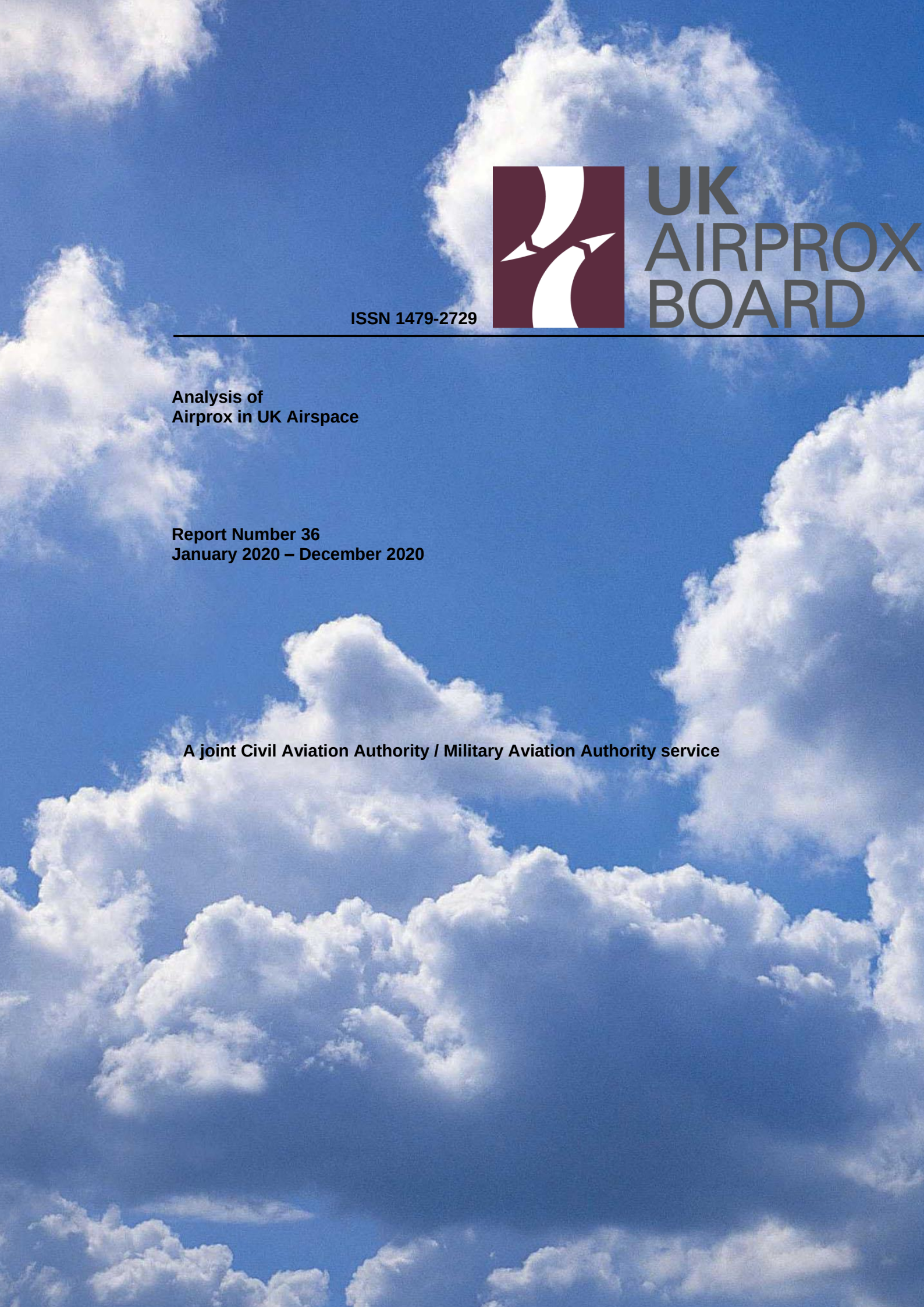

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UK AIRPROX BOARD

Analysis of Airprox in UK Airspace

Report Number 36
January 2020 – December 2020

A joint Civil Aviation Authority / Military Aviation Authority service

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Thirty-Sixth Report by the UK Airprox Board

Analysis of Airprox in UK Airspace

(January 2020 to December 2020)

Compiled by Director UK Airprox Board for

The Chief Executive Officer
UK Civil Aviation Authority

and

The Director
UK Military Aviation Authority

CONTENTS

INTRODUCTION

The UK Airprox Board (UKAB) assessed 163 Airprox in 2020, of which 118 were manned aircraft-to-aircraft encounters and 45 were incidents with Small Unmanned Air Systems (SUAS)[1]. 2020 was a unique year shaped by the unprecedented circumstances surrounding the Covid 19 pandemic which redefined all aspects of life. I do not need to remind anybody of the effects of the pandemic on the aviation industry – these are well documented, well known and manifested themselves, in terms of Airprox, in a significant downturn in reported events. The implications of this for this report are significant. It is not viable at this juncture to conduct detailed rate analysis, and comparisons of the Airprox landscape should be done with care to account for differences in circumstance and the changes in the aviation environment. What is significant and thankfully possible, is to introduce a new format which concentrates on those aspects of Airprox which are not reliant on trend or rate analysis to elicit observations or to draw conclusions: this is a shift towards understanding the human tapestry using an approach which concentrates more on barrier performance and draws out their associated Contributory Factors (CF). This can be done for all Airprox, but more significantly we can now delve into sector performance which allows us to identify the most relevant area for each sector. This should serve to raise awareness of any differences between sectors as well help shape a focussed approach to risk mitigation.

This evolution has been possible due to a considerable overhaul of the way in which I collect data. I am now able to sectorise all aspects of an Airprox and to examine relevant areas: airspace; altitude; and risk through the lens of the sector in which it is occurring.

With this in mind, the majority of this report will cover in detail the 5 weakest performing barriers and examine the observed behaviours behind them in an effort to identify areas where interventions can be more effectively focussed to better mitigate against Mid Air Collision (MAC) and enhance air safety. I will, of course present appropriate statistics, but these need to be taken in the context of the time; care must be taken not to draw inaccurate or incomplete conclusions and comparisons with previous years should not be made apart from in specific and focussed areas.

Suffice it to say that the granularity that is emerging from our approach will undoubtedly help shift focus towards the 'why' and 'so what's' as well as describe the 'what'. The performance of the safety barriers is consistent; the weakest areas reside in Electronic Conspicuity (EC) which is captured in the **Electronic Warning Systems** barrier**,** planning and execution which is captured in the **Tactical Planning and Execution** barrier, situational awareness which is captured in the **Ground Elements Situational Awareness barrier** and the **Flight Elements Situational Awareness barrier** and finally the **See and Avoid barrier.** Within these barriers, the most common CF are incompatibility of EWS, planning and communication, generic or late situational awareness and monitoring of other aircraft. There is still a welcome focus within the CAA on promoting EC and a common approach will certainly improve situational awareness in both ground and air elements. However, it is clear that the most vulnerable barriers are those where there is a 'human in the loop'. Importantly there is evidence of barrier performance differing between sectors. In addition to this, the CF which underpin and define barrier performance also vary depending on sector mix.

[1] For Airprox reporting purposes, SUAS are broken down into 5 categories: drones; balloons (including toy balloons and meteorological/research balloons); model aircraft; Kites and unknown objects. SUAS Airprox usually involve only a fleeting encounter wherein the reporting pilot is often only able to give an outline description of the other air vehicle; as a result, the distinction between a drone, model aircraft and object is often down to the choice of wording by the reporting pilot. UKAB policy is to review the associated description and, if the reporting pilot positively describes something with drone-like properties (e.g. '4 rotors'), then that is taken at face-value as a drone; if the reporting pilot can only vaguely describe 'an object' then that is classified as an unknown object. The distinction between 'drone' and 'model aircraft' is more difficult given that many fixed-wing drones are not easily distinguishable from model aircraft. Although the UKAB tries to take the context of the sighting into account, it is therefore likely that some reported 'Model Aircraft' or 'Unknown Object' incidents might be drones, and vice versa.

HEADLINE FIGURES AND HISTORIC DATA

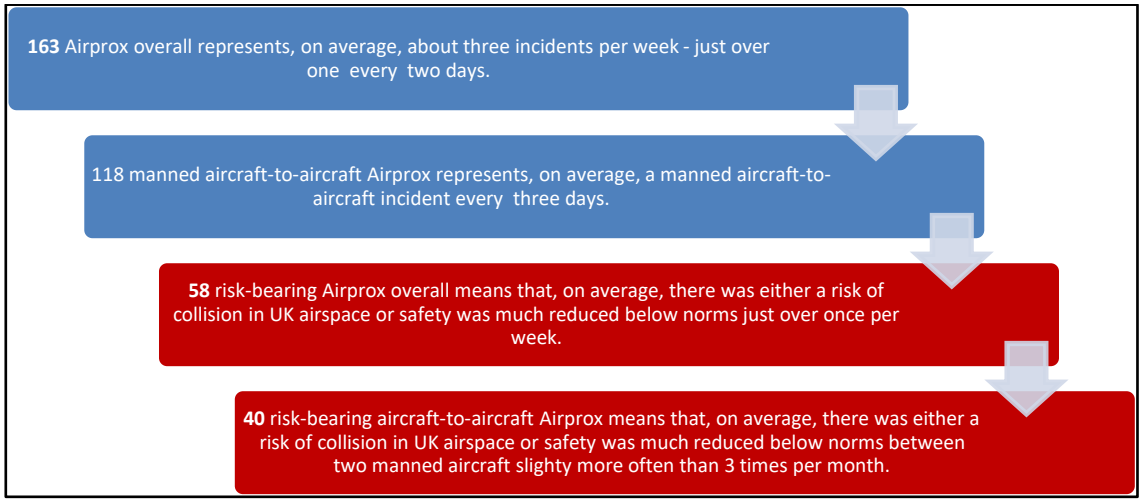

Table 1: All Airprox 2011 – 2020 by Risk Category

All Airprox 2011 - 2020

RISK	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	10yr AVERAGE
A	23	18	22	28	41	51	45	65	60	17	37
B	36	27	43	68	66	72	82	96	86	41	62
C	88	97	72	86	78	104	111	120	147	73	98
D	2	5	9	9	12	11	12	5	11	3	8
E	12	14	26	33	20	27	22	33	24	29	24
Risk Bearing	59	45	65	96	107	123	127	161	146	58	99
% Risk Bearing	37%	28%	38%	43%	49%	46%	47%	50%	45%	36%	42%
Total	161	161	172	224	217	265	272	319	328	163	228

When considering ALL Airprox there has been a slow but steady increase in the reported numbers over the last 10 years. This has been significantly influenced by the increase in SUAS events since 2014. This is not just in the number of reported events, but the fact that the majority of Airprox involving SUAS are classified as risk bearing. The reasons for this are mainly a function of the reporting aircraft – predominantly Commercial Air Transport (large carriers) (CAT) and the stages of flight in which they observe the SUAS – predominantly in the departure or landing phase which is characterised by high workload and high rates of climb/descent which tend to precipitate in a fleeting encounter with a SUAS whereby it is impossible for the pilots to manoeuvre effectively. This results in an encounter which, by its very nature, holds a risk of collision. As a result, and in order to gain a better appreciation of Airprox and the associated risk of collision, it is useful to think about the 2 areas (aircraft to aircraft encounters and SUAS encounters) separately.

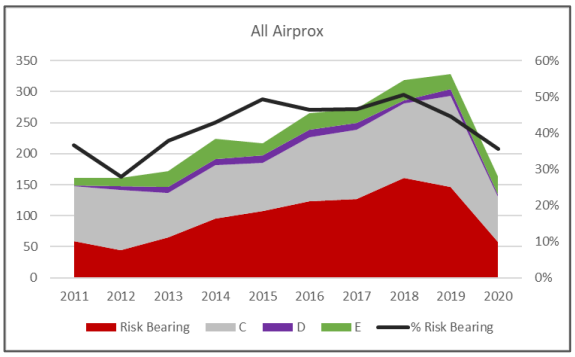

Figure 1: All Airprox 2011 – 2020 by Risk Category

Table 2: All Aircraft to Aircraft Airprox 2011 – 2020 by Risk Category

All Aircraft to Aircraft Airprox 2011 - 2020

RISK	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	10yr AVERAGE
A	23	18	22	25	27	17	13	20	18	8	19
B	36	27	43	64	52	41	49	50	50	32	44
C	88	96	72	85	75	79	75	80	106	51	81
D	1	1	9	6	5	8	5	2	6	2	5
E	11	13	26	33	18	25	20	29	23	25	22
Risk Bearing	59	45	65	89	79	58	62	70	68	40	64
% Risk Bearing	37%	29%	38%	42%	45%	34%	38%	39%	33%	34%	37%
Total	159	155	172	213	177	170	162	181	203	118	171

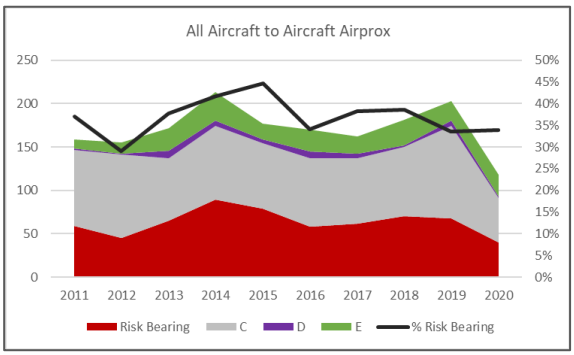

Figure 2: All Airprox 2011 – 2020 by Risk Category

As can be seen in Table 2 and Figure 2, the reported numbers and the associated proportion of risk bearing occurrences has remained largely constant over the last 10 years, notwithstanding the sharp drop experienced as a direct result of the Covid 19 pandemic in 2020. In fact, the percentage risk bearing for both 2019 and 2020 is sitting below the 10-year average of 37% at 33 and 34% respectively.

Turning specifically to Airprox involving SUAS, I have included the 10-year picture to explicitly demonstrate the surge which occurred in 2014 as the small drone recreational market took off.

Table 3: Airprox Involving SUAS 2011 – 2020 by Risk Category

Airprox Involving SUAS 2011-2020

RISK	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	10yr AVERAGE
A				3	14	34	32	45	42	9	26
B				4	14	31	33	46	36	9	25
C		1		1	3	25	36	40	41	22	21
D	1	4		3	7	3	7	3	5	1	4
E	1	1			2	2	2	4	1	4	2
Risk Bearing	0	0	0	7	28	65	65	91	78	18	35
% Risk Bearing	0%	0%	0%	64%	70%	68%	59%	66%	62%	40%	43%
Total	2	6	0	11	40	95	110	138	125	45	57

Following the initial increase in reported Airprox involving SUAS, the picture began to stabilise with the introduction of regulation and registration. The increased focus on this area is critical as commercial entities begin to exploit technological advances opening up new opportunities which will take larger drones more into the realms of Class G Airspace with the potential for an increased risk picture in the below 500ft altitude band. From an Airprox perspective I am seeing a welcome increase in the awareness of recreational and professional drone operators who are beginning to report Airprox with aircraft and other drones. It is almost always the case that when a drone operator reports an Airprox, that the aircraft pilot is unaware of their presence, so it is likely that there will be an increase in the number of SUAS Airprox (specifically drones) which reflects a healthy reporting culture as well as a potential increase in the risk picture.

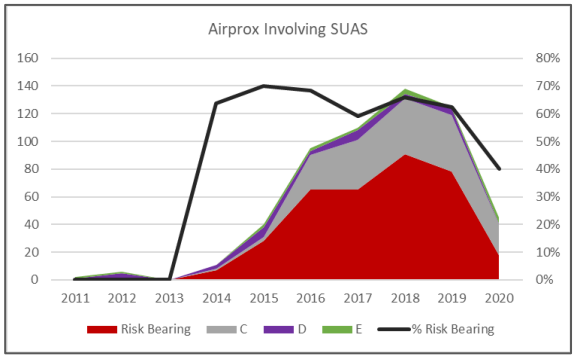

Figure 3: All Airprox 2011 – 2020 by Risk Category

SECTOR MIX 2010-2020

Airprox vary by sector. They vary by risk distribution, airspace and altitude and each of them requires specific examination to best understand the Airprox landscape. There are 7 sectors of interest: General Aviation (including sports and recreational and PPL/CPL training), Civil Commercial (including air taxis, and commercial rotary); Commercial Air Transport (primarily large air carriers); Military (including Foreign military); Emergency Services (covering air ambulance, police and coastguard); Unknown aircraft (although the aircraft in this category could not be traced, their descriptions are almost exclusively descriptions of general aviation light aircraft) and finally, SUAS.

> For the purposes of this report, these sectors will be abbreviated as follows: GA, Civ_Comm, CAT, Mil, Emerg-Servs, Unk ac and SUAS

This section presents the data in graphical and diagrammatic form and describes Airprox in terms of sector mix, altitude, airspace and risk. It describes the 'what' and makes no attempt to divine the 'why' at this point in the report. Observations and insights as to the 'why' will be explored in the Safety Barriers and CF sections.

Following a complete rationalisation of all Airprox data since 2010, I have been able to apply a consistent method to the classification of Unk ac and, since 2019, introduced the Civ_Comm descriptor. The sectors are important: Civ_Comm, Emerg Servs and Mil sectors are professional pilots operating in primarily Class G airspace; The CAT sector represents professional pilots, primarily operating in Controlled Airspace and GA and Unk ac (including untraced) sector represent pilots flying for recreational purposes who primarily operate in class G airspace and who also operate a variety of air systems including gliders, lighter than air vehicles, microlights and light aircraft of myriad configurations. Figure 4 below depicts these sector interactions from 2010. The areas of interest are any mix which involves GA aircraft, specifically GA-GA, and any involving Military aircraft.

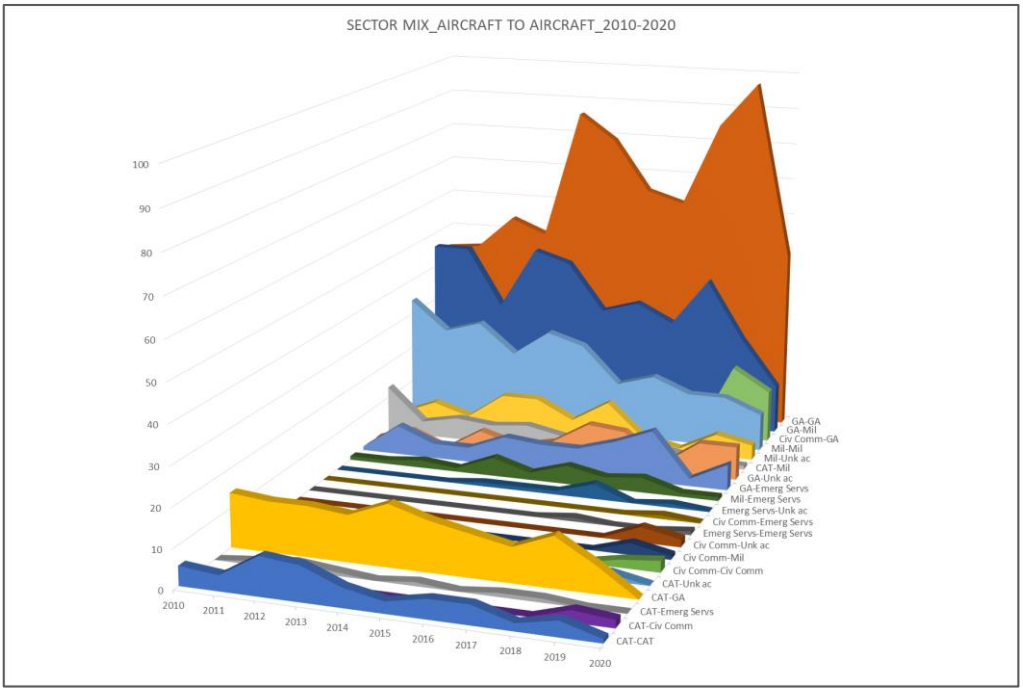

Figure 4: All Airprox 2011 – 2020 by SECTOR MIX

Figure 5 shows the Sector mix interaction as a percentage of the 2489 aircraft to aircraft occurrences reported since 2010. (note the small numbers of Emergency Services and Civ_Comm reflect their recent inclusion in a specific category where previously they would have been captured in either CAT or GA) It is striking that only 17% of the chart shows non GA sector interactions. This ratio is reflected in the 2020 distributions as well, although the actual numbers were significantly reduced as a result of the Covid 19 pandemic

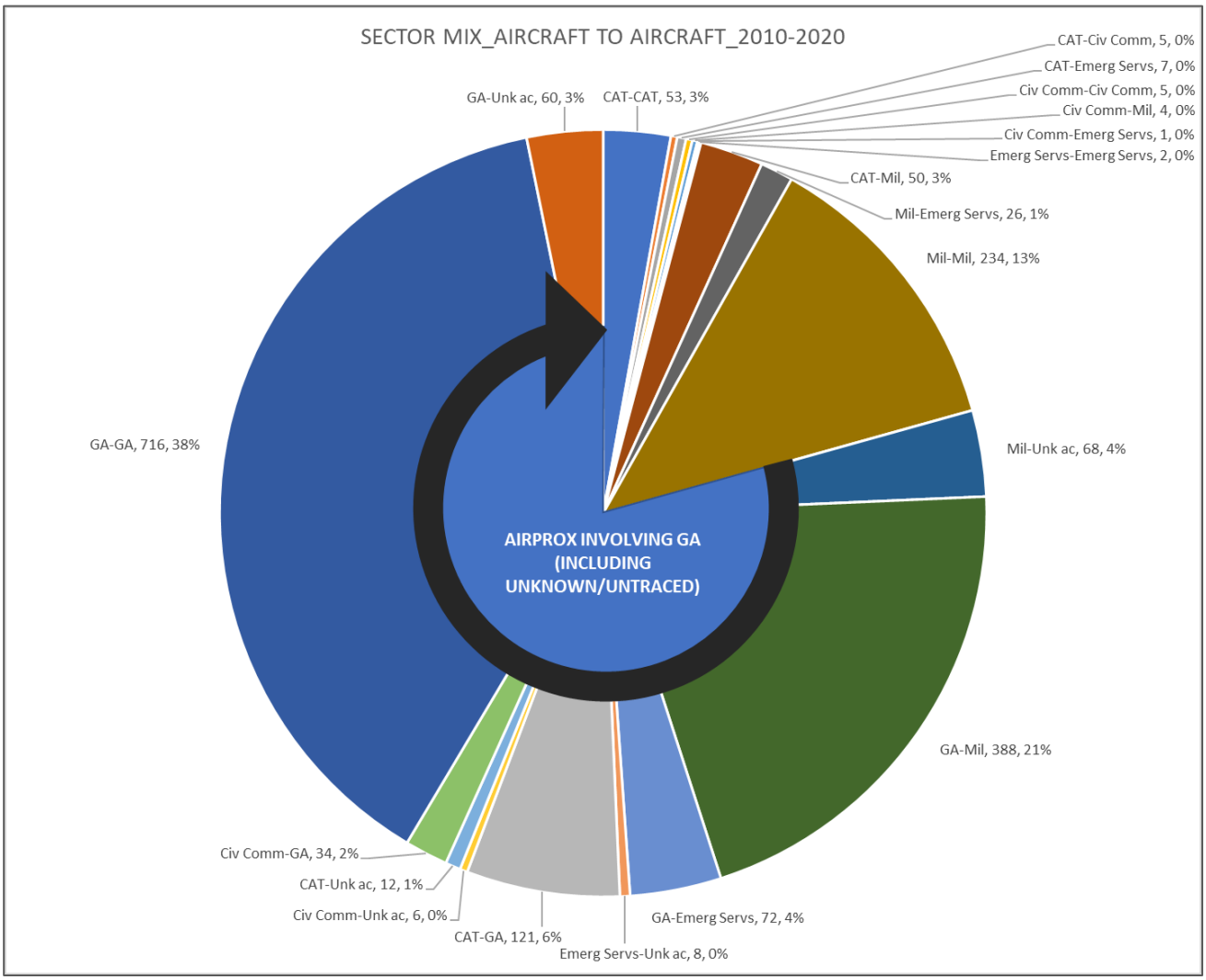

Figure 5: All Airprox 2011 – 2020 by SECTOR MIX

Understanding this picture is important as it describes the significant influence of the GA sports and recreational community on the Airprox landscape and emphasises the importance and value of the sectorised approach to understanding Airprox.

2010-2020

80% of aircraft to aircraft events involved a GA sports and recreational light aircraft (This number includes Unknown_Untraced aircraft where the description fitted this category)

Also, it is useful to think about the percentage risk bearing Airprox, in terms of overall percentage, and percentages of risk bearing of those involving GA, Mil and CAT_Civ_Comm.

Risk Bearing Trends

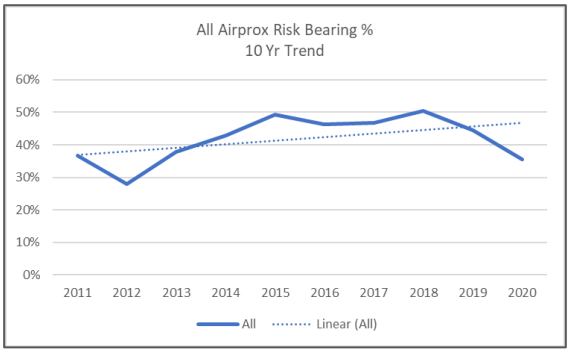

Figure 6: All Airprox Risk Bearing % 2011-2020

As previously mentioned, the percentage risk bearing figures for 2019 are lower than the 10-year average, however the overall linear trend indicates a gradual rise in the percentage of risk bearing Airprox. It should be noted that those involving SUAS are included in this graphic and one could consider this a misleading influence, as the majority of SUAS encounters are with the CAT and Civ_Comm sectors which carry an elevated proportion of events which are determined to be risk bearing.

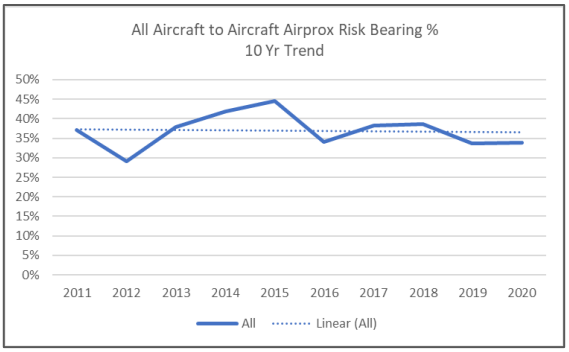

Figure 7: All Aircraft tot Aircraft Airprox Risk Bearing % 2011–2020

When looking at aircraft to aircraft only Figure 7, the picture seems to be more positive, and shows a very gentle reduction, however it is useful to consider the sector distribution: Fig 8 depicts the risk bearing percentage by sector of all aircraft to aircraft Airprox.

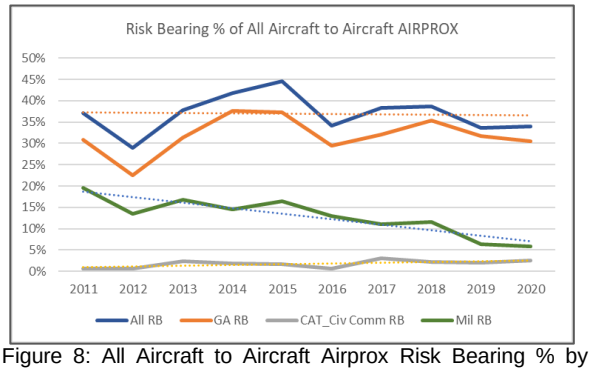

Figure 8: All Aircraft to Aircraft Airprox Risk Bearing % by sector 2011–2020

In 2020 risk bearing Airprox involving Military aircraft represented 6% of all aircraft to aircraft Airprox and risk bearing Airprox involving GA aircraft represented 30% of all aircraft to aircraft Airprox. The steady decline in those risk bearing events involving Military aircraft is encouraging and can be considered as evidence of a consistently improving risk picture.

The final graphs and charts in this section – Figures 9 and 10 show the sector risk bearing percentage of all *risk bearing* aircraft to aircraft Airprox. It can be seen that the GA sports and recreational community represented just over 80% of all risk bearing aircraft to aircraft in 2011, this has steadily increased to 90% in 2020. For the military sector, 52% of risk bearing aircraft to aircraft Airprox involved military aircraft in 2011, vice only 18% in 2020. Note – the percentage totals per year do not add up to 100%. Although seemingly incongruent, this is because (at least) 2 aircraft are involved in a single Airprox event and when those Airprox involve the mixing of sectors, the instance will be counted in the figures for each sector.

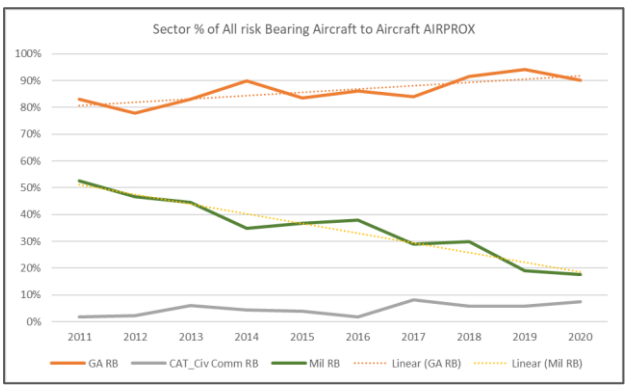

Figure 9: All Aircraft to Aircraft Airprox Risk Bearing % by sector 2011–2020

In 2020 - 90% of all risk bearing aircraft to aircraft events involved a GA sports and recreational light aircraft (This number includes Unknown_Untraced aircraft where the description fitted this category)

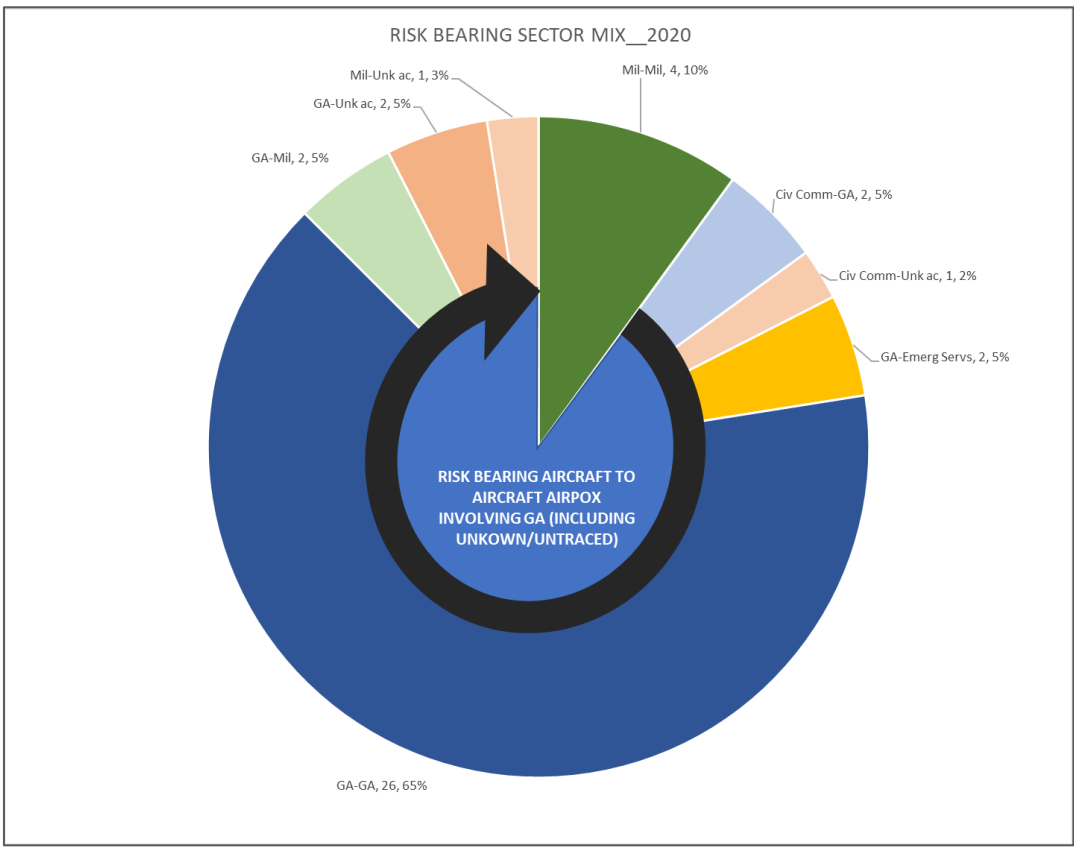

Figure 10: All Aircraft to Aircraft Airprox % by sector 2020

ALTITUDE, AIRSPACE AND RISK - 2020 Overview

The following collection of charts depict airspace, altitude and risk combinations for 2020. 87% of all aircraft to aircraft Airprox involved either the GA community or unknown/untraced aircraft, most of these occurred in Class G airspace below 3000.

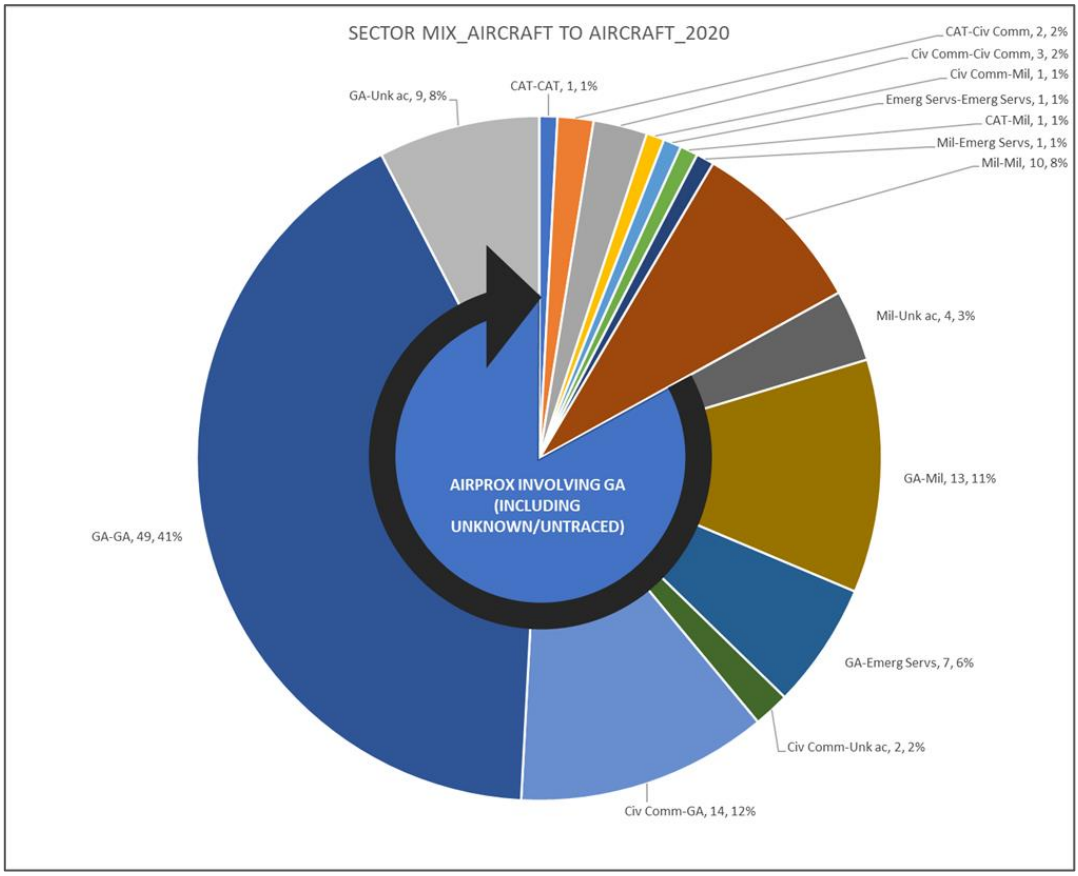

Figure 11: All Aircraft to Aircraft Airprox % by sector 2020

In 2020 – 87% of aircraft to aircraft events involved a GA sports and recreational light aircraft (This number includes Unknown_Untraced aircraft where the description fitted this category)

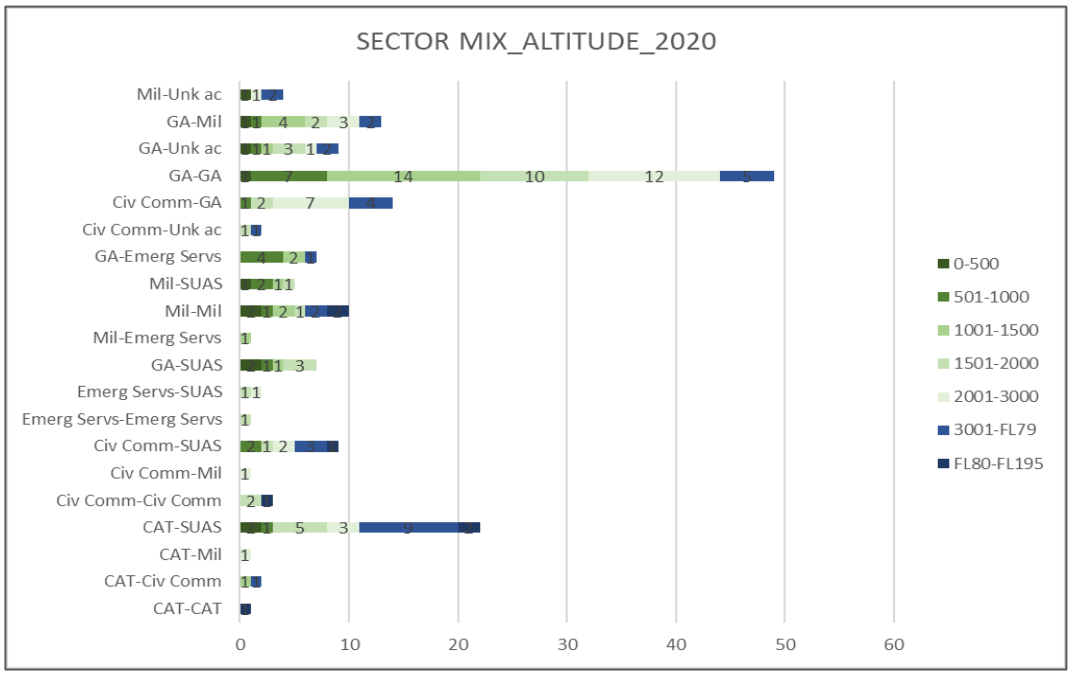

Figure 12: All Aircraft to Aircraft Airprox Risk Bearing % by sector 2011–2020

In 2020 – 76% of all events and 80% of all aircraft to aircraft events took place at or below 3000'

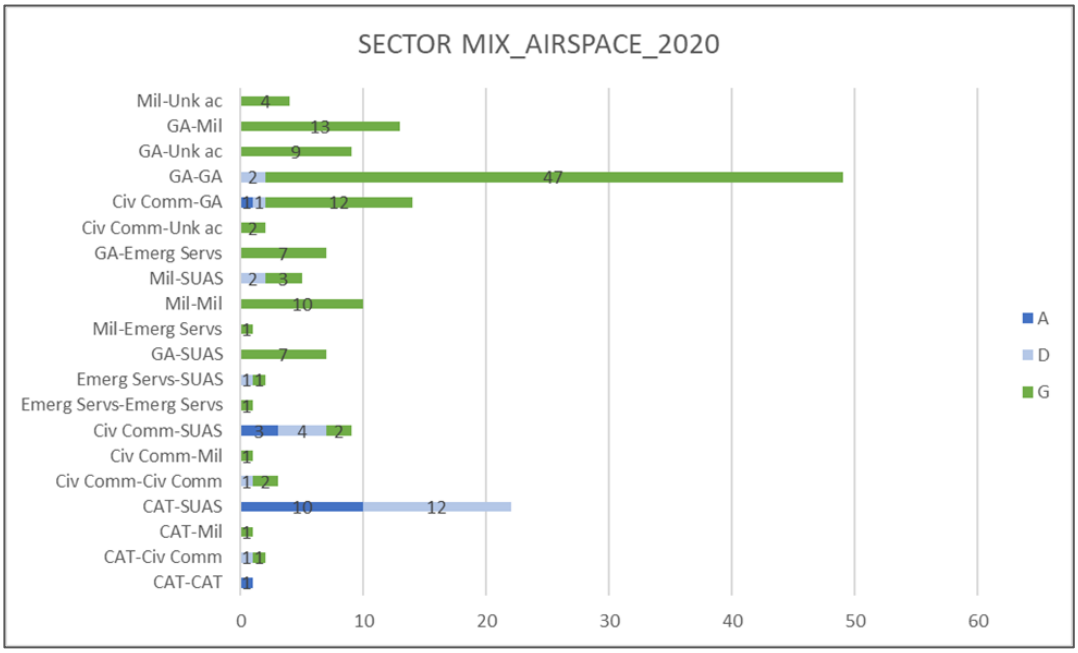

Figure 13: All Aircraft to Aircraft Airprox Risk Bearing % by sector 2011–2020

In 2020 – 76% of all events and 92% of all aircraft to aircraft events took place in Class G Airspace

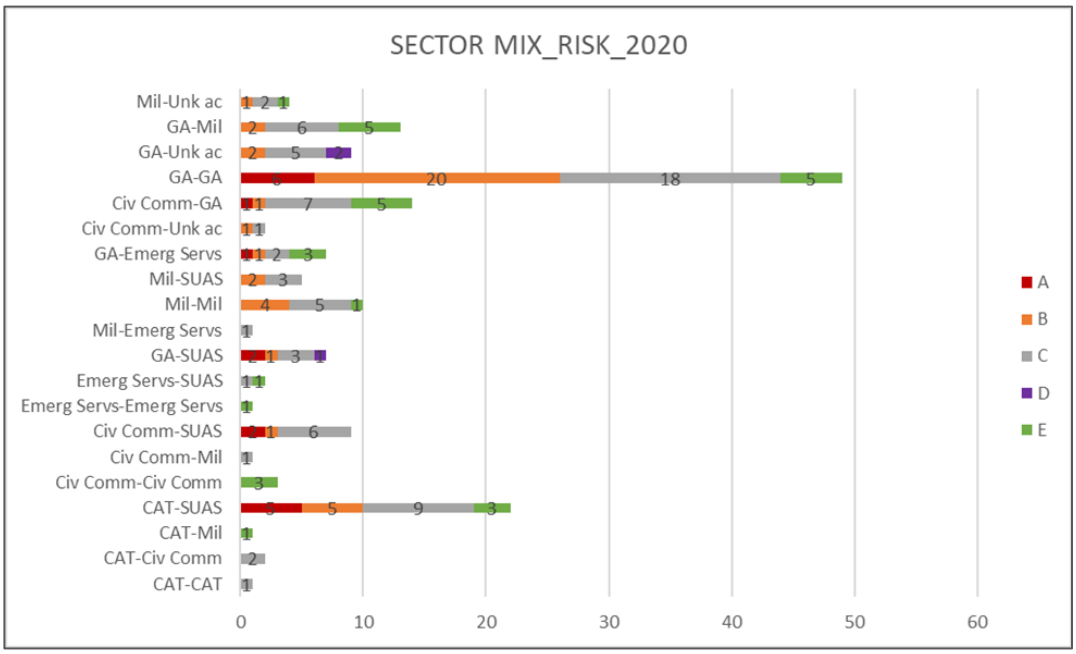

Figure 14: All Aircraft to Aircraft Airprox Risk Bearing % by sector 2011–2020

We have already seen that 90% of all risk bearing Airprox occur in the GA sports and recreation community, but it is useful to have a graphical breakdown of the specifics. The above chart clearly shows the sector mix distributions, and the levels of risk for each sector combination.
Tables 4 and 5 provide links to all aircraft to aircraft risk bearing events.

In 2020 – **All** Category A Aircraft to aircraft Airprox involved GA sports and recreational light aircraft.

Airprox No	Year	Alt Block	Risk Category	Sector Mix
2020045	2020	1001-1500	A	GA-GA
2020082	2020	2001-3000	A	GA-GA
2020109	2020	3001-FL79	A	Civ Comm-GA
2020127	2020	1001-1500	A	GA-GA
2020141	2020	1001-1500	A	GA-GA
2020146	2020	501-1000	A	GA-Emerg Servs
2020159	2020	1501-2000	A	GA-GA
2020160	2020	1501-2000	A	GA-GA

Table 4: Category A Aircraft to Aircraft events

Airprox No	Year	Alt Block	Risk Category	Sector Mix
2020001	2020	3001-FL79	B	GA-Unk ac
2020010	2020	1501-2000	B	GA-Unk ac
2020014	2020	501-1000	B	GA-GA
2020018	2020	1001-1500	B	Mil-Mil
2020035	2020	0-500	B	Mil-Mil
2020037	2020	3001-FL79	B	Mil-Mil
2020060	2020	1501-2000	B	Civ Comm-Unk ac
2020062	2020	1001-1500	B	GA-GA
2020064	2020	2001-3000	B	GA-GA
2020066	2020	2001-3000	B	GA-GA
2020069	2020	3001-FL79	B	GA-Mil
2020070	2020	2001-3000	B	GA-GA
2020085	2020	501-1000	B	GA-GA
2020094	2020	1001-1500	B	GA-GA
2020095	2020	2001-3000	B	GA-Mil
2020096	2020	3001-FL79	B	Mil-Unk ac
2020103	2020	1501-2000	B	GA-GA
2020104	2020	3001-FL79	B	GA-GA
2020106	2020	1001-1500	B	GA-GA
2020117	2020	2001-3000	B	GA-GA
2020126	2020	0-500	B	GA-GA
2020133	2020	2001-3000	B	GA-GA
2020134	2020	1001-1500	B	GA-GA
2020136	2020	501-1000	B	GA-GA
2020137	2020	1501-2000	B	GA-GA
2020143	2020	1001-1500	B	GA-Emerg Servs
2020152	2020	1501-2000	B	GA-GA
2020153	2020	501-1000	B	GA-GA
2020154	2020	1001-1500	B	Mil-Mil
2020156	2020	501-1000	B	GA-GA
2020161	2020	501-1000	B	GA-GA
2020166	2020	3001-FL79	B	Civ Comm-GA

Table 5: Category B Aircraft to Aircraft Events

In 2020 – There were **no** Category A Aircraft to aircraft Airprox involving Military aircraft.

In 2020 – There were **7** Category B Aircraft to aircraft Airprox involving Military aircraft.

ATZ and MATZ Airprox

In terms of numbers, those instances occurring within an ATZ or MATZ has remained relatively constant. Commensurate with a reduction in general flying, the numbers reported in 2020 continues to reduce. However, when examining percentages of those events which are determined to be risk bearing, one can see an upturn since 2017, which has continued into 2020. Most of these events involve the GA sports and recreational sector. The top 5 CF associated with these Airprox are shown in Table 6 and links to those occurring in 2020, including the risk and sector mix are in table 7 for ease of reference.

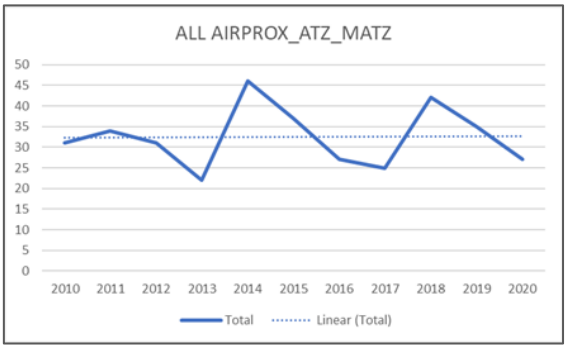

Figure 15: All Aircraft to Aircraft Airprox Risk Bearing % by sector 2011–2020

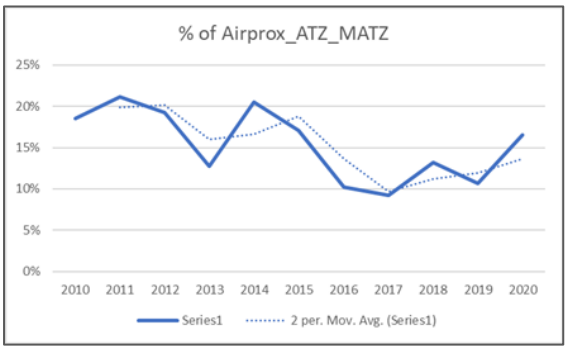

Figure 16: All Aircraft to Aircraft Airprox Risk Bearing % by sector 2011–2020

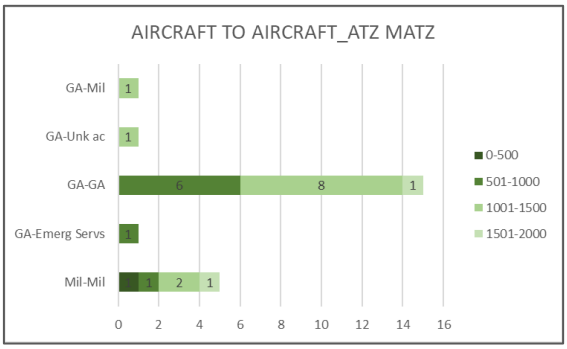

Figure 17: All Aircraft to Aircraft Airprox Risk Bearing % by sector 2020

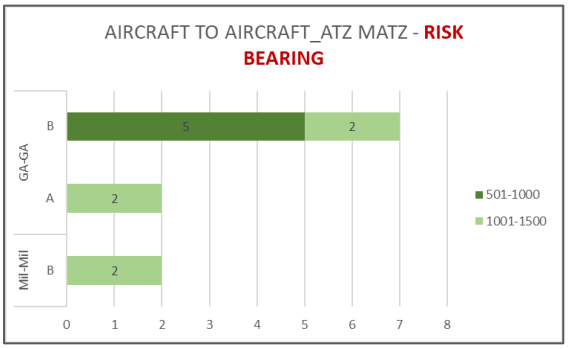

Figure 18: All Aircraft to Aircraft Airprox Risk Bearing % by sector 2020

Barrier	CF
Tactical planning and Execution	Did not conform with established pattern of Traffic
Situational Awareness	No, Late or generic Situational Awareness
	Did not assimilate traffic information
	Did not request further information
See and Avoid	Effective non-sighting

Table 6: ATZ_MATZ top 5 CF

Airprox No	Year	Alt Block	Risk Category	Sector Mix
2020014	2020	501-1000	B	GA-GA
2020018	2020	1001-1500	B	Mil-Mil
2020085	2020	501-1000	B	GA-GA
2020094	2020	1001-1500	B	GA-GA
2020127	2020	1001-1500	A	GA-GA
2020134	2020	1001-1500	B	GA-GA
2020136	2020	501-1000	B	GA-GA
2020141	2020	1001-1500	A	GA-GA
2020154	2020	1001-1500	B	Mil-Mil
2020156	2020	501-1000	B	GA-GA
2020161	2020	501-1000	B	GA-GA

Table 7: All Aircraft to Aircraft Risk Bearing Airprox in ATZ/MATZ - 2020

Flying Rates:

With regard to rates, the CAA continues to refine its methodologies in the collection of flown hours for the GA sports and recreational community and this year the figures for military hours have been compiled by the MAA. The instances of aircraft to aircraft events involving CAT are too low to warrant comment.

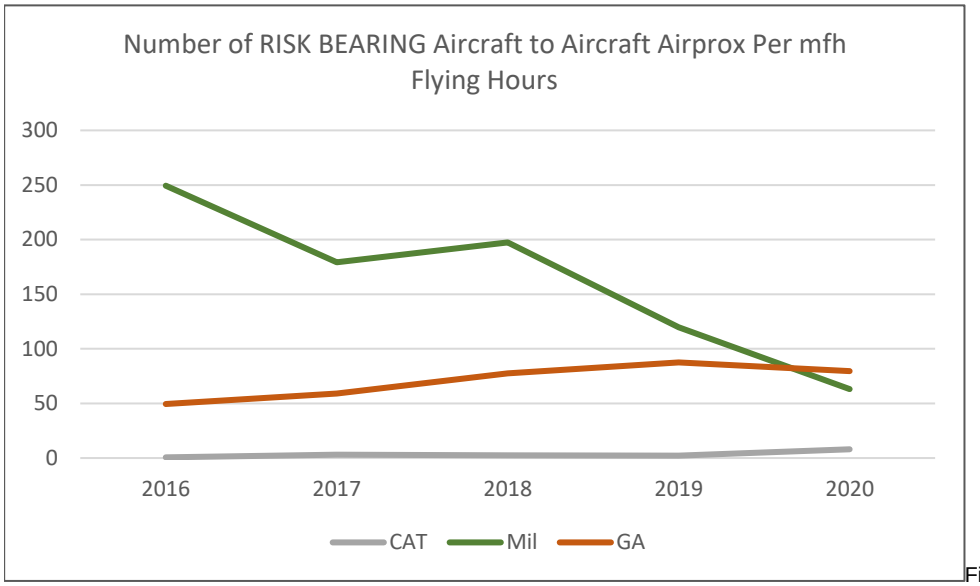

Figure 19: All Aircraft to Aircraft Airprox Risk Bearing % by sector 2011–2020

The revised figures reach back to 2016. Using those figures one can see the steady increase in risk bearing occurrences per million flying hours for the GA sports and recreational sector and the continued and steady reduction in military cases which has been evident in the previously presented graphics.

Although rates may be of interest, it is more useful to attempt to understand the nature of an Airprox, as this allows interested parties to identify and begin to tackle weak areas within their sector, perhaps refocus training, refine risk management and gain a better understanding of the other sectors with whom they are interacting.

The remainder of this report therefore, attempts to describe the aviation landscape through safety barriers and their associated CF, whilst also conceptualising barrier interactions and their differing levels of influence within the Airprox context. It draws out, where evident, any differences between sectors. The intent behind the identification of differences is NOT to compare how one sector may perform in comparison to another, or to imply that one sector is 'riskier' than another. The intent is to highlight that one sector may wish to concentrate or focus in different areas or with differing levels of emphasis than another sector.

SAFETY BARRIERS AND CONTRIBUTORY FACTORS

[Director's Note: Safety barrier and contributory factor analysis encompasses data collected from 2019 and 2020]

The safety barrier and CF methodologies continue to evolve; however, there is now enough data to demonstrate that the barriers are interlinked and interdependent. Prior to changing methods of data recording and sectorisation, it was not possible to demonstrate barrier interactions within a particular Airprox as the only thing that was collected was the 'count' of the performance assessment of each barrier and a separate and de-linked 'count' of the CF collected. This meant that it was previously impossible to see the combined set of barrier performances for each Airprox and therefore impossible to see their interactions. Having now been back through all of 2019 Airprox data I have individually extracted and recorded the barrier performances and the associated CF for each event and I have attempted to conceptualise those interactions in the following schematic and the accompanying text:

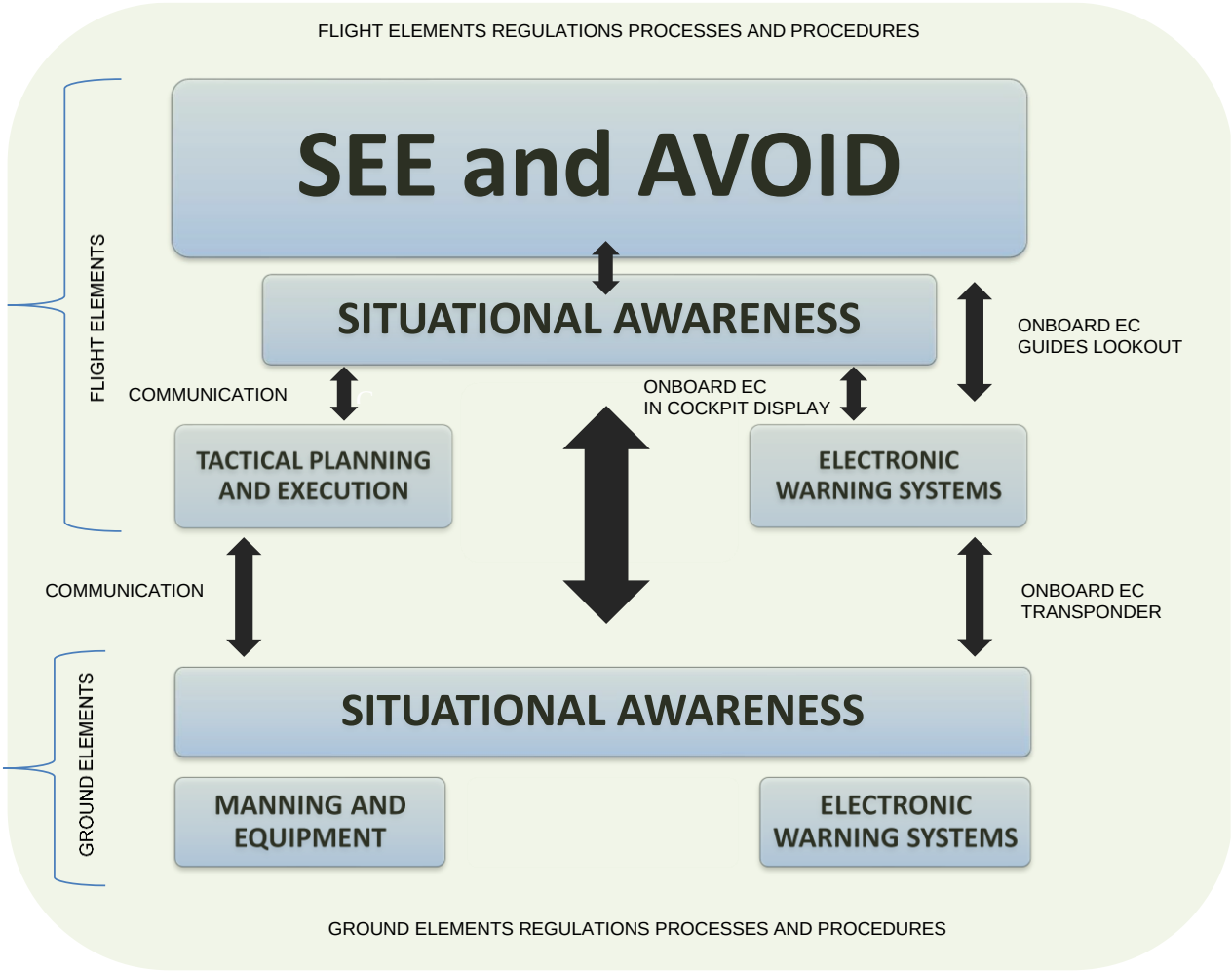

Figure 20: Schematic representation of top level barrier interactions

- For both Ground and Flight Elements, the performance of the **Regulations, Processes and Procedures** barriers underpin everything as it aims to capture the availability and the application of generic and specific standardised operating and regulatory principles for aviation activity, aerodrome operation and ATM provision. A misapplication or misinterpretation in this area will almost certainly be contributory to the performance of (mainly) the Situational

Awareness barrier (Ground Elements) and (mainly) the Tactical Planning and Execution barrier (Flight Elements)

- The performance of **Ground Elements Manning And Equipment** and the **Ground Elements Electronic Warning Systems** barriers are the other 2 pillars which support the Ground Elements Situational Awareness barrier – It is of note, however that the Ground Elements Electronic Warning Systems barrier is rarely present as Airprox almost exclusively take place in the visual arena and predominantly in Class G airspace – however, where it is employed, it is always fully effective.
- The **Ground Elements Situational Awareness** barrier acts as the interface between any communicating ground agent and the airborne traffic. It is strengthened (amongst other things) by robust and accurate two-way communication, positive identification through EC means (i.e. transponding traffic) and the selection of an appropriate Air Traffic Service (ATS) by the aircraft concerned.
- The **Tactical Planning and Execution** barrier captures 3 areas of aviation activity: Planning and briefing (Threat and Error Management), appropriate and effective communication with ground agencies and the actual execution of the flight. This barrier is the easiest to strengthen and is the one which *can release the most capacity* to the individual pilot. The communication part of this barrier contributes directly to the pilots' and any controllers' situational awareness as well as to that of other aviators who are on the same frequency.
- The **Electronic Warning Systems** barrier, if used appropriately, can directly influence the performance of 3 other barriers: Transponding aircraft influence the Ground Elements Situational Awareness barrier (if the Air Navigation Service (ANS) provider is appropriately equipped) and compatible EWS or EC equipment enhances both the Flight Elements Situational Awareness barrier and the critical See and Avoid barrier (through guiding the lookout). However a thorough understanding of the equipment fitted, its operation and compatibility with other types of equipment is critical as unfamiliarity can cause distraction and thereby drain capacity Additionally, an over reliance or unconsidered/unquestioned trust in its performance can lead to complacency and an assumption that it will (in and of itself) keep one safe.
- Finally, the most important barrier is the **See and Avoid** barrier – We are generally talking about Airprox which occur in the visual environment and in uncontrolled airspace. Safety is the individual's responsibility and the primary way of avoiding getting uncomfortably close to another aircraft is to spot it first and then to avoid as appropriate. Additionally, class G airspace is occupied by the most diverse range of air systems and encompasses the full range of pilot experience, competence and qualifications. It is important therefore that every tactic is employed to release capacity to look out.

One of the major things that I have been battling with when trying to understand and explain barrier interactions is that one never knows 'what good looks like' apart from the inference that all the barriers would be designated as fully effective and an Airprox would not happen. It is a fact, with Airprox, or any situation where there is a negative outcome, that the data is elicited from situations where something negative has occurred which has warranted a report. Consequently, there is no comparator and no way to measure success. However, the closest recording of an uneventful flight is captured in a category E Airprox. Category E Airprox are occasions where the Board has determined that normal safety parameters have been met – although (at least) one party has felt the need to report the event. By comparing barrier interactions of Category E events with those of Category A and B (risk bearing) events, it is possible to demonstrate the interdependent nature of the barriers and to evaluate their respective importance. In order to progress with this concept I have looked at: the influence of the Tactical Planning and Execution barrier on the Situational Awareness barrier, the influence of the Electronic Warning Systems barrier on the Situational Awareness barrier and separately on the See and Avoid barrier and finally the effect of the Situational Awareness barrier on the See and Avoid barrier.

My aim is to demonstrate the positive interactions between barriers under 'normal' circumstances as opposed to the negative interactions which are evident in a risk bearing Airprox scenario.

BARRIER INTERACTIONS

The Effect of the Tactical Planning and Execution barrier on Situational Awareness:

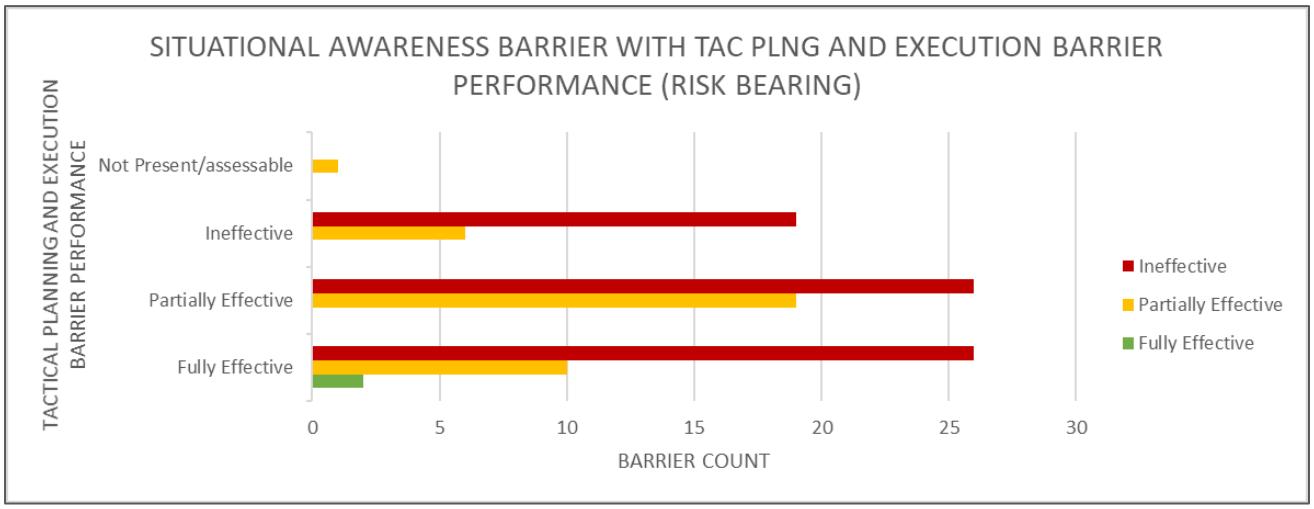

Figure 21 Risk Bearing: Tactical Planning and Execution Barrier on Situational Awareness

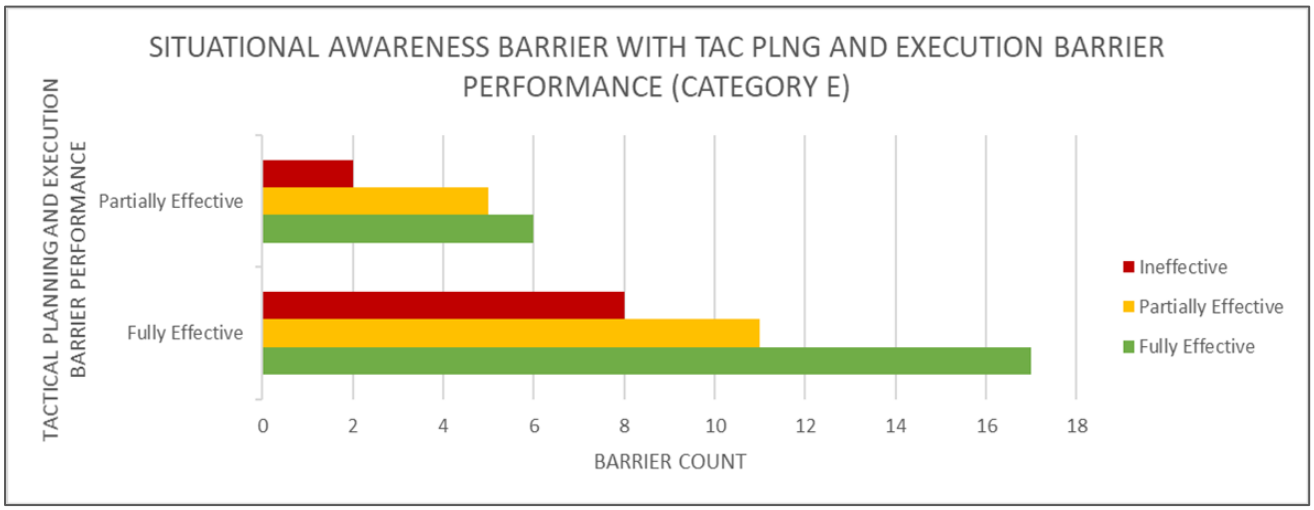

Figure 22: Category E: Tactical Planning and Execution Barrier on Situational Awareness.

Examining the risk bearing chart (Figure 21), I was rather surprised to see that that a fully effective Tactical Planning and Execution barrier yields as many instances of an ineffective Situational Awareness barrier as when the Tactical Planning and Execution barrier is only partially effective. This seems to conrtadict the assertion that good planning, preparation, execution and communication are essential parts of every flight, however the picture is still significantly different when compared to the Category E depiction (Figure 22) which does describe a positive relationship between the two barriers. One reason for this could be that the Tactical Planning and Execution barrier encompasses three distinct areas: planning and preparation; communication and execution, where any one of those areas may have yielded a CF which affected the Situational Awareness barrier, but which was not determined (in overall effect) to have rendered the barrier completely ineffective. On further examination, when the Tactical Planning and Execution barrier is fully effective (in risk bearing scenarios) then we begin to accumulate a different set of CF in the Situational Awareness barrier – namely 'lack of assimilation of Situational Awareness', and 'lack of action despite of Situational Awareness'. More interestingly, when this barrier is either partially effective or ineffective, the Situational Awareness barrier is *never effective* and this barrier is *never ineffective* (i.e always either partially or fully effective) in Category E events.

The Effect of the Electronic Warning Systems barrier on Situational Awareness:

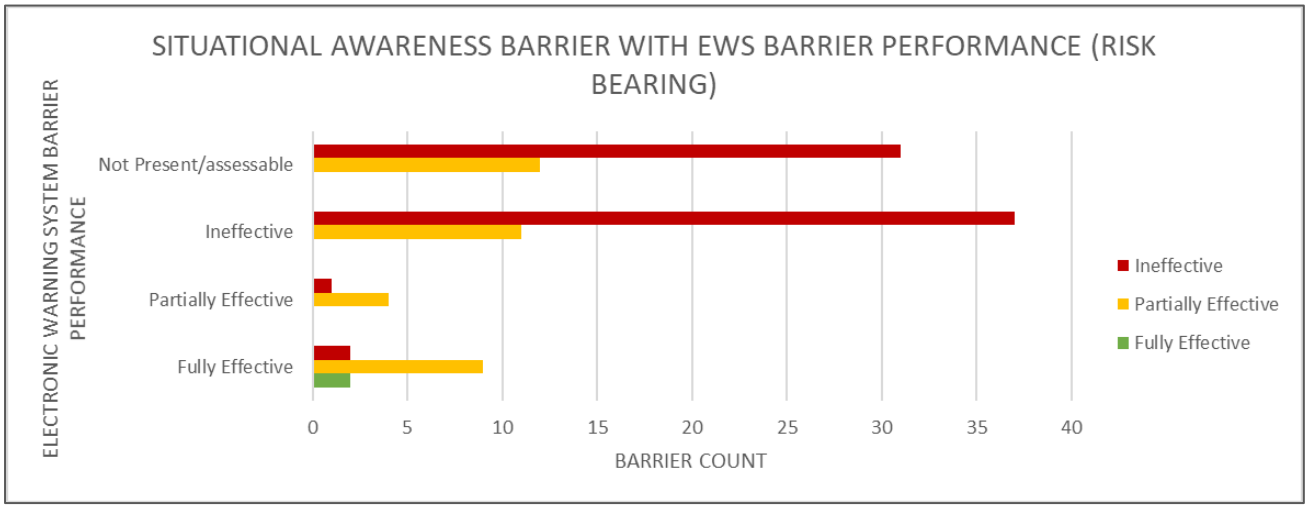

Figure 23: Risk Bearing: Electronic Warning Systems Barrier on Situational Awareness

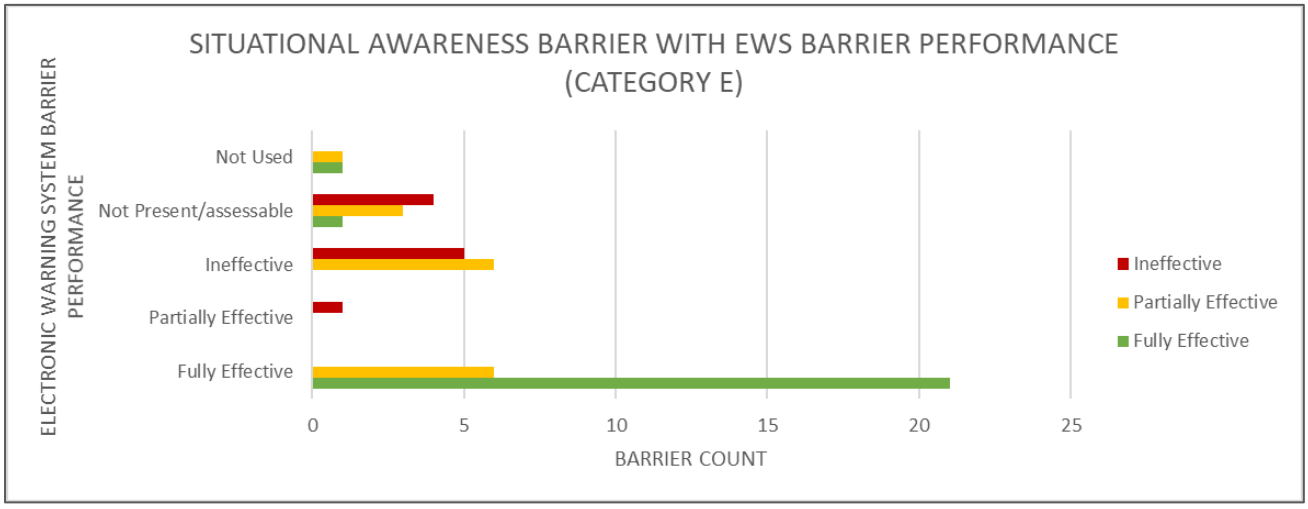

Figure 24: Category E: Electronic Warning Systems Barrier on Situational Awareness

The most striking thing about this pairing of charts is the dramatically different effect of the Electronic Warning Systems barrier with regard to risk bearing and category E events. In the overwhelming majority of cases with the risk bearing events, the Electronic Warning Systems barrier is either not present, or completely ineffective and on no occasion is the Situational Awareness barrier effective when this is the case. Conversely, in category E events, the barrier is effective in the majority of cases and offers a positive contribution to the performance of the Situational Awareness barrier. We will discuss the performance of the Electronic Warning Systems barrier in more detail later in this report, where it will become clear that incompatibility of EC devices is the major factor in the poor performance of this barrier for risk bearing events.

The Effect of the Electronic Warning Systems Barrier on the See and Avoid Barrier:

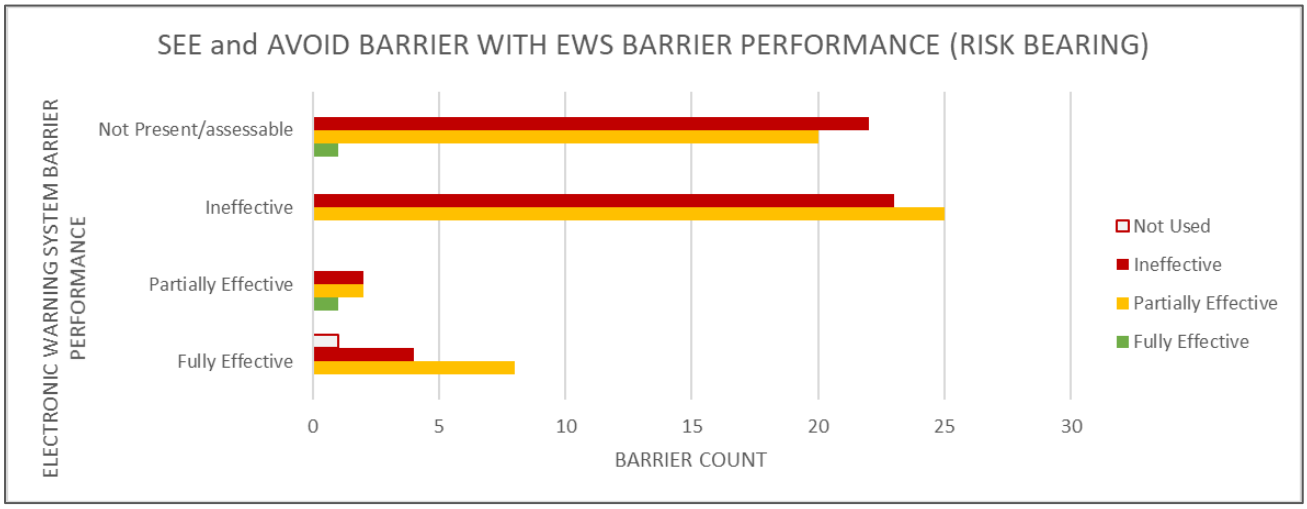

Figure 25: Risk Bearing: Electronic Warning Systems Barrier on See and Avoid Barrier

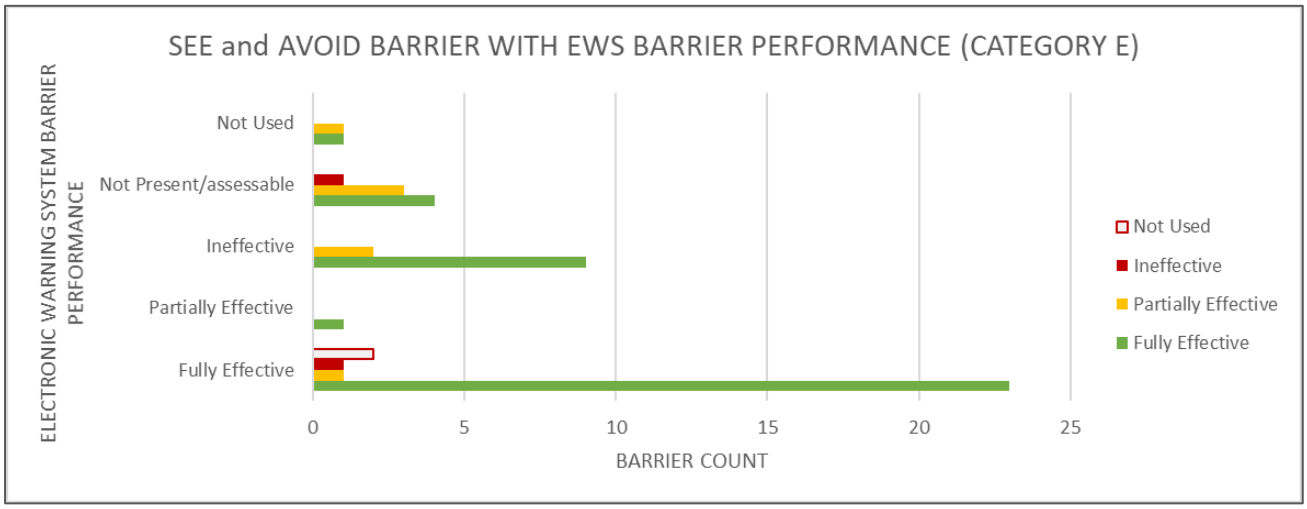

Figure 26: Category E: Electronic Warning Systems Barrier on See and Avoid Barrier

The effect of the Electronic Warning Systems barrier on the See and Avoid barrier is just as clear – in risk bearing Airprox, where this barrier is not present or ineffective, the outcome is an ineffective (or at best) partially effective See and Avoid barrier whereas in Category E events, the fully effective operation of the barrier – i.e. instances of a TAS /TCAS alert, have allowed the pilots enough time to assimilate that traffic is proximate and have allowed them to acquire and subsequently avoid that traffic visually.

The Effect of the Situational Awareness on the See and Avoid Barrier

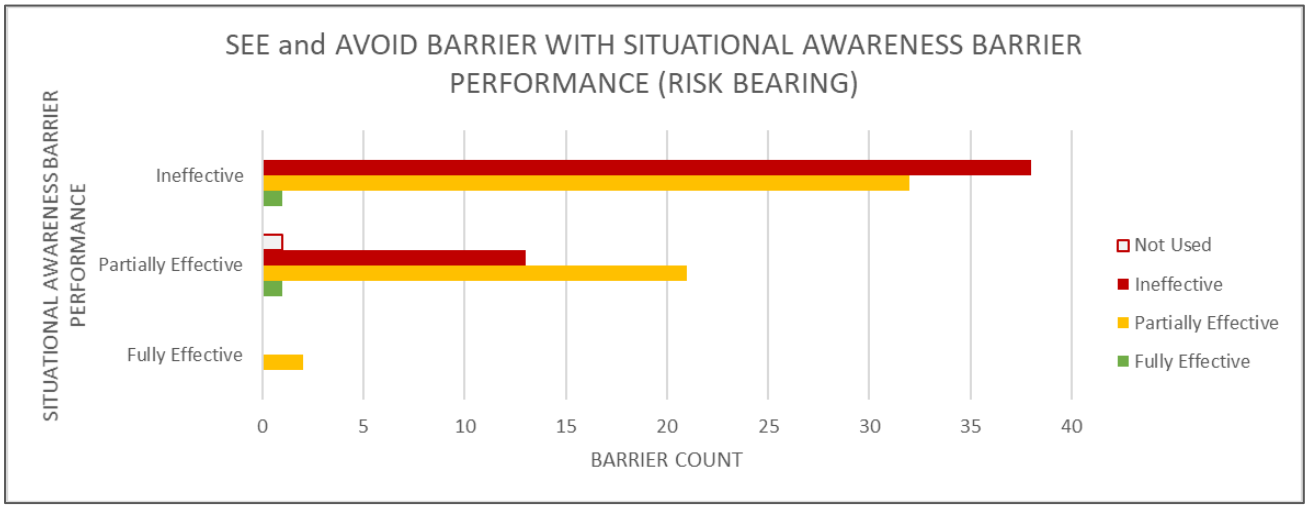

Figure 27: Risk Bearing: Situational awareness barrier on See and Avoid barrier

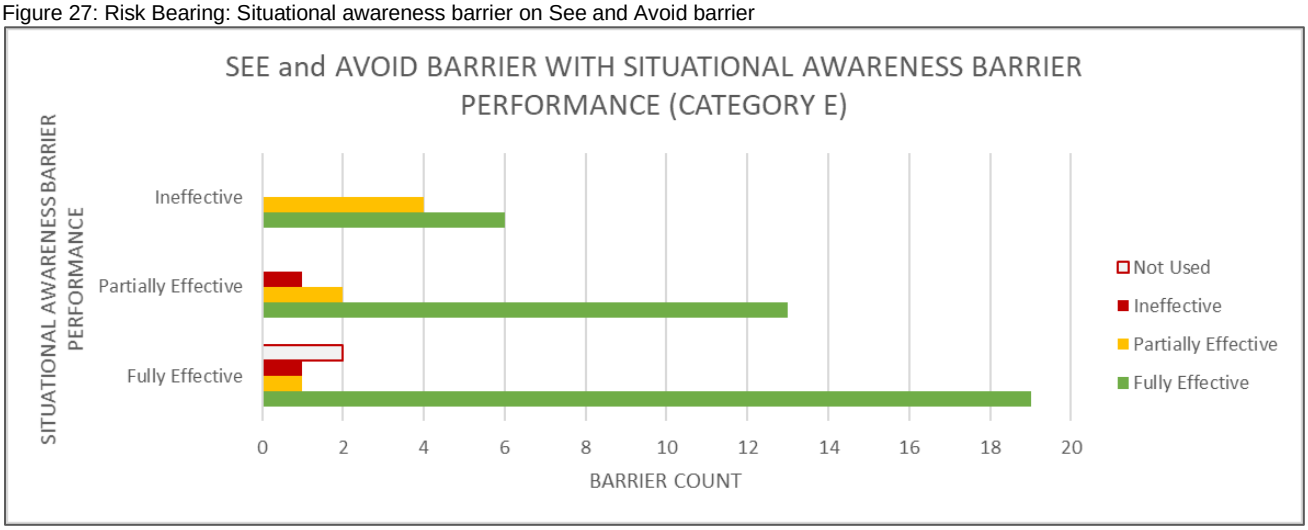

Figure 28: Category E: Situational Awareness Barrier on See and avoid barrier.

Finally, the last relevant combination in this series is how the Situational Awareness' barrier affects the See and Avoid barrier. In risk bearing occurrences, the Situational Awareness barrier was only fully effective twice throughout 2019 and 2020 and yielded only a partially effective See and Avoid Barrier on each occasion. Conversely, under 'normal operating conditions', for our purposes in a category E encounter, the Barrier is either fully or partially effective for most of the time yielding a fully effective See and Avoid barrier.

This preliminary analysis exposes (all be it crudely as data points are low) that there is a relationship between the barriers in accordance with the conceptual depiction at the beginning of this section.
To re-iterate: the **Tactical Planning and Execution** and **Electronic Warning Systems** barrier performance influences the **Situational Awareness** barrier; the **Electronic Warning Systems** barrier influences both the **Situational Awareness** barrier and the **See and Avoid** barrier and finally that **Situational Awareness** barrier influences the **See and Avoid** barrier. It also exposes that the Barrier with the weakest influence in its ability to strengthen other barriers is the Tactical Planning and Execution barrier, however, as previously stated, this is the most complex in its make-up, encompassing the full gambit of planning, preparation, communication and execution and is the only one for which the in-cockpit pilot is fully responsible. There is, therefore, large potential for it to be affected by the experience and competence of an individual across a variety of different skill areas.

BARRIERS AND CONTRIBUTORY FACTORS BY SECTOR

Having looked at barrier interactions it is useful to examine the specific performance of the barriers as individual entities, it is also useful to sectorize the aviation communities where differences in performance or their associated CF are evident.

This barrier analysis uses data from 2019 and 2020 and will examine the sector breakdown for All Airprox[2], Airprox not involving GA, Airprox involving Mil and Airprox only involving Mil. Note – where there are minimal differences in barrier performance, sector interactions are not explicitly discussed. Additional sector interactions may be inserted to illustrate a point should that be warranted.
It is also important to appreciate that CF are almost exclusively captured in relation to a compromised barrier – as such they are normally negative indicators. For reference, a table depicting the barrier performance distribution for each CF accompanies each barrier presentation.

Examining CF according to sector interactions allows a focussed approach where relevant lessons are identified and communicated – it is not to designed, (nor should it be used) to criticize or judge the observed 'performance' of one sector over another.

SITUATIONAL AWARENESS BARRIERS – GROUND AND FLIGHT ELEMENTS

Ground Elements – Situational Awareness

The Ground Elements Situational Awareness barrier is a two-pronged barrier based upon the relationship between an ANS provider (controller/FISO/AGO) and the pilot. For the barrier to be fully effective the controller themselves *must* have situational awareness about the two aircraft involved in the Airprox. For a large number of Airprox, the type of service provided either did not require the ANS provider to monitor the aircraft on radar (Basic Service), was not using a radar, or was not required to integrate the traffic in the visual circuit (FISO/AGO). In these circumstances the Board normally assesses the barrier as 'not used'. Furthermore, even when providing a service whereby the controller was required to give Traffic Information, if the controller has no knowledge of the conflicting aircraft, Traffic Information cannot be provided; an example of this might be a glider not displaying on the radar. Finally, the controller must be able to pass on the associated information to the pilot.

All Airprox

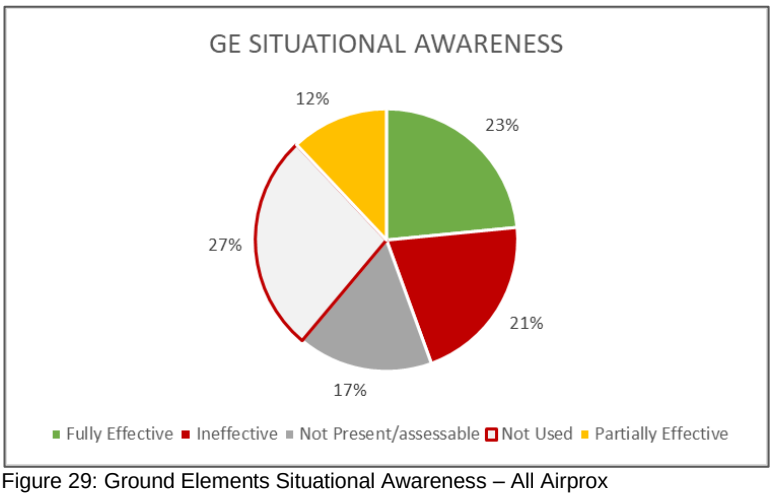

Figure 29: Ground Elements Situational Awareness – All Airprox

Taking all 324 Airprox, the Ground Elements Situational Awareness barrier was assessed as ineffective for 21% of the time and in 12% it was partially effective. However, of note it was not used in 27% of Airprox (i.e. the pilot had used an ATS that meant the controller was not required to provide Traffic Information) and was not present in 17% of Airprox (i.e. there was no ATC involvement at all).

[2] As GA aircraft are present in the vast majority of aircraft to aircraft events (85% in 2019 and 87%% in 2020) the all Airprox representations and contributory factor graphics can also be considered to reflect the behaviours of the GA sector (including Unk/untraced ac).

Turning to risk bearing Airprox only (Category A or B Airprox) (109 Airprox), the barrier was not effective 24% of the time, was partially effective 9%, not used 34% and not present in 25% of Airprox. Therefore, in 59% of risk bearing Airprox either ATC was not used in a way that would provide Traffic Information (e.g. Basic Service) - or was not present at all.

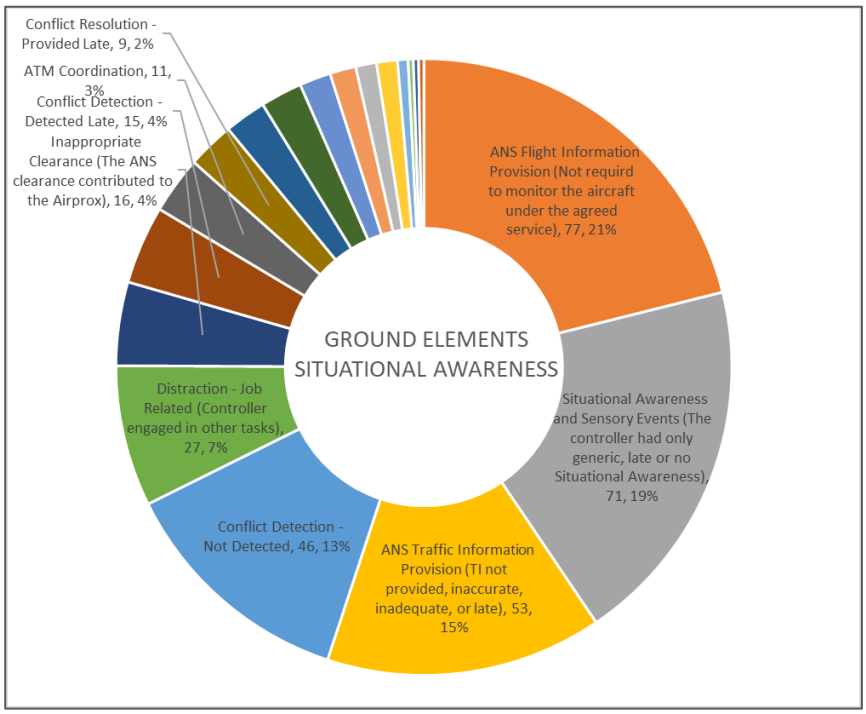

Figure 30: Ground Elements Situational Awareness – All Airprox

Looking in more detail at those CF that featured most frequently to weaken the barrier and taking only the top 5 CF: in 21% of Airprox (77 Airprox) the controller was not required to monitor the flight i.e. the ATS being provided was a Basic Service or being provided by a FISO/AGO; in 19% (71 Airprox) the controller had late, generic or no situational awareness, i.e. the controller themselves did not know the full intentions of, or was not aware of, the conflicting traffic; in 15% (53) it was assessed that the controller passed late or inadequate Traffic Information and in 13% (46) the conflict was not detected by the controller. Finally in 7% (27) Airprox the controller was engaged in other tasks[3].

GROUND ELEMENTS SITUATIONAL AWARENESS – ALL AIRPROX	
ANS Flight Information Provision (Not required to monitor the aircraft under the agreed service)	77(21%)
Situational Awareness and Sensory Events (The controller had only generic, late or no Situational Awareness)	71(19%)
ANS Traffic Information Provision (TI not provided, inaccurate, inadequate, or late)	53(15%)
Conflict Detection - Not Detected	46(13%)
Distraction - Job Related (Controller engaged in other tasks)	27(7%)

Table 7: Ground Elements Situational Awareness – Contributory Factors – All Airprox – All categories

In 59% of risk bearing Airprox either ATC was not used in a way that would provide Traffic Information (e.g. Basic Service) or was not present at all.

When the Ground Elements Situational Awareness barrier is Fully Effective – the Airprox is classified as either **Category E** (normal safety parameters pertained) or a **Category C** (no risk of collision, although safety may have been compromised) **88% of the time.**

[3] This CF distribution remained broadly similar for Airprox assessed as risk bearing.

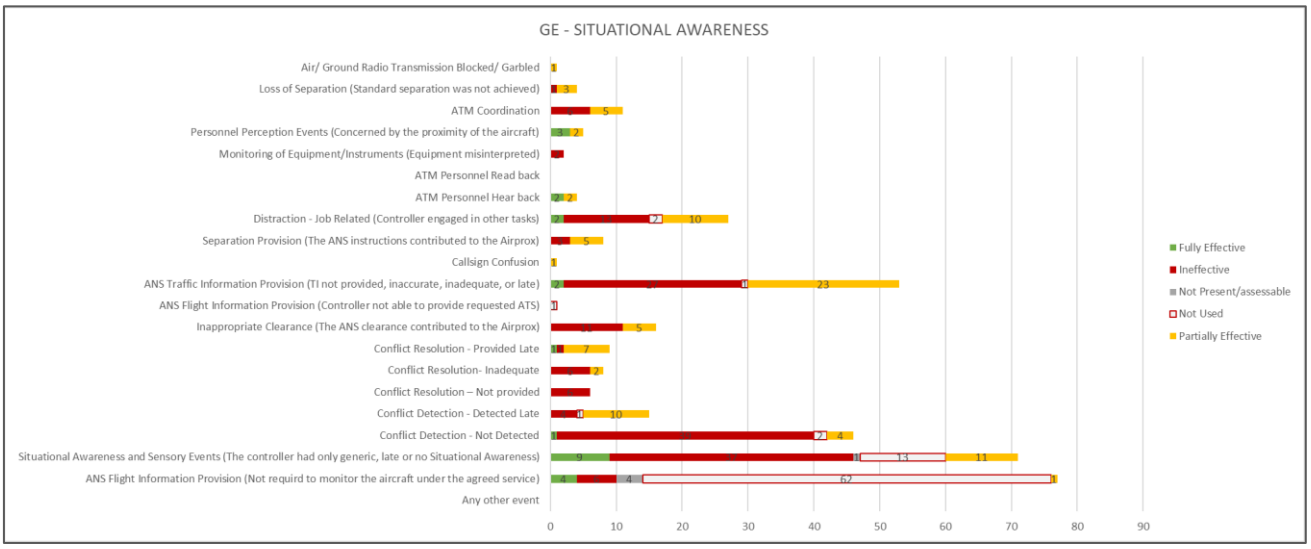

Figure 31: Ground Elements Situational Awareness – Contributory Factors with Barrier Performance – All Airprox

Figure 31 shows the CF within this barrier for all Airprox and the performance of the barrier associated with their collection

All Airprox Not involving GA (52 Airprox)

When all Airprox excluding GA were assessed, the barrier increased its effectiveness to 34%. It was 25% partially effective and 27% ineffective, however, not used and not present reduced to only 10% and 4% respectively. It could therefore be assumed that, in general, non-GA pilots were more likely to request an ATS that required the controller to monitor the flight.

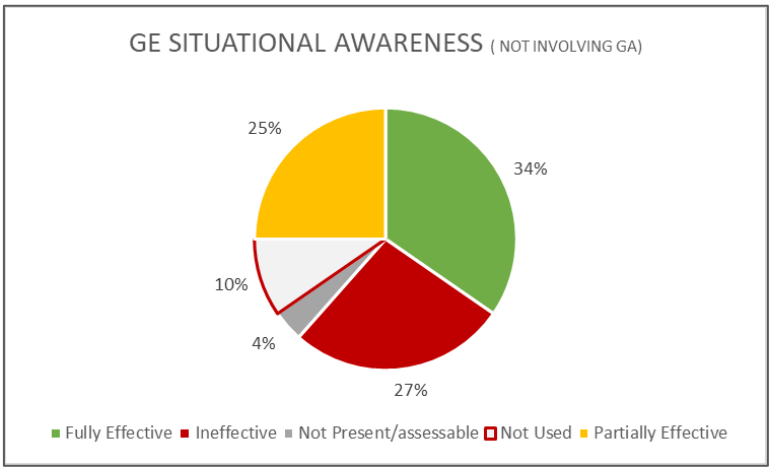

Figure 32: Ground Elements Situational Awareness –Airprox NOT Involving GA

There were only 8 risk-bearing Airprox in this category and for these, the barrier worked for 12% of them (1 Airprox), was partially effective for 13%, not effective for 50% and was not present and not used for 1 Airprox in each category (25% combined). Therefore, for non-GA pilots, the likelihood of having a risk-bearing Airprox increased if they were not receiving an ATS or had an ATS where the controller was not required to monitor the flight.

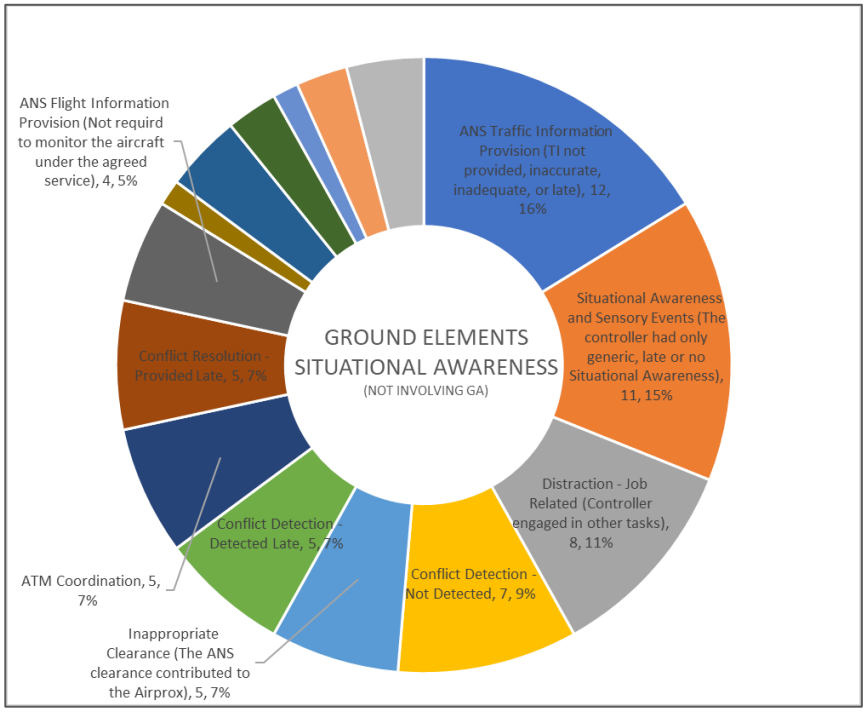

Figure 33: Ground Elements Situational Awareness –Airprox NOT Involving GA

Looking in more detail at the CF in Airprox not involving GA (Figure 33), the obvious difference compared to Airprox involving GA was that only in 4 Airprox (5%), the ANS was not required to monitor the flight.

The most frequently occurring Contributory Factor was that Traffic Information was provided late or not provided for 12 Airprox (16%) and the controller themselves had late or generic situational awareness for 11 Airprox (15%).

GROUND ELEMENTS SITUATIONAL AWARENESS – AIRPROX NOT INVOLVING GA		
ANS Traffic Information Provision (TI not provided, inaccurate, inadequate, or late)		12(16%)
Situational Awareness and Sensory Events (The controller had only generic, late or no Situational Awareness)		11(15%)
Distraction - Job Related (Controller engaged in other tasks)		8(11%)
Conflict Detection - Not Detected		7(9%)
Inappropriate Clearance (The ANS clearance contributed to the Airprox)		5(7%)

Table 8: Ground Elements Situational Awareness –Airprox NOT Involving GA

All Airprox involving Military (82 Airprox)

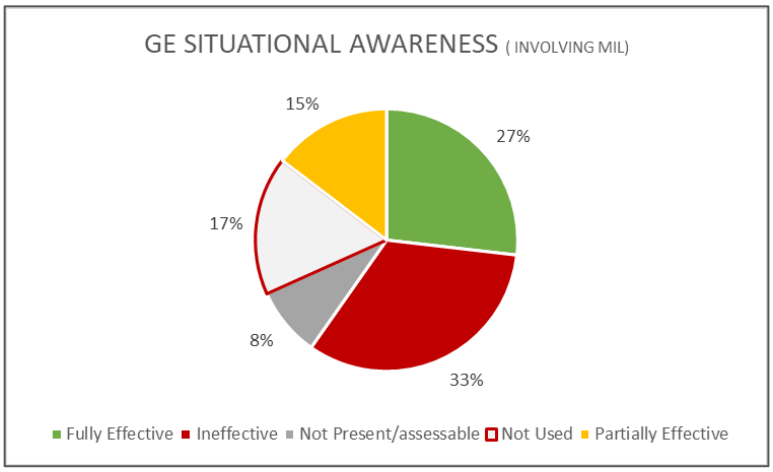

Figure 34: Ground Elements Situational Awareness –Airprox NOT Involving GA

The effectiveness of the barrier for military aircraft probably also reflects the hypothesis that military pilots are more likely to be in receipt of an ATS than GA pilots. The barrier was 33% ineffective and 15% partially effective with much lower not used/not present percentages (Figure 34).

Turning to the top 5 CF which weaken this barrier for Airprox involving military ac; in 20% the controller only had generic or late situational awareness; Traffic Information was not provided in 17% of Airprox; the conflict was not detected by the controller in 16% (17) Airprox; the ANS provider was not required to monitor the flight was evident in 12% of Airprox and the Controller was distracted or engaged in other tasks for 9% of the occurrences.

GROUND ELEMENTS SITUATIONAL AWARENESS – AIRPROX INVOLVING MIL	
Situational Awareness and Sensory Events (The controller had only generic, late or no Situational Awareness)	22(20%)
ANS Traffic Information Provision (TI not provided, inaccurate, inadequate, or late)	18(17%)
Conflict Detection - Not Detected	17(16%)
ANS Flight Information Provision (Not required to monitor the aircraft under the agreed service)	13(12%)
Distraction - Job Related (Controller engaged in other tasks)	10(9%)

Table 9: Ground Elements Situational Awareness –Airprox Involving Mil

Mil/Mil (24)

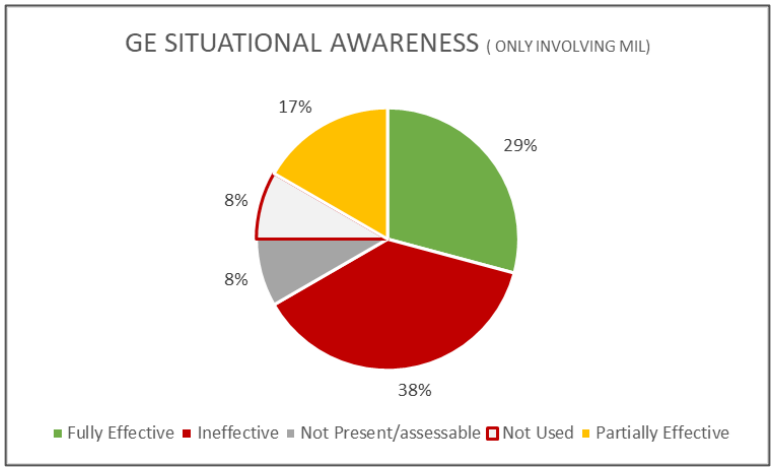

Figure 35: Ground Elements Situational Awareness –Airprox ONLY Involving Mil

The numbers for military against military Airprox are small at only 24 Airprox. Again, the number of times that the barrier was not used/not present was low at only 8% each, representing just 4 Airprox in total, once again reflecting that, where possible, military pilots will use an ATS. The barrier was ineffective 38% of the time (9 Airprox) and partially effective 17% (Figure 9). There were only 7 risk bearing Airprox in this category, resulting in 3 Airprox where the barrier was ineffective and 1 Airprox in each of the other categories

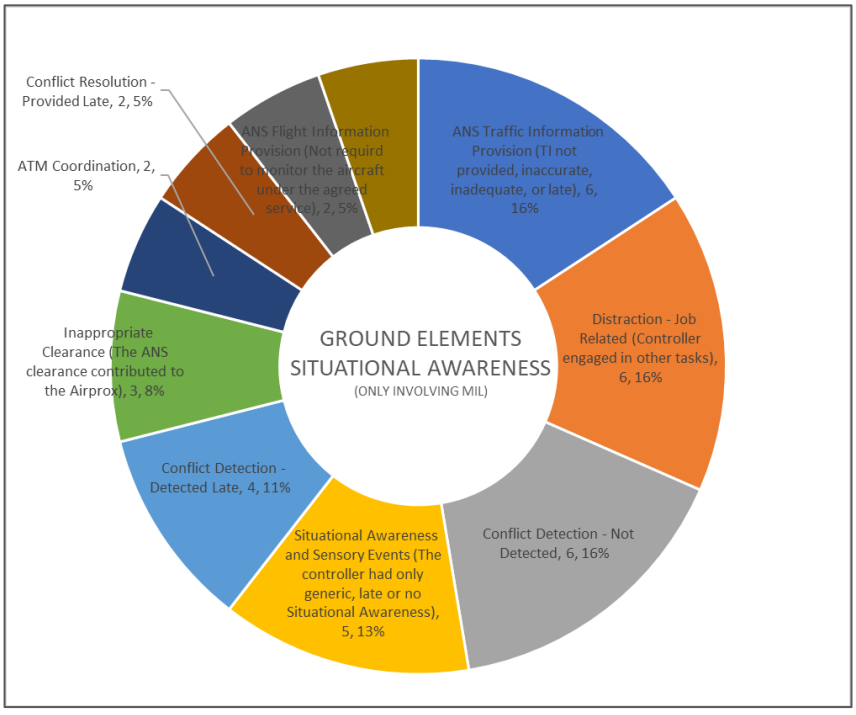

Figure 36: Ground Elements Situational Awareness –Airprox ONLY Involving Mil

The top CF for the military to military Airprox are at Figure 36 and Table 10. Most frequently occurring were that: Traffic Information was not provided on 6 occasions (16%); Distraction; where the controller was engaged in other tasks (16%) and conflict not detected by the controller, also 6 (16%). The controller had generic, or late situational awareness in 5 Airprox (13%). Of note the ANS provider was not required to monitor in only 2 Airprox (6%), reflecting that where possible many military pilots will request a *radar derived* ATS.

GROUND ELEMENTS SITUATIONAL AWARENESS – AIRPROX ONLY INVOLVING MIL	
ANS Traffic Information Provision (TI not provided, inaccurate, inadequate, or late)	6(16%)
Distraction - Job Related (Controller engaged in other tasks)	6(16%)
Conflict Detection - Not Detected	6(16%)
Situational Awareness and Sensory Events (The controller had only generic, late or no Situational Awareness)	5(13%)
Conflict Detection - Detected Late	4(11%)

Table 10: Ground Elements Situational Awareness –Airprox ONLY Involving Mil

Flight Elements Situational Awareness

The Flight Elements Situational Awareness barrier describes all elements of situational awareness available within the cockpit, be that controller derived from listening out on a frequency or from EC equipment. The Board may also be of the view that a pilot should have generic situational awareness derived from planning documents: e.g. gliders should be expected near a glider site marked on a chart.

All Airprox

When assessing all 324 Airprox together, the Flight Elements Situational Awareness barrier was found to be ineffective 46% of the time, 35% partially effective and 18% effective. One Airprox was deemed unassessable.

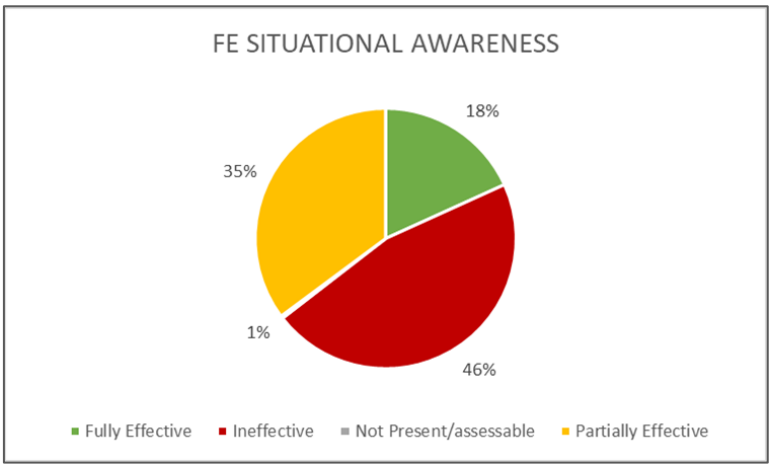

Figure 37: Flight Elements Situational Awareness –All Airprox

When looking at risk bearing Airprox only (Category A or B) the Situational Awareness barrier was only Fully effective 2% of the time. It was assessed as ineffective for 65% and only partially effective on 33% of occasions. In reality, this makes perfect sense, in that having situational awareness on the presence and position of an other aircraft is integral to not having a risk-bearing Airprox.

Figure 38: Flight Elements Situational Awareness –All Airprox (Risk Bearing)

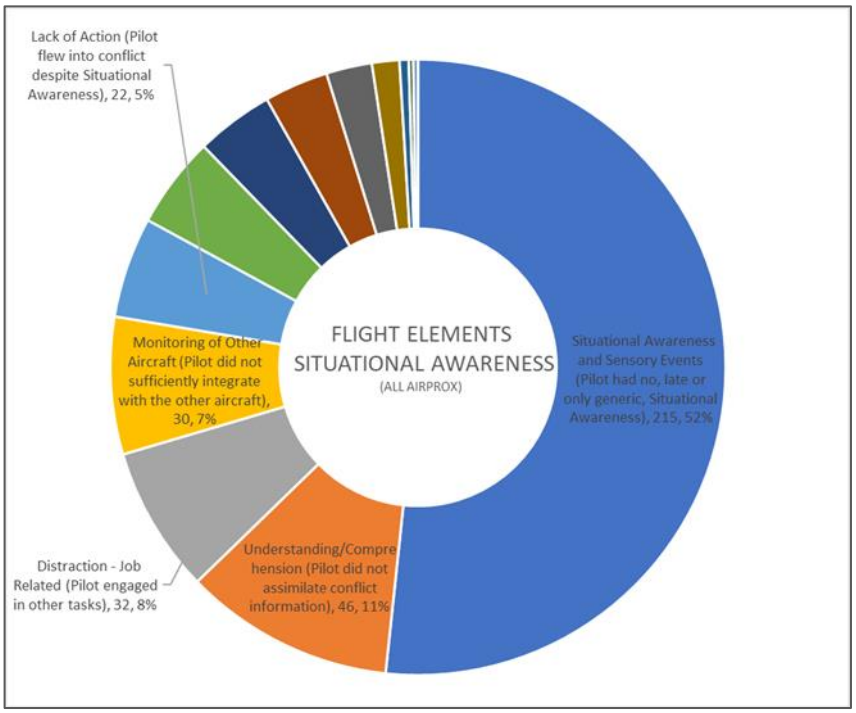

Figure 39: Ground Elements Situational Awareness –Airprox ONLY Involving Mil

Turning to the CF that determined whether or not the barrier was effective (Figure 14), the top recurrent factor was that the pilot had no, late or only generic situational awareness, which occurred in 215 Airprox equating to 52% of Airprox, making it by far the most frequent. The next most frequent was that the pilot did not assimilate the conflict information, the Board usually assigned this factor when the pilot had information from either ATC, from on-board systems, or from hearing the other pilot of the frequency, but had not assimilated that the other aircraft was a factor, this was considered to be contributory in 11% of Airprox.

In 8% (32 Airprox) distraction featured; in these cases the pilot was normally involved in completing other work-related tasks that held their attention. Monitoring of other aircraft (pilot did not sufficiently integrate) was evident in 30 (7%) occasions and was normally assigned when a pilot joining a visual circuit and did not sufficiently integrate with other traffic already in the circuit. Finally, in 5% of the Airprox, it was determined that the pilot flew into conflict despite having situational awareness. These top 5 CF remained the same and in the same order when only the risk-bearing Airprox were compared.

FLIGHT ELEMENTS SITUATIONAL AWARENESS – ALL AIRPROX	
Situational Awareness and Sensory Events (Pilot had no, late or only generic, Situational Awareness)	215(52%)
Understanding/Comprehension (Pilot did not assimilate conflict information)	46(11%)
Distraction - Job Related (Pilot engaged in other tasks)	32(8%)
Monitoring of Other Aircraft (Pilot did not sufficiently integrate with the other aircraft)	30(7%)
Lack of Action (Pilot flew into conflict despite Situational Awareness)	22(5%)

Table 11 : Flight Elements Situational Awareness – All Airprox

Figure 40 shows the CF within this barrier for all Airprox and the performance of the barrier associated with their collection

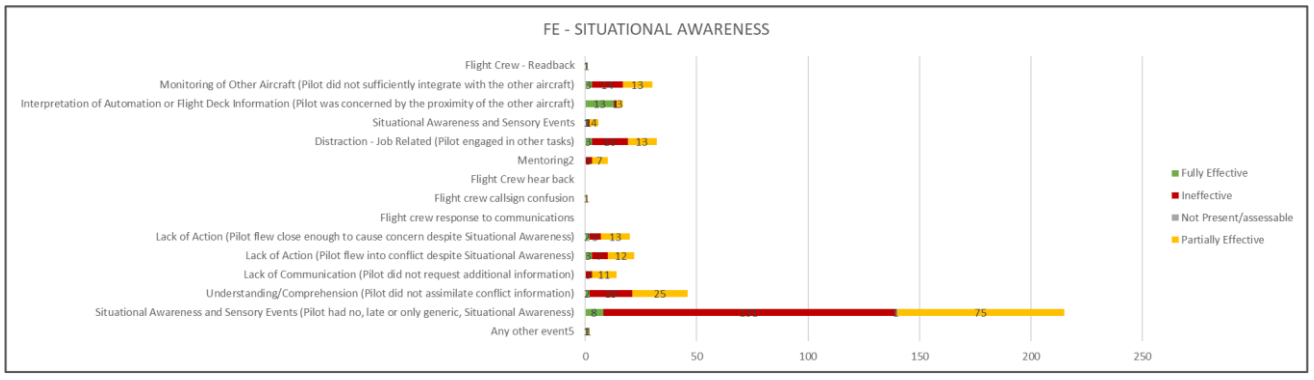

Figure 40: Flight Elements Situational Awareness – Contributory Factors with Barrier Performance – All Airprox

Airprox not involving GA

For the 52 Airprox not involving GA the Situational Awareness barrier was noticeably more effective at 40% (Figure 17), probably due to both the type of ATS that the pilot was receiving *and* that most non-GA aircraft carry some form of EWC.

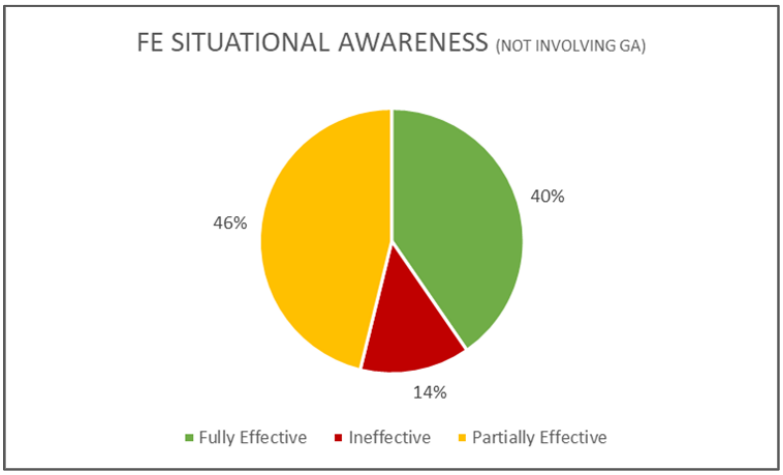

Figure 41: Flight Elements Situational Awareness –All Airprox (Risk Bearing)

This is reflected in the different top CFs attributed (Figure 42) in that no or generic situational awareness was cited in only 28% of Airprox. There followed 4 CFs each attributed 8 times (12%): job related distraction; the pilot not assimilating the situational awareness; the pilot was concerned by the proximity of the other aircraft, and lack of action (where the pilot flew close enough to cause concern despite situational awareness), this particular CF was normally attributed when the pilot had some situational awareness about the other aircraft but continued on track without making any adjustment to their flight. often because the pilots themselves did not view that any action was necessary. Finally, the 5th most common CF was where the pilots were concerned by the proximity of the other aircraft.

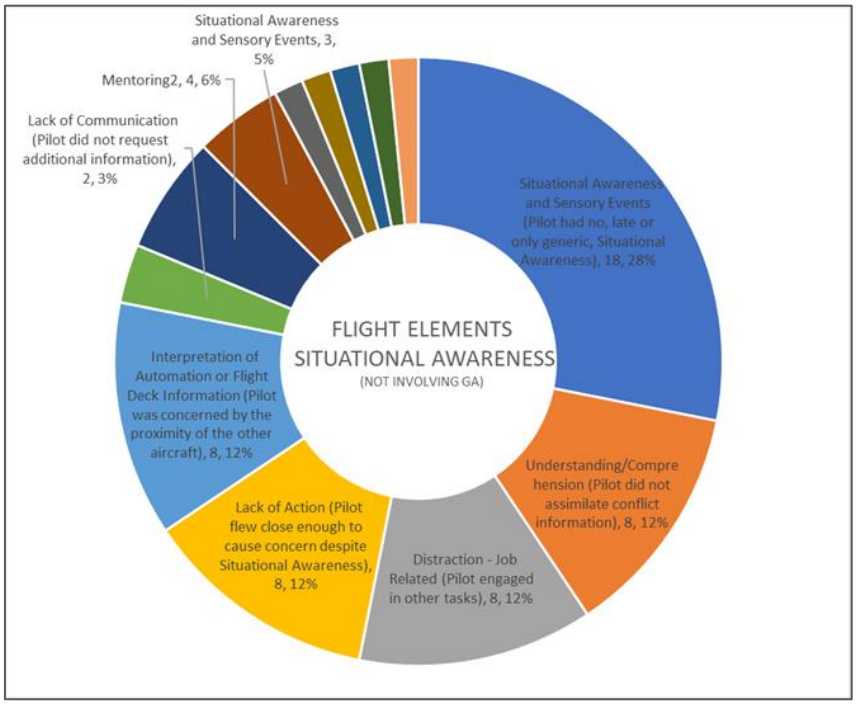

Figure 42: Ground Elements Situational Awareness –Airprox NOT Involving GA

FLIGHT ELEMENTS SITUATIONAL AWARENESS –AIRPROX NOT INVOLVING GA	
Situational Awareness and Sensory Events (Pilot had no, late or only generic, Situational Awareness)	18(28%)
Understanding/Comprehension (Pilot did not assimilate conflict information)	8(12%)
Distraction - Job Related (Pilot engaged in other tasks)	8(12%)
Lack of Action (Pilot flew close enough to cause concern despite Situational Awareness)	8(12%)
Interpretation of Automation or Flight Deck Information (Pilot was concerned by the proximity of the other ac)	8(12%)

Table 12 : Flight Elements Situational Awareness – All Airprox

Airprox Involving Mil

For all Airprox involving military aircraft (81 Airprox), the barrier was more effective than for GA only, but less than the dataset that included CAT and Civ Comm, nevertheless it was still partially effective 45% of the time and ineffective 35%.

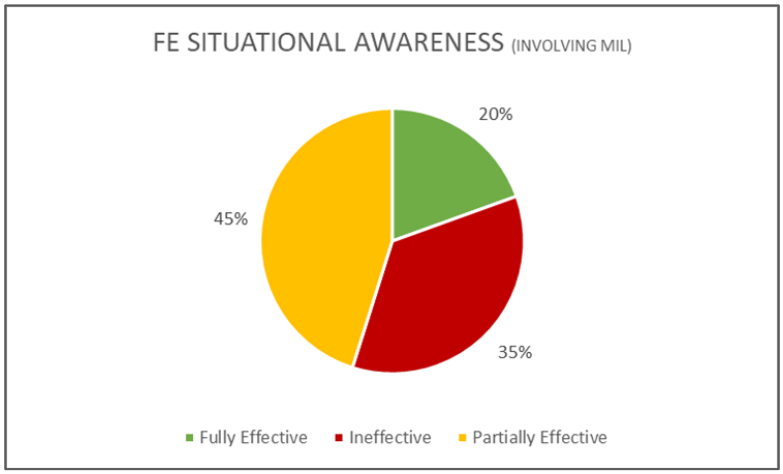

Figure 43: Flight Elements Situational Awareness –Airprox Involving Mil

However, when looking at risk A/B Airprox only, the barrier became fully effective for only 5% of Airprox and increased to ineffective for 55%.

When looking at solely military to military Airprox (Figure 21) the barriers changed again to being partially effective for 67% of Airprox, reflecting that military pilots usually had some prior information, even if only generic, either from ATC, from hearing the other aircraft on frequency, or from EC.

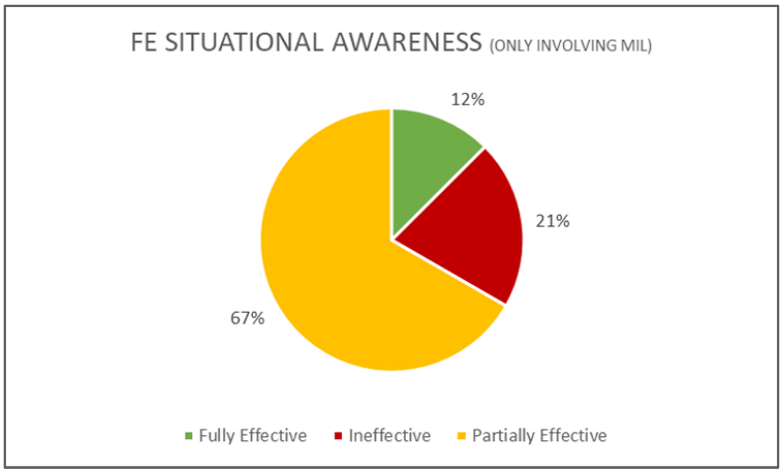

Figure 44: Flight Elements Situational Awareness –Airprox ONLY Involving Mil

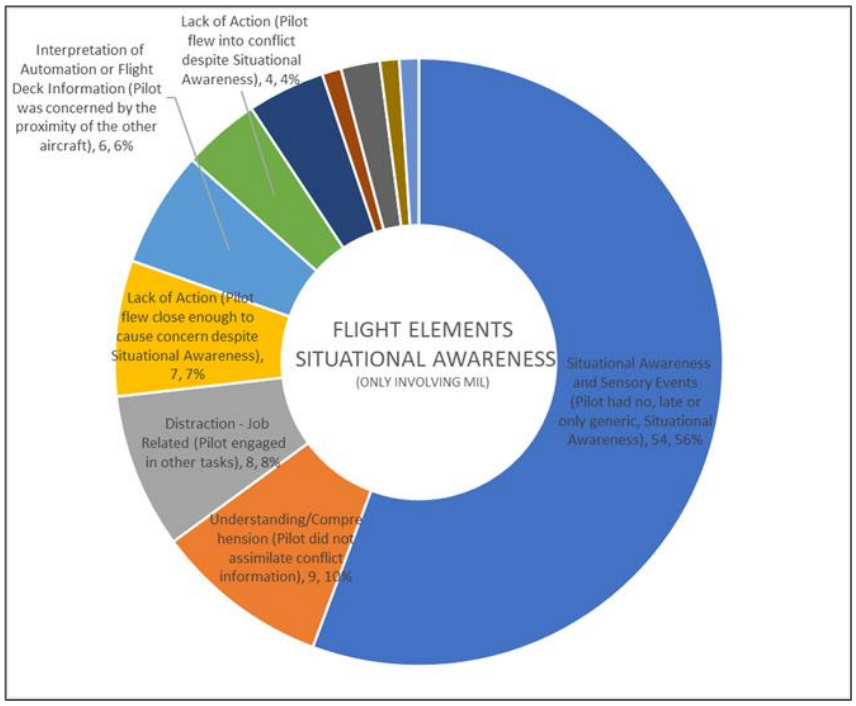

Figure 45: Ground Elements Situational Awareness –Airprox ONLY Involving Mil

Turning to the CF in the Airprox only involving Military aircraft (Figure 45), in 56% of Airprox it was assessed that the pilot had no, late, or only ha generic situational awareness, this contributory factor occurred 54 times and was the main contributory factor by some margin. Unfortunately, the barrier does not differentiate between the pilot having no SA and having late or generic SA, but as the barrier was considered to have been effective or partially effective more times than not, it could be assumed that a large portion of these times would have been late or generic information.

The next most frequent contributory factor was the pilot not assimilating the conflict information. In 8% of Airprox distraction was a factor, again job-related. The Contributory Factor 'Interpretation of flight deck information' was given on 6 occasions, this factor was usually assigned by the Board when a pilot perceived that the other aircraft was in close proximity due to information provided by on-board equipment, and all 6 of these Airprox were assessed as non-risk bearing (Categories C or E). When looking at the military-to-military Airprox (Figure 23) the top two CF, were the same as for all Airprox involving military, however, lack of action was third, attributed 7 times.

FLIGHT ELEMENTS SITUATIONAL AWARENESS –AIRPROX ONLY INVOLVING MIL	
Situational Awareness and Sensory Events (Pilot had no, late or only generic, Situational Awareness)	54(56%)
Understanding/Comprehension (Pilot did not assimilate conflict information)	9(10%)
Distraction - Job Related (Pilot engaged in other tasks)	8(8%)
Lack of Action (Pilot flew close enough to cause concern despite Situational Awareness)	7(7%)
Interpretation of Automation or Flight Deck Information (Pilot was concerned by the proximity of the other aircraft)	6(6%)

Table 13 : Flight Elements Situational Awareness –Airprox ONLY Involving Mil

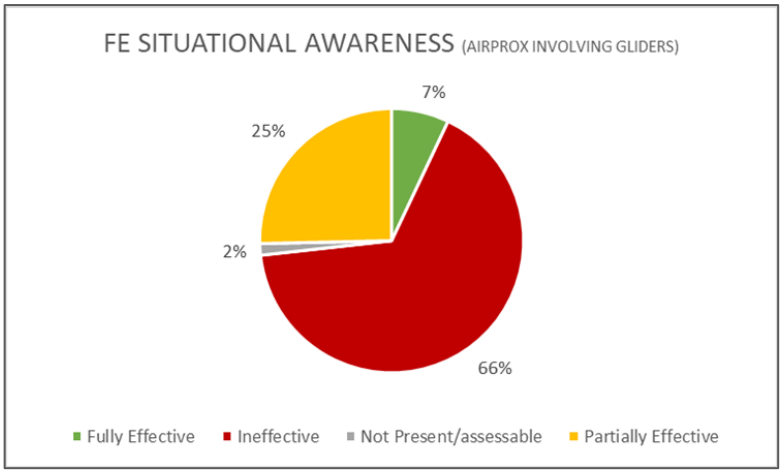

Figure 46: Flight Elements Situational Awareness –Airprox Involving Mil

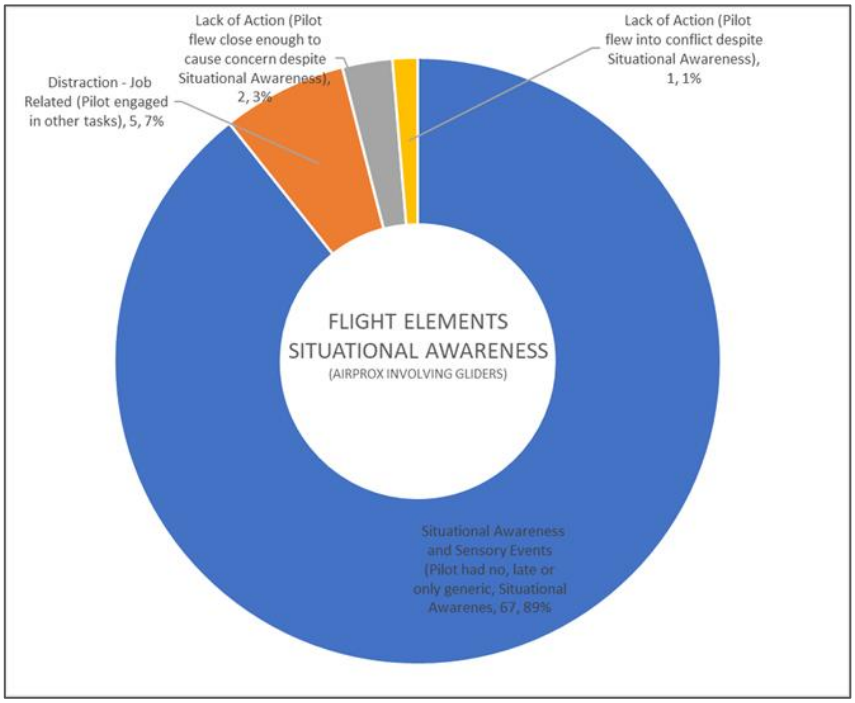

Figure 47: Ground Elements Situational Awareness –Airprox ONLY Involving Mil

Finally, it is worth briefly examining the Performance of the barrier when a glider is involved. For Airprox involving gliders the barrier was ineffective 67% of the time and only effective in 7% of cases. As we will see later, this sector subset of Airprox also elicits the worst performance in the Electronic Warning System barrier. This can be attributed to the fact that glider pilots rarely employ an ATS, and the fact that powered aircraft who come into proximity with gliders in the vicinity of a glider site generally do not communicate with that glider site – even though they are perfectly capable of doing so. This results in neither pilot, ATS or Glider control site having any specific situational awareness of other traffic in the vicinity. In addition, although gliders are *almost always* fitted with an EC device, that device is generally incompatible with the preferred solution of other sectors. As a result, in 89% of the cases involving gliders the CF of No late or generic situational awareness was assigned by the board.

FLIGHT ELEMENTS SITUATIONAL AWARENESS –AIRPROX INVOLVING GLIDERS	
Situational Awareness and Sensory Events (Pilot had no, late or only generic, Situational Awareness)	67(89%)
Distraction - Job Related (Pilot engaged in other tasks)	5(7%)
Lack of Action (Pilot flew close enough to cause concern despite Situational Awareness)	2(3%)
Lack of Action (Pilot flew into conflict despite Situational Awareness)	1(1%)

Table 14 : Flight Elements Situational Awareness – All Airprox Involving Gliders

Situational Awareness Ground and Air Interactions

- When the Ground Elements Situational Awareness barrier was assessed as **not used**, i.e. when the ANS provider was not required to monitor the flight, the Flight Elements Situational Awareness barrier was subsequently judged to be either ineffective, or only partially effective *in all but 7 Airprox*.

- When the Ground Elements Situational Awareness barrier was assessed as **not present/unassessable** the Flight Elements Situational Awareness barrier was assessed as ineffective or only partially effective *in all but 1 Airprox*.

- On the 137 occasions where the pilot was either operating without an ATS or was utilising an ATS where the controller was not required to monitor, the pilot had full situational awareness *on only 8 occasions.*

- When the Ground Elements Situational Awareness barrier was assessed as **ineffective** the Flight Elements Situational Awareness barrier was also assessed as *ineffective, or partially ineffective 85% of the time*.

- When the Flight Elements Situational Awareness barrier was assessed as **fully effective** the controller also had either *full or partial situational awareness 71% of the time*.

> Requesting and actively engaging with a ATS where the controller monitors the flight is key to maintaining situational awareness in the air.

The following table summarises the areas which, if addressed, will significantly improve the performance of these two barriers.

SECTOR	Focus Areas (Situational Awareness)
All Sectors	Proactive use of a surveillance based ATS
	Assimilation of conflict information
	Minimising in-cockpit and Ground Elements Distraction

Table 15 : Flight Elements Tactical Planning and Execution – Focus Areas

TACTICAL PLANNING AND EXECUTION BARRIER

The Tactical Planning and Execution barrier involves both pre-flight and in-flight planning, plan adaption, communication and execution and it is available to be used in all Airprox environments. It also forms a fundamental and intrinsic part of Threat and Error Management and should be diligently undertaken prior to every flight. This barrier is primarily concerned with doing everything possible on the ground to release capacity in the air which then enables accurate and effective execution of the task and comprehensive communication with ground agencies and other air users. As such it should be the easiest barrier for pilots to address. It is, however the barrier most susceptible to human performance driven errors – especially those routed in inexperience.

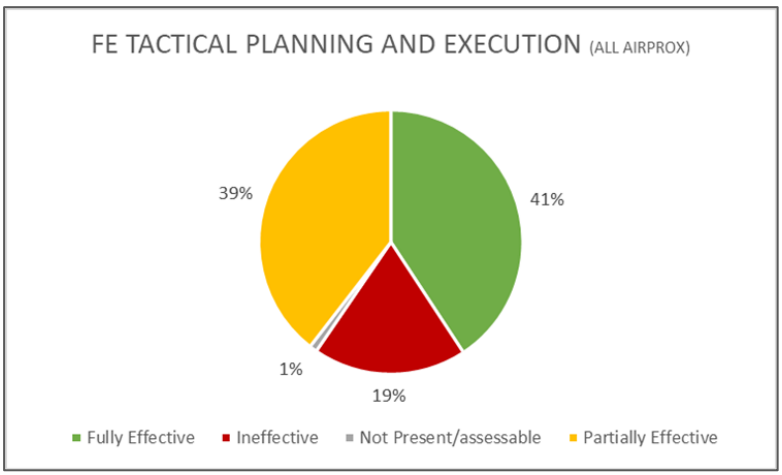

Figure 48: Flight Elements Tactical Planning and Execution – All Airprox

Although the Tactical Planning and Execution barrier is available to be utilised in all Airprox situations it was assessed as not present or not assessable on 3 occasions, meaning there was insufficient information available to the Board for an objective assessment to be made.

The barrier was partially effective for 39% of all reported Airprox and ineffective for 19% of reported Airprox, meaning that the barrier was not fully functional for 58% of all Airprox reported in 2019 and 2020.

The Tactical Planning and Execution barrier performance varies little between sector, apart from when one considers Airprox involving Gliders and Airprox involving Military aircraft. For both sectors the barrier performed significantly better than for all Airprox and for both sectors it attracted slightly different CF when it was deemed ineffective or only partially effective. Also, and as described in the previous section, the influence of this barrier on the outcome of an Airprox is lower than that of the other barriers – I believe that this is a result of the composition of this barrier – which is primarily influenced by human performance which is a function of experience, recency and currency. Although the order of the CF does not change much, concentrating on the most prevalent will point to the most valuable area to focus attention for each sector.

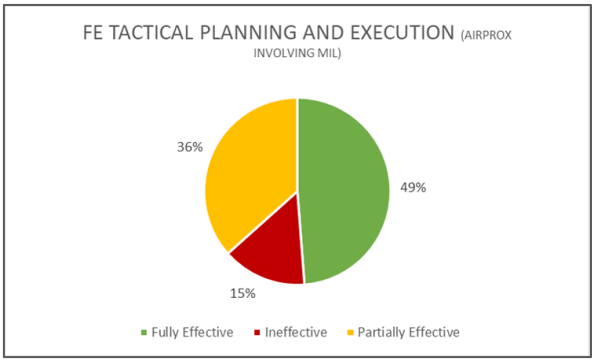

Figure 49: Flight Elements Tactical Planning and Execution – All Airprox

Figure 50: Flight Elements Tactical Planning and Execution - Airprox Involving Gliders

Contributory Factors All Airprox

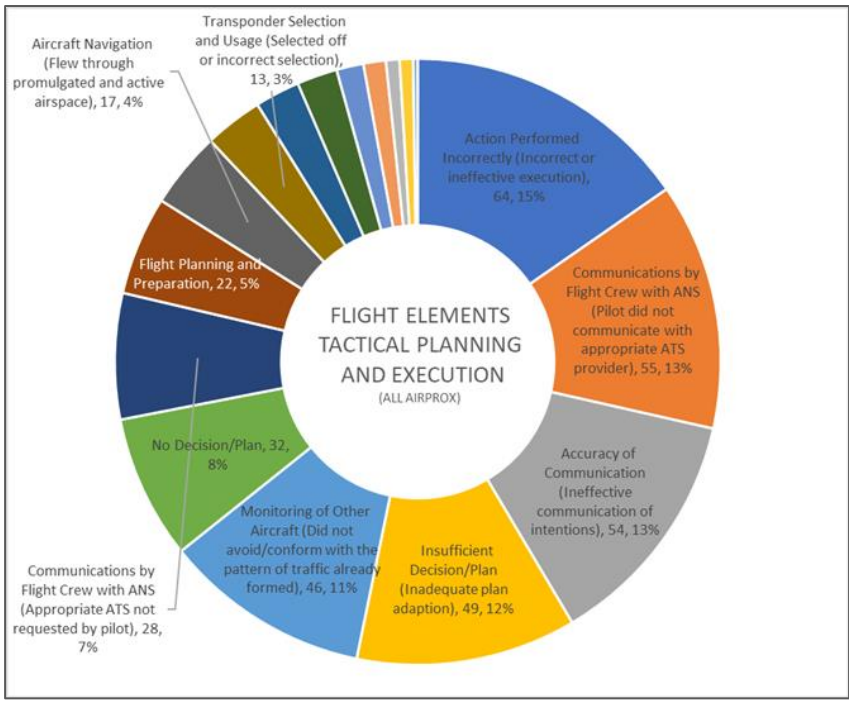

Figure 51: Ground Elements Situational Awareness –Airprox ONLY Involving Mil

When examining All Airprox, the most prevalent CF was concerned with the execution of the task which was a factor in 64 (15%) of the Airprox. This was closely followed by areas concerning communication, (both in selection of the most appropriate ATS provider and in the accuracy of the communication), plan adaption (where one or both of the parties did not effectively alter their plan to cater for a changing scenario) and finally, a failure to execute an action effectively, specifically a failure to integrate with the pattern of traffic already formed in a circuit environment.

The first and this last CF are almost exclusively in relation to Airprox involving GA and the latter, specifically reflecting flight in and around ATZs or attempting to join or operate in a circuit. The 'communicate' factors are a mixture of either not communicating with the correct agency, not requesting an adequate service for the type of flight, or not providing accurate information which often result in flawed situational awareness for other airspace users.

TACTICAL PLANING AND EXECUTION – ALL AIRPROX	
Action Performed Incorrectly (Incorrect or ineffective execution)	64(15%)
Communications by Flight Crew with ANS (Pilot did not communicate with appropriate ATS provider)	55(13%)
Accuracy of Communication (Ineffective communication of intentions)	54(13%)
Insufficient Decision/Plan (Inadequate plan adaption)	49(12%)
Monitoring of Other Aircraft (Did not avoid/conform with the pattern of traffic already formed)	46(11%)

Table 16 : Flight Elements Situational Awareness – All Airprox

Figure 52 shows the CF within this barrier for all Airprox and the performance of the barrier associated with their collection

Figure 52: Flight Elements Tactical Planning and Execution – Contributory Factors with Barrier Performance – All Airprox

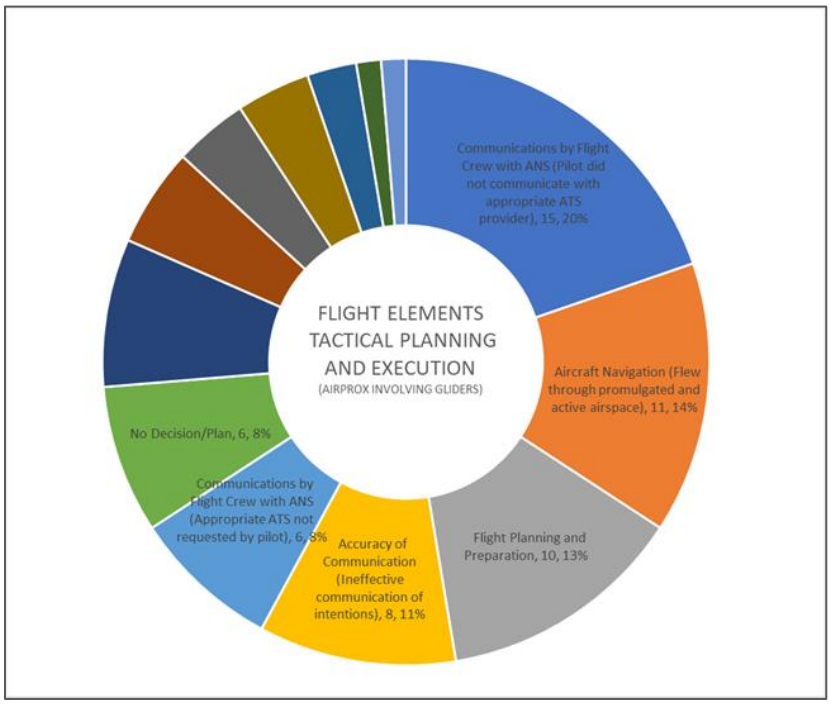

Figure 53: Ground Elements Situational Awareness –Airprox Involving Gliders

Turning to the factors that affected Airprox that involved gliders it should be first noted that the top 3 CFs assigned to this barrier concern Communication, Navigation and planning and are primarily assigned to the (normally) Powered aircraft which *conflict* with the glider whereby they have chosen to plan to fly too close to promulgated and active glider sites (sometimes directly over *and/or* below the winch launch altitude) and have not chosen to communicate with that glider site. The other 2 CF (also concerning communication) are relatively evenly split between both involved aircraft.

TACTICAL PLANING AND EXECUTION – AIRPROX INVOLVING GLIDERS	
Communications by Flight Crew with ANS (Pilot did not communicate with appropriate ATS provider)	15(20%)
Aircraft Navigation (Flew through promulgated and active airspace)	11(14%)
Flight Planning and Preparation	10(13%)
Accuracy of Communication (Ineffective communication of intentions)	8(11%)
Communications by Flight Crew with ANS (Appropriate ATS not requested by pilot)	6(8%)

Table 17 : Flight Elements Situational Awareness – All Airprox

Aircraft Navigation – where the (normally) powered other aircraft involved flew too close to, or through promulgated and active glider sites and sometimes at or below advertised winch launch altitudes – is a key factor in Airprox involving gliders

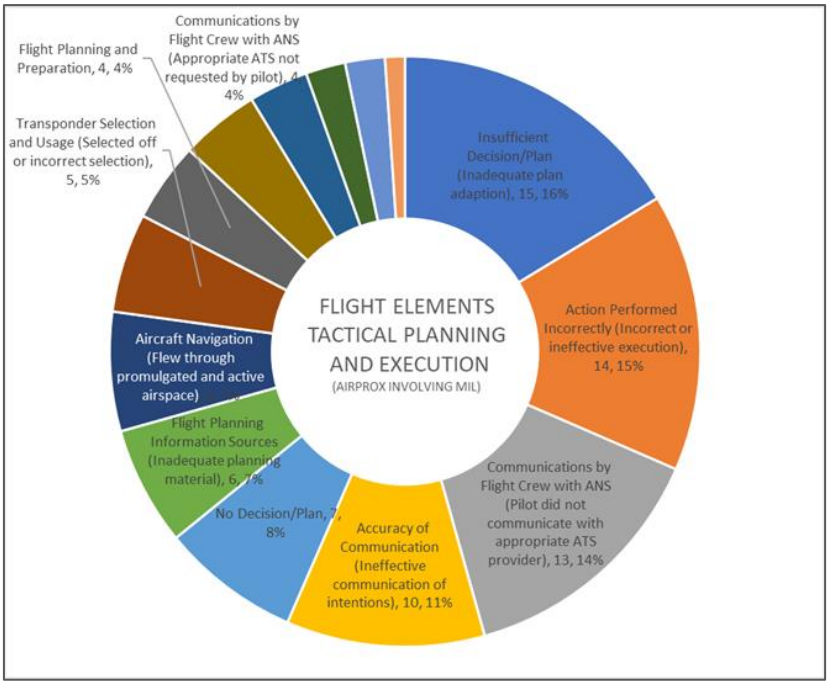

Figure 54: Ground Elements Situational Awareness –Airprox Involving Mil

Finally, turning to Airprox involving Military aircraft. The most frequently collected CF was concerning planning and plan adaption. This is not to say that military pilots do not plan effectively – it merely refers to the fact that when an Airprox involves a military aircraft, planning has featured more frequently than any other CF.

TACTICAL PLANING AND EXECUTION – AIRPROX INVOLVING MIL	
Insufficient Decision/Plan (Inadequate plan adaption)	15(16%)
Action Performed Incorrectly (Incorrect or ineffective execution)	14(15%)
Communications by Flight Crew with ANS (Pilot did not communicate with appropriate ATS provider)	13(14%)
Accuracy of Communication (Ineffective communication of intentions)	10(11%)
No Decision/Plan	7(8%)

Table 18 : Flight Elements Situational Awareness – Airprox Involving Mil

The following table summarises the areas which, if addressed, will significantly improve the performance of this barrier.

SECTOR	Focus Areas (Tactical Planning and Execution)
Primarily GA community	Correct execution of a manoeuvre or procedure
	Navigation
	Integration with established traffic patterns
All Sectors	Planning and preparation
	Communication with an appropriate ATS
	Selection of the most appropriate ATS

Table 19 : Flight Elements Tactical Planning and Execution – Focus Areas

ELECTRONIC WARNING SYSTEMS BARRIER

The Electronic Warning Systems barrier is available for use in all Airprox and indeed forms a key element in the safety barrier system. Like the Tactical Planning and Execution barrier, it contributes to both the Ground and Flight Elements Situational Awareness barrier, but also contributes to the See and Avoid barrier (through guiding visual acquisition) and additionally to the Ground Elements Electronic Warning Systems barrier. This barrier is slightly different from the others in that it is independent to a very large degree of human factors: a system is either fitted (appropriately) or it is not. Of course, its efficacy also depends on the geometry of the Airprox and the familiarity of the user with their equipment (amongst other factors), however these factors feature less than the presence of Electronic Conspicuity (EC) or its compatibility.

Electronic Conspicuity is the generic term used to describe the concept of collision warning systems and other conspicuity devices (e.g. transponders) which are enabled by the transmission and detection of RF signals between aircraft. Each aircraft becomes 'electronically conspicuous' by transmitting a signal containing information such as position, altitude and speed, which can be received and processed by suitable equipment in another aircraft to provide a timely warning of converging flight paths. In theory, this allows for a more robust barrier to Airprox (and MAC) than that provided by the See and Avoid barrier because it is not subject to the many factors that reduce the effectiveness of human lookout and influence perception. Modern systems are also light weight, have low power requirements and are not expensive when compared to total operating cost. As such, EC is attractive as a means to provide additional mitigation against MAC, especially in uncontrolled airspace were a surveillance-based information service may not be available or used.

EC has been mandated for many years in the CAT sector in the form of the Traffic Collision Avoidance System (TCAS) and is used in the gliding, GA and Civ_Comm sectors with such products as Flight Alarm (FLARM), Pilot Aware, SkyEcho, and Power FLARM which are (amongst many others) available from major avionics developers. These systems are generally characterised by the standard to which they are certified, if at all. For example, TCAS is required to operate to a minimum detection standard, which it does using a frequency that is protected from interference by other activities. Other systems may have certified components (typically the GPS) but may not have a minimum detection standard. In addition, they may operate on a publicly available part of the electromagnetic spectrum and hence do not have the same frequency protection as TCAS. The cost of installing and maintaining TCAS is many orders of magnitude greater than that of the other systems and its use is generally limited to CAT, other commercial operations and some military aircraft. Experience has shown that the effectiveness of non-TCAS systems is sufficient to justify installation, despite not being certified to the same standards. However, without EC equipment there can be no EC mitigation to MAC and, despite their effectiveness, the degree of non-mandated uptake is still relatively poor, for example EC is not present or assessable in over 50% of risk bearing Airprox involving GA.

Each system's RF signal contains information that allows the receiving aircraft's equipment to calculate future flight paths and hence closure and minimum separation. If this is less than a predetermined value an alarm is issued, which can include avoidance advice (TCAS RA) or simply the range and bearing of the other aircraft in order to facilitate visual acquisition and subsequent 'see-and-avoid' action. For non-TCAS devices, there is no standard protocol to format the RF signal information which can therefore vary between device manufacturers which in turn can lead to issues of incompatibility between equipment and consequent non-detection. UKAB data shows that incompatible EC was a contributory factor in 46% of all risk bearing Airprox and that it was not a contributory factor in any risk bearing Airprox involving CAT aircraft. This can be directly attributed to a mandated common standard for CAT but no such common standard otherwise. 'In August 2017 the Civil Aviation Authority confirmed that ADS-B using 1090 MHz is its preferred national system to improve EC for general aviation'[4], however, 'The DfT and CAA are not recommending any specific device to pilots but do recommend that all pilots understand and consider the functional benefits, and

[4] AIC Y 141/2019

limitations, of any EC device so they make informed decisions on the level of reliance that can be placed on the information provided to them.'[5]. When a common system *is* mandated, such as in the UK military, the contrast is stark: there were no risk bearing military Airprox with incompatible EC as a contributory factor and that EC was fully or partially effective in 57% of cases, as opposed to 12% of cases in risk bearing GA Airprox with no common mandated system.

An alert of proximate traffic is dependent on a number of factors. Compatible equipment and RF signal protocols have already been mentioned. Assuming those items are compatible, signal reception becomes the dominant factor. This is dependent upon signal strength and polarisation at the receiving aerial, which is a product of aerial installation. Single aerial systems may blank a signal from another aircraft by dint of the receiving aircraft's structure, e.g. an aircraft converging from below may not be detected if an aerial has been installed on the upper fuselage of the other aircraft. In other words, detection between mutually compatible systems is by no means guaranteed. Indeed, Airprox data shows that 18% of EC systems did not alert as expected in risk bearing GA Airprox. This figure is almost identical (17%) to that found in risk bearing military Airprox, where EC compatibility is mandated. Hence the issue of not alerting when expected seems to be independent of any particular system.

> This 1 in 5 probability of not alerting when expected emphasises that EC is not a panacea for avoidance of MAC and that it exists solely as a complement to existing MAC mitigations, the most important of which is see-and-avoid.

The essential parts of an effective EC environment are uptake, compatibility and effectiveness. Uptake is either mandated or incentivised and in the absence of a GA mandate, has been incentivised by a DfT grant of funds to subsidise EC equipment purchase. However, this incentivisation has potentially been undermined by the lack of a common standard for EC equipment. Commercially competing companies have produced their own solutions which, by their incompatibility, reduce the effectiveness of EC overall. Even if an EC protocol is mandated, the gliding aviation sector in particular has been operating using its own EC standard, FLARM, for some time. FLARM is not suitable as a MAC mitigation for traffic faster than gliders and the threat of imposition of a new standard would be met with understandable resistance by a sizeable sector of the aviation community.

The best way of demonstrating the effect of EC on the Electronic Warning Systems barrier is to look at 3 areas: All Airprox, Airprox not involving GA and Airprox involving gliders. These 3 combinations describe the full range of Airprox interactions and are used to demonstrate the EWS or EC tapestry so that individuals are aware of the fallibility of this barrier and are aware of sectors with whom they may be incompatible with so that they can make informed choices.

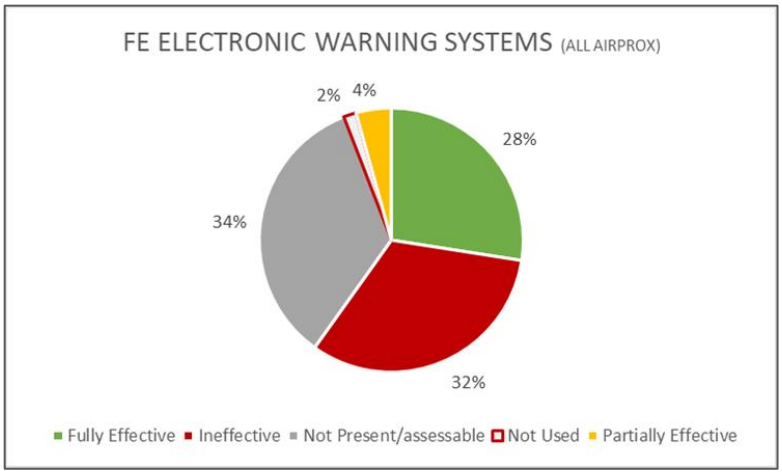

Figure 55: Flight Elements Electronic Warning Systems – All Airprox

The EWS barrier is either ineffective, not present/not assessable or not used 68% of the time when considering All Airprox and 87% of the time when considering all Airprox which involve GA or unknown/untraced aircraft. When the barrier is ineffective it is almost exclusively because of equipment incompatibility. This is demonstrated clearly in Figure 57.

[5] https://www.caa.co.uk/General-aviation/Aircraft-ownership-and-maintenance/Electronic-Conspicuity-devices/

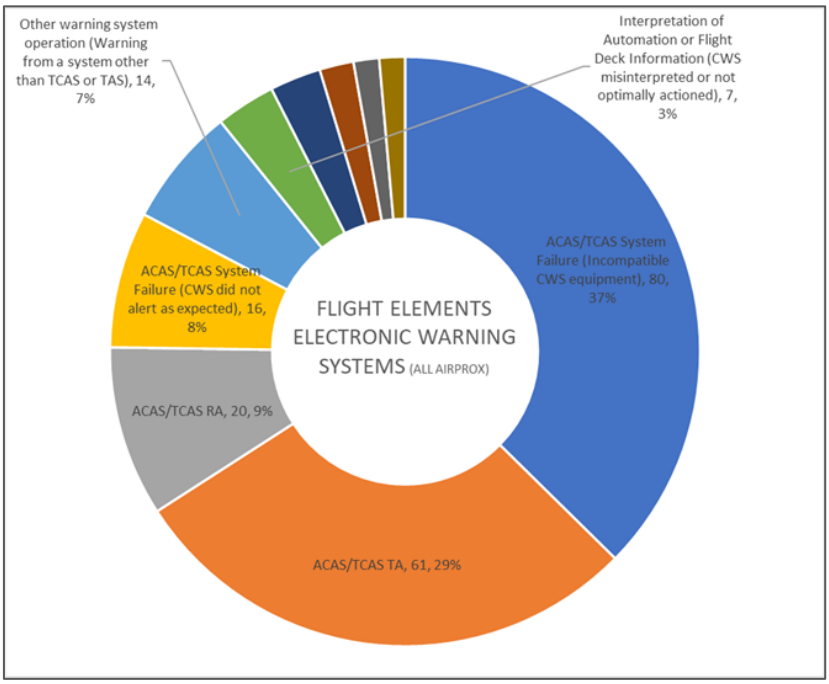

Figure 56: Flight Elements Electronic Warning Systems – All Airprox

Figure 57 shows the CF within this barrier for all Airprox and the performance of the barrier associated with their collection.

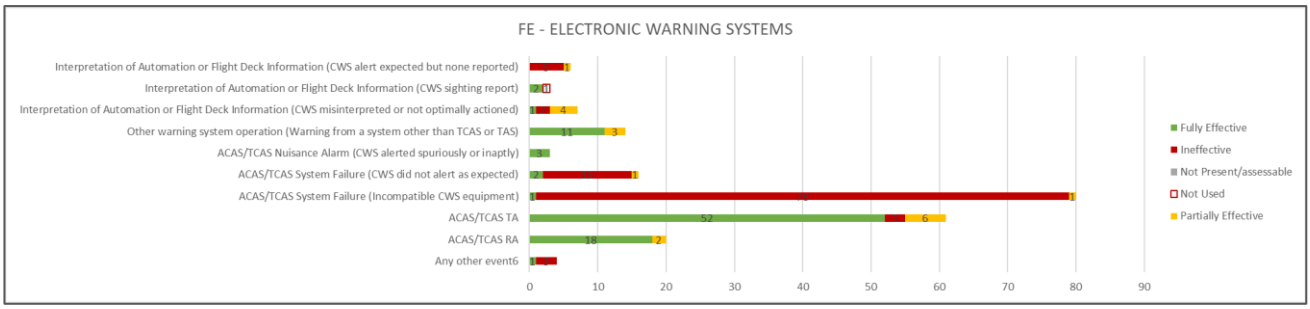

Figure 57: Flight Elements Electronic Warning Systems – Contributory Factors with Barrier Performance – All Airprox

The following set of charts describe the performance and behaviours of this barrier with those Airprox involving Gliders and those Airprox not involving GA. With Airprox involving gliders the barrier is only effective 4% of the time. Not present in either aircraft 23% of the time, and ineffective 73% of the time. Note: for this barrier to be ineffective it must be present (in some form) in one or both of the aircraft.

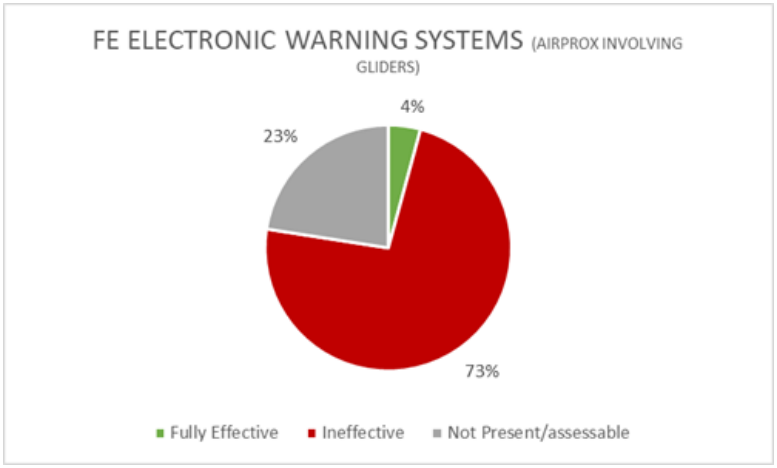

Figure 58: Flight Elements Electronic Warning Systems – Airprox Involving Gliders

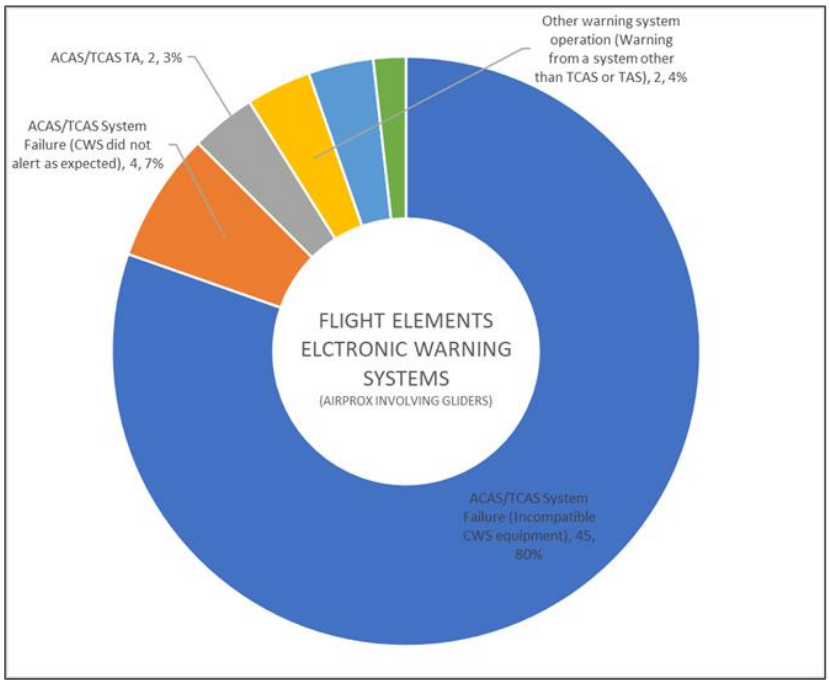

Figure 59: Flight Elements Electronic Warning Systems – Airprox Involving Gliders

With these Airprox, where this barrier is ineffective, for 80% the time it is as a result of incompatible EC.

Please note that this is simply an observation based on collected data from Airprox and is highlighted simply to raise awareness of an area where compatibility considerations may feature significantly.

When the GA sports and recreational community is excluded – i.e. we are only examining CAT, Civ Comm, Military and Emergency services (Figure 60) this barrier is proven to be most effective and, in fact 88% of the time (Airprox not involving GA) an Effective EWS barrier results in a Category E or at worst Category C event.

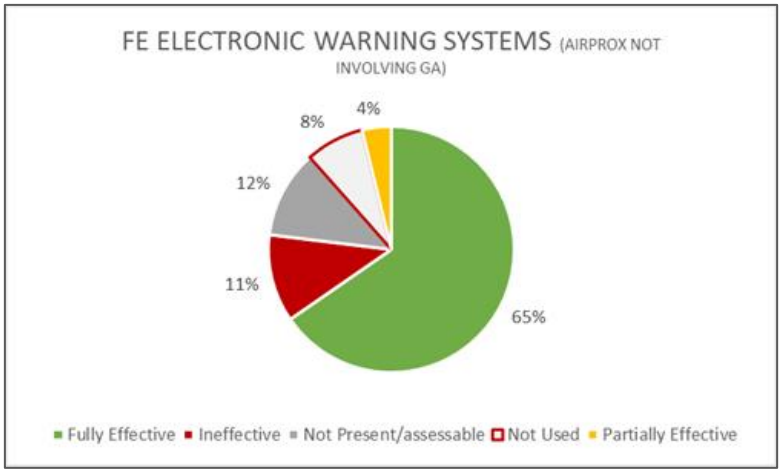

Figure 60: Flight Elements Electronic Warning Systems – Airprox NOT Involving GA

ELECTRONIC WARNING SYSTEMS – ALL AIRPROX	
ACAS/TCAS System Failure (Incompatible CWS equipment)	80(37%)
ACAS/TCAS TA	61(29%)
ACAS/TCAS RA	20(9%)
ACAS/TCAS System Failure (CWS did not alert as expected)	16(8%)
Other warning system operation (Warning from a system other than TCAS or TAS)	14(7%)

Table 20 : Flight Elements Electronic Warning Systems – All Airprox

With the Electronic Warning Systems barrier being so binary in nature, there is the need to address one area in particular in order to significantly increase the performance of this barrier

SECTOR	Focus Areas (Electronic Warning Systems)
All Sectors but especially the GA community	Understanding of the limitations of and the compatibility challenges of the different available electronic warning systems and other EC equipment.

Table 21 : Flight Elements Tactical Planning and Execution – Focus Areas

See and Avoid Barrier

The See and Avoid barrier, according to the conceptual model presented at figure 20 can be considered to be the last barrier to a serious Airprox – however it should be noted that barrier interactions are rarely consecutive in nature and any one of them can be in play at any one time. Additionally, the influence of this barrier overrides the performance of any of the others. Where the See and Avoid barrier was **fully effective, the result of the encounter was either a category C, D or E event in 98.5% of those Airprox.**

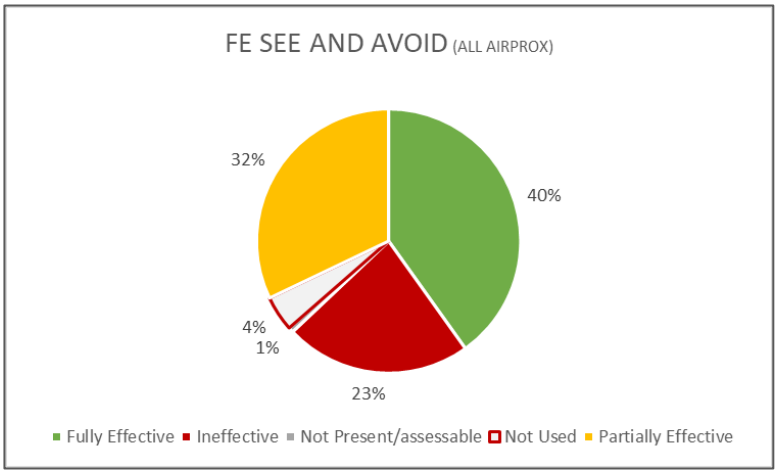

Figure 61: Flight Elements See and Avoid – All Airprox

The See and Avoid Barrier is available to be utilised in almost all Airprox. On those occasions where it was assessed that this barrier was 'not used' (14), 5 Airprox involved aircraft that were not proximate, 4 involved aircraft that were IMC, in 3 cases TCAS had already commanded a manoeuvre, in one case the pilots were already responding to controller's instructions to resolve the conflict and in another case the pilot was following a briefed deconfliction manoeuvre; in these latter 2 scenarios the See and Avoid barrier was redundant. In 2 other Airprox, the barrier was unassessable due to a paucity of available information (untraced aircraft). As this barrier is rather binary in its function it is more useful to examine the underpinning CF which contribute to the weakening of this barrier. Certain CF have been excluded from this analysis because they describe outcomes rather than factors contributing to the Airprox; those excluded are as follows: Note: These have been designated into an 'Outcome' category for 2021.

EXCLUDED CFs from the See and Avoid Barrier (Outcomes)
Loss of Separation – A conflict in the FIR
Near Airborne Collision with a Piloted Air Vehicle.
Near Airborne Collision with Other Airborne Object.
Near Airborne Collision with RPAS.
Other warning system operation (Warning from a system other than TCAS or TAS)

Table 22 : Flight Elements See and Avoid barrier – Excluded Contributory Factors

Figure 62 shows the CF within this barrier for all Airprox and the performance of the barrier associated with their collection

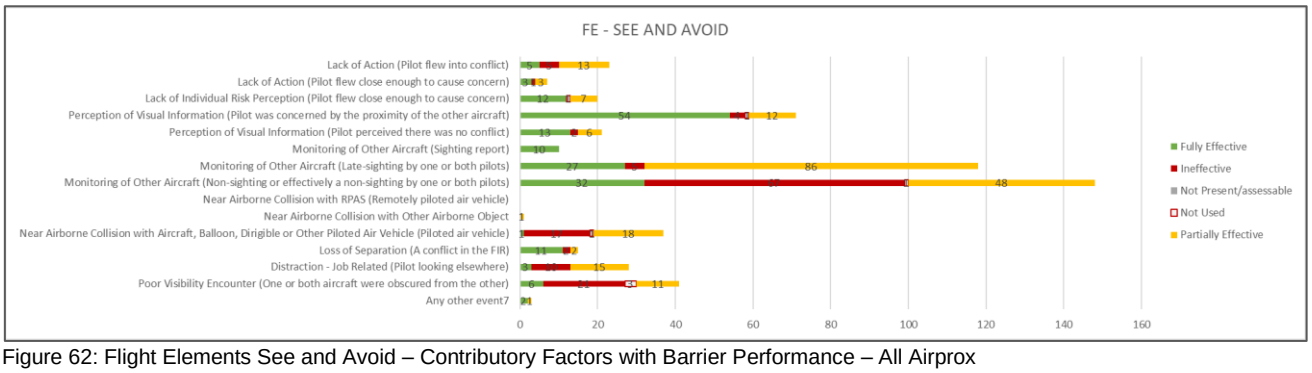

Figure 62: Flight Elements See and Avoid – Contributory Factors with Barrier Performance – All Airprox

On examination of the Associated CF for All Airprox, it is the case that the 2 most frequently assigned are generally a function of a of a risk bearing event with the 3rd being pilots' perception of visual information (pilot was concerned by the proximity) This CF is normally assigned in association with a non-risk bearing event (Category C) where startle factor has played a role. In 8% and 6% of the cases, Obscuration and distraction feature. These 2 CFs represent easy areas to address, where pilots can improve the effectiveness of this barrier simply by appreciating the configuration of the aircraft, accounting for potential areas of blanking and by breaking up any task which may require them to divert attention from outside the ac to inside their cockpit.

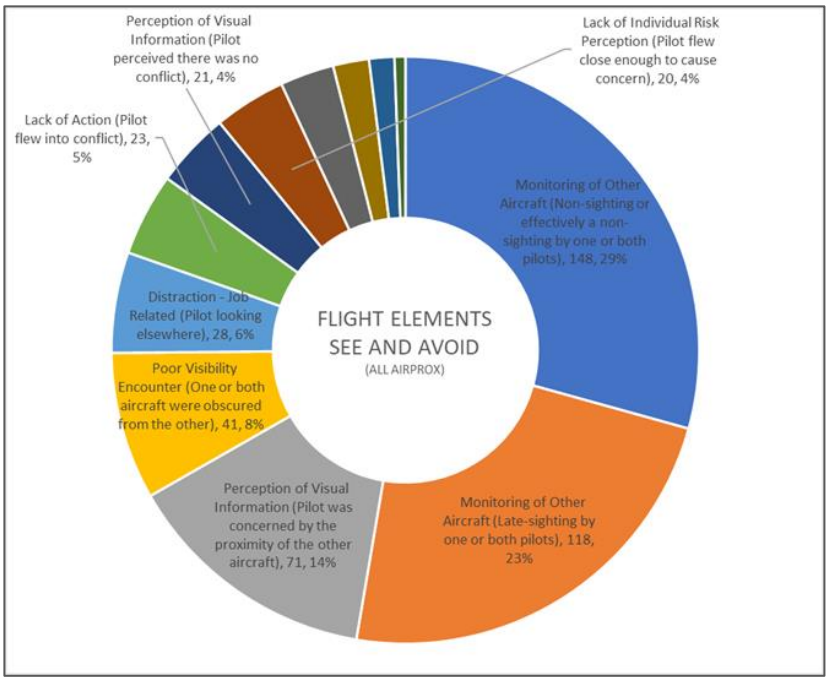

Figure 63: Flight Elements Electronic Warning Systems – Airprox Involving Gliders

Analysis of the relative performances of the Flight Elements Situational Awareness and See and Avoid barriers showed that when the Situational Awareness barrier was judged to have been fully effective, the See and Avoid barrier was assessed as ineffective on only 17% of occasions. Furthermore, when the See and Avoid barrier was assessed to have been ineffective, the Situational Awareness barrier had been fully effective in only 7% of Airprox. Put another way, this means that when pilots are forewarned of the *presence* of another aircraft, they are far more likely to sight the other aircraft in time to take action to increase separation (if required).

As stated, the third most significant factor affecting the efficacy of this barrier is 'pilot was concerned by the proximity of the other aircraft'. Whilst this could be considered to be more of an outcome than a factor contributing to barrier performance, it has been included because it occurs in 15% of all Airprox where the See and Avoid barrier has been available and employed. The Board assigns this contributory factor in those cases where an Airprox has been declared but, after analysis, there was deemed to be no risk of collision or where normal safety standards had pertained. This is not to say that lessons cannot be drawn from these encounters which add to the understanding of the contemporary operating environment.

SEE AND AVOID BARRIER – ALL AIRPROX	
Monitoring of Other Aircraft (Non-sighting or effectively a non-sighting by one or both pilots)	148 (29%)
Monitoring of Other Aircraft (Late-sighting by one or both pilots)	118(23%)
Perception of Visual Information (Pilot was concerned by the proximity of the other aircraft)	71 (14%)
Poor Visibility Encounter (One or both aircraft were obscured from the other)	41 (8%)
Distraction - Job Related (Pilot looking elsewhere)	28 (6%)

Table 23 : Flight Elements See and Avoid – All Airprox

When those events involving GA are removed the ineffectiveness of the barrier drops to just 12% and the partial effectiveness drops to 19% with the effectiveness rising to 54%, reflective of the fact that the vast majority (84 and 87% in 2019 and 2020 respectively) of all Airprox involve GA aircraft as do 90% of the risk bearing events. The increased effectiveness, or the reduced ineffectiveness in those occurrences which do not involve GA reflects the fact that most of these Airprox are classified as Category C or E events. There are a number of influencing factors in this, which include the wider use of on-board collision warning and alerting systems outside the GA sector and the more prevalent use of a surveillance-based ATS, both of which cue a pilot's lookout. Conversely it is entirely possible (but unusual) for all the other barriers to exhibit full or partial effectiveness, yet still a risk bearing Airprox occurs. Casting back to the charts in Figures 25-28 (relating to the influence of the Electronic Warning Systems and Situational Awareness barriers on the See and Avoid barrier), on 12 occasions the EWS barrier was fully effective and on 2 occasions the Situational Awareness barrier was fully effective (Figure 25), yet a risk bearing event still occurred implying that one cannot disregard the importance of maintaining an active and effective lookout to complement ones' situational awareness.

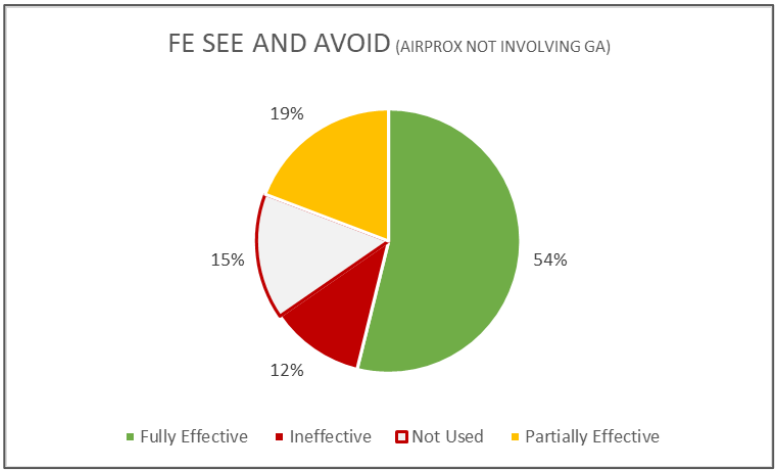

Figure 64: Flight Elements See and Avoid –Airprox NOT Involving GA

It is notable that, when Airprox involving GA are excluded from the statistics, the rate of attribution of the perception of visual information CF doubles to 30% (Figure 65). This would indicate that, in general, GA pilots are more comfortable being in closer proximity to other aircraft than non-GA pilots. It may also suggest possible under-reporting from the GA sector when compared to other sectors. Figures for Airprox involving military aircraft show an even split between late-sighting and 'pilot was concerned by the proximity' (both 21%); this could indicate that military pilots are more likely to report an Airprox even if their own assessment in the reporting is an evaluation of 'low risk'.

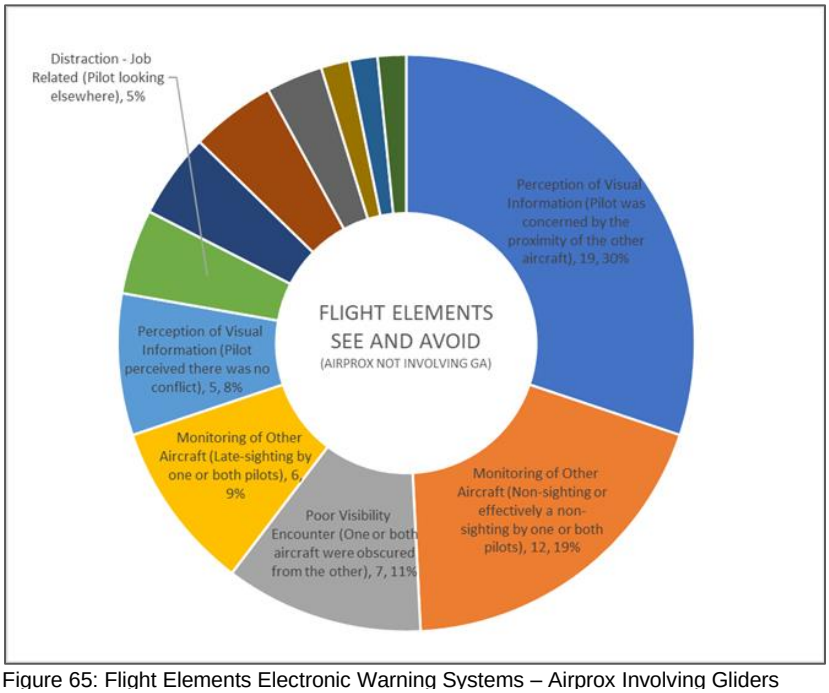

Figure 65: Flight Elements Electronic Warning Systems – Airprox Involving Gliders

SEE AND AVOID BARRIER –AIRPROX NOT INVOLVING GA	
Perception of Visual Information (Pilot was concerned by the proximity of the other aircraft)	19 (30%)
Monitoring of Other Aircraft (Non-sighting or effectively a non-sighting by one or both pilots)	12 (19%)
Poor Visibility Encounter (One or both aircraft were obscured from the other)	7 (11%)
Monitoring of Other Aircraft (Late-sighting by one or both pilots)	6 (9%)
Perception of Visual Information (Pilot perceived there was no conflict)	5 (8%)

Table 24 : Flight Elements See and Avoid – All Airprox

The last of the significant CF in the See and Avoid barrier concerns external influences which reduce the efficacy of this barrier: 'Poor Visibility Encounter – One or both aircraft were obscured from the other'. There were 41 instances of this factor contributing to an Airprox in 2019 and 2020. However, on 3 occasions the barrier was not used and on 6 occasions Board judged that the barrier had, nevertheless, been fully effective. Of the 32 Airprox where the barrier was judged to be either ineffective or partially effective, 22 of these were risk-bearing (Category A or B) with the barrier considered to be ineffective in 66% of the risk-bearing events. The most prevalent explanations for the obscuration were: Airprox geometry (e.g. aircraft approaching from behind - 6 instances; aircraft wing configuration (e.g. high wing aircraft, other aircraft above 5 instances; cockpit construction (e.g. pillar obscuring view - 5 instances, and; flying in, or close to, cloud (5 instances). In nearly three-quarters of these cases mitigations are available to pilots, such as actively moving the head to see around the cockpit structure, weaving or moving the aircraft in flight to eliminate blind spots and flying far enough away from the cloud structure to enable earlier sightings of other aircraft (and also affording the pilot of the other aircraft a greater chance of spotting them).

Although not included in this top 5 CF table, it is worthy to mention that on some occasions pilots seemed to have flown deliberately into conflict despite visually acquiring the other aircraft of the 23 occasions that this CF was assigned, 21 of them occurred with Airprox involving the GA community. Although small in number, flying discourtesy is a factor which can easily be addressed by individuals by adopting a little humility and consideration for others.

SECTOR	Focus Areas (See and Avoid)
All Sectors	Obscuration
	Maintaining an active and efficient lookout
Primarily GA	Distraction

Table 25 : Flight Elements See and Avoid – Focus Areas

FINAL COMMENTS

This report has presented the data collected for the Airprox which occurred in 2020. It has then used 2019 and 2020 data in an exploration of barrier performance and an examination of the underlying CF which drive the performance of the barriers. To do this I have devised and used a conceptual model of barrier interactions and demonstrated the positive and negative interdependencies of certain barriers using risk bearing and Category E events. I have highlighted the most frequent 5 CF for each sector (where there are differences) for each of the 5 weakest performing barriers and I have also highlighted generic areas which should be given specific consideration. Focussing attention on these areas will significantly affect the performance of the associated barrier.

Given the radical revision to the historic format of this report, I would welcome any constructive feedback that reader may wish to offer.

Rachael Caston

Director UKAB
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ADDITIONAL INFORMATION

The following section is additional data comprising of the following:

- A set of 5 charts for each sector where one can easily refer to the Sector mix, the altitude, the Airspace and the Risk distributions. These charts provide a quick access overview of the Airprox demographic:

SUAS	CAT Civ Comm	GA	Mil

- A summary of recommendations (2020 and 2019)
- The 2020 Airprox Catalogue including Links to specific reports.

SUAS SECTOR MIX

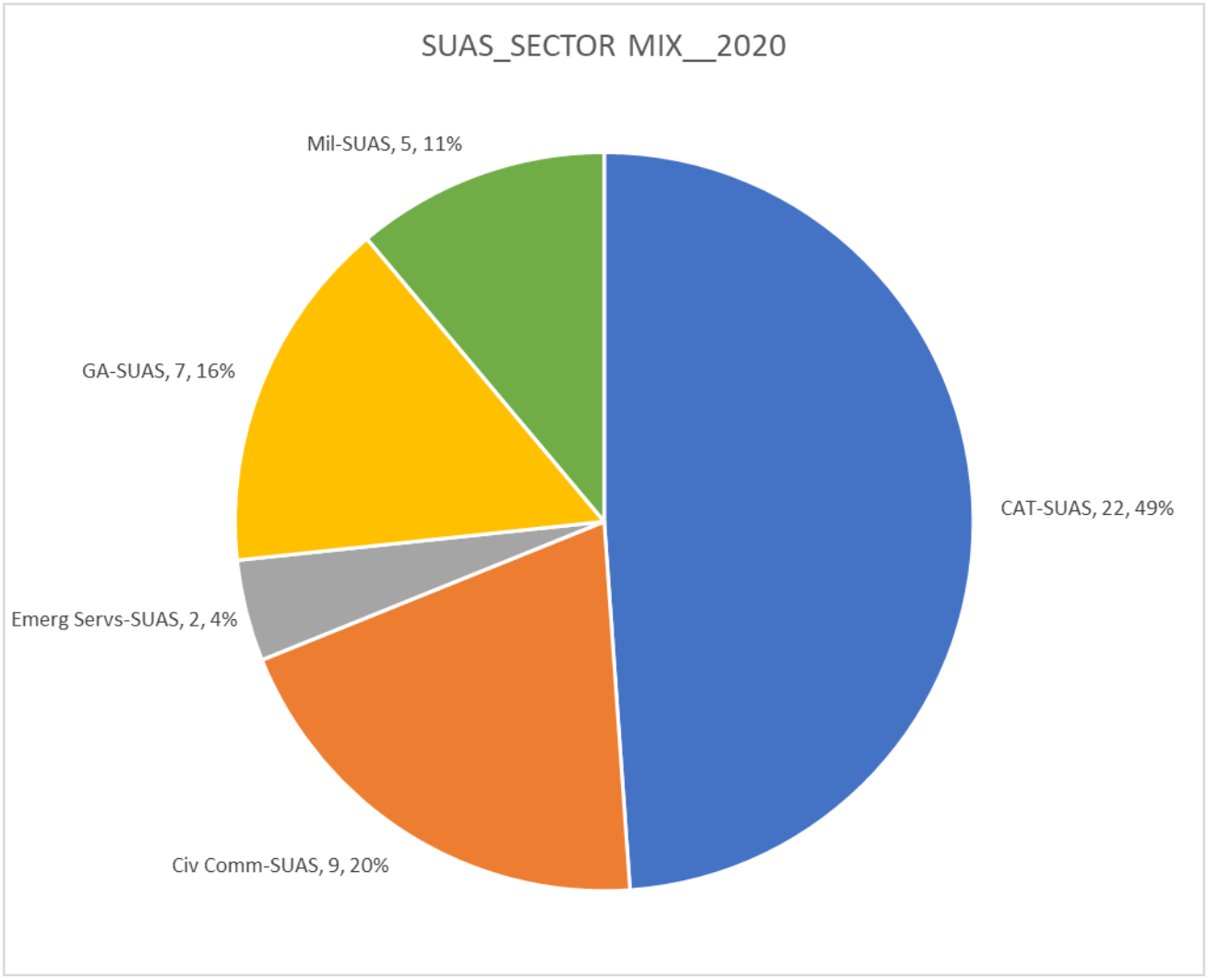

Figure 66: SUAS Sector Mix_2020

SUAS SECTOR MIX_ALTIUDE

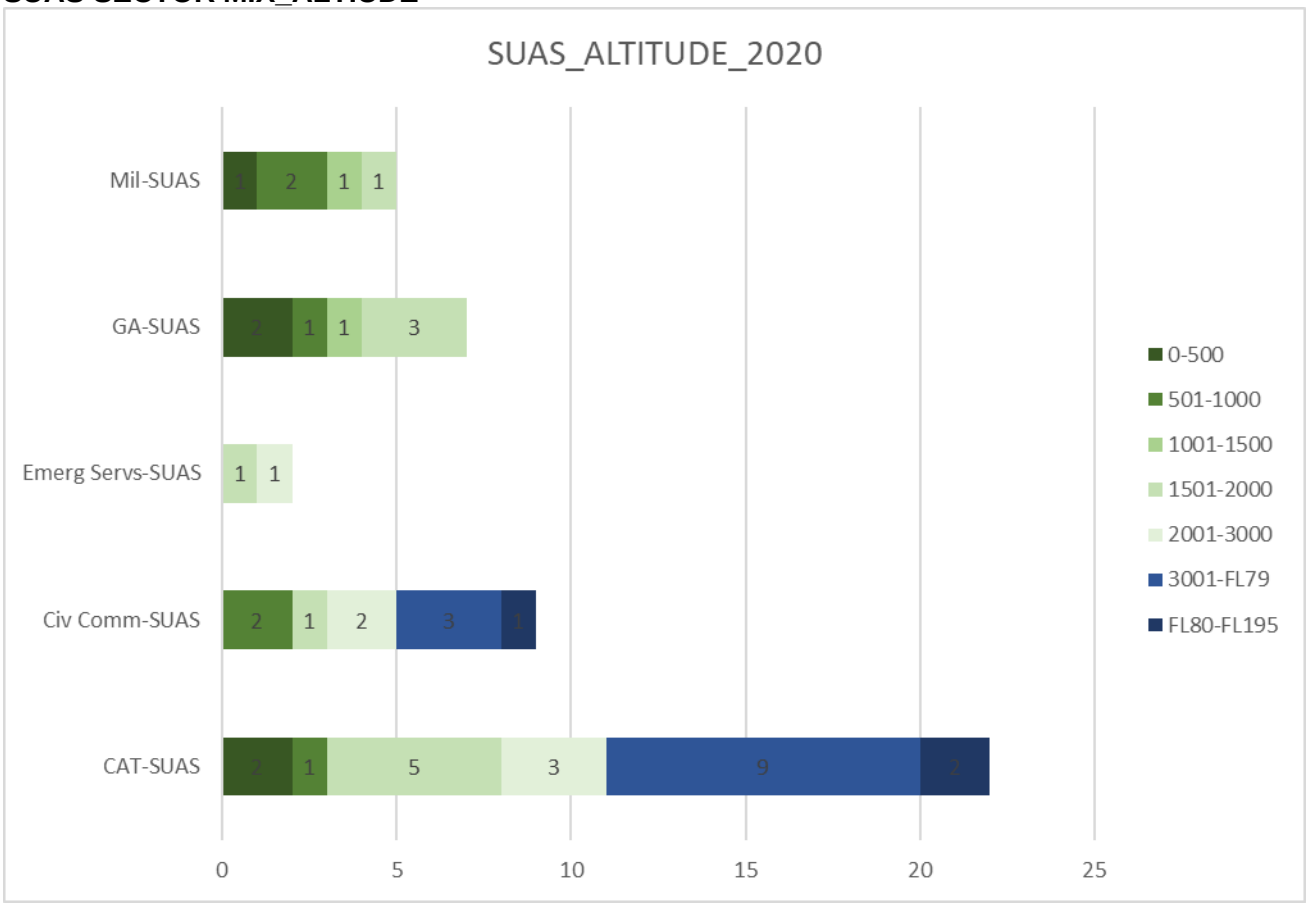

Figure 67: SUAS Sector Mix_Altitude_2020

SUAS SECTOR MIX_AIRSPACE

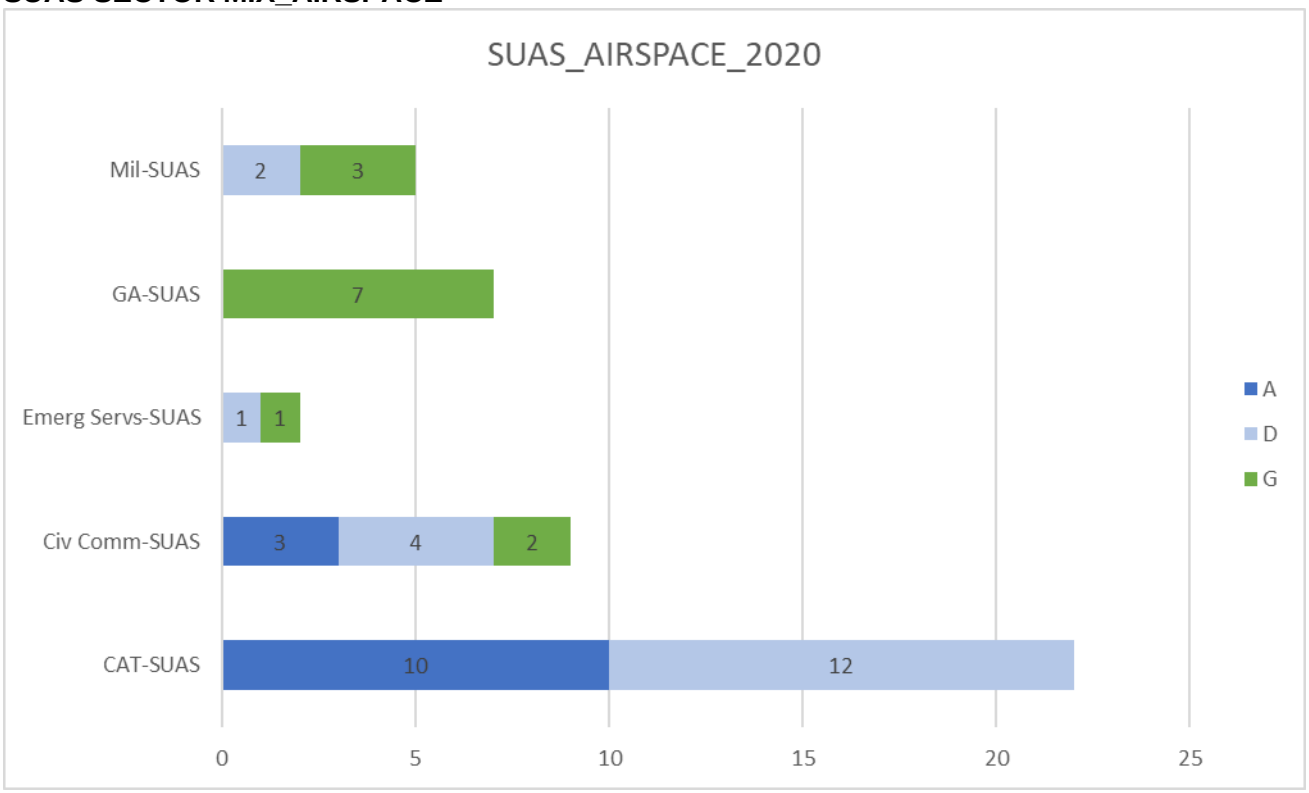

Figure 68: SUAS Sector Mix_Airspace_2020

SUAS SECTOR MIX_AIRSPACE_ALTITUDE_RISK BEARING

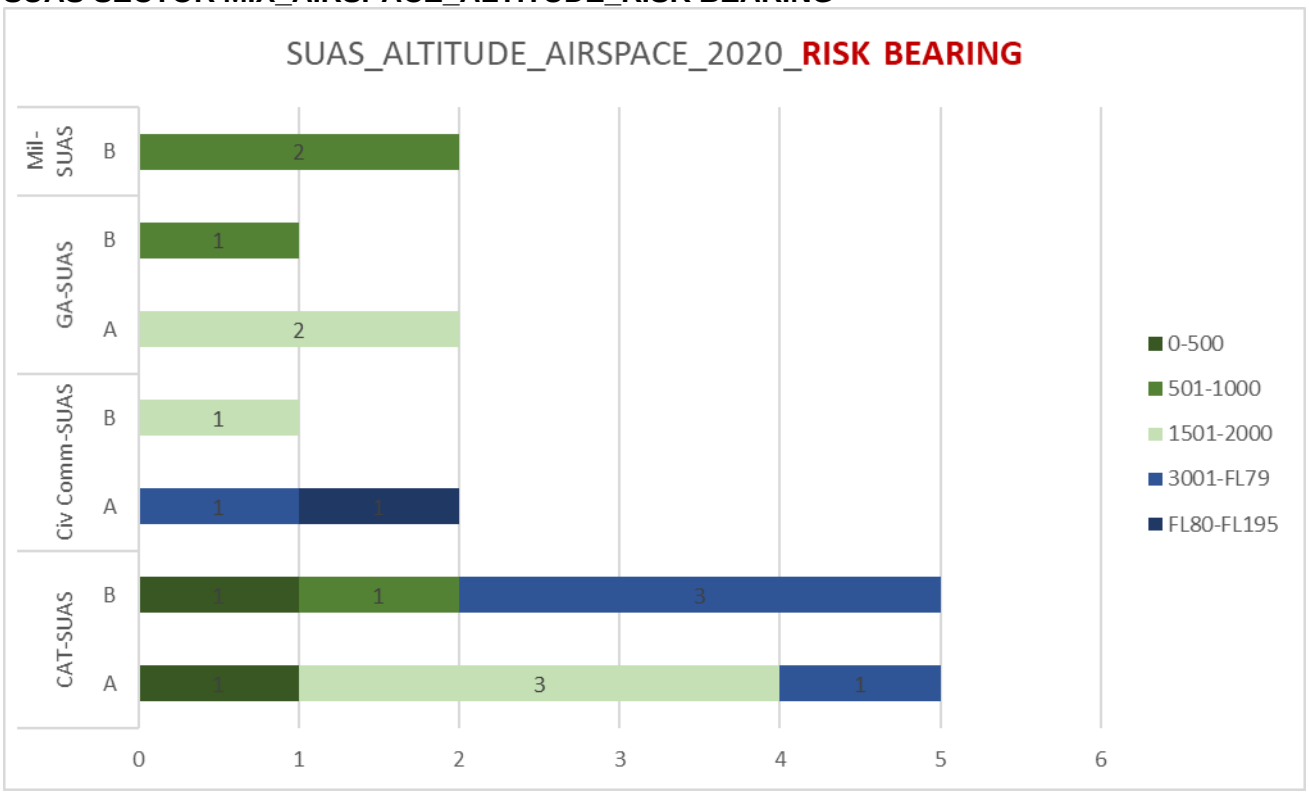

Figure 68: SUAS Sector Mix_Airspace_Altitude_Risk Bearing_2020

SUAS SECTOR MIX_AIRSPACE_ALTITUDE_RISK BEARING

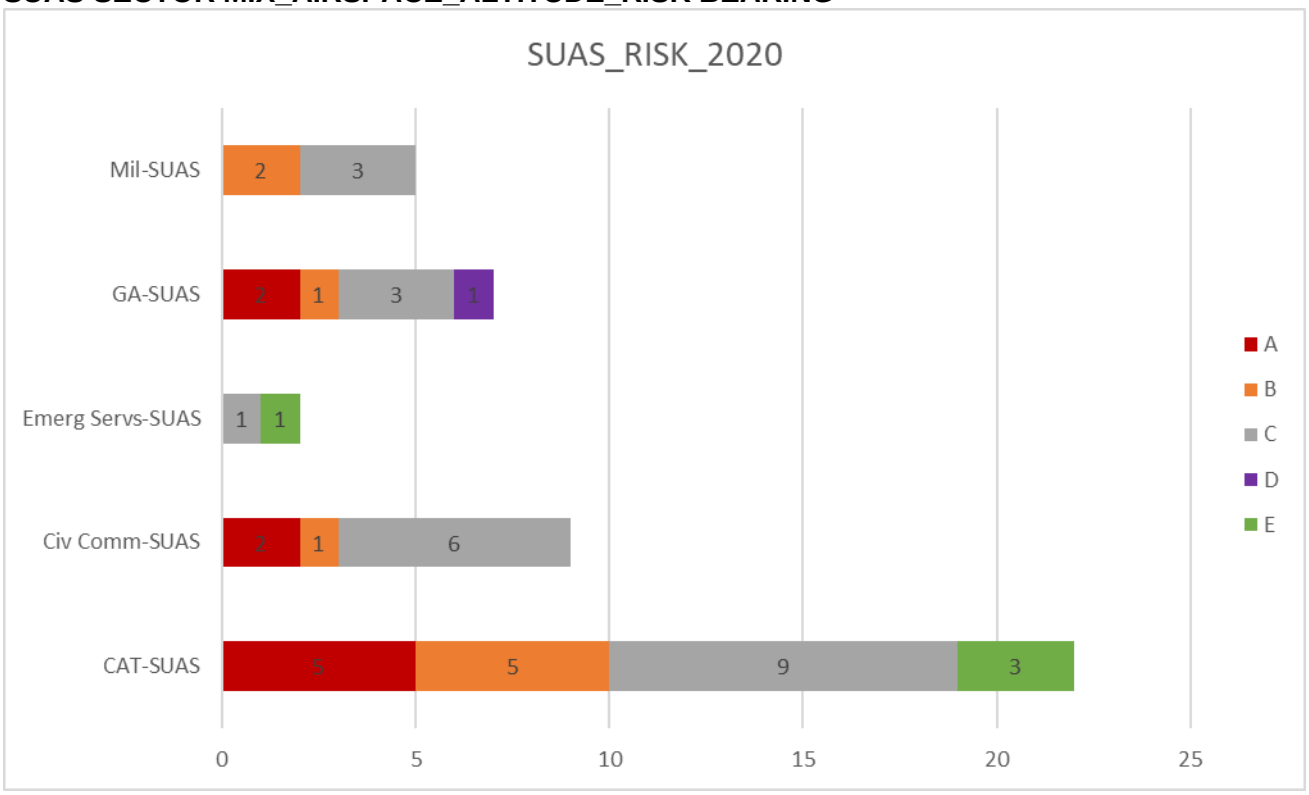

Figure 69: SUAS Sector Mix_Risk_2020

CAT_CIV COMM SECTOR MIX

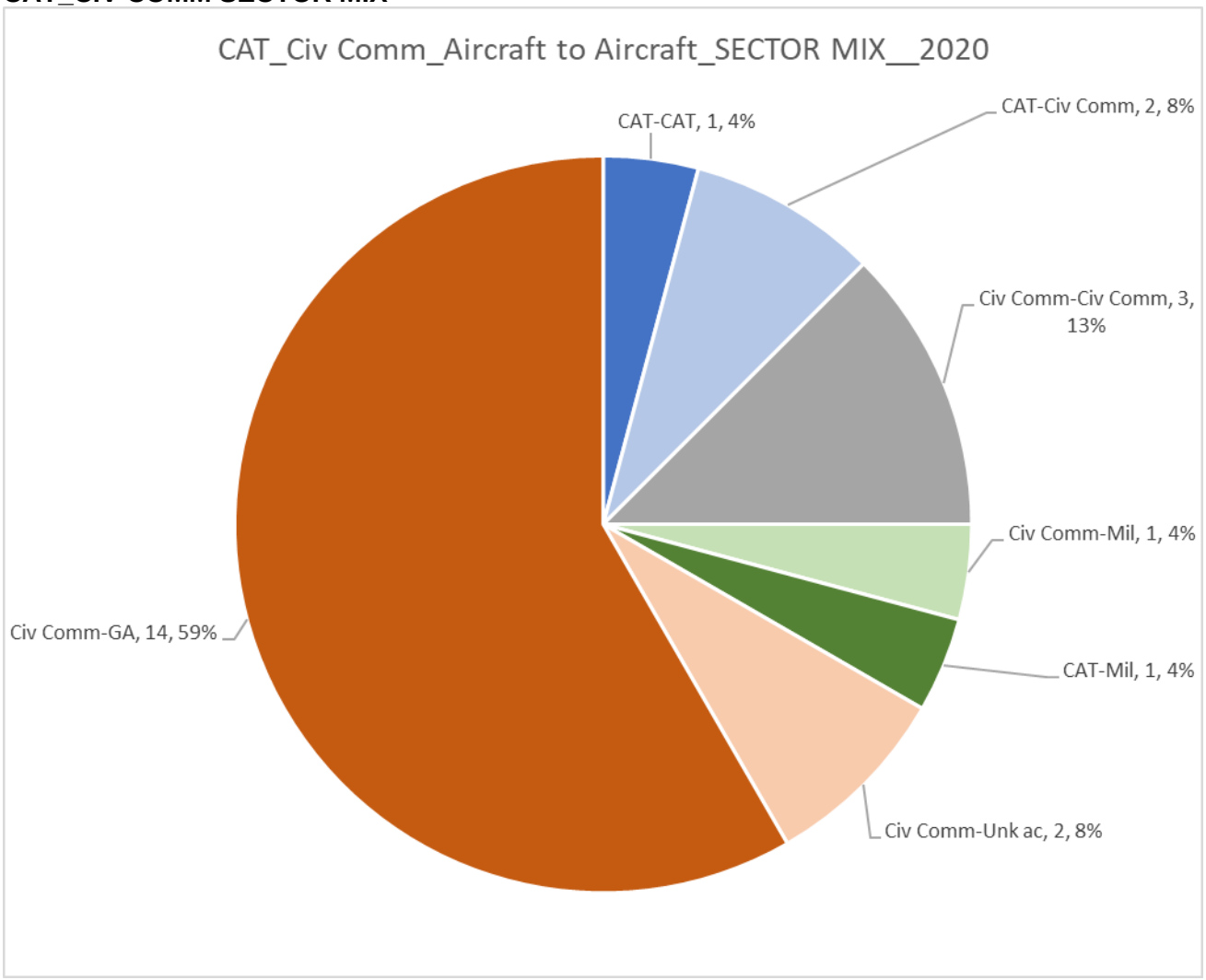

Figure 70: CAT_Civ Comm Sector Mix_2020

CAT_Civ Comm SECTOR MIX_ALTIUDE

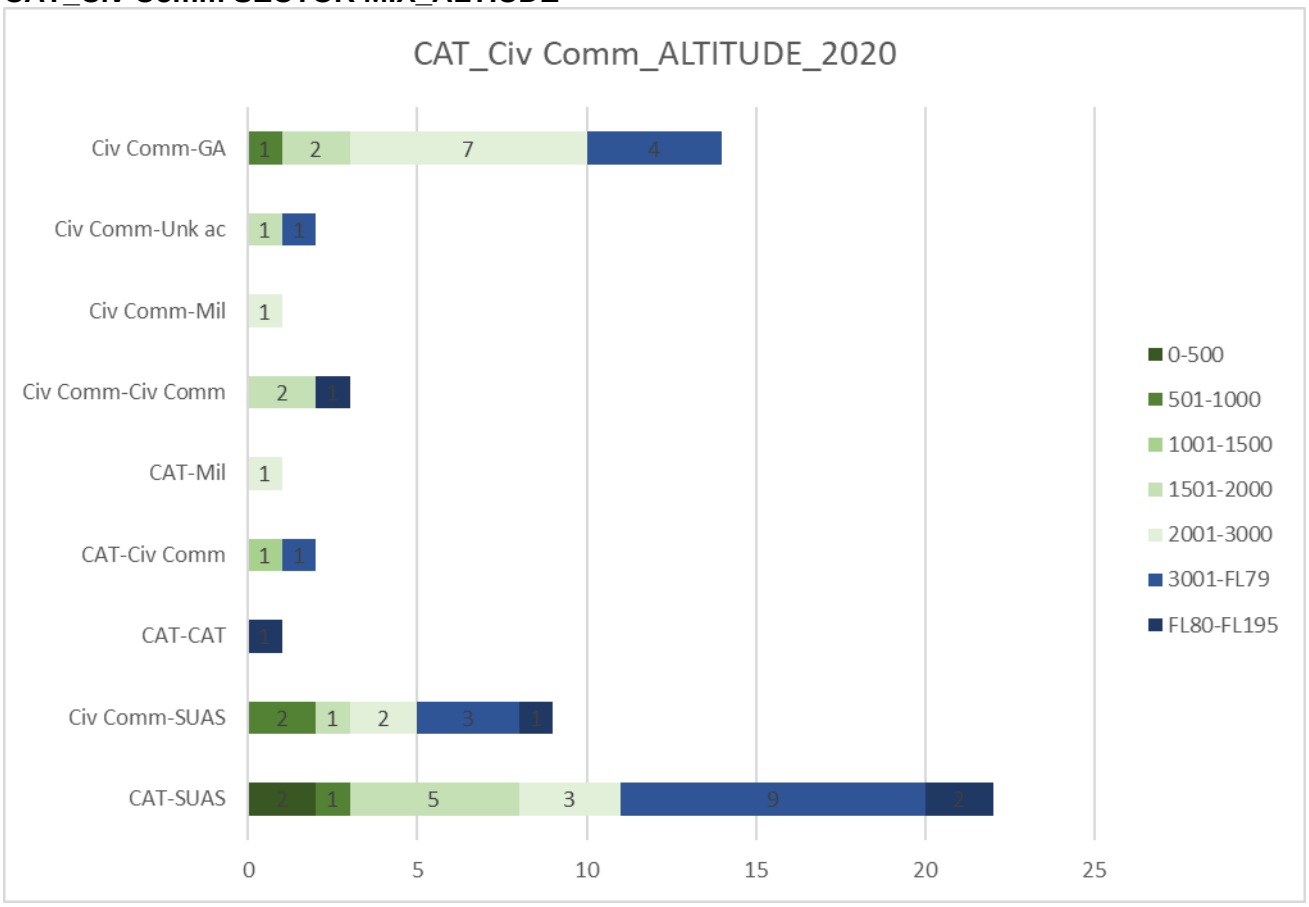

Figure 71: CAT-Civ Comm Sector Mix_Altitude_2020

CAT_Civ Comm SECTOR MIX_AIRSPACE

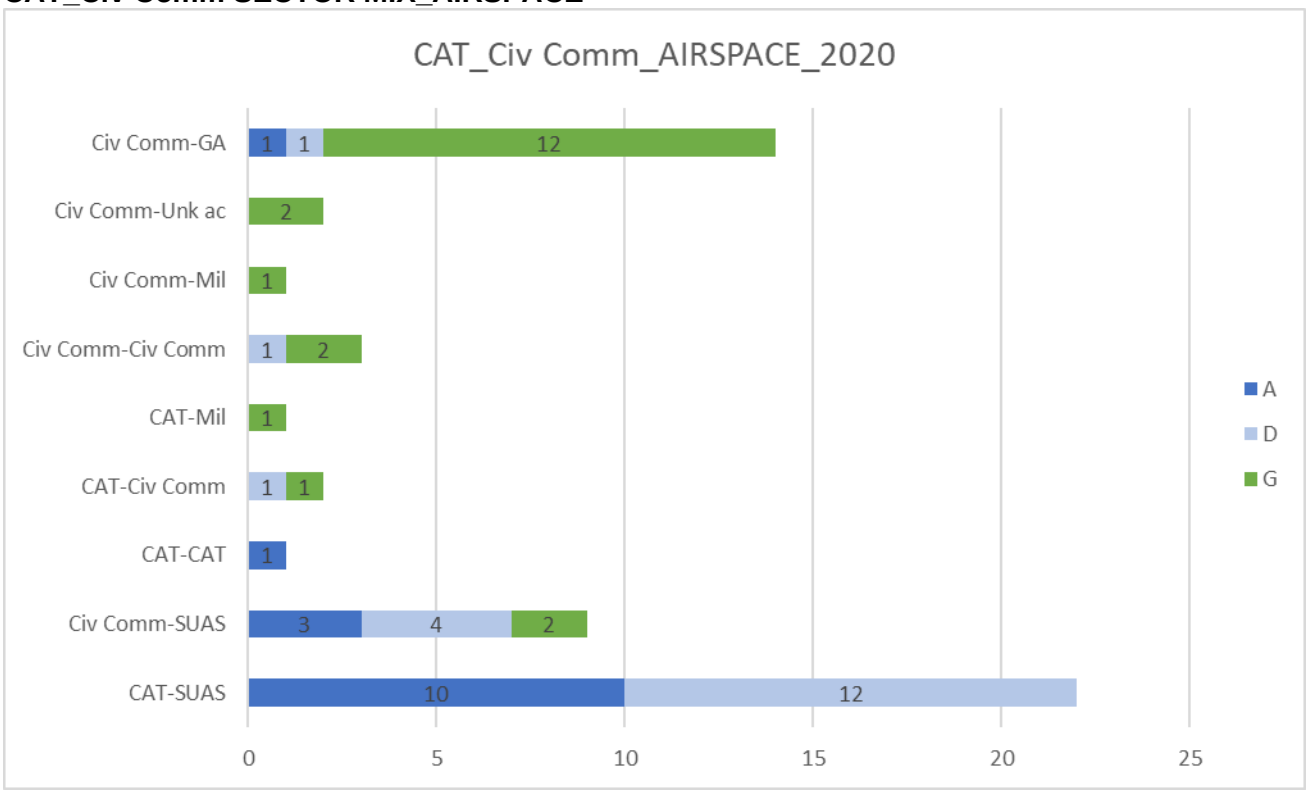

Figure 72: CAT-Civ Comm Sector Mix_Airspace_2020

CAT_Civ Comm SECTOR MIX_AIRSPACE_ALTITUDE_RISK BEARING

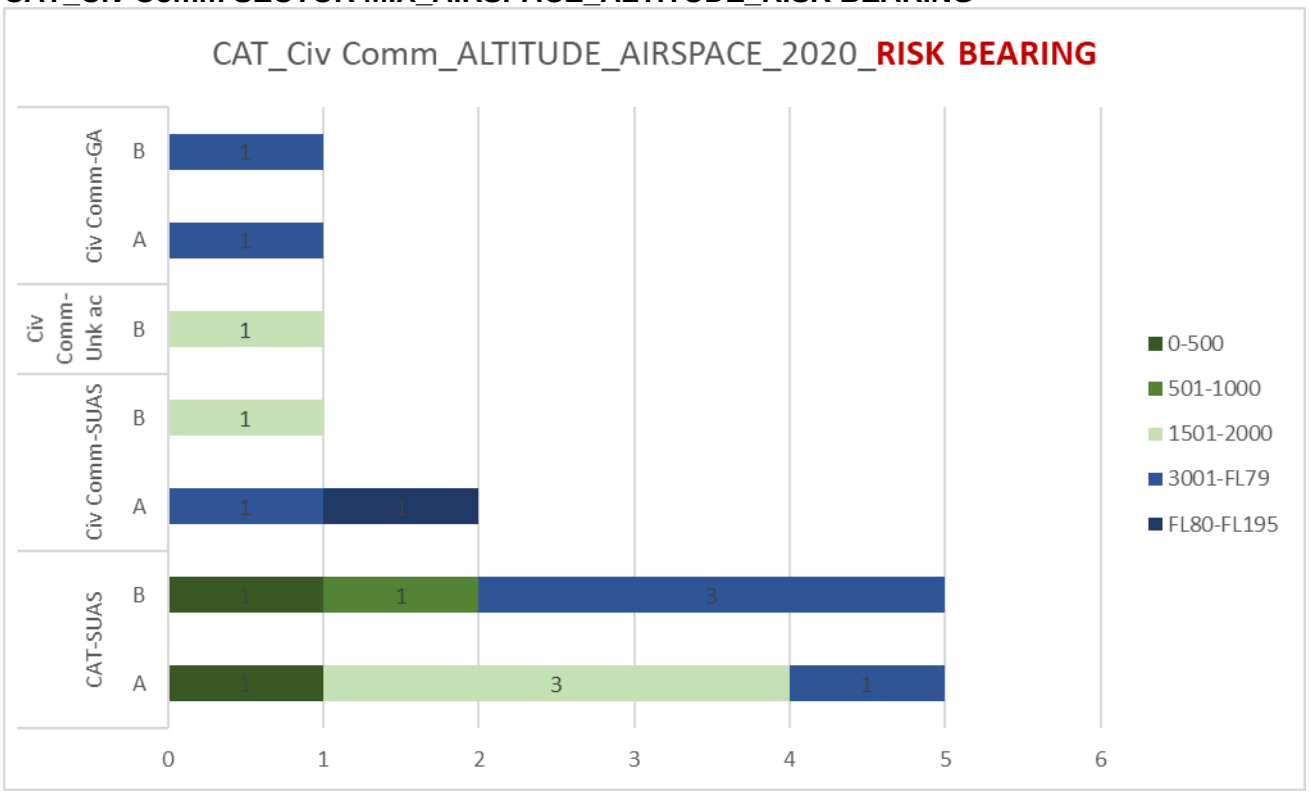

Figure 73: CAT_Civ Comm Sector Mix_ Airspace_Altitude_Risk Bearing_2020

CAT_Civ Comm SECTOR MIX _RISK

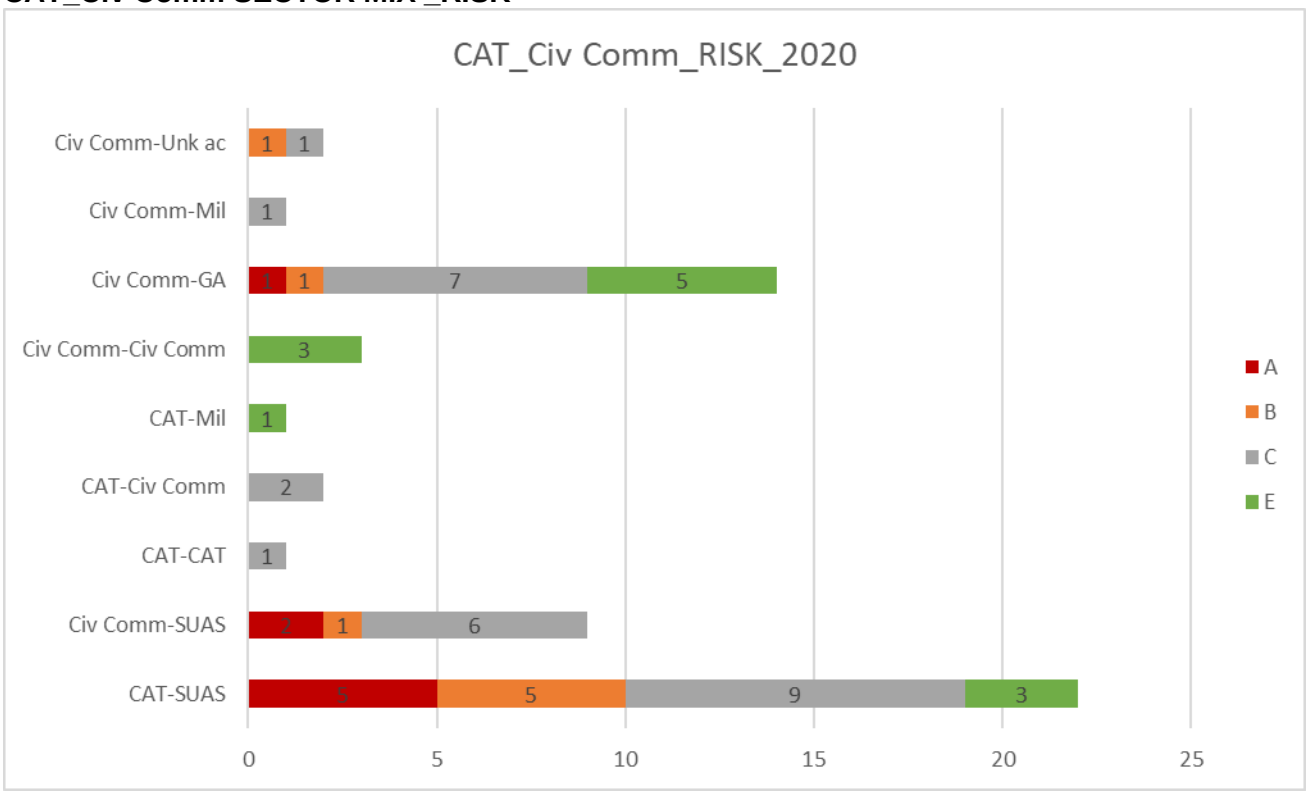

Figure 74: CAT_Civ Comm Sector Mix_ Airspace_Altitude_Risk Bearing_2020

GA (Sports and Recreational – including Unknow/Untraced) SECTOR MIX

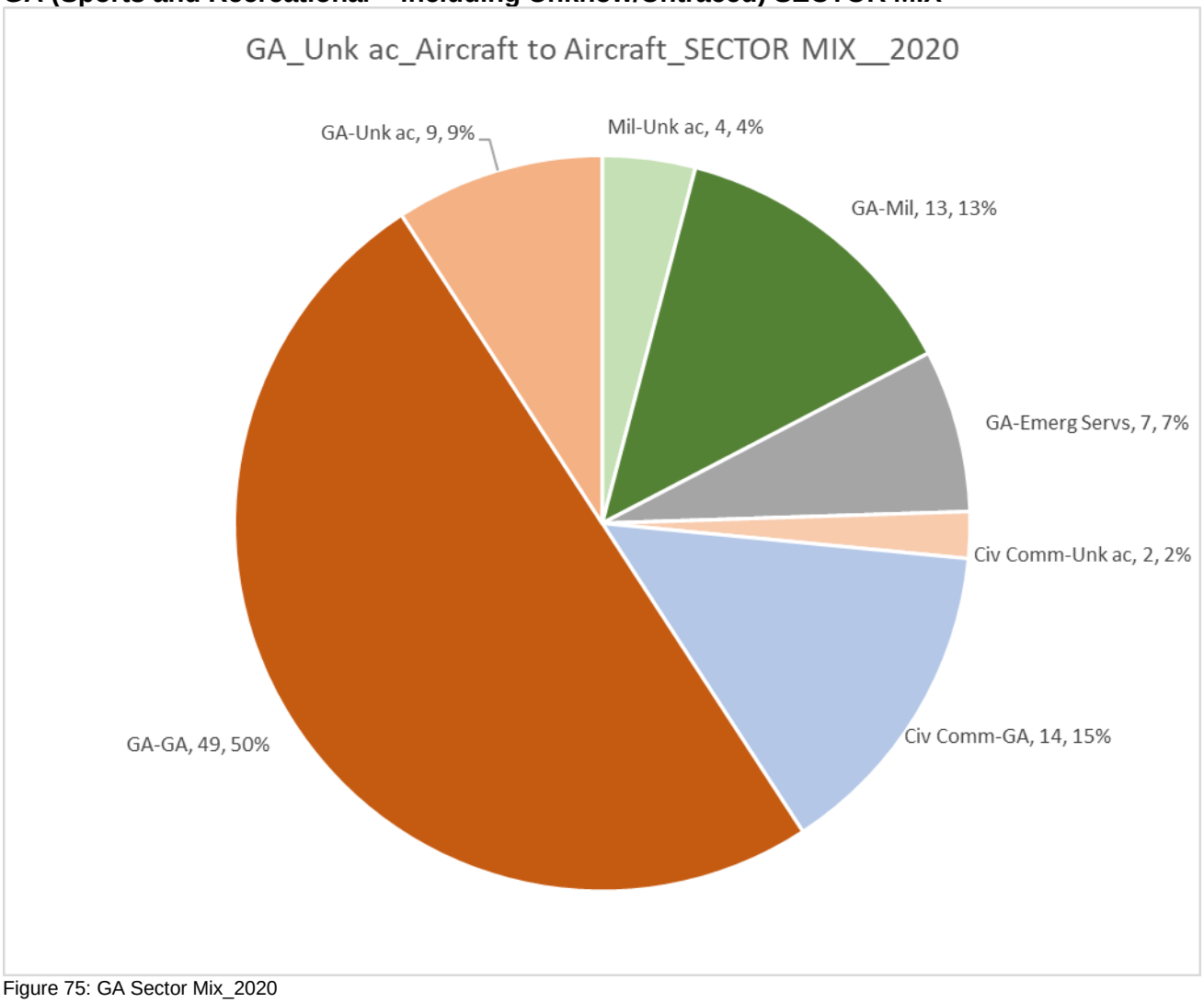

Figure 75: GA Sector Mix_2020

GA SECTOR MIX_ALTIUDE

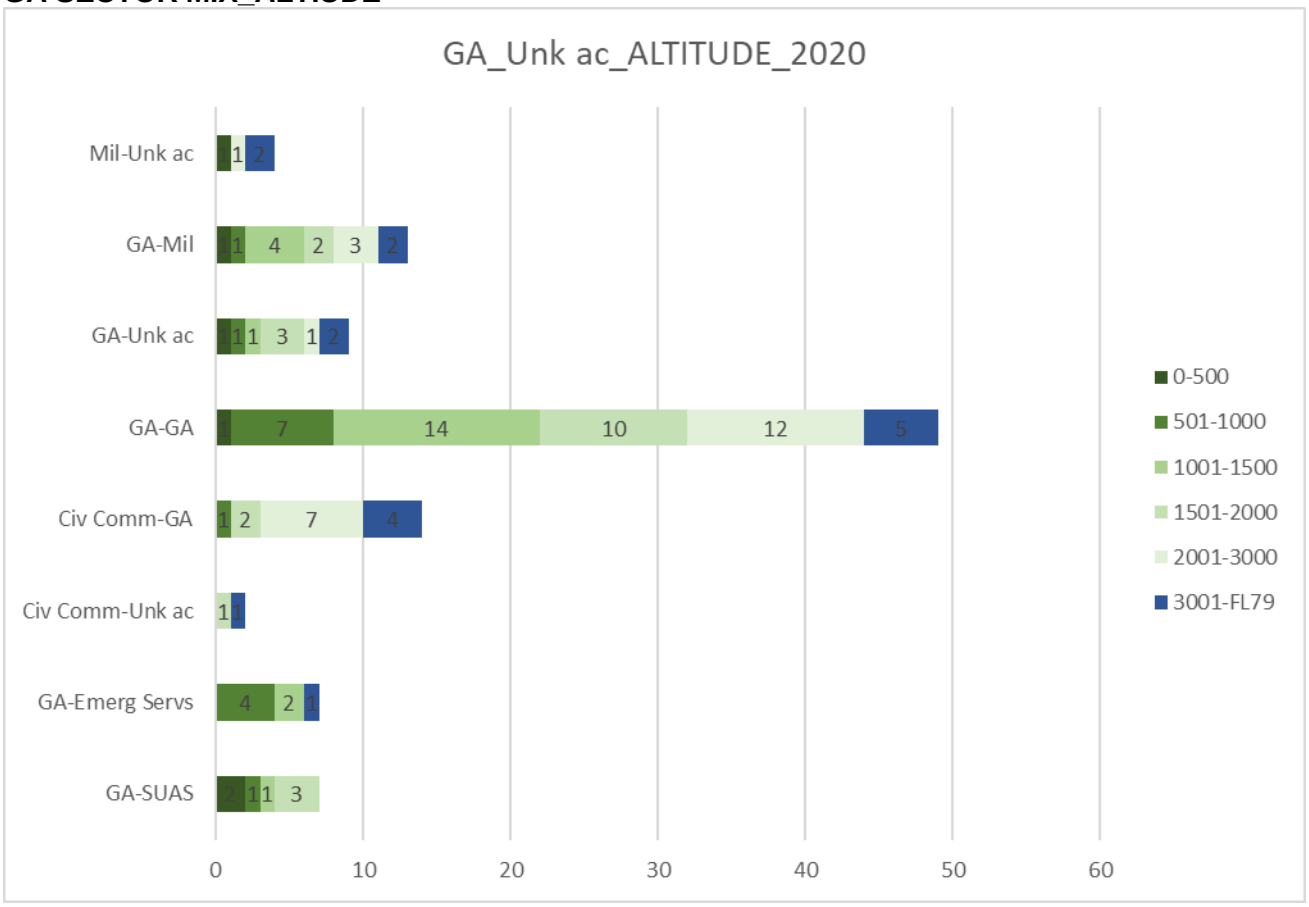

Figure 76: GA Sector Mix_Altitude_2020

GA SECTOR MIX_AIRSPACE

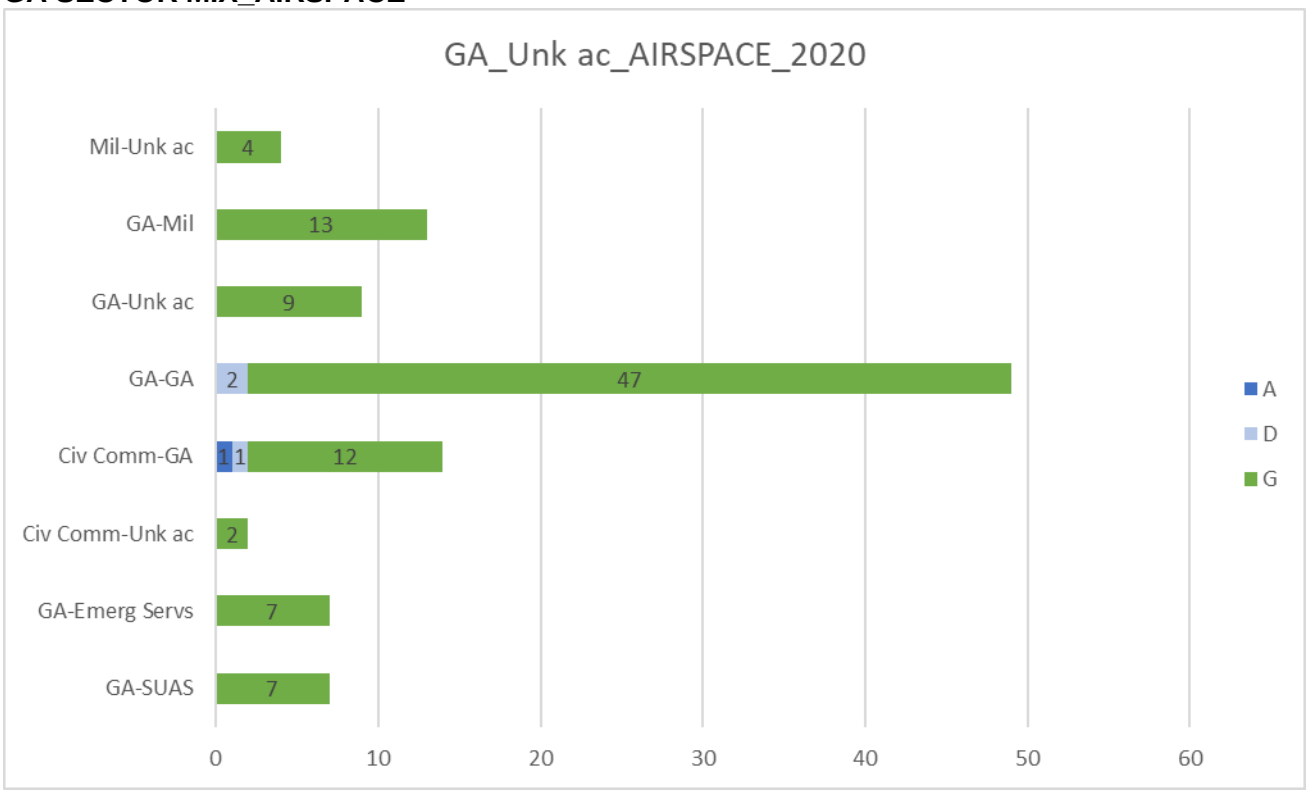

Figure 77: GA Sector Mix_Airspace_2020

GA SECTOR MIX_AIRSPACE_ALTITUDE_RISK BEARING

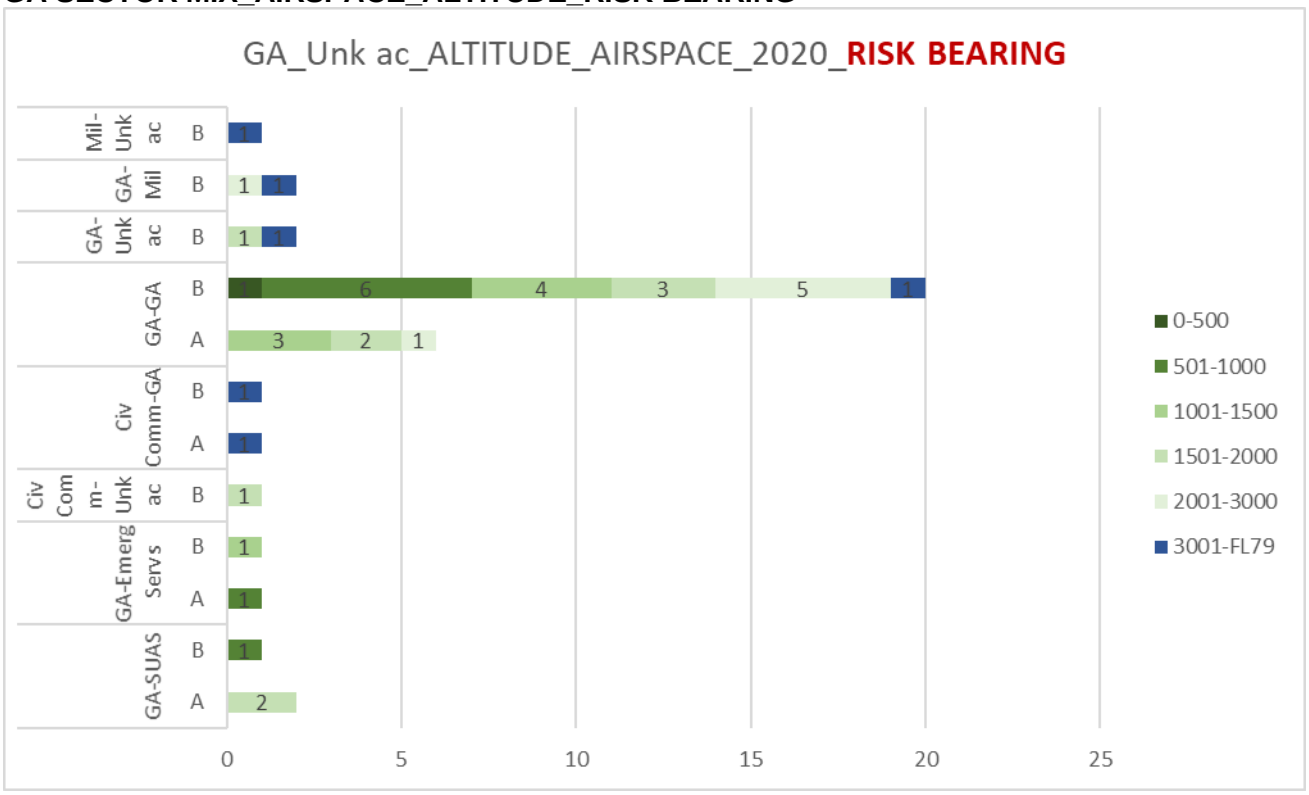

Figure 78: CAT_Civ Comm Sector Mix_ Airspace_Altitude_Risk Bearing_2020

GA SECTOR MIX _RISK

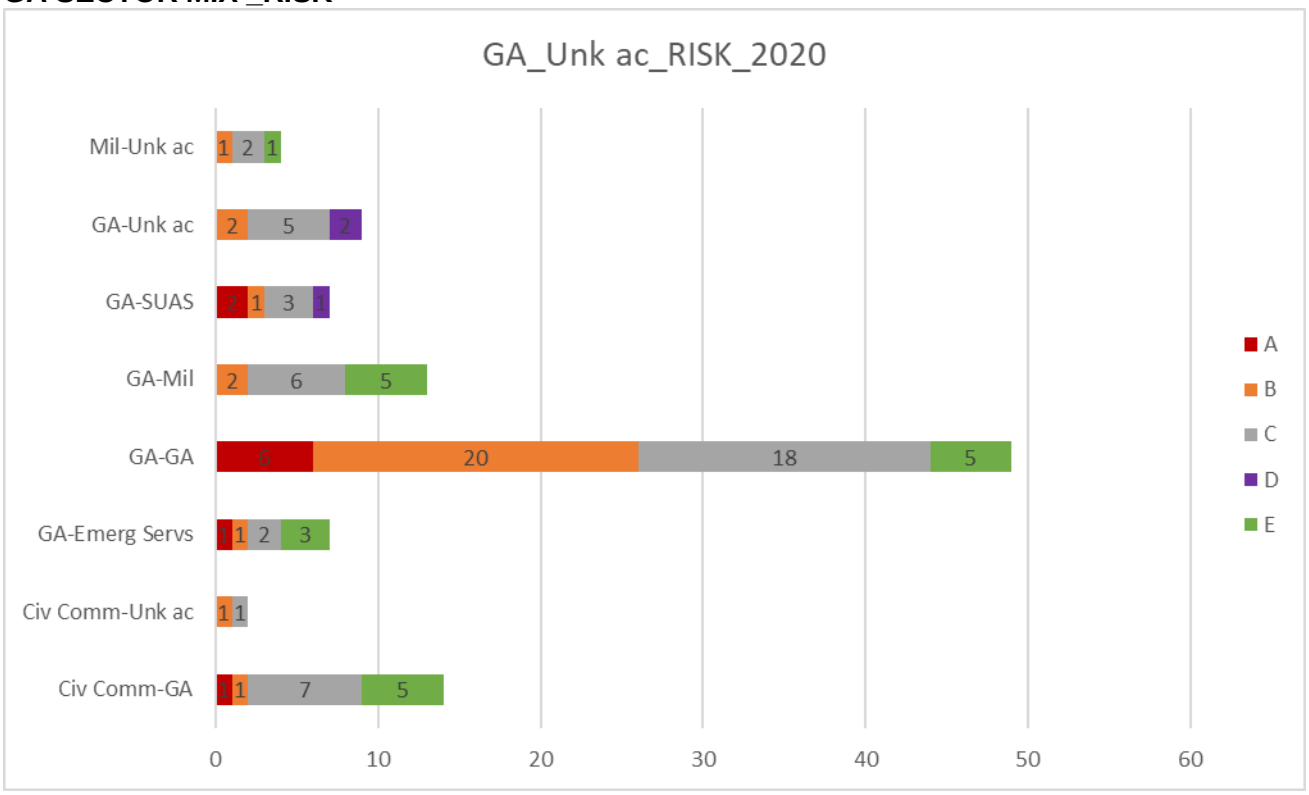

Figure 79: GA Sector Mix_ Risk_2020

MILITARY SECTOR MIX

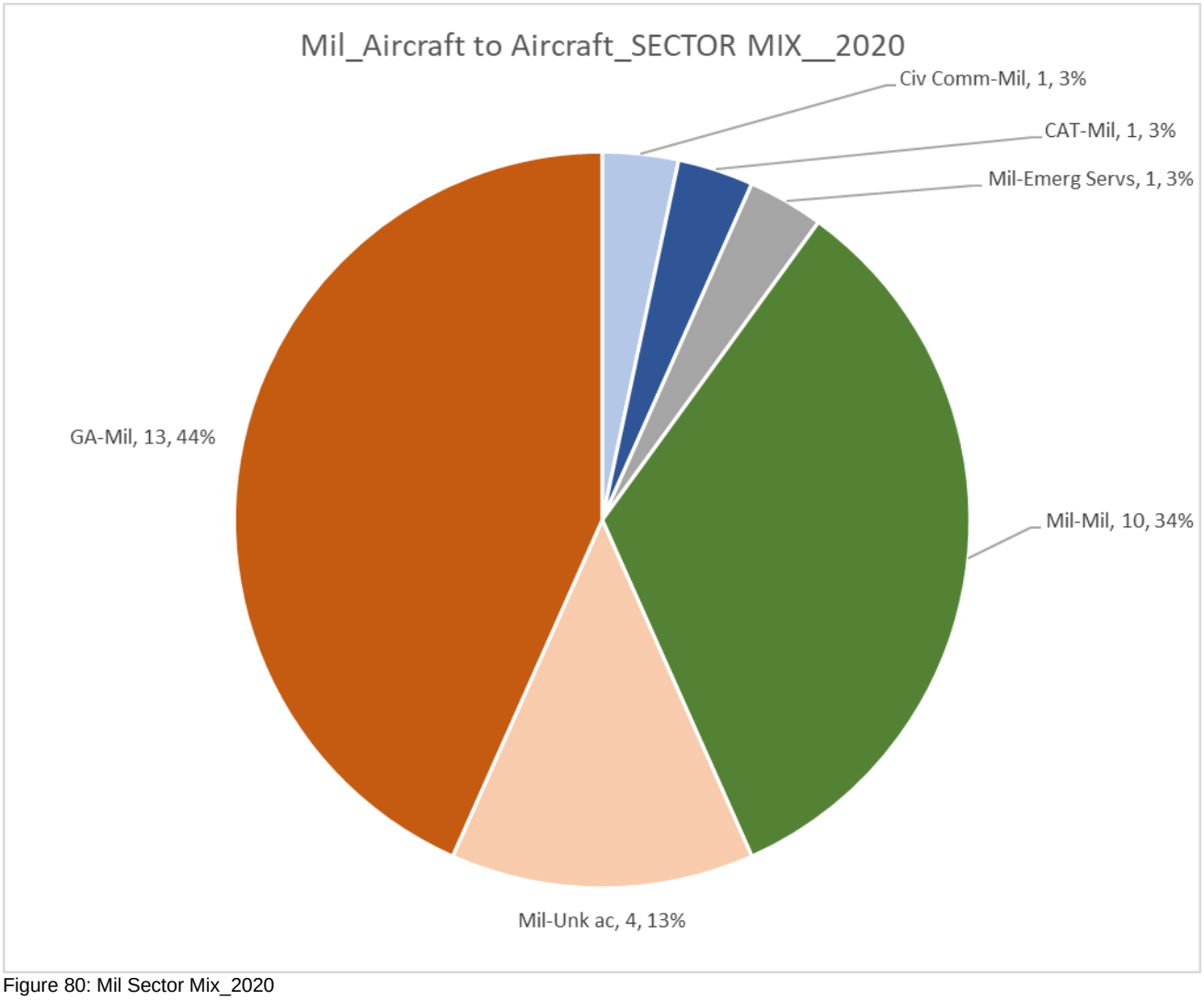

Figure 80: Mil Sector Mix_2020

MILITARY SECTOR MIX_ALTIUDE

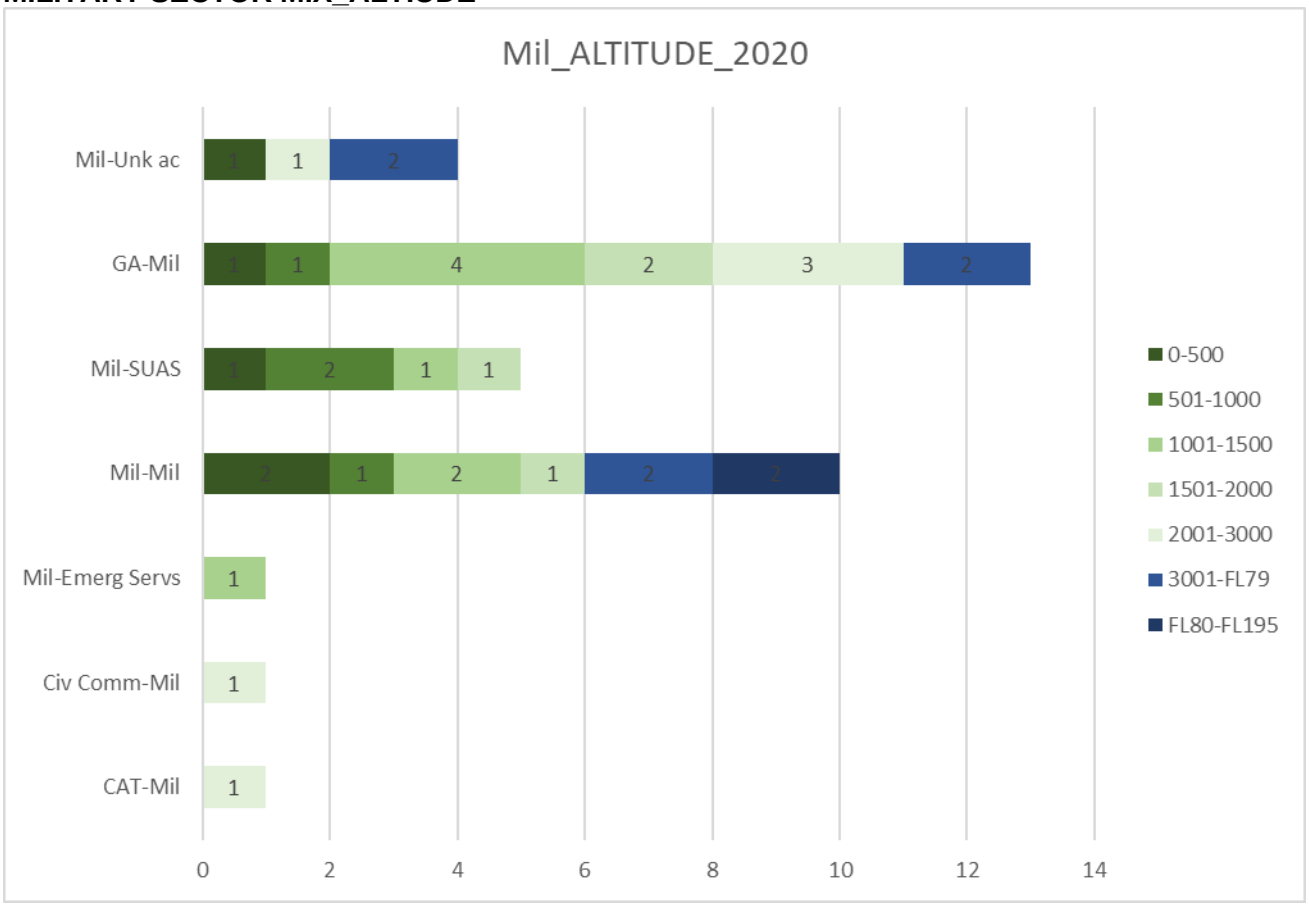

Figure 81: GA Sector Mix_Altitude_2020

MILITARY SECTOR MIX_AIRSPACE

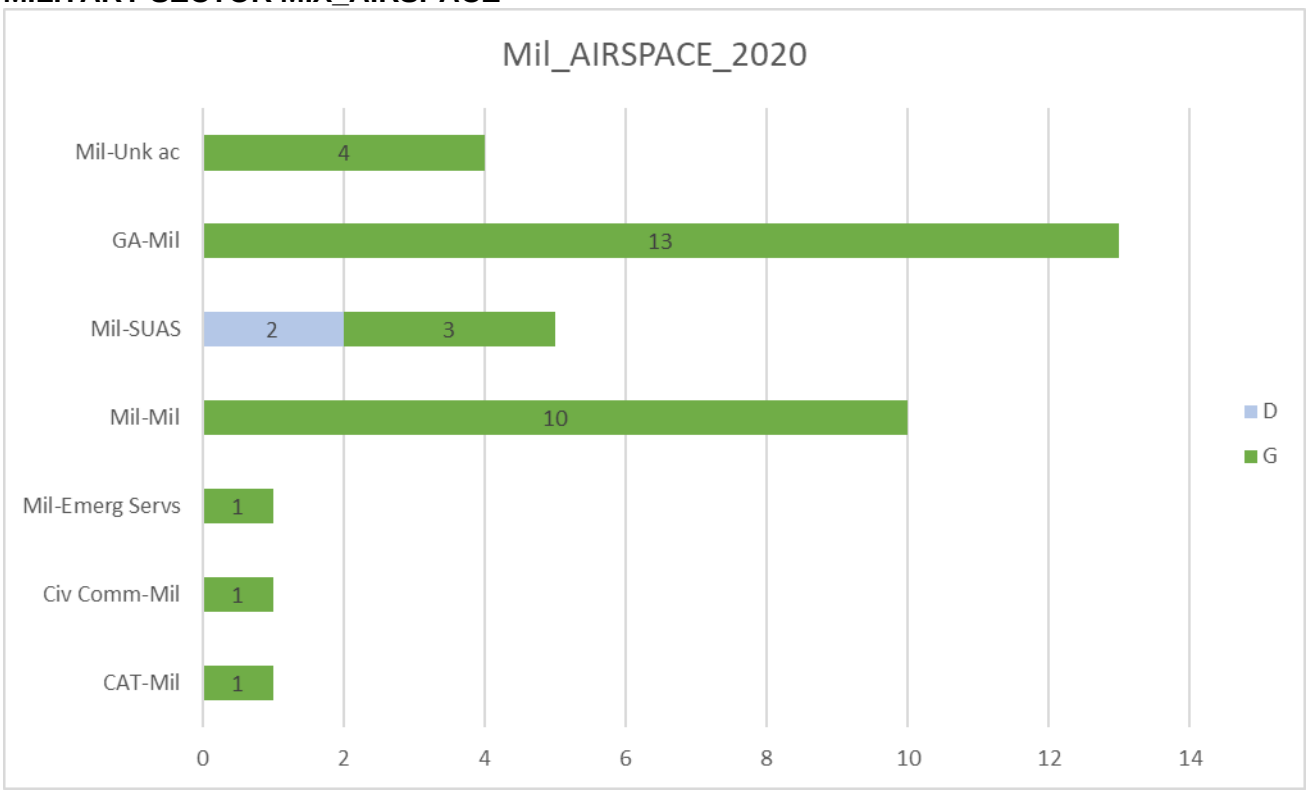

Figure 82: Mil Sector Mix_Altitude_2020

MILTARY SECTOR MIX_AIRSPACE_ALTITUDE_RISK BEARING

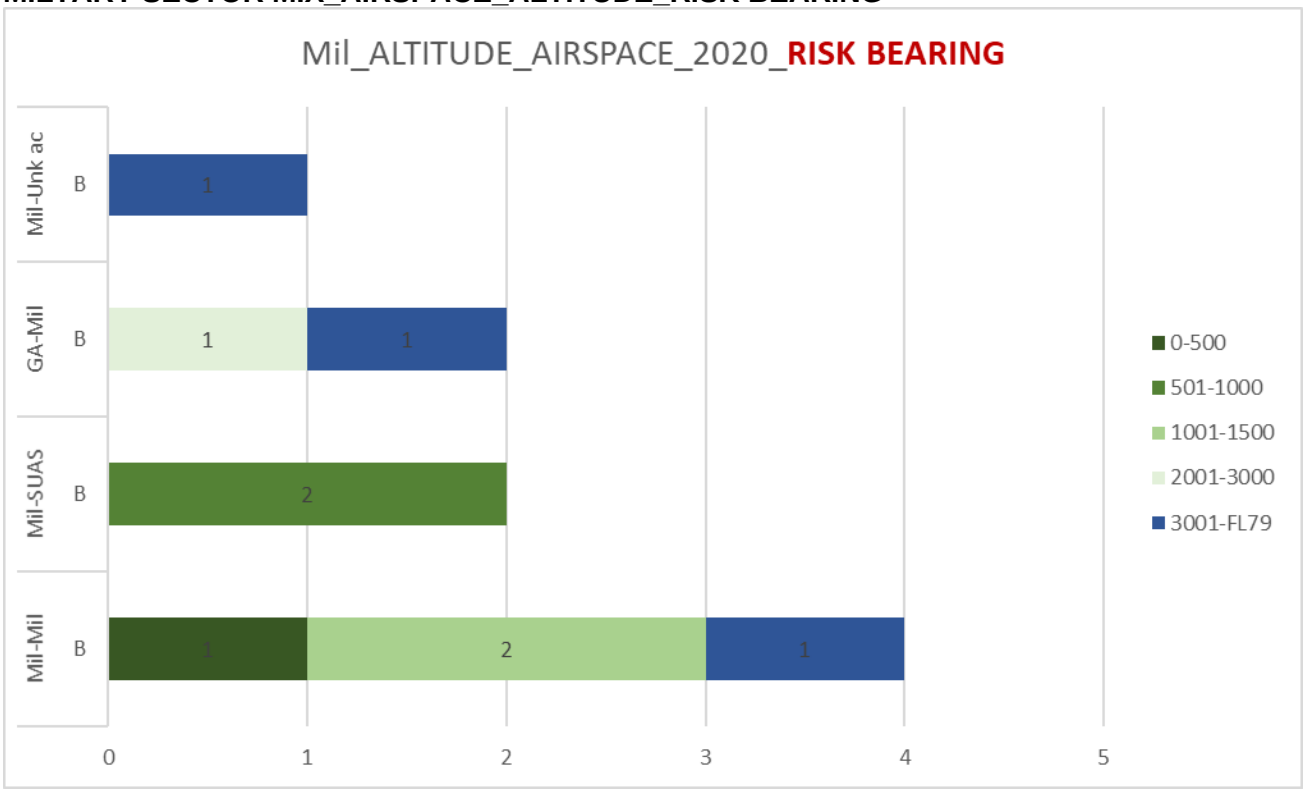

Figure 83: Mil Sector Mix_ Airspace_Altitude_Risk Bearing_2020

MILTARY SECTOR MIX_AIRSPACE_ALTITUDE_RISK BEARING

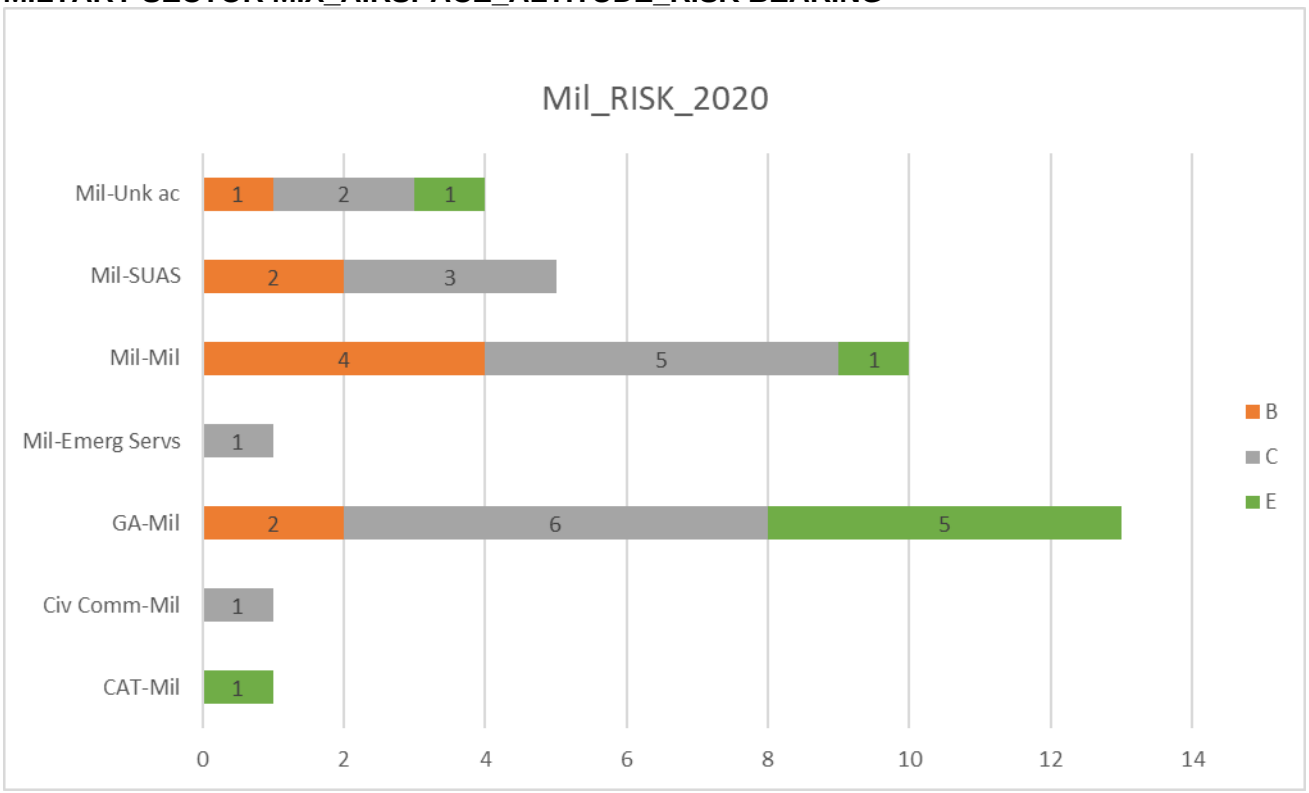

Figure 83: Mil Sector Mix_ Risk_2020

UKAB 2020 SAFETY RECOMMENDATIONS

ACCEPTED	PARTIALLY ACCEPTED	REJECTED

Airprox	Recommendation	Comments
2020083	The CAA includes glider site ICFs, as supplied by the BGA, in the UK AIP ENR 5.5.	Partially Accepted
2020086	The CAA reviews the Southend ATC Safety Case activity to ensure that it includes robust mitigations for the known incompatibility between the SSR processor and Garrecht-type transponders.	The CAA has liaised with Southend ATC unit and confirmed that the known incompatibility issue with the Garrecht transponder has been risk assessed and ATC procedures issued to provide visibility to ATC Staff of the issue. The risk assessments appeared to suitably identify available mitigations and were accepted by the allocated Air Traffic Operations Inspector. The mitigations were initially notified to ATCOs via ATC Supplementary Instructions. These have subsequently been incorporated into the Southend Manual of Air Traffic Services Part 2 Issue 4 v1.1 (01/10/2020). The Southend ATC Engineers have advised that they will discuss the matter with Leonardo during their weekly calls with the Vice President of Sales at Leonardo. The incident has also been highlighted to the SARG Surveillance Specialist for further investigation and follow up action, if deemed necessary.
2020167	The CAA conducts a review to establish the reasons behind why many training airfields chose not to maintain their ATZ when the requirement to hold an aerodrome licence to conduct training activity was removed. Where those reasons fall within the competency of the CAA – take appropriate action to mitigate against any increase in risk associated with the removal of the protection previously afforded to them (by an ATZ).	The CAA provided a detailed response outlining the background behind the removal of the requirement for training establishments to hold a license and (where there was no provision of an air traffic service) the consequent removal of the associated ATZ. The response also included a precis of the extent of their authority over unlicensed aerodromes and highlighted the limited regulatory levers available to them. They noted that recent work on the UK approach to recreational GA, commissioned and funded by the DfT in 2020 and published in CAP1886, stated that 'Additional regulation is not justified and is unlikely to significantly improve safety'. Nevertheless, they undertook to review the position regarding what they would consider to be an acceptable level of regulatory oversight for the purposes of airspace management and committed to report back to the UKAB once the work was complete.

UKAB 2019 SAFETY RECOMMENDATIONS

ACCEPTED		PARTIALLY ACCEPTED	REJECTED
Airprox	**Recommendation**	**Comments**	
2019002	Wellesbourne Mountford update their AIP entry to reflect the BRUNO approach.	Whilst we see the values and benefits in formalising the BRUNO procedures as an instrument training aid for use in VMC conditions, our CAA ATS Inspector has stated that the use of this approach is likely to introduce significant risk to the operation of the airfield, as well as the safety management system and has informed us that the practice of using this procedure even in VMC conditions must cease with immediate effect. Subsequently we have met with stakeholders and have communicated that the BRUNO procedure must not be used.	
2019004	CAA and MAA provide advice and guidance on the interpretation and use of electronic conspicuity equipment.	the CAA is leading a programme to enable the carriage and operation of 'interoperable' electronic conspicuity equipment, this programme is well underway, having made a call for evidence and held a multi-stakeholder conference on the issue. The programme is now moving into the phase in which the strategy for deployment will be crafted; that phase will be led by the CAA but inclusive of ALL affected stakeholders. A full consultation on the draft final strategy will be held before mandated deployment is initiated. In support of that strategy there are a number of key issues that will be addressed, such as: the creation of and/or alignment to suitable standards for use and fitting of such equipment; a fully integrated trial to 'prove the concept'; consideration of the integration of other users, such as Drones; the Human Factors associated with the introduction of new equipment into the cockpit, and, the education of pilots in its use.	
2019008	CAA and MAA provide advice and guidance on the interpretation and use of electronic conspicuity equipment.	As above	
2019028	The P68 operating company consider the incorporation of a TAS.	The company purchased 2 x SkyEcho2 portable ADSB receiver units to trial on their P68 aircraft. These units were evaluated over 3 months and pilot feedback was canvassed. The SkyEcho2 unit integrated with and overlaid onto on-board iPads running Sky Demon software. They found that this form of electronic conspicuity did add some value, however the effect was limited. Commercial airliners were all detectable. Some GA aircraft were detectable. The 'bearing-less target' mode for Mode C detection had been disabled by the manufacturer. The addition of a 'FLARM' licence for the Sky Demon software led to some suitably equipped gliders being detectable. The trial was extended onto one of their rotary survey helicopters for further evaluation.	

ACCEPTED		PARTIALLY ACCEPTED	REJECTED
Airprox	**Recommendation**	**Comments**	
2019071	The CAA review R/T procedures at non-ATS aerodromes.	We have reviewed CAP 413 (Radiotelephony Manual) Chapter 4 Aerodrome Phraseology but do not believe there is a case for introducing a requirement for pilots to report at all designated positions in the aerodrome traffic circuit. However, the review has highlighted the need for some structural changes to Chapter 4, and the following will be considered: • Page 1 subtitle 'Aerodrome Control Service Phraseology' to move to page 5. • Paras 4.6 and 4.7 to be moved to Chapter 4 Introduction. • 'Designated Positions in the Traffic Circuit' and 'Standard Overhead Join Procedure' content to follow the Introduction and be applicable to ATC, AFIS and AGCS alike. • New header to indicate applicability. • Requirement in both cases for aircraft to report base leg to be enhanced to read 'if required by ATS provider or aerodrome operator'. It may not be universally applicable - the decision can be made at local level to satisfy local requirements.	
2019101	SkyDemon review the selection and depiction of sites used for aerial sporting and recreational activities	SkyDemon agreed to review the selection and depiction of sites used for aerial sporting and recreational activities with a view to enhancing map conspicuity and preventing inappropriate deselection of such sites from map depiction.	
2019110	SkyDemon review the selection and depiction of sites used for aerial sporting and recreational activities	SkyDemon agreed to review the selection and depiction of sites used for aerial sporting and recreational activities with a view to enhancing map conspicuity and preventing inappropriate deselection of such sites from map depiction.	
2019151	Westonzoyland and Middlezoy airfield managers develop a letter of agreement regarding integration of their operations.	Email response from WestonZoyland stating that once the latest COVID restrictions are lifted a meeting will be organised between the interested parties at both WestonZoyland and Middlezoy to enable a way forward to be agreed.	
2019192	Gloucester considers reviewing fixed-wing and rotary-wing circuit separation.	Work is on-going regarding new procedures with a potential change due to development on the north-side of the airfield. A final decision has been delayed until a new Head of Operations is in place sometime in the new year. In the meantime, an Airport Advisory Notice has been issued, reminding operators of the importance of height keeping in the visual circuit.	
2019201	1. The P68 operating company considers further mitigations to MAC for survey operations.	Letter sent Company1 October 2020 closing as 'partially accepted'.	
2019201	2. The CAA considers mandating additional cockpit crew to enable enhanced lookout for single-pilot survey operations.	CAA revised response - 'We recognise the unique hazard of the operations in question and therefore, in response to the recommendation, confirm that the CAA Partially Accepts this recommendation and will conduct a review of the risk assessments of survey operators, to ensure they meet the requirements of AMC SPO.OP.230(b) and are robust in addressing this risk.'	

ACCEPTED	PARTIALLY ACCEPTED	REJECTED

Airprox	Recommendation	Comments
2019208	1. The P68 operating company considers further mitigations to MAC for survey operations.	This subject is both a safety matter and a commercial matter. The P68 is certified as a Single Pilot Aeroplane. EASA (CAT and Part SPO) and ANO regulation does not deal with any requirement for two pilots for this type of work. We operate in a commercial market with other UK entities, EU operators and Non-EEA operators. The many SPO-type flights that operate are both Commercial and Non-Commercial SPO and vary greatly in aircraft type/class/rotary/flight conditions, heights, altitudes and flight levels, in and outside of controlled airspace. We see the benefits of two crew in certain areas of airspace and we do what we can to encourage the end user to take the additional cost burden and reduction in other payload or fuel and therefore endurance. In the past we have also refused to operate in areas unless the clients accept the position of two crew. This has been to their cost and also as a cost neutral in some cases so that we can operate and complete the work. Mitigations that we routinely consider or that are currently in progress are: • Scheduling of survey tasks to take advantage of surveillance-based Air Traffic Services where available. • Fitting ACAS to the fleet where possible – this is an ongoing programme. • Where commercial considerations permit, carriage of an extra crewmember to supplement the lookout task. We remain engaged with the UK CAA in trying to influence a change to the regulation such that all operators conducting survey tasks in UK airspace would be required to show enhanced MAC mitigation measures over and above the minimum requirements of EASA Part SPO. We also have further discussions to have with the CAA over Single Crew V Multi Crew operation of larger NCO aircraft that can also be used as CAT.
2019208	2. The CAA considers mandating additional cockpit crew to enable enhanced lookout for single-pilot survey operations.	CAA revised response - 'We recognise the unique hazard of the operations in question and therefore, in response to the recommendation, confirm that the CAA Partially Accepts this recommendation and will conduct a review of the risk assessments of survey operators, to ensure they meet the requirements of AMC SPO.OP.230(b) and are robust in addressing this risk.'

ACCEPTED		PARTIALLY ACCEPTED	REJECTED
Airprox	**Recommendation**	**Comments**	
2019210	Gloucestershire Airport to clarify their AIP entry regarding departure procedures.	An AIP change has been submitted and should be in place in the October AIRAC.	
2019221	Old Sarum to review their AIP entry to ensure coherence with the Old Sarum website and proprietary flight guide information.	Old Sarum has voluntarily surrendered their Aerodrome License and has now closed. This action was carried out prior to the recommendation being implemented by the Airport Manager.	
2019226	1. The P68 operating company considers further mitigations to MAC for survey operations.		
2019226	2. The CAA considers mandating additional cockpit crew to enable enhanced lookout for single-pilot survey operations.	CAA revised response - 'We recognise the unique hazard of the operations in question and therefore, in response to the recommendation, confirm that the CAA Partially Accepts this recommendation and will conduct a review of the risk assessments of survey operators, to ensure they meet the requirements of AMC SPO.OP.230(b) and are robust in addressing this risk.'	
2019227	1. The C404 operating company considers further mitigations to MAC for survey operations.	Company has reviewed the Risk Assessment, is considering TAS for the lighter (<5700kg) aircraft in their fleet, is reviewing supplementing lookout (through use of the task specialist, rather than a supplementary crewmember), is reviewing task locations and scheduling and has re-issued a Safety Notice to crews on the subject of operating ivo glider sites.	
2019227	2. The CAA considers mandating additional cockpit crew to enable enhanced lookout for single-pilot survey operations.	CAA revised response - 'We recognise the unique hazard of the operations in question and therefore, in response to the recommendation, confirm that the CAA Partially Accepts this recommendation and will conduct a review of the risk assessments of survey operators, to ensure they meet the requirements of AMC SPO.OP.230(b) and are robust in addressing this risk.'	
2019238	The MAA ensures that military operators fully understand the definition and application of the term 'MARSA'.	RA amended with a reference for individuals to refer to MARSA.	
2019257	Gloucester to consider applying for an SSR transponder conspicuity code.	Recommendation rejected due to workload and a backlog of training requirements.	
2019264	Goodwood to review fixed-wing and rotary-wing circuit deconfliction.	RECCOMMENDATION REMAINS OPEN	
2019282	Kent Gliding Club and Lydd Airport establish a Letter of Agreement to address the risk of concurrent activities in the same volume of airspace.	Recommendation rejected.	

ACCEPTED		PARTIALLY ACCEPTED	REJECTED
Airprox	**Recommendation**	**Comments**	
2019287	Nottingham/Tollerton airfield to consider publishing procedures for the integration of faster jet aircraft with other circuit traffic.	The airport safety committee re-visited the incident with the possibility of a fast jet circuit being implemented at Nottingham. Of the committee members present at the meeting, there was a unanimous decision against a fast jet circuit. Following on from a previous meeting the Jet Provost crews have agreed to re-join the circuit via an overhead join. The Nottingham AIP entry will be amended to warn users that a fast-jet operates from the airfield and posters have been displayed for increased awareness of local pilots.	
2019294	The BGA reiterate guidance to gliding clubs regarding the significant mitigation to mid-air collision afforded by fitment of SSR transponders to tug aircraft.	The BGA has subsequently reminded their clubs that transponders in tug aircraft may help to reduce MAC risk under certain circumstances. In addition, they worked with a major club to establish a towing transponder code, which is now in use and was promulgated to clubs earlier this year.	
2019298	Dunkeswell airfield and the Devon And Somerset Gliding Club reach agreement to include parachuting operations within their Letter of Agreement.	Cooperation Agreement signed between Dunkeswell Airfield (inc Skydiving ops) and DSGC.	
2019300	MoD considers the introduction of a flow arrow for the Honister Pass.	Recommendation rejected after comprehensive safety review.	
2019323	The CAA considers reviewing the UK AIP, ENR 1.6, paragraph 4.5.5, to define the point at which the ‘lifting’ call is to be made.	The CAA has reviewed the recommendation internally, and has also consulted with the offshore industry, the outcome of which is that the current AIP entry is deemed to remain appropriate for the current operating environment. There was a consensus that the UKAB's observations about the Forties Field communications availability on deck does not extend to all offshore platforms and, as such, the 'not above 1000ft or as soon as practical' remains fit for purpose.	

AIRPROX CATALOGUE 2020

The table below is an abbreviated form of the 2020 Airprox Index that is available on the UKAB Website - Individual reports can also be accessed using the hyperlinks within the table.

NUMBER	RISK	AIRCRAFT 1	AIRCRAFT 2	SECTOR MIX
2020001	B	SOCATA - TB20	UNKNOWN	GA-Unk ac
2020002	C	DIAMOND - DA42	PIPER - PA28	GA-GA
2020003	D	DE HAVILLAND - DHC1	UNKNOWN	GA-Unk ac
2020004	C	BOEING - 787	UNKNOWN (RPAS)	CAT-SUAS
2020006	C	CESSNA - 421	PIPER - PA28	Civ Comm-GA
2020007	B	BOEING - 737	UNKNOWN (RPAS)	CAT-SUAS
2020008	B	MCDONNELL DOUGLAS - MD900	UNKNOWN (Kite)	GA-SUAS
2020010	B	DIAMOND - DA40	UNKNOWN	GA-Unk ac
2020011	C	AIRBUS - A319	UNKNOWN (Object)	CAT-SUAS
2020012	C	EMBRAER - ERJ190	UNKNOWN (Object)	CAT-SUAS
2020014	B	PIPER - PA28	ROBINSON - R44	GA-GA
2020016	E	OTHER - Military (Wildcat)	OTHER - Military (Tutor)	Mil-Mil
2020017	C	BOMBARDIER - CL600 2B19	MOONEY - M20J	Civ Comm-GA
2020018	B	OTHER - Military (Phenom)	OTHER - Military (Tutor)	Mil-Mil
2020019	C	OTHER - Military (Tutor)	DIAMOND - DA42	GA-Mil
2020020	C	AIRBUS - A320	AIRBUS - A380	CAT-CAT
2020021	E	BOEING - 757	UNKNOWN (Object)	CAT-SUAS
2020022	E	SCHLEICHER - ASK21	MD HELICOPTER - 500	GA-GA
2020023	C	DE HAVILLAND - DHC8 - 400	UNKNOWN (Object)	CAT-SUAS
2020024	A	SAAB - 340 - B	UNKNOWN (RPAS)	CAT-SUAS
2020025	E	OTHER - Military (Chinook)	AEROSPATIALE - AS350	GA-Mil
2020026	C	DIAMOND - DA42	CESSNA - 152	GA-GA
2020027	C	OTHER - Military (Prefect)	CESSNA - 182	GA-Mil
2020028	B	PILATUS - PC21	UNKNOWN (RPAS)	Mil-SUAS
2020030	E	SAAB - 340 - B	F15	CAT-Mil
2020031	D	UNKNOWN (DJI Mavic 2 RPAS)	OTHER (Cabri G2)	GA-SUAS
2020032	C	OTHER - Military (Puma)	BRITTEN NORMAN - BN2T	Civ Comm-Mil
2020033	C	BOEING - 747	UNKNOWN (Object)	CAT-SUAS
2020034	E	AIRBUS - A320	UNKNOWN (Object)	CAT-SUAS
2020035	B	OTHER - Military (Apache)	OTHER - Military (Apache)	Mil-Mil
2020036	B	BOEING - 747	UNKNOWN (RPAS)	CAT-SUAS
2020037	B	OTHER - Military (Hawk)	OTHER - Military (Texan)	Mil-Mil
2020038	C	OTHER - Military (Apache)	EUROCOPTER (EC145)	Mil-Emerg Servs
2020039	C	OTHER - Generic (DJI Matrice)	CESSNA - 150	GA-SUAS
2020040	C	OTHER - Military (Voyager)	UNKNOWN	Mil-Unk ac
2020041	C	CYCLONE AIRSPORTS - PEGASUS QUIK	UNKNOWN	GA-Unk ac
2020042	C	DASSAULT - MYSTERE FALCON20	UNKNOWN (Model Aircraft)	Civ Comm-SUAS
2020043	C	DASSAULT - MYSTERE FALCON20	UNKNOWN (RPAS)	Civ Comm-SUAS
2020044	C	DASSAULT - MYSTERE FALCON20	SCHLEICHER - ASK13	Civ Comm-GA
2020045	A	CYCLONE AIRSPORTS - PEGASUS QUIK	NORTH AMERICAN - P51 - D	GA-GA
2020046	B	OTHER - Military (Shadow)	UNKNOWN (RPAS)	Mil-SUAS
2020047	E	OTHER - Military (Avenger)	SCHEMPP HIRTH - DISCUS A	GA-Mil
2020048	C	VANS - RV10	OTHER (Paramotor)	GA-Unk ac
2020049	E	EUROCOPTER (EC145)	UNKNOWN (Object)	Emerg Servs-SUAS
2020050	C	FUJI - FA200	UNKNOWN	GA-Unk ac
2020051	E	AVIONS ROBIN - DR400 (and Arcus T)	ROBINSON - R44	Civ Comm-GA

NUMBER	RISK	AIRCRAFT 1	AIRCRAFT 2	SECTOR MIX
2020052	E	PIPER - PA28	OTHER - Military (Osprey)	GA-Mil
2020053	E	BEECH - 200	EXTRA	GA-Emerg Servs
2020054	E	GROB - G102 - STANDARD ASTIR	CESSNA - 182	GA-GA
2020055	C	OTHER - Military (Juno)	CESSNA - 172	GA-Mil
2020056	C	UNKNOWN (RPAS)	AEROSPATIALE - AS355	Civ Comm-SUAS
2020057	E	DASSAULT - FALCON2000	OTHER - Military (Hunter)	Civ Comm-Civ Comm
2020058	C	AIRBUS - A320	PARTENAVIA - P68	CAT-Civ Comm
2020059	C	DIAMOND - DA40	NORTH AMERICAN - P51	GA-GA
2020060	B	BELL - 412 - EP	UNKNOWN	Civ Comm-Unk ac
2020061	E	OTHER - Military (Wildcat)	SLINGSBY - T67	GA-Mil
2020062	B	SCHLEICHER - ASK21	DE HAVILLAND - DH104	GA-GA
2020063	E	OTHER - Military (Wildcat)	UNKNOWN	Mil-Unk ac
2020064	B	BEAGLE - A61	SOCATA - TB10	GA-GA
2020065	C	PIPER - PA28	UNKNOWN (RPAS)	GA-SUAS
2020066	B	GROB - G109	EVEKTOR AEROTECHNIK - EV97	GA-GA
2020067	C	GROB - G115	UNKNOWN	GA-Unk ac
2020068	C	OTHER - Military (Shadow)	OTHER - Military (Typhoon)	Mil-Mil
2020069	B	OTHER - Military (Typhoon)	CESSNA - 182	GA-Mil
2020070	B	GROB - G102	COMCO IKARUS - IKARUS C42	GA-GA
2020071	C	AIRBUS - A320	UNKNOWN (RPAS)	CAT-SUAS
2020072	B	BOEING - 787	UNKNOWN (Object)	CAT-SUAS
2020073	A	CESSNA - 172	UNKNOWN (RPAS)	GA-SUAS
2020074	C	CHRISTEN - EAGLE II	OTHER - Military (Tutor)	GA-Mil
2020075	B	BOEING - 787	UNKNOWN (Object)	CAT-SUAS
2020076	C	SCHEMPP HIRTH (Arcus T)	DIAMOND - DA40	GA-GA
2020077	C	OTHER (Cabri G2)	PIPER - PA28	GA-GA
2020078	C	OTHER - Not mapped (AW169)	MILES (Gemini)	GA-Emerg Servs
2020079	A	CESSNA - 560	UNKNOWN (Balloon)	Civ Comm-SUAS
2020080	C	SCHLEICHER - ASK21	YAKOVLEV - YAK1	GA-GA
2020081	E	OTHER - Generic (EC145)	BOEING - EC135	Emerg Servs-Emerg Servs
2020082	A	AMS - LS6	PIPER - PA34	GA-GA
2020083	C	EUROCOPTER - EC135	ROLLADEN SCHNEIDER - LS4	GA-GA
2020084	E	CESSNA - 680	PIPER - PA46	Civ Comm-GA
2020085	B	COMCO IKARUS - IKARUS C42	COMCO IKARUS - IKARUS C42	GA-GA
2020086	C	OTHER (AW169)	RIHN - DR107	GA-Emerg Servs
2020087	C	OTHER - Military (Tutor)	OTHER - Military (F15)	Mil-Mil
2020088	C	AIRBUS - A400M	UNKNOWN	Mil-Unk ac
2020089	C	SCHLEICHER - ASW27	PILATUS - PC12	Civ Comm-GA
2020090	C	GROB - G102 - CLUB ASTIR	BEECH - 23	GA-GA
2020091	E	OTHER (Cabri G2)	PIPER - PA28	GA-GA
2020092	E	BEECH - 200	SCHEMPP HIRTH - DUO DISCUS	Civ Comm-GA
2020093	C	OTHER - Generic (Skyranger)	PIPER - PA28	GA-GA
2020094	B	CESSNA - 152	CESSNA - 182	GA-GA
2020095	B	OTHER - Military (Juno)	BEECH - 55	GA-Mil
2020096	B	OTHER - Military (F15 x 2)	UNKNOWN (Glider x 2)	Mil-Unk ac
2020097	C	AIRBUS - A320	UNKNOWN (RPAS)	CAT-SUAS
2020098	C	CESSNA - 404	UNKNOWN (RPAS)	Civ Comm-SUAS
2020099	C	SCHLEICHER - ASK13	SUPERMARINE - SPITFIRE	GA-GA
2020100	C	EMBRAER - EMB505	UNKNOWN (Object)	Civ Comm-SUAS
2020101	D	SCHLEICHER - ASW27	UNKNOWN	GA-Unk ac
2020102	E	GLASFLUGEL - 304	SCHEMPP HIRTH - VENTUS2C	GA-GA
2020103	B	OTHER (Skyranger)	PIPER - PA28	GA-GA
2020104	B	OTHER (Venture TMG)	MOONEY - M20	GA-GA

NUMBER	RISK	AIRCRAFT 1	AIRCRAFT 2	SECTOR MIX
2020105	A	BOEING - 737	UNKNOWN (Object)	CAT-SUAS
2020106	B	DIAMOND - DA40	PITTS - S1	GA-GA
2020107	E	PIPER - PA25	CESSNA - 510	Civ Comm-GA
2020108	A	AIRBUS - A320	UNKNOWN (RPAS)	CAT-SUAS
2020109	A	DASSAULT - FALCON2000	GLASFLUGEL - 303	Civ Comm-GA
2020110	A	AIRBUS - A319	UNKNOWN (RPAS)	CAT-SUAS
2020111	C	DIAMOND - DA40	UNKNOWN	GA-Unk ac
2020112	C	PARTENAVIA - P68	UNKNOWN	Civ Comm-Unk ac
2020113	C	EUROCOPTER - EC135	UNKNOWN (RPAS)	Emerg Servs-SUAS
2020114	E	EUROCOPTER - EC135	ROBINSON - R22	GA-Emerg Servs
2020115	E	DASSAULT - MYSTERE FALCON20	PIPER - PA18	Civ Comm-GA
2020116	C	PIPER - PA28	MCDONNELL DOUGLAS - 500	GA-GA
2020117	B	SISLER - SF2	PIPER - PA23	GA-GA
2020118	C	BOEING - 737	UNKNOWN (Balloon)	CAT-SUAS
2020119	E	OTHER - Military (Hawk)	EVEKTOR AEROTECHNIK - EV97	GA-Mil
2020120	E	PARTENAVIA - P68	PAC - 750XL	Civ Comm-Civ Comm
2020121	C	SIKORSKY - S92	CYCLONE AIRSPORTS - PEGASUS QUIK	Civ Comm-GA
2020122	C	DIAMOND - DA40	CIRRUS - SR20	GA-GA
2020123	C	OTHER - Military (Apache)	UNKNOWN (RPAS)	Mil-SUAS
2020124	C	CESSNA - 404	PIPER - PA28	Civ Comm-GA
2020125	A	DASSAULT - MYSTERE FALCON20	UNKNOWN (RPAS)	Civ Comm-SUAS
2020126	B	DIAMOND - DA42	OTHER - (Jet Provost)	GA-GA
2020127	A	PIPER - PA28	CESSNA - 172	GA-GA
2020128	E	BOEING - 737	UNKNOWN (Object)	CAT-SUAS
2020129	C	SCHLEICHER - ASK21	BEECH - 36	GA-GA
2020130	B	AIRBUS - A319	UNKNOWN (RPAS)	CAT-SUAS
2020131	C	PIPER - PA28 - 161	UNKNOWN (RPAS)	GA-SUAS
2020132	C	OTHER - Military (Hawk)	OTHER (RotorSport MT-03)	GA-Mil
2020133	B	PIPER - PA18	PIPER - PA46	GA-GA
2020134	B	PIPER - PA28	PIPER - PA32	GA-GA
2020135	C	AIRBUS - A321	UNKNOWN (RPAS)	CAT-SUAS
2020136	B	OTHER - (Sportavia)	DIAMOND - DA40	GA-GA
2020137	B	OTHER - Generic (Cabri G2)	DE HAVILLAND - DH115	GA-GA
2020138	E	OTHER (Canopy Suspended)	AEROSPATIALE - AS355	GA-GA
2020139	C	FOURNIER - RF3	OTHER - Not mapped (CZA SportCruiser)	GA-GA
2020140	C	OTHER - Military (Tutor)	UNKNOWN (RPAS)	Mil-SUAS
2020141	A	COMCO IKARUS - IKARUS C42	CESSNA - 152	GA-GA
2020142	C	OTHER - Military (Hawk)	UNKNOWN (Model Aircraft)	Mil-SUAS
2020143	B	OTHER - Generic (EC145)	CESSNA - 150	GA-Emerg Servs
2020144	A	CIRRUS - SR22	UNKNOWN (RPAS)	GA-SUAS
2020145	C	BEECH - 76 - NO SERIES EXISTS	EMBRAER - EMB505 - PHENOM 300	Civ Comm-GA
2020146	A	OTHER (AW169)	PIPER - PA28	GA-Emerg Servs
2020147	C	SCHLEICHER - ASK21	PIPER - PA28	GA-GA
2020148	C	CESSNA - 510	UNKNOWN (Object)	Civ Comm-SUAS
2020149	E	OTHER - Generic (AW169)	ROBINSON (R66)	GA-Emerg Servs
2020150	A	AIRBUS - A321	UNKNOWN (Object)	CAT-SUAS
2020151	C	PIPER - PA34	GROB - G109	GA-GA
2020152	B	SCHEIBE - SF25 - C	PIPER - PA28	GA-GA
2020153	B	SCHLEICHER - ASK13 - NO SERIES EXISTS	PIPER - PA22	GA-GA
2020154	B	OTHER - Military (Tutor)	OTHER - Military (F35x2)	Mil-Mil
2020155	B	PIPER - PA31	UNKNOWN (RPAS)	Civ Comm-SUAS

NUMBER	RISK	AIRCRAFT 1	AIRCRAFT 2	SECTOR MIX
2020156	B	OTHER (Sonaca 200)	PIPER - PA28	GA-GA
2020157	C	BEECH - 200	EMBRAER - EMB145	CAT-Civ Comm
2020158	C	OTHER - Military (Wildcat)	OTHER - Military (Wildcat)	Mil-Mil
2020159	A	PZL BIELSKO - SZD51	PIPER - PA28	GA-GA
2020160	A	COMCO IKARUS - IKARUS C42	PIPER - PA28	GA-GA
2020161	B	COMMANDER	ROBINSON - R44	GA-GA
2020162	C	OTHER - Military (Voyager)	OTHER - Military (Typhoon)	Mil-Mil
2020163	E	SIKORSKY - S92	EUROCOPTER (EC175)	Civ Comm-Civ Comm
2020164	C	EVEKTOR AEROTECHNIK - EV97	OTHER (A-22 Foxbat)	GA-GA
2020165	C	OTHER - Military (Wildcat)	OTHER - Military (Merlin)	Mil-Mil
2020166	B	DIAMOND - DA42	OTHER - Military (Jupiter)	Civ Comm-GA
2020167	C	VANS - RV9	OTHER - Military (Phenom)	GA-Mil
2020168	C	OTHER (Nova Mentor 4 paraglider)	JODEL - D117	GA-GA