skies Forum, December 2020.

Whether or not an aeronautical publication is issued for a particular conflict zone varies from state to state (see Table 2). The content of the advice or regulations for a particular conflict zone also varies between publicizing states, as is the case for the airspace concerned. This can be caused by several factors: for example, differences in the information position of states, and variations in how each state assesses the associated risks and determines the degree of mitigation necessary to sufficiently reduce the risk. The relationship between states and their political, diplomatic and economic interests may also affect the content of a publication.

As state guidance is published through aeronautical publications, states and airlines around the world benefit from and are able to incorporate the provided information in their own risk assessments.

Table 2: Aeronautical publications[58] on conflict zones applicable on 5 January 2021 by Canada, France, Germany, the United Kingdom, the United States and EASA. The colours indicate the type of publication. Red: prohibition to fly, orange: advice not to fly, yellow: advice to take the potential risks into account. The text indicates the applicable airspace.

58 Sources: Canada NOTAMs H0047/20, H0655/20, NOTAM H0413/20, NOTAM H0330/20,
France AIC 23/20, Germany AIC 18/20, United Kingdom AIP ENR 1.1,
United States KICZ NOTAM A0013/19, A0019/20, A0022/20, A0036/20, A0038/20, A0040/20,
United States SFAR 77, 79, 107, 112, 113, 114, 115, 117
EASA CZIBs.

	Publishing state					
Conflict zone	**Canada**	**France**	**Germany**	**United Kingdom**	**United States**	**EASA (CZIB)**
Afghanistan	-	below FL260	below FL330	below FL250	below FL330	all
Armenia	-	all except airways	-	-	-	-
Azerbaijan	-	all except airways	-	-	-	-
Egypt (Sinai Peninsula)	-	-	below FL260	below FL250	below FL260	all
Iran	all	all	all	-	all	below FL250
Iraq	all	below FL320 except airways	below FL260	all except airways	all	all
Kenya	-	-	-	below FL250	below FL260	-
Libya	all	all	all	all	all	all
Mali (Niamey FIR)	-	below FL320	below FL260	below FL250	below FL260	below FL250
North Korea	-	all	all	all	all	-
Pakistan (Karachi FIR and Lahore FIR)	-	below FL260	below FL260	below FL250	below FL260	below FL250
Saudi Arabia (Jeddah FIR)	-	all	all			all
Somalia	-	below FL260	below FL260 except airways	below FL250	below FL260	below FL250
Sudan	-	below FL260	-	-	-	-
South Sudan	-	below FL260	below FL260	below FL250	-	below FL250
Syria	all	all	all	all	all	all
Ukraine (Eastern part)	-	all except airways	-	all except airways	all	all
Venezuela	-	-	-	-	below FL260	-
Yemen (Sana'a FIR)	-	all	all except airways	all except airways	all	all except airways

As of June 2019, the states that issue aeronautical publications on conflict zones (the United States, Canada, the United Kingdom, Germany and Spain), together with the Netherlands (because of MH17), form the Expert Group on Risk Information overflying Conflict Zones (EGRICZ). Later on, Finland, Sweden and Switzerland also joined EGRICZ. EGRICZ is an informal international platform aimed at building a common approach towards security considerations when flying over or near conflict zones, and optimize cooperation, information exchange, and coordination. To this end EGRICZ organized workshops in June and November 2019 together with DG HOME, EASA and industry partners. The US Federal Aviation Administration (FAA) has proposed to set up a network with international contacts to exchange information between EGRICZ members in order to enable rapid information sharing in the event of a crisis (November 2019). The implementation of this proposal is currently in progress (as of January 2021).

Sub-conclusion
Several states provide advice or issue restrictions/prohibitions to their airlines. The advice or regulations are available for other airlines and states to use. However, the content of the information on a particular conflict zone may vary per publicizing state.

3.5 Information sharing prior to and after the PS752 crash

The functioning of the current system of information sharing for Dutch airlines in practice is illustrated by the situation as it evolved in January 2020. Two timelines are presented. The first timeline is from 1 January 2020 until the crash of flight PS752 on 8 January. The second timeline illustrates the events following the crash until the end of January 2020. This chapter provides an overview of the information available to Dutch airlines prior to and after the crash. In paragraph 4.4, the use of this information in the decision-making process of Dutch airlines is illustrated.

The situation in Iran and Iraq had been discussed in the Expert group before January 2020. Also within the EGRICZ network, the risk concerns in the Middle East region were on the agenda, for example during a meeting organized in November 2019, where a conflict zone threat update on the region was discussed. At the time of the conflict, which escalated with the attack on general Soleimani on 2 January 2020, several aeronautical publications were in effect with respect to the Iran and Iraq region. Firstly, a European CZIB[59] first issued in 2017 was still active for Iraqi airspace, indicating that the risk to operations at all altitudes were assessed to be high, except for the airways UL602, UM860 and UM688 above 26,000 feet (FL260) (see the airway chart in Figure 12). Secondly, a United States' Special Federal Aviation Regulation (SFAR)[60] from 2018 prohibited US airlines from flying in the Baghdad FIR below FL260. For Iran, the FAA issued a flight

59 CZIB-2017-09R6.
60 SFAR 77, FAA–2018–0927, 26 October 2018.

prohibition in 2019 in a NOTAM[61] for the overwater airspace of the Tehran FIR above the Persian Gulf and Gulf of Oman, due to increased military activity and political tension. No restrictions had been published for the rest of Iran. Finally, two advisory NOTAMs published by the FAA in August and September 2019 were still valid; one for the Tehran FIR regarding concerns about interference between military activities and civil flight operations[62], and one for the Persian Gulf and Gulf of Oman, including portions of the Tehran and Baghdad FIR, on the potential for misidentification of civil aircraft and heightened military activities.[63]

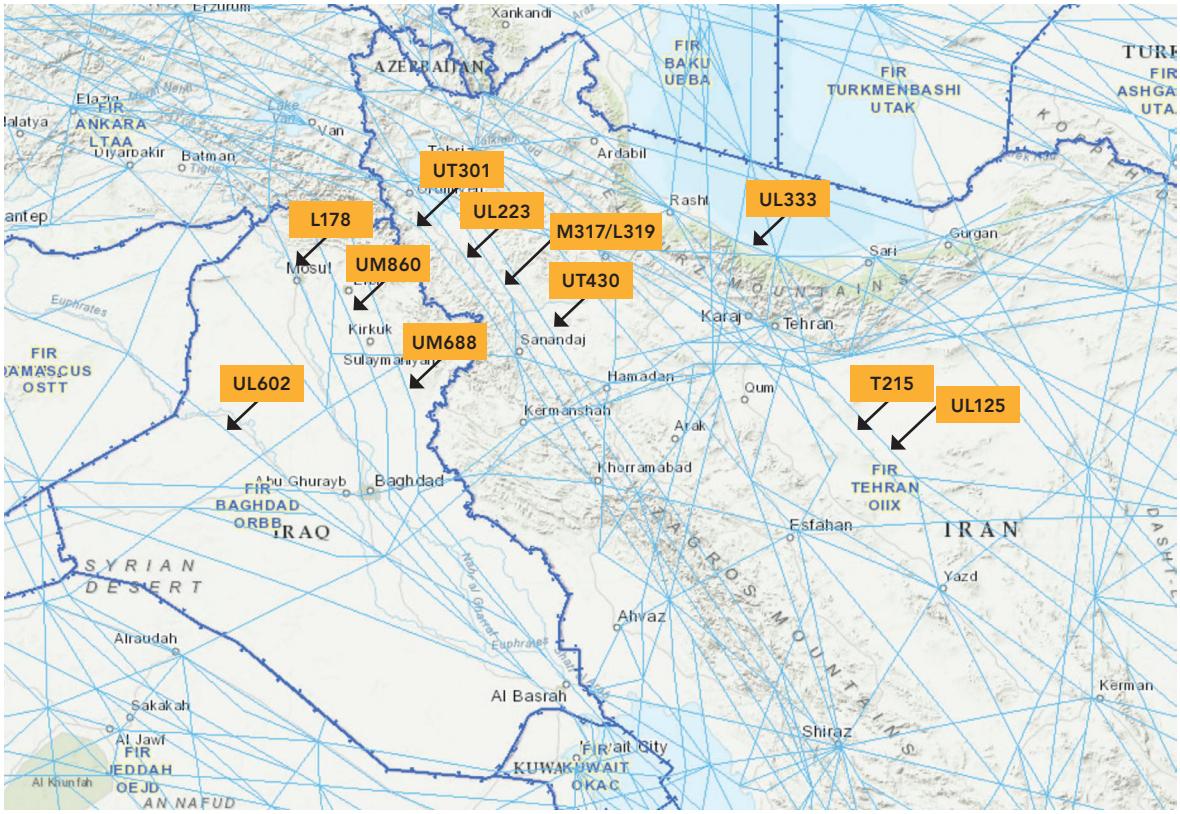


Figure 12: Airways in Iraq and Iran. (Source map: ICAO Geographic Information System gis.icao.int).

61 NOTAM KCIZ A0019/19, specified area of Tehran FIR, 21 June 2019 until perm.
62 NOTAM KCIZ A0024/19, Tehran FIR, 9 September 2019 until 9 September 2020.
63 NOTAM KCIZ A0022/19, Tehran FIR, 19 August 2019 until perm.

3.5.1 Timeline - 1 January 2020 until the crash of flight PS752

On 1 January 2020, the US Federal Aviation Administration (FAA) sent an e-mail as part of the ongoing collaborative dialogue with EGRICZ members. In the e-mail, the FAA informed the EGRICZ members, which included the Dutch Ministry of Infrastructure and Water Management and the Dutch Ministry of Defence, that in follow-up of the ongoing dialogue regarding the Persian Gulf region it had prepared risk mitigation options in case events in the Middle East were to escalate.

One day later, on 2 January, the US attacked the Iranian general Soleimani. On the same day, the Dutch Expert group requested information from the Dutch intelligence services about the attack and situation in the region. On the same day, Germany issued a NOTAM about possible danger in the Baghdad FIR below FL 260 on a limited number of airways in the east of Iraq (for instance UM860 and UM688) and Baghdad airport.[64]

On 3 January, the FAA published an information note, which warned of possible escalation and retaliatory attacks from Iran. The FAA distributes information notes to various US and foreign airlines and foreign government partners. Recipients of this particular information note included the Dutch government (the Dutch Ministry of Infrastructure and Water Management and the Dutch Ministry of Defence), KLM, and EASA. The information note indicated tensions in the region were increasing, and elaborated on the nature of the threat. It mentioned, for instance, the possibility of a heightened alert status among Iran's military air defence forces and the use of surface-to-air missiles. It also stated there was an increasing inadvertent risk to civil aviation in the region. This information note was circulated to all the members of the Dutch Expert group. The note was also circulated by EASA to its network of member states.

Another indication that tensions in the region were increasing was an e-mail, based on an ICAO Regional Middle East Regional Office (Cairo, Egypt) Information, sent by EASA to their member states' national aviation authorities, including the Dutch Ministry of Transport and Water Management, which showed that the ICAO Regional Middle East Regional Office had activated the Contingency Coordination Team[65] for the Baghdad FIR on 3 January 2020.

On 6 January, the Netherlands Defence Intelligence and Security Service provided the Expert group with an extensive situation update by e-mail. In the e-mail, the attack on general Soleimani was analyzed, and several possible targets for a retaliatory attack by Iran were mentioned. Also several scenarios and the possible effects on civil aviation in both the Iran and Iraq region were evaluated. The e-mail stressed the importance of contingency planning by the airlines, as the situation was assessed to be uncertain.

64 NOTAM B0002/20, Baghdad FIR, 2 January 2020 13:40 until 31 March 2020 23:59.

65 A Contingency Coordination Team is established to initiate and coordinate appropriate contingency actions and measures between relevant states and Air Navigation Service Providers in the event of disruption, for example in cases when airspace users decide to circumnavigate airspace due to conflict zones.

On 6 January, Germany replaced its NOTAM of 2 January with a new NOTAM about possible danger in the Baghdad FIR below FL 260.[66] The warning applied to six airways in the northeast of the nation, in addition to Baghdad Airport.

On 7 January 2020, Iran fired eleven to fourteen ballistic missiles towards two American air bases in Iraq. Shortly thereafter, the FAA published three NOTAMs and also e-mailed copies of the NOTAMs to various US and foreign airlines and foreign government partners, including the Dutch government, KLM, and EASA. The NOTAMs were all-altitude flight prohibitions for US civil aviation with respect to the Baghdad FIR, the Tehran FIR and the overwater airspace above the Persian Gulf and the Gulf of Oman.[67] Also these NOTAMs, were circulated to all the members of the Dutch Expert group.

After having been informed of the news about the ballistic missile attacks and the FAA NOTAMs, KLM contacted the Netherlands Defence Intelligence and Security Service about the situation and decided to stop flying in the Baghdad and Tehran FIR shortly after. Chapter 4 elaborates further on the decision-making process.

66 NOTAM B0007/20, Baghdad FIR, 6 January 2020 17:08 until 5 April 2020 23:59.
67 NOTAM KICZ A0001/20, Baghdad FIR, 7 January 2020 23:45 until perm.
NOTAM KICZ A0002/20, Tehran FIR, 8 January 2020 until perm.
NOTAM KICZ A0003/20, the overwater airspace above the Persian Gulf and Gulf of Oman, 8 January 2020 until perm.

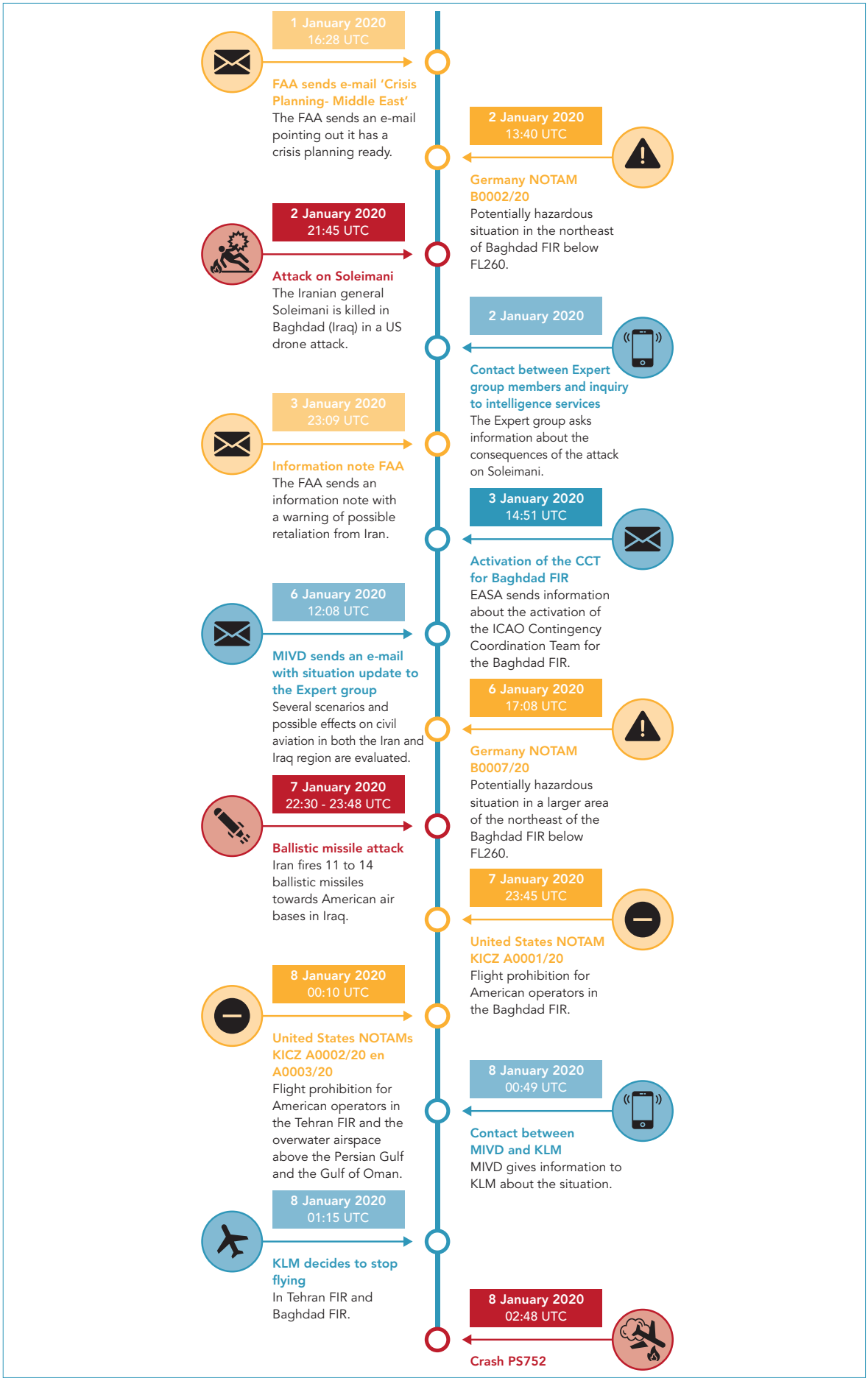


Figure 13: Timeline - 1 January 2020 until the crash of flight PS752 on 8 January 2020.

3.5.2 Timeline - crash of flight PS752 until the end of January 2020

On 8 January 2020, after the crash of flight PS752, the Expert group organized an ad hoc meeting in the afternoon to discuss the situation. On the same day, EASA sent an information note to its network of member states indicating that an initial review of airspace safety had been made for civil aviation in the region. As a precautionary measure, awaiting the results of the EU risk assessment to be conducted on 10 January, it was recommended that overflight of Iraqi airspace should be avoided. As there is no direct communication line between the European Commission/EASA and the airlines, the Ministry of Infrastructure and Water Management forwarded the information note immediately to the members of the Expert group.

Four NOTAMs were published shortly after the crash on 8 January. Iran issued two NOTAMs on 8 January regarding respectively the implemented air traffic route restrictions on the Iran-Iraq border and the closure of the airways in the western part of Iran.[68] Iraq issued a NOTAM that contained a warning of missiles being fired towards the Baghdad FIR.[69] A fourth NOTAM was issued by France, with the advice to avoid the Baghdad FIR and the Tehran FIR.[70] One day later, on 9 January, Germany published a NOTAM that warned of potential risk to aviation from military operations and anti-aviation weaponry in the Tehran FIR.[71]

On 10 January, the United Kingdom published two NOTAMs with advice to avoid the Baghdad FIR and the Tehran FIR.[72] On the same day the European Commission organized an *ad hoc* risk assessment meeting. After the meeting on 10 January 2020, EASA sent an information note with advice to avoid the Baghdad FIR at all altitudes and the Tehran FIR below FL250.

On 11 January, media reports stated that Iran acknowledged having shot down flight PS752. That same day, based on new information and in particular the public announcement made by Iran that its air defence forces shot down flight PS752 unintentionally, EASA sent an information note with advice to avoid the Baghdad FIR and Tehran FIR. Further, Canada published two NOTAMs with advice to avoid the Baghdad FIR and Tehran FIR.[73] On 14 January, Ukraine also published a NOTAM with a flight prohibition for Ukrainian operators for the Baghdad FIR and Tehran FIR.[74]

68 NOTAM A0086/20, OIIX Tehran FIR, valid from 8 January 2020 05:49 until 8 January 2020 12:00,
NOTAM A0087/20, OIIX Tehran FIR, valid from 8 January 2020 06:53 until 8 January 2020 13:00.
69 NOTAM A0018/20, ORBB Baghdad FIR, 8 January 2020 14:35 until 15 January 2020 23:59.
70 NOTAM F0024/20, Baghdad FIR and Tehran FIR, 8 January 2020 19:11 until 15 January 2020 23:59.
71 NOTAM B0023/20, Tehran FIR, 9 January 2020 19:42 until 13 January 2020 23:59.
72 NOTAM V0002/20, Tehran FIR, 10 January 2020 00:54 until 9 April 2020 17:00.
NOTAM V0003/20, Baghdad FIR, 10 January 2020 00:56 until 9 April 17:00 2020.
73 NOTAM H0047/20, Tehran FIR, 11 January 2020 2:21 ongoing.
NOTAM H0655/20, Baghdad FIR, 11 January 2020 2:21 revised on 13 March 2020 15:07 ongoing.
74 NOTAM A0068/20, Tehran FIR and Baghdad FIR, 14 January 2020 9:00 until 9 April 23:59 2020.

On 16 January, EASA published a CZIB for Iran containing the outcome of the risk assessment, namely that risks to operations were assessed to be 'HIGH' for flight levels below FL250.[75] The CZIB stated that due to the hazardous security situation and poor coordination between civil aviation and military operations, there is a risk of misidentification of civil aircraft, and operators should take this information and any other relevant information into account in their own risk assessments. No new CZIB for Iraq was published. The existing CZIB for Iraq (first published in 2017) remained unchanged.

75 CZIB 2020-01R1.
The reason why overflight above FL250 was considered safe has not been investigated by the Dutch Safety Board.

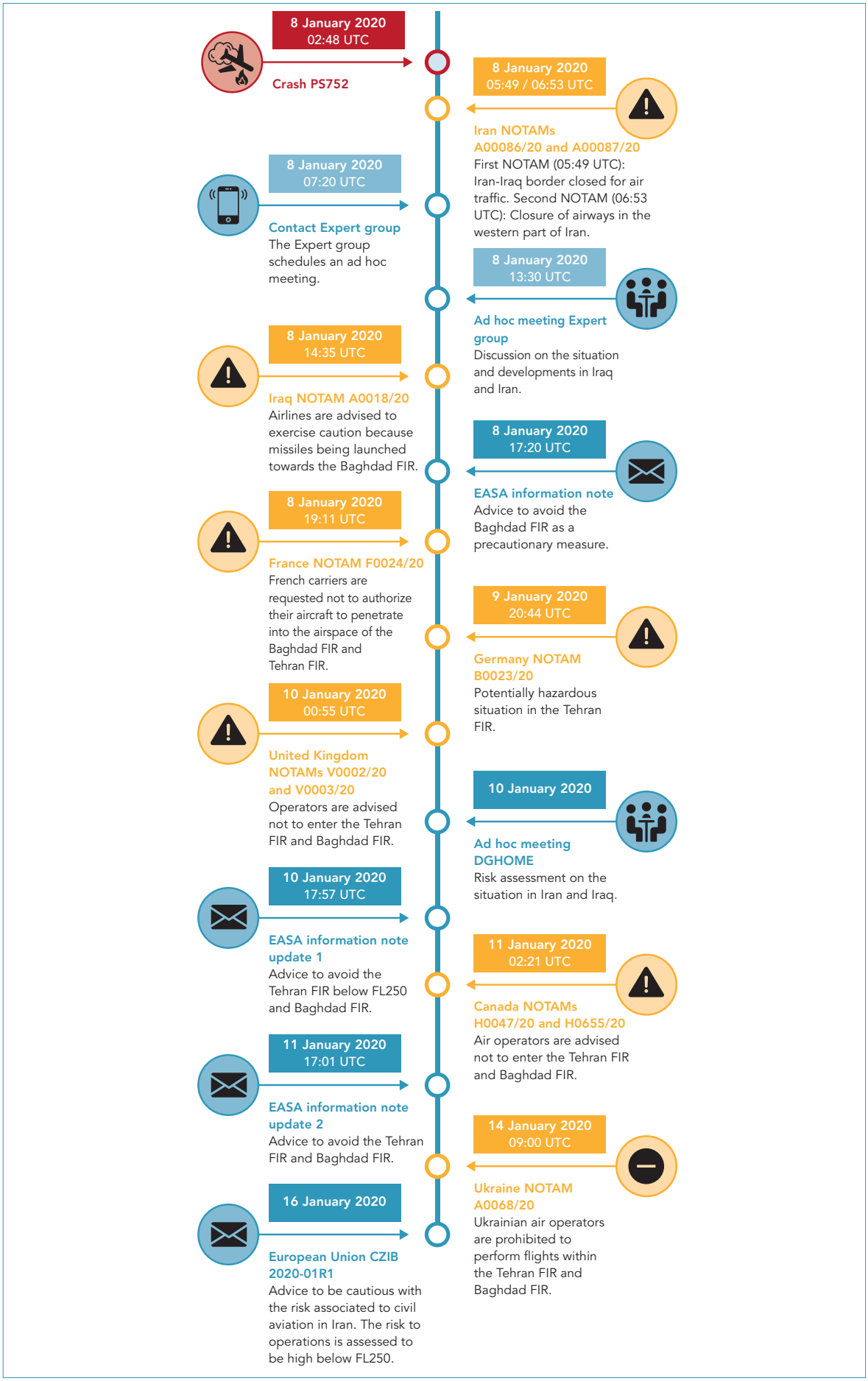


Figure 14 Timeline - from the crash of flight PS752 (8 January) until the end of January 2020.

3.5.3 Functioning of the current system of information sharing

The situation in the Iran and Iraq region escalated by the events on 2 January 2020. Several stakeholders in the aviation network pointed to the increase in tensions, the dynamic and uncertain situation and indicated possible retaliatory attacks from Iran. The FAA also noted the possibility of an inadvertent attack on civil aircraft in the region. The Dutch state and Dutch airlines received various communications on the situation, as well as information available within the international network.

With regard to the Expert group, the lines of contact were short and communications appeared to be open. Shortly after the attack on general Soleimani, the Expert group made an inquiry to the Dutch intelligence services, resulting in a situation report a few days later. When the conflict escalated further, contacts within the Expert group intensified and took place mainly digitally in order to spread the information faster. In the meeting that was organized shortly after the crash of flight PS752, the situation was discussed more thoroughly and the information was evaluated.

Although civil aviation stakeholders were aware of the risks prior to the ballistic missile attacks, not one state issued an advice to avoid, or a prohibition for Iranian airspace in the period 2 – 7 January 2020.[76] Following the ballistic missile attacks on American air bases in Iraq, the FAA promptly issued NOTAMs with flight prohibitions for their operators. This was three, respectively two and a half hours before the crash of flight PS752. These were the only foreign state publications issued between the time of the ballistic missile attacks and the crash of flight PS752. All the other foreign state publications followed more than twelve hours after the crash. In addition to the effect of time zones, the preparation and publication of official state publications such as NOTAMs or AICs require coordination between different parties or organizations. This process therefore takes some time to finalize.

The European CZIB was published eight days after the crash, after several states had already issued information. This illustrates the long duration of the process, as has also been highlighted in paragraph 3.3.3.

76 The Dutch Safety Board did not investigate the decision-making process in other states than the Netherlands.

Sub-conclusions
The investigation into the information sharing process before the ballistic missile attacks on American air bases in Iraq and the crash of flight PS752 shows that for both the Dutch state and Dutch airlines the current information gathering and sharing network provided them with the information available within the aviation network.

The situation in the Iran and Iraq region escalated by the events on 2 January 2020. The situation was dynamic and uncertain as there were several possibilities for a retaliatory attack from Iran. Although the information about the situation was available, not one state issued an advice to avoid, or a prohibition for, Iranian airspace in the period 2 – 7 January 2020.

The FAA issued two NOTAMs prohibiting US airlines to fly in the Baghdad and Tehran region three, respectively, two and a half hours before the crash. These NOTAMs, issued on 7 and 8 January were the only state publications issued between the ballistic missile attacks and the crash of flight PS752 on 8 January. All other foreign state publications were published in the hours, days and weeks after the crash.

3.6 Conclusions

In order to make a proper risk assessment with regard to flying over or near conflict zones, airlines need sufficient, high-quality information that is provided in a timely manner. Airlines need to set up a network and a process for gathering threat information. The precise manner in which airlines should gather threat information is not prescribed. Threat information is often shared in a confidential context because of its sensitivity or classification.

Both states and airlines have an important function in gathering threat information because they have access to different information sources. Airlines can use their own networks at destinations or with other airlines, while states have access to classified intelligence information. Therefore, a good relationship between airlines and their state is essential in order to obtain access to intelligence information.

The Dutch airlines all have an information gathering process in place. The practical implementation of this information gathering process differs between airlines, which may cause differences in information position. In the Netherlands, threat information is shared between the Dutch state and the Dutch airlines through the Expert group. A mechanism has been established whereby the parties to this group can reach each other, and it gives airlines a direct link to the Dutch intelligence services. Information is shared both on demand and unsolicited. The intelligence services' participants in the Expert group proactively inform airlines about information that has been obtained as supplementary to other activities. However, the legal security and intelligence tasks of the Dutch

intelligence services do not include collecting threat information specifically for the purpose of civil aviation.

In addition to the provision of information, a state of the operator can provide more guidance to their airlines in the form of advice (recommended actions) or regulations (restrictions/prohibitions). There is no legal basis in Dutch law to impose a flight prohibition or restrictions on Dutch aircraft in connection with flying in foreign airspace. Apart from providing information, the Dutch state has explicitly chosen not to provide specific guidance to Dutch airlines regarding conflict zones. Nevertheless, the Dutch state is involved in the development of EU recommended actions following from the EU Risk Assessment process.

Contrary to the Netherlands, several states such as France, Germany, the UK, the US and Canada do provide more guidance to their operators. Not all states have implemented this in a similar manner. France, for example, does not have a legal basis in the national regulatory framework to restrict or prohibit their operators. All of the states mentioned, however, publish their advice or regulations in aeronautical publications, thereby making it available to all operators worldwide. Despite being non-mandatory, an advice issued by a state is considered a forceful measure, as deviating from it usually requires thorough justification by airlines.

The Dutch state is involved in the EU Risk Assessment process on conflict zones. The aim of the process is to combine intelligence from EU member states and to provide EU states and airlines with an equal level of information on conflict zone risks to civil aviation. The physical meetings that are required for this EU Risk Assessment process in order to share and discuss classified information delay the process. The public Conflict Zone Information Bulletins (CZIBs) contain information and recommended actions, and are based on the outcome of the EU Risk Assessment process. The non-public EASA information notes contain information and recommended actions as well, including for situations where no EU risk assessment has taken place (yet). As agreement needs to be reached and coordination with the European Commission and EU member states is required, the time needed for publication of a CZIB, and to a lesser extent of an information note, is long for rapidly escalating conflicts.

Contrary to CZIBs, EASA information notes on conflict zones are non-public and distributed by EASA to their network of member states. The member states are requested to share the information in the notes with their airlines on a need-to-know basis. The lack of mandate to disseminate relevant information to airlines directly, limits EASA's effectiveness. In addition, it may be difficult to reach consensus between member states on the decisions to be taken in EU risk assessments. These divergences are caused by economic, diplomatic and other interests, including the fact that not all member states may have the same perception about flying to a specific region or state. Complementary to the current procedures, EASA is working on creating an information sharing platform on conflict zones focusing on non-classified information. This may contribute to the establishment of shorter communication channels and therefore the faster exchange of relevant information.

The sharing of information is only effective if the information is disseminated quickly to all relevant aviation stakeholders to allow them to perform risk assessments and take decisions. Investigation of the information sharing process in place before and after the crash of flight PS752 shows that for both the Dutch state and Dutch airlines the current information gathering and sharing network provided them with the information available within the aviation network. Queries prompted by the increased tensions in the Iran and Iraq region were initiated within the Expert group.

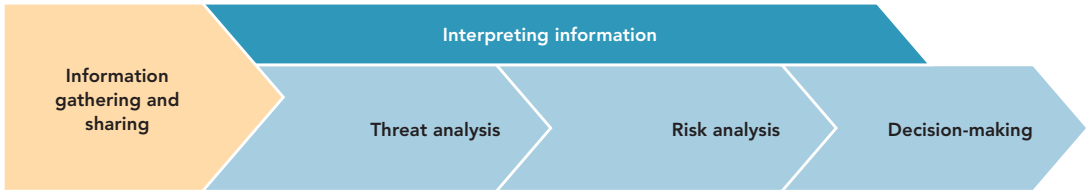
The situation in the Iran and Iraq region escalated by the events on 2 January 2020. The situation was dynamic and uncertain as there were several possibilities for a retaliatory attack from Iran. Although this information about the situation was available, not one state issued an advice to avoid, or a prohibition for, Iranian airspace in the period 2 – 7 January 2020. The US Federal Aviation Administration (FAA) issued a flight prohibition for the Baghdad and Tehran region after the ballistic missile attacks, a few hours before the crash. Other state publications followed hours, days and weeks after the crash. EASA issued its public CZIB eight days after the crash.

The situation as of 8 January 2020 shows that state and European guidance in the form of recommended actions or regulations (except for the NOTAMs issued by the FAA) was published well after most airlines already stopped flying in the region. In the event of a rapidly escalating conflict, state guidance in the form of restrictions or prohibitions might therefore be late.

4 AIRLINE DECISION-MAKING AND ACCOUNTABILITY

4.1 Significance

Chapter 2 shows that airlines and the states of the operator have to assess the risks of flying over or near conflict zones, because it cannot be assumed beforehand that the airspace over or near a conflict zone is safe. A thorough risk assessment process forms the basis for decision-making.[77] The previous chapter shows that Dutch airlines are capable of holding a good information position, one that is also supported by the efforts of the Dutch state through the provision of information. Information gathering about threats is performed prior to the analysis. The various steps of the risk assessment process are depicted in Figure 15.



Threat analysis: Determining possible threats based on the gathered information (also called security assessment).
Risk analysis: Determining the risks and uncertainties caused by specific threats.
Decision: Determining necessary route adjustments (none, flying at a higher altitude, taking an alternative route, not flying). Additional aspects are taken into account when taking a decision, such as possibilities for deviating to other airports, procedures in the event of a sudden loss of cabin pressure (decompression), as well as economic factors (destinations, available alternative routes) or changing weather conditions.

Figure 15: Steps in the risk assessment process (Source: Dutch Safety Board).

An airline is accountable towards the state authority that conducts safety oversight. This accountability can be broken down into two aspects: the process of risk assessment, and the outcome of the process, namely the decisions made. Appropriate oversight by the authority on both the process and outcomes contributes to a better risk assessment.

The Dutch Safety Board concluded in 2015 that public accountability of operators regarding their choice of whether or not to fly over conflict zones, should lead to transparency in the processes airlines use when choosing flight routes. This transparency could lead to a better risk assessment. Ideally operators actively provide information about routes (to be) flown, so that everyone can form a judgement, thereby increasing

77 ICAO Doc 10084, *Risk Assessment Manual for Civil Aircraft Operations Over or Near Conflict Zones*, Second Edition, 2018.

public attention for this issue. Public accountability is by no means a shift in responsibility, but it puts society, including passengers, consumer organizations, and media in a position to question the decisions.

4.2 Responsibilities and obligations

4.2.1 Risk assessments and decision-making

In accordance with international standards, an operator shall ensure that a flight will not commence unless it has been ascertained that the route from the aerodrome of departure to the aerodrome of arrival, including alternate aerodromes, can be safely used.[78] This standard also emphasizes that a risk assessment must be conducted when intending to operate over or near conflict zones, and appropriate risk mitigation measures must be taken to ensure a safe flight. Airlines must therefore make an informed decision about whether or not to fly over or near conflict zones.

Some states, for example the United States, Canada, Germany, France and the United Kingdom, conduct risk assessments for foreign airspaces.[79] Based on the outcome of these risk assessments, these states may issue warnings, advice, restrictions and/or prohibitions to their airlines.[80] States' assessments can be used as input for airlines' risk assessment, but do not substitute for the airlines' legal obligation to independently assess these risks.

ICAO guidelines

The ICAO standards on risk assessment do not provide details on the method to be applied. However, ICAO has published dedicated guidance material on the methodology for a conflict zone risk assessment[81] to support the implementation of the related ICAO standards. The method described consists of a threat analysis which determines the likelihood of a threat occurring, and a risk analysis which uses a risk matrix to combine likelihood and consequences.

78 ICAO Annex 6 Operation of Aircraft, Part I: Flight Operations, standard 4.1.2, applicable since 5 November 2020.
79 The Netherlands does not conduct risk assessments on foreign airspaces (see paragraph 3.3.2).
80 The EU also conducts risk assessments and issues recommendations. EASA publishes the recommendations in CZIBs (see paragraph 3.3.3).
81 ICAO Doc 10084, *Risk Assessment Manual for Civil Aircraft, Operations Over or Near Conflict Zones*, 2018.

Risk matrix

Airlines determine risks by combining the likelihood (or probability) of a threat occurring and the consequences (severity) according to a risk matrix. Risk matrices may differ from one airline to another, but generally have one axis representing an event severity on a scale ranging from negligible (no or insignificant consequences, damage or injury is negligible) to catastrophic (large consequences, irreparable major economic damage, fatalities), while the other axis represents the likelihood or probability of it occurring, on a scale ranging from frequent to extremely improbable.

Safety Risk		Severity				
Probability		Catastrophic A	Hazardous B	Major C	Minor D	Negligible E
Frequent	5	5A	5B	5C	5D	5E
Occasional	4	4A	4B	4C	4D	4E
Remote	3	3A	3B	3C	3D	3E
Improbable	2	2A	2B	2C	2D	2E
Extremely improbable	1	1A	1B	1C	1D	1E

Figure 16: Example safety risk matrix. (Source: ICAO doc 10084, Figure B-3)

The risk matrix is then used to determine the tolerability of the risk. Colours and/or numbers indicate the tolerability on a scale ranging from acceptable (no impact to safety, damage or injury is negligible, no action necessary) to extremely intolerable (safety is not guaranteed, intolerable risk). The idea behind the matrix is that activities that involve an extreme risk (the red areas in Figure 16) are intolerable and may not be undertaken. High and moderate risks (the orange areas in Figure 16) are tolerable, but require different types of mitigation (risk-reducing) measures. Low and negligible risks (the green areas in Figure 16) can be accepted without further measures.

The ICAO Doc 10084 on conflict zone risk assessment focuses primarily on the risk posed by long-range surface-to-air missiles (SAMs) as these are currently considered to pose the most significant risk to civil aircraft operating over or near conflict zones. The manual covers both the risk of intended and unintended attacks. The reasonable consequences of a SAM attack on an aircraft are catastrophic, resulting in many fatalities and the loss of the aircraft. In this context, the manual states that the most important risk factor when discussing conflict zones is the threat. The threat likelihood is the key driver of the risk assessment and will determine the mitigating actions to be taken. This likelihood is derived by analyzing the intent and capability of an attack on a civil aircraft, whether intentional or unintentional. The ICAO manual indicates that threat analyses are, in general, more qualitative than quantitative in nature, as intent and capability of the involved actors cannot be quantified. A combination of historical data as well as scenario-building should be applied, whereby the qualitative methods can help to consider for example the likelihood of the threat increasing over time or uncertainties that need to be taken into account.

The existence of heightened military tension in or near an area where civil aviation operations take place is a significant risk factor, especially when it can be assumed that SAMs are available to a party engaged in the conflict. ICAO Doc 10084 has listed the following factors as the most important risk factors to be considered when assessing the risk of an unintentional attack:

- the use of military aircraft (including drones) in a combat role or for hostile reconnaissance;
- the use of transport aircraft for military troops or equipment, as such aircraft may be more difficult to distinguish from civil aircraft;
- poorly trained or inexperienced personnel operating SAMs (this risk is likely to be the highest where SAMs may have been acquired by non-state actors);
- the lack of effective air traffic management;
- the routeing passes over or close to locations/assets of high strategic importance.

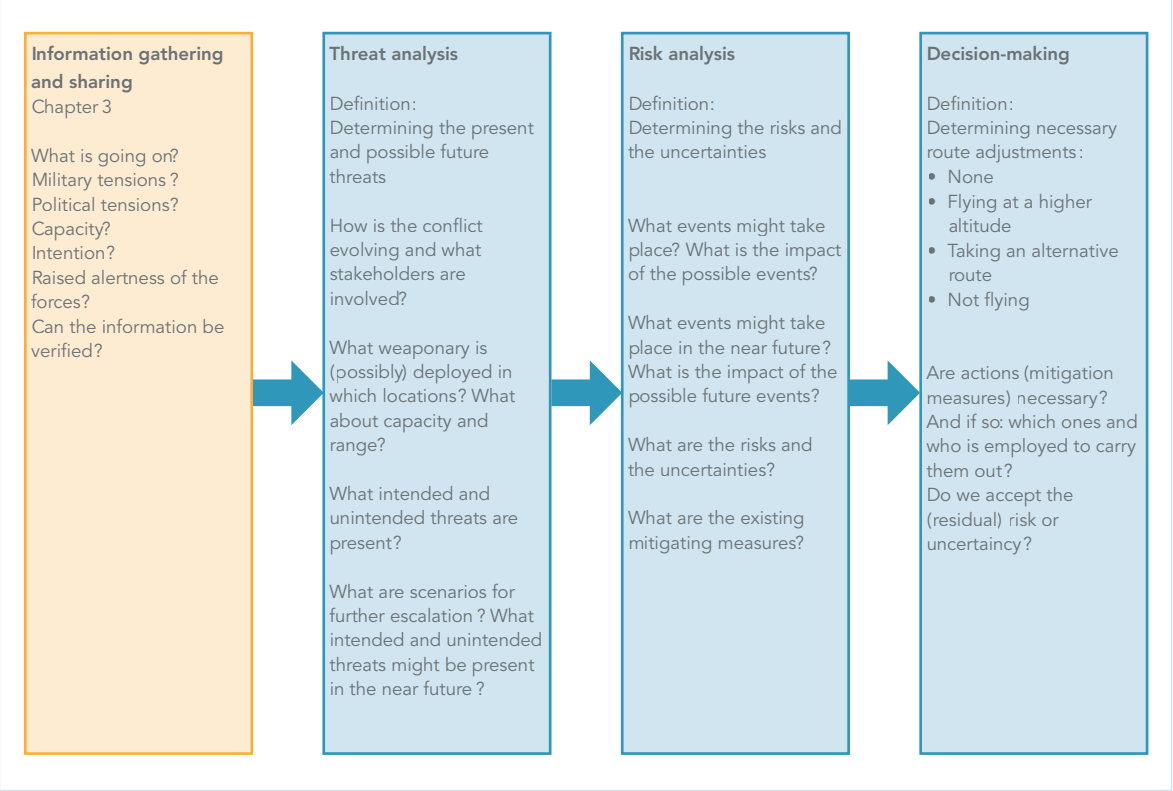


Figure 17: Risk assessment process, including risk-increasing and uncertain factors (Source: Dutch Safety Board).

Limitations of the present guidelines

The method described in ICAO Doc 10084 on conflict zone risk assessment is based on the traditional approach towards risks, referring to risk matrices for the security risk assessment and the safety risk assessment. Even though the importance of the combination of both quantitative and qualitative methods to assess the likelihood of scenarios is addressed, the manual does not describe the qualitative methods for assessing threats increasing over time or uncertain threat scenarios.

Risk assessment using a risk matrix is a professional working method and a well-established practice for safety management in civil aviation. The current high level of safety in civil aviation has been achieved through efforts of many different actors,

amongst other by introducing this systematic approach towards safety management and risk assessment. However, the risk matrix has limitations for the assessment of security risks related to flying over or near conflict zones, for example for the scenario involving civil aircraft being hit, either intentionally or unintentionally, by surface-to-air missiles. When the risk assessment is based only on the traditional risk matrix method, the high consequence of a civil aircraft being shot, combined with its low likelihood due to the uncertainty of the scenario, will result in a moderate risk for this scenario. However, instead of lowering the likelihood, uncertainties together with factors such as the escalation of a conflict and SAMs being present, should be used qualitatively to explore the possibility instead of the probability of catastrophic scenarios in conflict zones.

Uncertainties need to be part of a threat analysis. There can be uncertainties regarding the further development and escalation of a conflict. Also, risks should be included for which the intention or capability is uncertain, including inadvertent and unintentional acts. In 2015 the Dutch Safety Board issued two recommendations to ensure that airlines include risk-increasing and uncertain factors in their risk assessment process.

Recommendation 6 to ICAO (MH17 Crash report, 2015):
Amend relevant Standards so that risk assessments shall also cover threats to civil aviation in the airspace at cruising level, especially when overflying conflict zones. Risk-increasing and uncertain factors need to be included in these risk assessments in accordance with the proposals made by the ICAO Working Group on Threat and Risk.

Recommendation 8 to states (State of Operator) (MH17 Crash report, 2015):
Ensure that operators are required through national regulations to make risk assessments of overflying conflict zones. Risk-increasing and uncertain factors need to be included in these assessments, in accordance with the proposals made by the ICAO Working Group on Threat and Risk.

In its *MH17 Crash* report (2015), the Dutch Safety Board stressed that it is important that the sector innovates when estimating and assessing scenarios that have major consequences and where uncertainties are involved. Including uncertainties implies that possible scenarios must be given more weight when estimating and assessing uncertain threats with catastrophic consequences. Taking into account both the inherent uncertainty pertaining to rapidly escalating conflicts and the catastrophic consequences of a surface-to-air missile encounter, the mere possibility of the scenario should be sufficient to exercise precaution. The implementation of the precautionary principle ensures a risk approach that, in contrast to the more traditional risk matrix approach, results in more weight given to uncertain but catastrophic scenarios in assessing flight routes above and near conflict zones.

Precautionary principle

Past experiences from other domains have shown that a traditional approach towards risk has limitations with respect to environments and situations that are only partially known and controllable.[82] In its report, the Netherlands Scientific Council for Government Policy (in Dutch: *Wetenschappelijke Raad voor het Regeringsbeleid*) concludes that uncertain and ambiguous risks require a new approach where uncertainties are taken into account. The normative principle of such a new approach is precaution. This precautionary principle has also been recognized by the European Commission as an instrument that aims at ensuring a higher level of protection through preventative decision-taking in the case of risk.[83, 84]

The precautionary principle involves a risk approach based on the realization that uncertainties must be taken seriously and that dealing with uncertainties must therefore be explicitly organized. Where precaution is accepted as a normative principle, the stakeholders and processes are geared towards the early detection and discussion of uncertainties. When decisions are made, any remaining uncertainties will explicitly be taken into consideration.

The need to improve the conflict zone risk assessment process is acknowledged by members of the Expert Group on Risk Information overflying Conflict Zones (EGRICZ)[85] and Safer Skies[86]. These groups work on identifying and sharing best practices with regard to risk assessment and safety management.

82 Netherlands Scientific Council for Government Policy, *Uncertain Safety*, 1 October 2008.
83 European Commission, *Communication from the Commission on the precautionary principle, COM(2000) 1final*, 2 February 2000, https://eur-lex.europa.eu/legal-content/NL/TXT/?uri=LEGISSUM%3Al32042
84 More literature and research is available on the topic of the precautionary principle. For the purpose of this investigation, the references have been limited to the two sources mentioned.
85 See paragraph 3.4.
86 See paragraph 1.5.

Sub-conclusions

Airlines must conduct a risk assessment when intending to operate over or near conflict zones, and appropriate risk mitigation measures must be taken to ensure a safe flight. In its *MH17 Crash* report, the Dutch Safety Board concluded that airlines should apply a more qualitative risk approach, making an informed judgement related to the possibility of scenarios.

The ICAO standards on risk assessment do not detail the method for the assessment. The method described in the ICAO manual on conflict zone risk assessments is based on the traditional approach towards risks, referring to risk matrices for the security risk assessment and the safety risk assessment. Even though the manual addresses the importance of both quantitative and qualitative methods to assess the likelihood of scenarios, no criteria are provided on how and when risk-increasing factors and uncertainties must be included in the analysis. The implementation of the precautionary principle ensures a risk approach whereby, in contrast to the more traditional approach, dealing with uncertainties must be explicitly organized. A precaution-based risk approach results in more weight being given to uncertain but catastrophic scenarios.

4.2.2 Oversight

Airlines are primarily responsible for the safety of their activities and products. Public regulators ensure that parties fulfil their responsibility. Public regulators do not take over airline's responsibilities. Safety oversight in aviation is a task performed by the state of the operator to ensure that individuals and organizations performing an aviation activity comply with safety-related national laws and international regulations.[87] The individual state's responsibility for safety oversight is the foundation for safe international air operations. The international standards adopted by ICAO are implemented in Europe through the EU regulatory framework, which is directly binding for EU member states. The responsibilities for, and requirements of, safety oversight in the domain of air operations in the European Union are laid down in Regulation (EU) No 965/2012. In the Netherlands, the Human Environment and Transport Inspectorate (ILT) of the Ministry of Infrastructure and Water Management is responsible for the safety oversight of airlines.

The European Commission recently concluded that the ICAO Annex 6 requirements for airlines to conduct risk assessments for conflict zones - which became applicable on 5 November 2020 - can be considered as being included in already existing regulation on (safety) management systems.[88] However, the existing EU requirements address the identification of safety hazards and the risk management process only in general terms. There is no specific mention of the areas in which a risk assessment shall be conducted, i.e. there is no specific reference to the topic of decision-making in relation to conflict zones.

87 ICAO Safety Oversight Manual, Doc 9734, 2017.

88 Regulation (EU) No 965/2012 on air operations, Annex III (Part-ORO), mainly ORO.GEN.200 (a)(3) on the identification of safety hazards. EASA will further consider the need to develop additional acceptable means of compliance (AMC) or guidance material (GM) on the particular risk concerning the conflict zones.

In 2015, the Dutch Safety Board recommended to include the conduct of risk assessments by operators in national regulations. For EU member states this would be the applicable EU regulations.

Recommendation 8 to States (State of Operator) (MH17 Crash report, 2015):
Ensure that operators are required through national regulations to make risk assessments of overflying conflict zones. Risk-increasing and uncertain factors need to be included in these assessments, in accordance with the proposals made by the ICAO Working Group on Threat and Risk.

Sub-conclusion
The EU regulatory framework requires airlines established in the European Union to have a risk management process in general terms, but does not make specific reference to conflict zones.

4.2.3 Transparency

The Dutch Safety Board recommended public accountability by airlines regarding selected flight routes as this should lead to transparency in the processes airlines use when choosing flight routes.

Recommendation 10 to IATA[89] (MH17 Crash report, 2015):
Ensure that IATA member airlines agree on how to publish clear information to potential passengers about flight routes over conflict zones and on making operators accountable for that information.

Recommendation 11 to operators (MH17 Crash report, 2015):
Provide public accountability for flight routes chosen, at least once a year.

This aspect was also highlighted in a recent statement of the United Nations Special Rapporteur on extrajudicial, summary or arbitrary executions,[90] which notes that while the public should not be expected to analyse safety and threat data, the general availability of such data would allow organizations to provide guidance to passengers in selecting airlines and flights.

Transparency and public accountability by airlines regarding their flight route decision-making with respect to conflict zones are not a legal obligation. The Dutch Safety Board realizes that publishing details about choices of individual flight routes is not a

89 International Air Transport Association.
90 United Nations Special Rapporteur on extrajudicial, summary or arbitrary executions, *Statement, Commercial Airlines and conflict zones: Recommendations to strengthen air safety and prevent of unlawful deaths*, 8 January 2021.

straightforward matter, due to aspects such as the sensitivity of information and the complexity[91] of considerations. Nevertheless, in 2019 the Dutch Safety Board stated that this does not detract from the fact that airlines could look for ways to provide public accountability regarding the choices they make, such as by explaining the reasons for avoiding certain areas.

Sub-conclusion
Publishing details of choices of flight routes by airlines is not straightforward, due to aspects as sensitivity and complexity. However, some form of transparency and public accountability by airlines regarding selected flight routes is a final step for airlines to demonstrate that they are adequately considering risks related to conflict zones. This allows society, including passengers, consumer organizations, and media to form a judgement by themselves.

4.3 Decision-making and accountability for Dutch airlines

4.3.1 Risk assessment process

Dutch airlines have all implemented a risk assessment process addressing the overflight of conflict zones, which outcome is a decision to fly or not to fly in a specific airspace or region.[92] The main process steps are similar, and include a threat assessment, where intent and capability are assessed, and an operational safety assessment, which considers such aspects as the possibility of changing routes, decompression routes, alternate aerodromes, the impact of restrictions, and available alternatives. The Dutch airlines use risk qualification schemes that assess likelihood and consequences. Overall, their methods are comparable to the risk index matrices described in the ICAO manual on conflict zone risk assessments[93].

In general, regions are monitored on the basis of risk profiles or norms whereby several parameters are considered, such as terrorism, social unrest, crime rates, and military activity. If the picture changes in a region or if new information becomes available, this triggers an update of the threat assessment. For some longer-term conflict zones, scheduled assessment updates also take place. For sudden escalations where a decision is required more urgently, a dedicated and shorter procedure for assessment and decision-making is applied. Such shortened procedures allow for fast decision-making that is required using the information available at that time. More extensive risk assessments and group meetings may be held at a later stage in order to reconsider the decisions that were taken under pressure of time.

91 Apart from security risk assessment considerations, there are also operational (safety) considerations such as multiple routes to each destination, weather and atmospheric conditions, air traffic congestion, etc.
92 The security risk assessments usually differentiate between situations on the ground at the aerodrome, take-off and landing phases, and lower and upper altitude (overflights).
93 ICAO Doc 10084, *Risk Assessment Manual for Civil Aircraft, Operations Over or Near Conflict Zones*, Second Edition, 2018.

In their risk assessments, all Dutch airlines include scenarios for which the intention or capability is uncertain, such as inadvertent and unintentional acts. Uncertainties regarding the development of the conflict are reflected in the validity period of a risk assessment, the review cycle or are triggers for a new risk assessment. There is no uniform manner or clear method for addressing uncertain scenarios. Their risk approaches however do not result in more weight to be given to uncertain but catastrophic scenarios.

This decision-making process is often structured as part of a safety management or security management system. The box below illustrates that notwithstanding the similarities in the approaches each airline has implemented a different risk assessment process.

Risk assessments at Dutch Airlines – procedural steps

KLM has a dedicated security department with security officers monitoring incidents and news media 24/7. The areas where restrictions apply are monitored daily. For each of these areas several parameters are monitored on topics of terrorism, crime rate, and social unrest. In the event of changes to the standard values of the parameters, a new risk assessment is conducted. The standard value may differ per region. Examples of changes to the standards are a new weapon system in the region with a longer or higher range, or an increase in the frequency of incidents. Every two weeks, a Security Advice - consisting of a risk level and the related airspace restrictions - is presented to the KLM Security Briefing meeting (KFSSB, KLM Flight Safety & Security Briefing). This Briefing, chaired by a Chief Pilot, is responsible for the acceptance of risks and consequent decision-making. In the event of urgency, a 24/7 ad hoc Security Briefing meeting can also be held. In areas of substantial and/or high risk the related airspace shall not be used. Medium risk airspace areas shall not be planned to be used (or an altitude restriction applies), but may be used for contingency or emergency operations. KLM has overflight restrictions in place for more than 50 countries worldwide. At the same time, all codeshare flights with partner airline Delta Air Lines are affected by flight prohibitions issued by the FAA.[94] Despite being part of the Air France-KLM group, both KLM and Air France are autonomous in the decision-making regarding conflict zone risks. The airlines share the outcomes of the risk assessment and may discuss possible divergences.

Transavia makes use of the KLM security services and usually adopts the advice issued by KLM Security. The advice is usually received in writing, but in the event of urgency it is also communicated verbally. The Transavia Security Manager coordinates the advice internally with the responsible nominated persons and the accountable manager. A decision with respect to flight operations is then taken.

94 The Office of the Secretary of Transportation of the US Department of Transportation requires all codeshare flights with partner airline Delta Air Lines to abide by flight prohibitions issued by the FAA.

TUI fly Netherlands has a dedicated security department that conducts security assessments and issues advice. Each airline of the TUI Group (NL/BE, UK, DE, SE) has its own security department, and can raise or renew an Overflight Security Assessment (OSA). There can be several triggers to initiate an OSA: NOTAM driven, intelligence driven, event driven, or a scheduled or unscheduled review. All airlines jointly work on the OSA until it is approved by the Overflight Assessment Board (OAB). Afterwards, the Safety Review Board (SRB) can opt to accept or reject recommendations. Following a positive decision by the SRB, the recommendations are implemented into flight operations. In the event of new information requiring rapid decision-making, an Emergency Response Plan (ERP) is activated, which includes the main stakeholders at TUI fly Netherlands. In these cases the official OSA is completed/renewed at a later stage in order to reconsider the decisions made. For ad hoc flights the security department reviews the current security assessment and provides an advisory for each new flight.

Corendon Dutch Airlines conducts security assessments establishing the risks of overflying conflict zones, both for the usual areas of operation and for ad hoc flights. The situation is monitored for all conflict zones within the standard area of operation. For areas outside the standard operating area a risk assessment has to be conducted before a flight may be performed. The airline has established risk level guidance for the qualification of the risk. The outcome of the security risk assessments regarding overflying conflict zones are provided to the Operational Control Centre (OCC). The OCC implements restrictions and/or mitigations into the operational flight plans.

Sub-conclusions

Dutch airlines have all implemented a risk assessment process related to flying over or near conflict zones. They use risk qualification schemes that assess likelihood and consequences. Their methods are comparable to the method described in the ICAO manual on conflict zone risk assessments.

There are differences between Dutch airlines in how the risk assessment process is structured, as well as in the methodology implemented.

Dutch airlines take into account uncertainties to some extent, but this does not lead to more weight being given to uncertain but catastrophic scenarios.

4.3.2 Oversight of Dutch Airlines

The Human Environment and Transport Inspectorate (ILT) of the Ministry of Infrastructure and Water Management is responsible for the safety oversight of Dutch airlines. The oversight in relation to flying over or near conflict zones is conducted as part of:

1. regular oversight of the functioning of the required safety management system, where the overall risk assessment process is assessed,
2. regular oversight of flight preparation and dispatch, where it can be verified whether the flight routes used are in line with the outcome of the risk assessment process, and
3. flight inspections, where the information that the flight crew has available on board the aircraft is verified.

In general, the EU regulatory framework for management systems[95] requires that all aspects, including the risk assessment process, have to be reviewed every two years. In addition to scheduled audits, the legal framework offers the possibility for the ILT to respond to current events, for example in the event of escalation of a conflict, and to act on signals received. The conduct of oversight is therefore a continuous activity. As the EU regulatory framework does not contain specific requirements on the risk management in relation to flying over or near conflict zones, conflict zone risk assessment is not a mandatory part of the scope of the oversight conducted by ILT. The oversight of management systems usually focuses on the major risks identified by the operator. Conflict zones may be one of those top risks, depending on the airline or the situation. No specific oversight frequency has been determined by ILT for this topic.

The ILT has a range of instruments available for the conduct of oversight. In addition to audits, there is the possibility to conduct platform or theme inspections. Following the crash of flight PS752, the ILT performed a theme inspection into the conflict zone risk management process at Dutch operators.[96] Due to the COVID-19 situation, the investigation was conducted by means of a questionnaire (self-assessment), followed by interviews and verification. The ILT inspection report concludes that all Dutch operators perform a conflict zone related threat and risk analysis as part of their management system. The inspection report also notes that not all Dutch operators have access to the same information; for example, information coming from the Expert group is not shared with operators that have not signed the covenant[97]. The ILT concluded that as a result, operators may arrive at different risk assessments and decisions regarding flying over or near conflict zones.

The ILT's oversight activities of conflict zone risk assessments focus on the functioning of the implemented processes and procedures for risk assessment. This is similar to other topics that fall under the scope of the airline's management system. As a result, the ILT does not assess the actual decisions made. In addition, the ILT is currently not equipped to assess classified threat information and has no expertise on military aspects.

95 Regulation (EU) No 965/2012 on air operations, Annex III (Part-ORO), mainly ORO.GEN.200 (a)(3) on the identification of safety hazards.

96 Final report in Dutch: Inspectie Leefomgeving en Transport, *Overvliegen Conflictgebieden*, 24 September 2020.

97 The Dutch Air Operator Certificate (AOC) holders that perform international flights and have not signed the covenant are Exxaero B.V., JetNetherlands, CHC Helicopters Netherlands B.V., Heli Holland, and AIS Netherlands. These are charter/business aircraft and helicopter operators. These operators do not have a regular route network that may partly be over or near conflict zones.

Apart from the ILT, there are currently no other Dutch state authorities involved in the oversight of airlines with regard to the conduct of the risk assessment and resulting decision-making regarding conflict zones.

Sub-conclusions

Conflict zone risk assessment is not a mandatory part of the scope of oversight on airlines' management systems, because the EU regulatory framework does not contain specific requirements on the risk management in relation to conflict zones.

The ILT does conduct oversight on conflict zone risk assessments. The oversight activities of conflict zone risk assessments focus on the functioning of the implemented processes and procedures for risk assessment. There is no assessment of the final decisions taken by the airline following the conflict zone risk assessments. No other Dutch state authorities are involved in the oversight of airlines regarding conflict zone risk assessments and decisions.

4.3.3 Transparency by Dutch Airlines

Dutch airlines provide some information on their websites about flight routes and flying over or near conflict zones. The form and content of this information differ, but all airlines generally describe how they have selected a particular flight route, without providing any detail about the exact flight routes, restrictions or choices made. KLM also provides a flight routes map that illustrates the possible routes that may be flown. The Dutch Safety Board is aware that publishing details of choices in relation to conflict zones is not straightforward, and aspects as confidentiality and sensitivity play a role. Publishing more details may disrupt confidentiality and therefore damage the information position of the airlines and/or states.

Worldwide, airlines proactively publish little or no information about selected flight routes and related considerations on flights over or near conflict zones. The examples of Dutch airlines illustrate that it is possible to do more than the efforts made by most airlines.

Sub-conclusion

Worldwide, airlines proactively publish little or no information about selected flight routes and related considerations on flights over or near conflict zones. Dutch airlines provide some general information regarding conflict zone decision-making on their websites, but they are not transparent about the restrictions or choices made in order to protect their information position.

4.4 Decision-making at the time of the PS752 crash

The outcomes of the decision-making processes of Dutch and several other EU airlines at the time of the crash of flight PS752 was investigated by comparing flight route behaviour during that period. The decision-making process of Dutch airlines regarding the escalation of the conflict in Iran was detailed by a timeline analysis.

Iran and Iraq are countries in the Middle East region. Major airways and therefore flight routes pass through the Middle East, for instance routes from Europe to destinations in the United Arab Emirates (Dubai), China or south-east Asia. For the majority of states in this region, threats to civil aviation have been identified, for example, as the result of heightened military tension or potential use of arms. As an illustration the situation of 19 January 2021 as assessed by the OPSGROUP is depicted in Figure 19. Due to the tensions in this region, there is always the possibility of a conflict escalating at short notice. When planning flights to or over the Middle East, airlines navigate between the areas with the highest risks.

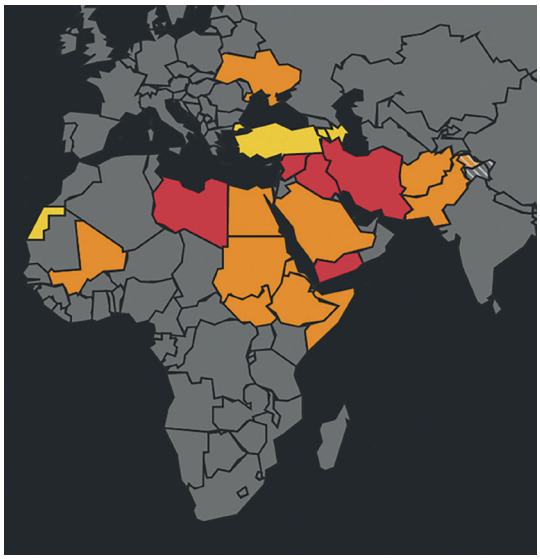


Figure 18: Conflict zones as indicated on safeairspace.net on 19 January 2021. Red: Risk level 1 (Do not fly), Orange: Risk level 1 (Danger exists), Yellow: Risk level 3 (Caution) (Source: OPSGROUP).

4.4.1 Flight analysis

An analysis of flights performed by considered EU airlines[98] was conducted in order to illustrate the decisions EU airlines made in reaction to the events on 2, 7 and 8 January 2020.

98 The operators included in the analysis are: Aerologic, Air Baltic, Air France, Alitalia, Austrian, British Airways, Cargolux, Condor, Eurowings, FinnAir, Holiday Europe, KLM, LOT, Lufthansa, Norwegian Air Shuttle, Swiss, Transavia, TUI Airways UK, TUI Germany, Virgin Atlantic, and Wizz Air. The selection is based on the operators that were active in this region in the time frame being analysed.

Figure 19 shows the number of flights[99] flown over Iraq and Iran by the considered airlines in the period between 30 December 2019 and 9 January 2020. The figure shows that the attack on general Soleimani on 2 January 2020 did not significantly change airlines' flight behaviour in the region. This indicates that airlines either assumed that it was safe to fly, or that they concluded so after a risk assessment process.

The ballistic missile attacks on American air bases in Iraq began at 22:30 on 7 January 2020. The crash of flight PS752 occurred at 02:48 on 8 January. In general, EU airlines stopped flying in Iran and Iraq over the course of the day on 8 January. In Figure 19, the clear reaction to the events can be seen. The number of flights was reduced by two-thirds (36 flights on 8 January 2020 compared to 99 –112 flights on the days before). On 9 January 2020, there were hardly any flights in the area (3 flights).

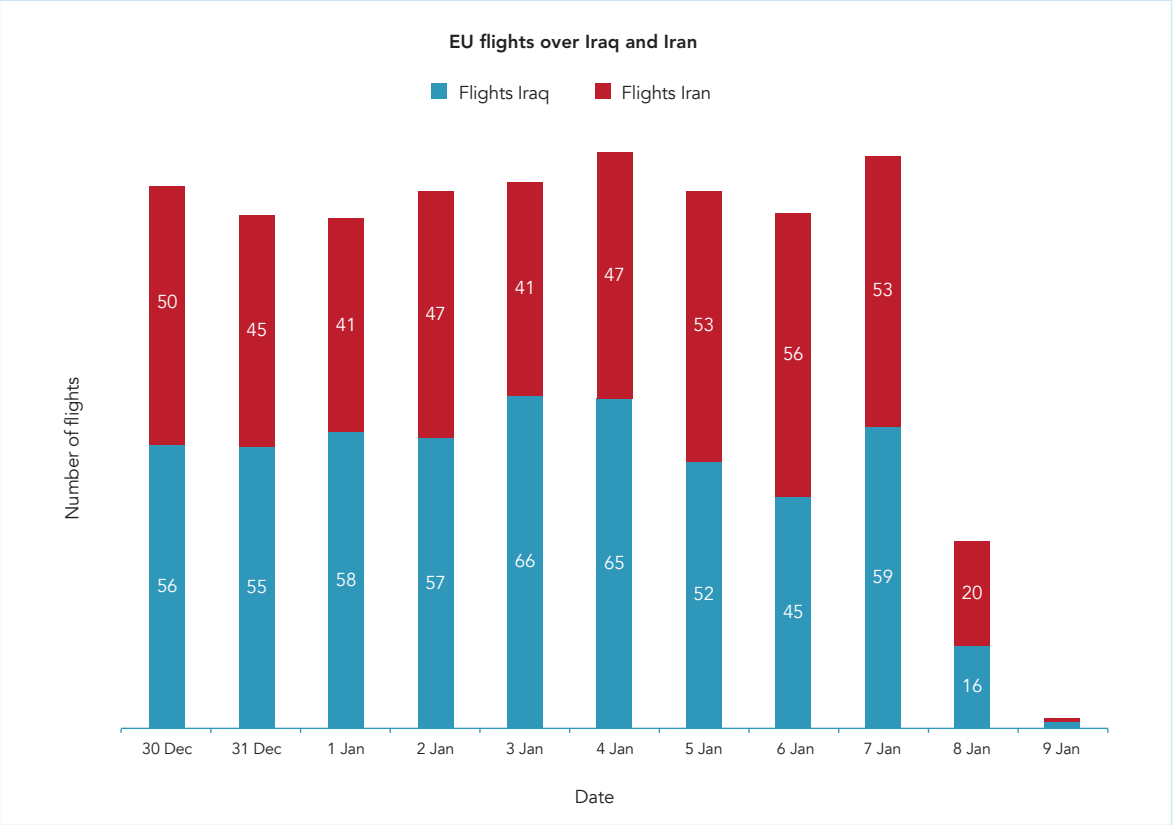


Figure 19: Number of flights conducted by a selection of EU airlines in Iran and Iraq from 30 December 2019 till 9 January 2020 (Source: Flightradar24). Included are flights over Iran and Iraq and flights with a destination or departure point in Iran or Iraq. The operators included in the analysis are: Aerologic, Air Baltic, Air France, Alitalia, Austrian, British Airways, Cargolux, Condor, Eurowings, FinnAir, Holiday Europe, KLM, LOT, Lufthansa, Norwegian Air Shuttle, Swiss, Transavia, TUI Airways UK, TUI Germany, Virgin Atlantic, and Wizz Air.

99 The following airways are included in the analysis: L178, UM860. UM688, UT301, UL223, M317/L319, UT430, T215, UL125 and UL333.

The number of flights at the time of the ballistic missile attacks on 7 January was analysed in more detail. Tehran Imam Khomeini International Airport was operational for civil aviation during and after the missile attack (see paragraph 2.4.2). Between the ballistic missile attacks and the crash of flight PS752, fifteen flights landed at the airport and nine flights departed from it. These airlines were from the following countries: Iran (10 flights), Turkey (6 flights), Qatar (4 flights), Russia (2 flights), Germany (1 flight) and Austria (1 flight).

Shortly before and during the missile attack, the airways over Iran and Iraq were neither closed nor restricted by aeronautical publication (see paragraph 2.4.2). No NOTAMs were issued by Iran on the airways restrictions in the western part of Iran until three hours after the crash. Several EU airlines flew over Iran and/or Iraq in the time frame between the ballistic missile attacks and the crash of flight PS752. The airlines were from the following countries: Germany (ten flights), The Netherlands (five flights), the United Kingdom[100] (four flights), France (four flights), Switzerland[101] (four flights), Luxembourg (two flights), Austria (one flight) and Bulgaria (one flight). The number of flights over Iraq and Iran is shown separately in Table 3.

Table 3: The number of overflights over Iran and Iraq by EU airlines between the start of the ballistic missile attacks and the crash of flight PS752 (22:30 UTC 7 January – 02:48 UTC 8 January 2020).

Country	Flights over Iraq	Flights over Iran
Germany	3	7
The Netherlands	3	2
United Kingdom	2	2
France	1	3
Switzerland	1	3
Luxembourg	1	1
Austria	1	0
Bulgaria	1	0

After the crash of flight PS752, several EU airlines flew over Iraq and Iran on 8 January. Those airlines came from the following countries: Bulgaria, Germany, Switzerland and Norway.

100 The United Kingdom withdrew from the European Union on 31 January 2020. At the time of the event of flight PS752 they were still part of the EU.
101 Switzerland is an EASA member state.

As was already highlighted in paragraph 2.4.2, following the events on 2 January the situation in the Iran and Iraq region escalated rapidly. Several aviation sources pointed to the increase in tensions and indicated the risk of possible retaliatory attacks from Iran. The next stage in the conflict was very uncertain at that moment. Both the FAA and the Netherlands Defence Intelligence and Security Service had indicated a broad spectrum of possible scenarios, as shown in paragraph 3.5.1. The FAA also noted the possibility of an inadvertent attack on civil aircraft in the region. In the analysed flight data, a change in flight behaviour was only visible after the ballistic missile attacks in Iraq on 7 January.[102] The amount of civil air traffic quickly reduced further after the crash of flight PS752 on 8 January.

Due to the ballistic missile attacks the alertness level of the Iranian air defence forces had been raised and consequently also the likelihood of human error, including the misidentification of aircraft (see paragraph 2.4.1). As shown, EU airlines from eight different countries flew over Iran and/or Iraq in the timeframe between the ballistic missile attacks and the crash of flight PS752. These airlines all flew in airspace where security threats and uncertainties had been identified.

Sub-conclusions

The increase in tensions in the Iran and Iraq region in the period 2 - 7 January 2020 and the uncertainty about the development of the conflict situation did not lead to a noticeable change in flight behaviour of the investigated EU airlines.

Only after the risk level further increased due to the ballistic missile attacks in Iraq, the number of flights dropped clearly.

Nevertheless, in the timeframe between the ballistic missile attacks and the crash of flight PS752, a total of 24 flights operated from or to Tehran Imam Khomeini International Airport, of which two flights of two EU airlines. In the same timeframe, a total of 31 flights of EU airlines from eight different countries flew over Iran or Iraq. These airlines all flew in airspace where security threats had been identified.

102 Measures taken by airlines relating to flight planning such as changes in contingency procedures and selection of alternate aerodromes are not observable from the data. See also paragraph 4.4.2.

4.4.2 Decisions timeline

This paragraph illustrates the decision-making process that took place at the Dutch airlines. At the time of the events in January 2020, KLM and Transavia were the only Dutch airlines with scheduled flights over Iran or Iraq.

Before January 2020, the situation in Iran and Iraq had been discussed in both the Expert group and EGRICZ, see paragraph 3.5. As a response to the FAA NOTAM that prohibited US airlines to fly within Iranian airspace over the Persian Gulf and Gulf of Oman, KLM and Transavia had already decided in July 2019 to avoid this area and to fly only over eastern Iran.[103] Overflight of Iraqi airspace was only permitted for parts of the airspace and an altitude restriction was applicable (minimum of 15,000 feet above ground level). TUI fly Netherlands also had implemented restrictions to limit their operations in the Baghdad and Tehran FIR. Overflight of Iraqi airspace was only permitted on a limited number of airways above 25,000 feet above ground level. And since July 2019, overflight of Iranian airspace was only permitted at FL260 or above and only on and north of airway G665. For Corendon Dutch Airlines, both Iranian and Iraqi airspace are outside the standard operating (monitored) area and no ad hoc flights were planned in this region in January 2020. Before operations outside the standard operating area a risk assessment is required by Corendon Dutch Airlines. Therefore no risk assessment regarding the Iranian and Iraqi airspace in in January 2020 was performed.

103 As a reaction to the US drone that was shot down on 20 June 2019, the FAA issued NOTAM KICZ A0019/19, *The overwater area of the Tehran FIR above the Persian gulf and Gulf of Oman*, 21 June 2019 01:48 until perm.

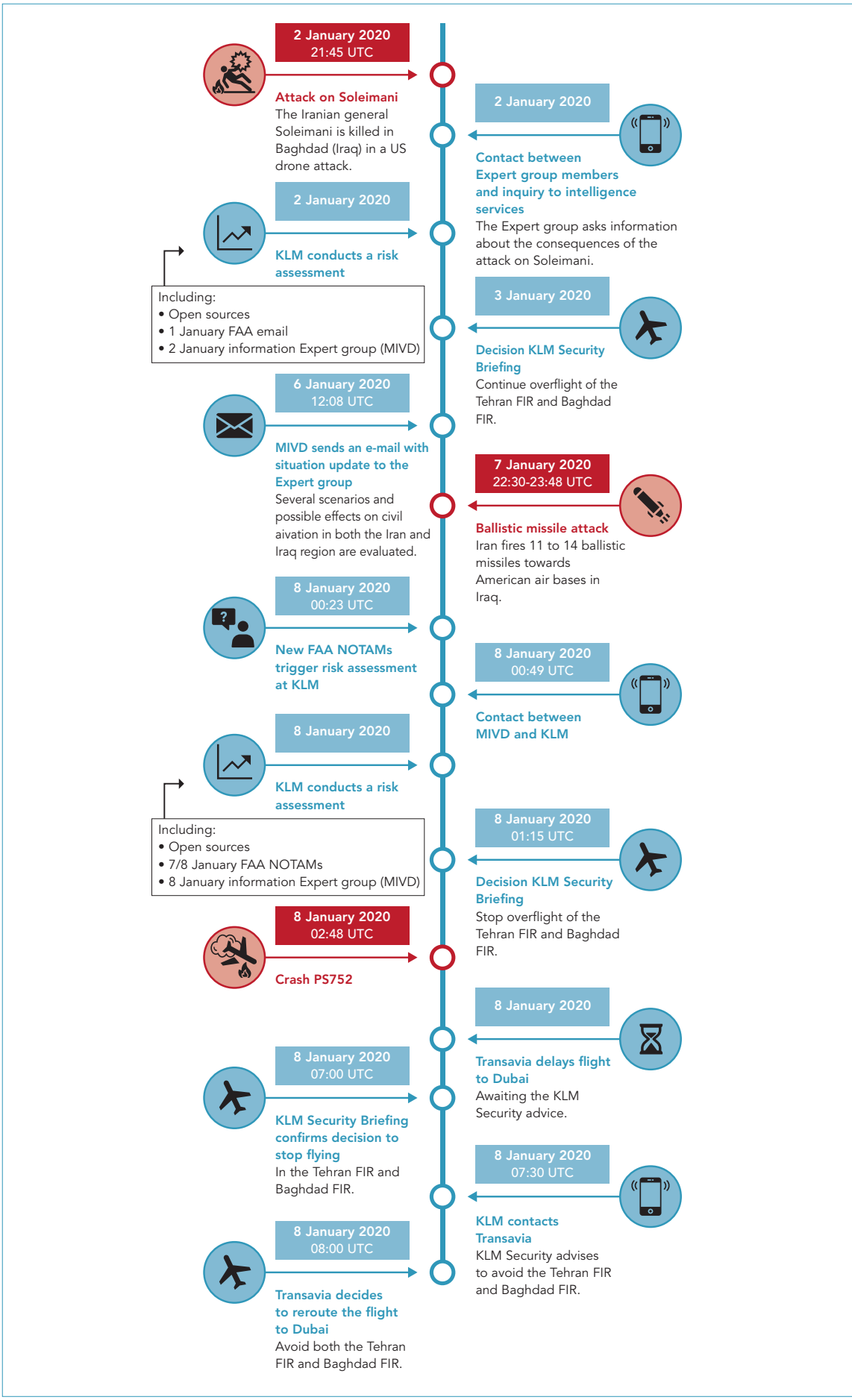


Figure 20: Decision timeline - 2 till 8 January 2020.

A timeline of the decision-making process at KLM and Transavia early January 2020 is presented in Figure 20. This timeline is complementary to and partially overlapping with the two timelines on information sharing in paragraph 3.5.1.

The attack on the Iranian general Soleimani on 2 January prompted KLM to initiate a risk assessment. For this assessment, the following information was used (see also paragraph 3.5.1): open source information, the FAA email sent on 1 January, information provided by a commercial provider, and information coming from the Expert group. Following the assessment of the available information, KLM decided on 3 January to maintain the already implemented restrictions and to continue overfly (eastern) Iran and Iraq at cruising altitude, and not to plan airports in both countries as destination alternates[104] in order to avoid take-off and landings in both countries.

The FAA information note sent on 3 January 2020 indicated that tension in the region was increasing, and elaborated on possible retaliation attacks from Iran (see also paragraph 3.5.1). It also mentioned the possibility of a heightened alert status among Iran's military air defence forces and the use of surface-to-air missiles. Furthermore, it stated that there was an increasing inadvertent risk to civil aviation in the region. This information note that described the uncertainties in the Gulf region due to possible retaliatory attacks from Iran, was assessed by the KLM security department, but did not lead to an immediate update of the existing risk assessment.

The extensive situation update sent by the Netherlands Defence Intelligence and Security Service on 6 January 2020 was a reaction to the inquiry of the Expert group on 2 January 2020. It indicated the uncertainty of the situation and the potential of escalation in the region and contained several possible scenarios for a retaliatory attack from Iran. Military actions aimed at civil aircraft in the airspace over Iran were considered unlikely. The possibility of misidentification on airways over the eastern part of Iran and Iraq was mentioned in the context of an actual combat; an escalation that was not considered as emerging at that stage. Overall, it was emphasized that there was no intent to target civil aviation. The emphasis on intent is in line with the threat analysis framework[105] for the determination of threat levels used by the Dutch intelligence services.

This situation update, which like the FAA information note elaborated on the uncertainties in the Gulf region about possible retaliation attacks, was assessed by KLM but did not lead to an update of the risk assessment. KLM still considered an attack on civil aircraft, either intentional or unintentional, on airways at cruising altitude unlikely for the eastern part of Iran and Iraq. KLM maintained the measures they decided upon on 3 January 2020. The situation update of 6 January also did not lead to an ad-hoc meeting of the Expert group, because the situation was considered as unchanged.

104 An alternate airport is an aerodrome to which an aircraft may proceed when it becomes either impossible or inadvisable to proceed to or land at the aerodrome of the intended landing where the necessary services and facilities are available, where aircraft performance requirements can be met and which is operational at the expected time of use. ICAO Annex 6 specifies when alternate airports for take-off, en-route and/or destination are required. The alternate airports shall be specified in the flight plan.

105 The factor intent plays an important role in the framework for the threat analysis used by the Dutch intelligence services: the absence of intention results in a negligible threat level and unlikely (or even highly unlikely) probability. Source: *Joint Doctrine Publication 2 Intelligence, Ministry of Defence*, 2012.

At 00:23 on 8 January, the operations department of KLM became aware of the just-published FAA flight prohibition NOTAMs for US civil aviation with respect to the Baghdad FIR, the Tehran FIR, and the overwater airspace above the Persian Gulf and the Gulf of Oman, following the ballistic missile attacks on American air bases in Iraq.[106] Subsequently, the KLM security department assessed the situation in Iran and Iraq. Open sources were consulted and the Netherlands Defence Intelligence and Security Service (MIVD) was contacted. At 00:59, the risk assessment was finalized for Iraq and Iran, followed by a decision at 01:15 to stop flying over Iran and Iraq. The reason to stop flying was that missiles had been fired and further unforeseen events might occur. The decision to stop flying was taken 1:30 hours before the crash of flight PS752 and 2:45 hours after the first ballistic missile was fired.

Two KLM aircraft were flying over Iraq and Iran at the moment the decision was taken. Figure 21 shows these KLM flights just before the decision was made to stop overflights of the region at 01:12. One aircraft flew in the Tehran FIR (flight KL878), just past Teheran. The other KLM flight was about to enter the Baghdad FIR (flight KL446).

Figure 21: KLM flights on 8 January at 01:12 UTC. (Source: Flightradar24, ICAO Geographic Information System gis.icao.int)

Flight KL878 continued its planned route through the Tehran FIR, which is shown in Figure 22 at 01:28. Flight KL446 also continued its planned route into the Baghdad FIR.

106 NOTAM KICZ A0001/20, Baghdad FIR, 7 January 2020 23:45 until perm.
NOTAM KICZ A0002/20, Tehran FIR, 8 January 2020 until perm.
NOTAM KICZ A0003/20, the overwater airspace above the Persian gulf and Gulf of Oman, 8 January 2020 until perm.

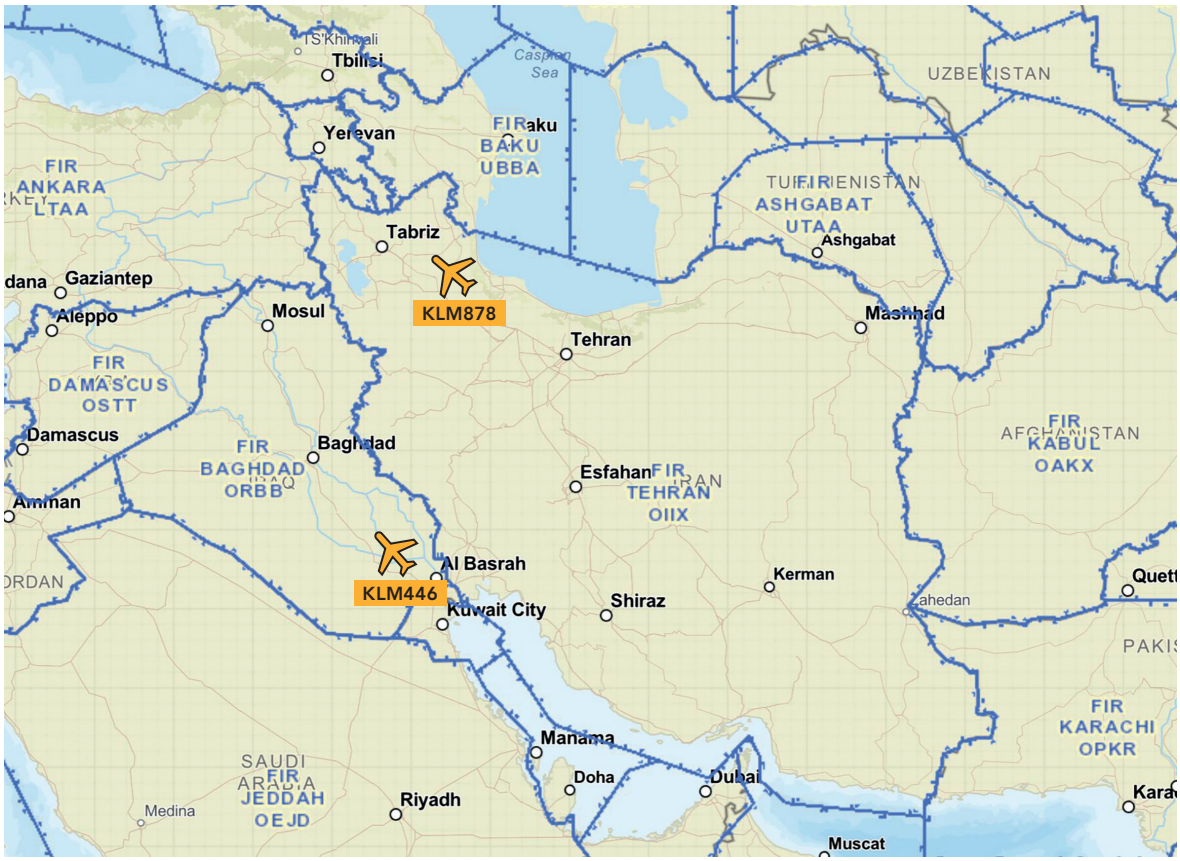


Figure 22: KLM flights on 8 January at 01:28 UTC. (Source: Flightradar24, ICAO Geographic Information System gis.icao.int)

The two KLM flights continued their original flight plan, as deviating from the planned route was considered a greater risk: deciding on an alternative route and requesting a deviation from a planned route take time, and deviating from a known airway might not meet the expectations of air traffic control and military operators. Unexpected flight movements were considered to introduce new risks. The available alternatives for re-routing in the Middle East were also influenced by the various tensions in the region (see Figure 18). This escalation of the conflict led to the decision that the flights should leave the airspace as quickly as possible.

Transavia has a daily scheduled flight from Amsterdam to Dubai, departing at 05:30 and passing through Iraqi airspace. This flight was also planned for 8 January. Following the media reports of the ballistic missiles, the Operations Control Centre (OCC) of Transavia contacted the KLM security department. It was decided to delay the flight until an analysis of the situation had been performed. At 07:30 KLM called Transavia with the advice not to overfly Iraq and Iran. The flight was then rescheduled to depart at 08:55 and was rerouted over Saudi Arabia. Transavia did therefore not operate in the region during the events.

Early January 2020, although TUI fly Netherlands had no scheduled flights in the Iran and Iraq region, the airline did have altitude restrictions in place on overflights in the Tehran and Baghdad FIR and restrictions on the use of airports in both states. In the underlying risk assessment, inadvertent and unintentional targeting of a civil aircraft was addressed and the risk for overflights was considered managed through the implemented

restrictions. The escalation of the conflict starting 2 January did not lead to an update of the risk assessment. However, on 5 January, TUI fly Netherlands was informed by TUI Airways (UK) that they prohibited operations in the Baghdad and Tehran FIR. TUI fly decided to immediately implement the same restrictions and a formal decision by the joint Safety Review Board to completely prohibit operations in the Baghdad and Tehran FIRs followed on 6 January. This decision was confirmed by TUI fly on 10 January through the conduct of a formal risk assessment (Overflight Security Assessment, OSA).

Sub-conclusion

The developments on 2 January in the Iran and Iraq region prompted a risk assessment at KLM in order to assess the threats for overflying this region. The KLM Security Briefing decided to continue overflights, but not to use airports in Iraq and Iran as alternates. In the period 2 – 7 January, both KLM and the Dutch intelligence services considered a military attack on a civil aircraft at cruising altitude as an unlikely scenario. Information about the heightened military tension and the uncertainty about further developments of the conflict in combination with the presence of surface-to-air missiles (SAMs) that could reach cruising altitude did not trigger additional measures or changes to flight routes at KLM. Although the threat assessment performed by the Dutch intelligence services stated the uncertainty and possible escalation, it did not elaborate on possible unintended consequences as a result of the increased tensions.

The ballistic missile attacks in Iraq on 7 January and the publication of the FAA NOTAMs with flight prohibitions for US airlines on 8 January triggered a new risk assessment and decision for the Dutch airlines that operated in the region. KLM decided to stop flying over Iran and Iraq 2:45 hours after the first ballistic missile was fired, which was shortly before the crash of flight PS752.

Two KLM flights were over Iraq and Iran at the moment the decision was taken. The flights continued their original flight plan, as deviating from the planned route was considered a greater risk.

The only Transavia flight over Iraq on 8 January was delayed in order to await the outcome of the risk assessment performed by KLM and, following this, the flight was re-routed.

TUI fly Netherlands and Corendon Dutch Airlines had no flights in the Iran and Iraq region early January 2020. As of 6 January, TUI fly Netherlands had implemented a prohibition for the Baghdad and Tehran FIR, following the notification from TUI Airways (UK).

4.5 Conclusions

Dutch airlines have all implemented a risk assessment process related to flying over or near conflict zones. They use risk qualification schemes that assess the likelihood and consequences of given risks. In their risk assessments, Dutch airlines include scenarios for which the intention or capability is uncertain, such as inadvertent and unintentional acts. Uncertainties regarding the development of the conflict are reflected in the validity period of a risk assessment, the review cycle or are triggers for a new risk assessment. They do not have a uniform manner or clear method for addressing uncertain scenarios. Their risk approaches do not result in more weight to be given to uncertain but catastrophic scenarios. Overall, their methods are comparable to the traditional risk assessment approach which is also described in the ICAO manual on conflict zone risk assessments.

The ICAO standards on risk assessment do not detail the method for the assessment. The method described in the ICAO manual on conflict zone risk assessments refers to risk matrices for the security risk assessment and the safety risk assessment. Even though the manual addresses the importance of both quantitative and qualitative methods to assess the likelihood of scenarios, no criteria are provided on how and when risk-increasing factors and uncertainties must be included in the analysis.

Risk matrices have limitations for the assessment of security risks related to flying over or near conflict zones, for example for the scenario involving civil aircraft being hit, either intentionally or unintentionally, by surface-to-air missiles. In its *MH17 Crash* report (2015), the Dutch Safety Board therefore stressed that it is important that the sector innovates when estimating and assessing scenarios that have major consequences and where uncertainties are involved. The implementation of the precautionary principle allows to take uncertainties into account in the decision-making phase. It entails a risk approach whereby, in contrast to the more traditional approach, dealing with uncertainties must be explicitly organized. A precaution-based risk approach results in more weight being given to uncertain but catastrophic scenarios. The precautionary principle has not been integrated in the risk assessment approach concerning the safety of flight routes above or near conflict zones. Applying the precautionary principle may result in the decision to (temporarily) avoid a certain region.

There is currently no evaluation of the actual decisions taken by airlines during state oversight activities. In the Netherlands, the ILT is responsible for the safety oversight of airlines. Risk assessments for conflict zones are currently considered mainly as part of the oversight of management systems and flight dispatch as the EU regulatory framework does not contain specific requirements on the risk management of conflict zones. Therefore, ILT oversight focuses on the airline's conflict zone risk assessment process and the implementation of the outcomes of the process in flight operations. The actual decisions taken by the airlines are not assessed by ILT. No other Dutch state authorities are involved in the oversight of airlines regarding conflict zone risk assessments and decisions.

Worldwide, airlines proactively publish little or no information about selected flight routes and related considerations on flights over or near conflict zones. Dutch airlines provide some information on their websites about their risk assessment process for flying over or near conflict zones, but like airlines worldwide, they are not transparent about restrictions or choices made in order to protect their information position. This makes it difficult for passengers, consumer organizations, and media, to form a judgement and question the decisions of airlines.

In the period 2-7 January 2020, tensions in the Middle East increased due to the attack on general Soleimani, and the situation was uncertain due to the possibility of a retaliatory attack of Iran on several targets. Several parties had already addressed the potential for conflict escalation in the Iran and Iraq region and the possible consequences for civil aviation. This matter was widely communicated within the aviation network (see also paragraph 3.5.1). Although civil aviation stakeholders were aware of the risks prior to the ballistic missile attacks, not one state issued an advice to avoid, or a prohibition for, Iranian airspace in the period 2 – 7 January 2020 (see paragraph 3.5). KLM and Transavia, which were the only Dutch airlines flying in the region at that time (for Iran and Iraq only overflights), decided to maintain their restrictions and continue overflights over Iraq and eastern Iran, but not to use airports in Iraq and Iran in contingency situations. Following assessment of the situation, KLM considered the scenario of an inadvertent SAM attack on a civil aircraft at cruising altitude on an airway unlikely. As the flight behaviour of other EU airlines, too, did not significantly change following the increase in tensions in the period 2-7 January 2020, the Dutch Safety Board concludes that a scenario comparable to that of flight PS752 was either not considered or considered unlikely by most airlines. The increased tension in combination with the presence of surface-to-air missiles was despite of identification of these aspects as risk-increasing factors and uncertainties no reason to practice precaution and stop flying in that region.

The conflict escalated further due to the ballistic missile attacks on 7 January. KLM decided to stop flying over Iran and Iraq 2:45 hours after the first ballistic missile was fired. This shows that when threats actually materialize airlines have an effective process in place, so fast decisions can be taken and implemented. After the risk level further increased due to the ballistic missile attacks in Iraq, the number of flights dropped clearly. Nevertheless, in the timeframe between the ballistic missile attacks and the crash of flight PS752, a total of 24 flights operated from or to Tehran Imam Khomeini International Airport, of which two flights of two EU airlines. In the same time frame, a total of 31 flights of EU airlines from eight different countries flew over Iran or Iraq. These airlines all flew in airspace where security threats had been identified and risks for civil aviation had increased.

This shows that in situations of a rapidly escalating conflict, it is not the likelihood but the mere possibility of a catastrophic scenario which should warrant precaution. The tragic crash of flight PS752 has shown once again that the risks of flying over or near conflict zones should not be underestimated, and that scenarios depicting the possibility of serious risks to civil aircraft should not be assessed as unlikely: Instead more weight should be given to uncertainties and hence to possible scenarios with catastrophic consequences. Considering both the inherent uncertainty pertaining to the rapidly escalating conflict in the Middle East in January 2020 and the catastrophic consequences

of a surface-to-air missile encounter, a precaution-based risk approach towards such scenarios is necessary. Indicators as heightened military tension, an increase in the alertness level of a state's military force in combination with the presence of SAMs that can reach cruising altitude, should be key indicators in any risk assessment. The crash of flight PS752 shows that these signals should be acted upon, both by states and airlines, well in advance of an actual escalation of a conflict and well before threats to civil aviation materialize.

5 CONCLUSIONS

Since the crash of flight MH17, important steps have been taken by various aviation parties to better manage the risks of flying over or near conflict zones. In the *MH17 Crash* report (2015) the Dutch Safety Board concluded that aviation stakeholders did not adequately recognize the risks of conflict zones to overflying civil aviation. The international system for civil aviation was based on the assumption that, in principle, civil aviation is always possible: unless an airspace has been closed, flights take place. In the *Follow-up* report (2019), the Dutch Safety Board concluded that airlines are more aware of the risks posed by flights over or near conflict areas. Also, states and international organizations have become more aware of the risks, which is reflected in new ICAO standards, the EU Integrated Aviation Security Risk Assessment process, the Expert group in the Netherlands and the establishment of international expert fora on conflict zone risk assessments EGRICZ and Safer Skies (SSCC).

Despite the increase in awareness of risks of conflicts to civil aviation, the improvements made regarding the sharing and gathering of information and the increasing number of states that issue recommendations or prohibitions in relation to conflict zones, the investigation reveals that with regard to the conflict in Iran, civil aircraft continued to operate in airspace where security threats had been identified.

The increase in tensions in the Iran and Iraq region after the attack on the Iranian general Soleimani by the US on 2 January 2020 and the uncertainty about the development of the conflict situation did not lead to a noticeable change in flight behaviour of the investigated EU airlines. The airspace in the region was not closed prior to the crash of flight PS752. The US Federal Aviation Administration (FAA) informed their aviation network, including the Dutch state and KLM, about the heightened military tensions. Although the increase in tension and the uncertainty of the developments in the region were known prior to the ballistic missile attacks, not one state issued an advice to avoid, or a prohibition to fly in Iranian airspace in the period 2 – 7 January 2020 as a precaution to protect passengers and crew. The FAA published a prohibition for US airlines to fly in the Baghdad and Tehran region following the ballistic missile attacks on 7 January, a few hours before the crash. These Notice to Airmen (NOTAMs) were the only state publications issued between the ballistic missile attacks and the crash of flight PS752 on 8 January. Other foreign state publications followed more than twelve hours after the crash. This was after most airlines had already stopped flying in the region. The vast majority of EU airlines, including the relevant Dutch airlines, decided to stop flying in the area not until 8 January 2020. Overall, it can be concluded that in practice this means that even if threats to civil aircraft are considered possible, flights continue unless threats actually materialize.

In accordance with the prevailing risk assessment methodology, both states and airlines assessed scenarios drawing uncertain threats with catastrophic consequences to civil aircraft as unlikely. The increased tensions in combination with the presence of surface-

to-air missiles (SAMs) was despite of identification of these aspects as risk-increasing factors no reason to stop flying.

Airspace management
Airspace management in conflict zone situations is an effective safety barrier in theory, but not in practice. Most states with a conflict zone on their territory or near to their territory do not close or restrict their airspace, nor do they share information about the conflict. This was also the case in Iran in January 2020. At the time of the ballistic missile attacks by Iran on American air bases in Iraq on 7 January and the subsequent crash of flight PS752 near Tehran on 8 January, the airspace in Iran was not closed. The two NOTAMs on airspace management measures implemented by Iran were not published timely. These NOTAMs, published three and four hours after the crash, did not contain information about the ongoing conflict.

Although ICAO standards and guidelines related to airspace management have been amended following the crash of flight MH17, no criteria have been developed on when a state should close or restrict its airspace.

Information gathering and sharing
Investigation of the information sharing process before and after the crash of flight PS752 shows that for both the Dutch state and Dutch airlines the current information gathering and sharing network gave them the information that was available within the aviation network. Within the Dutch Expert group information about the weapon systems and the armed forces was shared and information was validated by the Dutch intelligence services. The network of the Expert group appears to have been effective with regard to the gathering and sharing of information about this escalating conflict.

The Dutch intelligence services' participants in the Expert group proactively inform airlines about information that has been obtained as supplementary to their other activities, but the intelligence services do not collect threat information specifically for the purpose of civil aviation.

Risk assessments
In the period 2 – 7 January 2020 information about the heightened military tension and the uncertainty about further developments of the conflict in combination with the presence of surface-to-air missiles (SAMs) that could reach cruising altitude was present. Nevertheless, a military attack on a civil aircraft at cruising altitude was assessed as an unlikely scenario and Dutch airlines decided to continue flying over Iran and Iraq. The investigation reveals that the problem was not the information available, nor the identification of possible scenarios or the decision-making procedure, but a lack of giving sufficient weight to possible scenarios with catastrophic consequences.

Dutch airlines all implemented a risk assessment process related to flying over or near conflict zones in which they use risk qualification schemes that assess likelihood and consequences. In their risk assessments, Dutch airlines include scenarios for which the intention or capability is uncertain, such as inadvertent and unintentional acts. Uncertainties regarding the development of the conflict are reflected in the validity

period of a risk assessment, the review cycle or are triggers for a new risk assessment. The airlines' risk approaches do not result in more weight to be given to uncertain but catastrophic scenarios. Therefore, their risk assessment methods allow continuing to fly in case of unlikely, but possible scenarios.

The risk assessment methods by Dutch airlines are comparable to the traditional method described in the ICAO manual on conflict zone risk assessments. Even though the manual addresses the importance of both quantitative and qualitative methods to assess the likelihood of scenarios, no criteria are provided on how and when risk-increasing factors and uncertainties must be included in the analysis.

The precautionary principle, which has not been integrated in the risk management approach for conflict zone risk assessments, entails a risk approach that results in more weight to be given to uncertain but catastrophic scenarios in assessing flight routes above and near conflict zones. A precaution-based risk approach is necessary for flight routes over or near conflict zones considering the inherent uncertainty pertaining to rapidly escalating conflicts and the catastrophic consequences of a surface-to-air missile encounter.

Dutch state guidance and oversight
In addition to the provision of information, a state of the operator can provide more guidance to airlines in the form of advice (recommended actions) or regulations (restrictions/prohibitions). Several states, such as the United States, Canada, the United Kingdom, France and Germany, provide advice or issue restrictions/prohibitions to their airlines. The advice or regulations are available for other airlines and states to use.

In accordance with its policy, the Dutch state did not provide recommended actions or regulations regarding the conflict in Iran to the Dutch airlines. Nevertheless, the Dutch state did attribute to the EU recommended actions through participation in the EU Risk Assessment process. There is no legal basis in Dutch law to impose a flight prohibition or restrictions on Dutch aircraft in connection with flying in foreign airspace.

The Dutch state's oversight by the Human Environment and Transport Inspectorate (ILT) focuses on the airlines' conflict zone risk assessment processes and the implementation of the outcomes of this process in flight operations. This is in line with the oversight practice on the airline's (safety) management system. The current implementation of oversight activities does not include an assessment of the actual decisions made by the airlines. The ILT is currently not equipped to assess classified threat information and has no expertise on military aspects.

Current decision-making regarding flying over or near conflict zones is left entirely to the Dutch airlines. The Dutch state does not assess the risk as a base for state guidance in the form of advice or flight prohibition, nor does it assess the actual decisions made by airlines. Apart from the (threat) information sharing process, the Dutch State has not implemented measures as a precaution to protect passengers, crew and citizens.

European guidance

The Dutch state is involved in the EU Risk Assessment process on conflict zones. This process combines intelligence from different EU member states. Conflict Zone Information Bulletins (CZIBs) and EASA information notes contain recommended actions for airlines and thereby contribute to ensuring an equal level of information for EU airlines and states. Despite being non-mandatory, an advice issued by EASA is considered a forceful measure, as deviating from it usually requires thorough justification by airlines.

The lack of mandate to disseminate relevant information to airlines directly, limits EASA's effectiveness. Because the agreement of the European Commission and the member states on the information to be published is required, neither EU decisions nor EU communications to airlines are fast enough in the case of rapidly escalating conflicts. Therefore, the time needed for the dissemination and publication of a CZIB, and to a lesser extent of an information note, is long for a rapidly escalating conflict.

6 RECOMMENDATIONS

To the Minister of Infrastructure and Water Management and the Minister of Justice and Security:

National: advice and regulation

1. Consider expanding the possibilities for the Dutch state, in addition to the provision of information to airlines, to also issue advice, and as the ultimate remedy, to impose a flight prohibition for Dutch operators in foreign airspace.

To the Minister of Infrastructure and Water Management:

International: innovation of the risk assessment methods

2. Encourage the development and application of risk assessment methods based on the precautionary principle for civil aviation operations over or near conflict zones. Take the initiative on international level to further develop the risk assessment methods as described in ICAO Doc 10084. Closely involve airlines and work out how possible catastrophic scenarios can be identified in the event of an escalating conflict, and how uncertainties must be taken into account in the analysis and decision-making.

International: criteria for airspace closures

3. Take the initiative at international level to develop a specific proposal for a stricter definition of the responsibility of states with regard to airspace management, so that it is clear in which cases the airspace should be closed. Urge the inclusion of this proposal in the Chicago Convention and the underlying Standards and Recommended Practices.

To the European Union Aviation Safety Agency (EASA):

European: effectiveness of European guidance

4. Further develop the European Information Sharing and Cooperation Platform on Conflict Zones by expanding the available information without losing rapidity, including analysis and recommendations to member states, airlines and other stakeholders.

To the Commissioner for Home Affairs and the Commissioner for Transport of the European Commission:

European: effectiveness of European guidance

5. Enhance the efficiency and the effectiveness of the European Integrated Aviation Security Risk Assessment process, so that Conflict Zone Information Bulletins are published faster and include information and recommendations that are tailored to the operational needs of airlines.

APPENDIX A

EXPLANATION OF THE INVESTIGATION

This appendix describes the general investigation process, the most important quality assurance measures and the project organization.

A.1 Background and aim of the investigation

Flight MH17 crashed over the eastern part of Ukraine on 17 July 2014. This flight was shot down by a missile when it flew over a conflict zone. The Dutch Safety Board investigated the cause of this crash and the decision-making process related to flying over or near conflict zones. Considering the impact of the crash and the importance the Dutch Safety Board attaches to the recommendations, in 2018 the Board started an investigation into the follow-up to the recommendations with regard to flying over or near conflict zones. On 8 January 2020, Ukraine International Airlines flight PS752 was shot down in Iran, killing all 176 people on board the aircraft. As this flight was also shot down by a missile while flying over a conflict zone, this crash once more raised concerns about the decisions made regarding flying over or near conflict zones. With reference to this recent event, the Dutch Minister of Infrastructure and Water Management asked the Dutch Safety Board to reflect on the desired adjustments to the global, European and national system – relating to the Dutch government's role as State of the Operator - to better manage the risks associated with flying over or near conflict zones. The Dutch Safety Board decided to respond to the Minister's request by starting an additional follow-up investigation into the safety of flight routes.

The aims of this additional follow-up investigation are to provide insight into the current practice of the selection of safe flight routes by Dutch airlines, and to determine whether new lessons can be learned to further reduce the risks associated with flying over or near conflict zones.

A.2 Scope of the investigation

The scope of this additional follow-up investigation is complementary to the previous follow-up investigation, as it is not limited to the recommendations in the *MH17 Crash* report (2015). This new investigation builds on the findings of the previous investigations and takes the context of Dutch airlines and the Netherlands as State of the Operator as the starting point.

This report provides an update regarding various aspects that emerged from the previous investigations. The following five aspects that contribute to the safety of flight routes are central to the investigation:

I. the management of airspace in states with a conflict zone on their territory or near to their territory;
II. the sharing of (threat) information by states and airlines[107];
III. providing guidance to airlines by the state of the operator in the form of advice or regulation;
IV. the airlines' own risk assessment processes and how these feed into their decisions about flying over or near conflict zones;
V. accountability by airlines for their decisions (distinguishing between public accountability and transparency about chosen routes on the one hand, and accountability towards the relevant state authority about their risk assessment process on the other).

The investigation focuses on what parties do in practice for each of these five aspects in general, and, in particular on their response to the escalating conflict in Iran and Iraq at the time of the crash of flight PS752.

The investigation focuses on the parties that, from the perspective of Dutch airlines, have or may have a major contribution in the decision-making process regarding the safety of flight routes. These parties are Dutch and foreign airlines, the Dutch government, foreign states, and the European Union, EASA in particular. The focus on the Dutch context allows consideration of possible lessons for the broader international context as well. These broader lessons may improve the safety of civil aviation globally, which is relevant for all states as citizens also take flights with airlines based outside their own country.

A.3 Investigation questions

The key question of this follow-up investigation is as follows:

> How is the safety of flight routes in relation to conflict zones organized for Dutch airlines, and what further improvements are possible?

This key question is divided into the following investigation questions:

a. How do states with a conflict zone on their territory or near to their territory manage their airspace?
b. What is the practice of information-sharing and decision-making for Dutch airlines?

107 For the purpose of this investigation the focus is on airlines. ICAO Annex 6 defines an operator as a person, organization or enterprise engaged in or offering to engage in an aircraft operation. An airline is considered an operator offering public transport of passengers and/or cargo.

c. What was the process of information-sharing and decision-making for Dutch airlines with regard to the escalating conflict in Iran and Iraq before and at the time of the flight PS752 crash?
d. How do Dutch airlines account for the routes they fly?

A.4 Investigative approach

This report synthesizes the findings of the Dutch Safety Boards' previous investigations (2015 and 2019), complemented with new findings on the current practice of airspace management, information sharing and decision-making in the context of flying over or near conflict zones.

The present investigation is chosen to be limited in scope. The practice of information sharing and decision-making by Dutch airlines was investigated through interviews and assessment of relevant documents. For foreign airlines, flight behaviour was analysed using publicly available flight data.

Interviews
The Dutch Safety Board conducted semi-structured interviews with representatives of the Dutch Expert group, KLM, Corendon Dutch Airlines, TUI fly Netherlands, ILT, EASA, and the European Commission (DG HOME and DG MOVE). Semi-structured interviews are conducted with a fairly open framework which allows focused two-way communication. Additional questions were answered by e-mail. Transavia answered a written questionnaire.

Documents
Several documents were consulted as part of the investigation, including public aeronautical information, ICAO documents and standards, EU legislation, and internal and/or confidential documents of the interviewed parties.

Flight analysis
A Flightradar24 analysis was carried out to gain insight into the flight behaviour of EU airlines in the period around the crash of flight PS752. Flights of EU airlines were counted in the period from 31 December 2019 until 9 January 2020. Table 4 provides an alphabetical overview of the EU airlines that have been included in the analysis. The count was disaggregated in the number of flights over Iraq, the number of flights over Iran, and the number of arrivals and departures at Tehran Imam Khomeini International Airport. In addition to the flight analysis of EU airlines, the flight behaviour of Dutch airlines was examined more extensively, in particular their decisions to stop flying over Iran and Iraq.

Table 4: Airlines included in the analysis.

Aerologic	Condor	Norwegian Air Shuttle
Air Baltic	Eurowings	Swiss
Air France	FinnAir	Transavia
Alitalia	Holiday Europe	TUI Airways UK
Austrium	KLM	TUI Germany
British Airways	LOT	Virgin Atlantic
Cargolux	Lufthansa	Wizz Air

Freedom of Information Act (in Dutch: WOB)
The Dutch ministry of Infrastructure and Water Management and the Dutch ministry of Justice and Security have both received a Freedom of Information Act (in Dutch WOB) request regarding the security of Iranian airspace. Some of the requested documents are described in this report, while the documents have not been made public (not even after objection). The requests relate to non-public documents (information notes, e-mails) from EASA, the US FAA and the Dutch intelligence services described in paragraphs 3.5.1 and 4.4.2. In the report, the relevant documents have not been reproduced in their entirety, but have been summarized in text. Documents or parts of the documents that are not relevant or strictly necessary for the purpose of this investigation have been omitted.

A.5 Quality assurance

The team made a quality plan based on a quality session in which the risks and mitigation measures were discussed.

Several regular quality measures have been applied, namely analysis sessions with the team as well as with the team and the portfolio manager, a stakeholder analysis, a quality session with colleagues who were not involved in the investigation, discussion of analyses and the preliminary report with the Board, and consultation of the advisors on methodology, research questions, and reporting.

The draft report was sent for consultation to the parties directly involved. These parties were requested to check the contents of the draft report for factual inaccuracies and ambiguities (please refer to Appendix B for more information).

A.6 Project organization

Prof. M.B.A. van Asselt acted as portfolio manager for this investigation on behalf of the Dutch Safety Board. The investigation was carried out by the project team, which comprised the following members:

S.M. Berndsen	Investigation manager
E.M. Berends	Project leader/investigator
S.M. van Hijum	Investigator
R. Dijkstra	Investigator
G.J. Vogelaar	Investigator
M. Leibbrand	Trainee
L. van Krimpen	Advisor
E.J. Willeboordse	Advisor

APPENDIX B

RESPONSES RECEIVED FOLLOWING CONSULTATION ON DRAFT REPORT

In accordance with the Dutch Safety Board Act, a draft version of this report, with the exception of the summary, consideration and recommendations, was submitted to the parties directly involved for review. The following parties have been requested to check the report for any factual inaccuracies and ambiguities:

- Dutch Ministry of Infrastructure and Water Management
- Dutch Ministry of Justice and Security
- Dutch Ministry of Defence
- Dutch Ministry of the Interior and Kingdom Relations
- Dutch Ministry of Foreign Affairs
- The following airlines:
  - KLM Royal Dutch Airlines
  - Transavia
  - TUI fly Netherlands
  - Corendon Dutch Airlines
- European Commission (DG HOME and DG MOVE)
- European Union Aviation Safety Agency (EASA)
- The following accident investigation boards:
  - Iran, Aircraft Accident Investigation Board
  - Canada, Transportation Safety Board
  - United States, National Transportation Safety Board (and through the NTSB the Federal Aviation Administration)
  - Ukraine, National Bureau of Air Accidents Investigations

The responses received, as well as the way in which they were processed, are set out in a table that can be found on the Dutch Safety Board's website (www.safetyboard.nl).

The responses received can be divided into the following categories:

- Corrections and factual inaccuracies, additional details and editorial comments that were taken over by the Dutch Safety Board (insofar as correct and relevant). The relevant passages were amended in the final report.
- Responses that were not adopted by the Dutch Safety Board. The reason for this decision is explained in the table.

DUTCH
SAFETY BOARD

Visiting address
Lange Voorhout 9
2514 EA The Hague
T +31 70 333 70 00

Postal address
PO Box 95404
2509 CK The Hague

www.safetyboard.nl