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Statistics of Military Helicopter Accidents in Czechoslovakia and the Czech Republic

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Abstract:

The article is focused on the statistics of aviation accidents of military helicopters in the service of Czechoslovakia and the Czech Republic since 1956, when helicopters were first assigned to military units in the former Czechoslovakia, until the end of 2021. It contains not only a unique and previously unpublished comprehensive numerical overview of aviation accidents (disasters, crashes and damage events), but also an analytical review in terms of the type of accidents, the date of their occurrence, the type of helicopter and also the number of killed and surviving crew members. These numerical summaries are accompanied by comments, as well as by a list of literature and information sources that are currently still available in relation to the subject.

Keywords:

aviation accident, Army of the Czech Republic, Czechoslovak People's Army, military helicopter, statistics

1 Introduction

In the former Czechoslovakia, the history of military helicopter aviation began only in 1956, when the first Soviet Mil Mi-4 helicopters were introduced into the airforce inventory of the then Czechoslovak People's Army (hereafter "CSLA" from "Československá lidová armáda" in Czech).

Another 11 types of helicopters, largely of Soviet design, followed over time (listed in chronological order of the year of introduction in the service with the CSLA: the Mil Mi-1, Mil Mi-8, Mil Mi-24, Mil Mi-2, Mil Mi-9, Mil Mi-17, Mil Mi-35, and Mil Mi-171Š). Among the helicopters introduced into the inventory were also the Czechoslovak Aero HC-2 "Heli Baby", the Polish PZL W-3A Sokol, and the American Enstrom 480B-G.

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Some of them were even operated in many versions, albeit only in one or a few units, such as in particular the Soviet-designed Mil Mi-4 (versions: -, A, B, A/B, A/F), Mil Mi-1 (versions: -, A, B, U, M, MU, Mb, MNCh, NCh), Mil Mi-8 (versions: T, S, P, PS, PPA), Mil Mi-24 (versions: D, V, DU), and Mil Mi-2 (versions: T, P, Sz, URP, RCh) [1].

As far as helicopter versions are concerned, an interesting example is the Mil Mi-9 Ivolga (original Soviet designation Mil Mi-8 VKP) with the marking 0001. Only one helicopter of this type was operated between 1984 and 2005 as a reserve military air command for all-military, tank or air divisions. It was then converted to the P version ("passenger" variant for 18 passengers) and served as such until 2017 [1].

It is also a little known fact that the designations Mil Mi-17 and Mil Mi-171Š are merely export designations for the original Soviet and then Russian Mil Mi-8MTV (modernized transport high-altitude version) and Mil Mi-8AMTŠ (military transport and attack version) helicopters.

Similarly, the Mil Mi-35 is the export designation of the partially modified Mi--24V helicopter, which was retrofitted by the manufacturer at the request of the customer (Czech Republic) with a more powerful altitude engine, modified power steering, black cockpit color compatible with night vision goggles (NVG) systems in use, and dashboard labels in English.

It has become difficult to accurately link certain types and versions of helicopters to specific aviation accidents, especially when it comes to damage-type accidents (see Section 3) of the Mil Mi-4, Mil Mi-1, Mil Mi-8 and Mil Mi-2 helicopters. This is due to the technical modifications often made in the past to some of these types of helicopters, which led to changes in their version designation and, not infrequently, to changes in the marking. In this manner, the original identity of some of the aircraft has been lost in the archive documentation over time and therefore it is sometimes difficult to draw up a summary table with the number of air accidents for individual versions of helicopters. But this problem is not fatal, because often only minor differences between helicopter versions had almost no influence on the occurrence and course of an air accident and the determining factor was usually the type of helicopter.

The study of past experience is absolutely essential for the flight safety of today. There we find a number of inspiring suggestions and the roots of still present professional customs and traditions, sadly including the dangerous ones. The creation and study of statistical analyses of air accidents in military aviation is therefore still indispensable.

2 Thematic Framework and Available Information Sources

This study focuses on the statistics of aviation accidents of military helicopters in the service of Czechoslovakia and the Czech Republic between 1956 and 2021, covering the entire period of military helicopter aviation in the former Czechoslovakia and the present Czech Republic. Aviation accidents are divided into three types: disasters, crashes and damage (see Section 3 for details).

The information sources used to compile the summaries below can be divided into five groups.

The first group consists of aviation non-fiction books by Libor Režňák [2, 3] and Jaroslav Špaček [3], based on expert interpretation of sources from the Military Central Archives in Prague [5] and their own experience in military aviation. The books are mainly devoted to military aviation accidents in the former Czechoslovakia. For

the purpose of this article, the information from their books was suitably supplemented by personal correspondence and consultations with both authors. The first two sources (that is [2, 3]) cover in detail the period 1948-1960.

The second group of information sources covers the period from 1960-1984 and consists principally of a five-volume military instruction book for the Air Forces of the CSLA written by Col. Stanislav Slavík, Senior Flight Safety Inspector in the 10th Air Force in Hradec Králové from the 1960s to the 1980s [6-10]. The individual volumes of the book contain, among other things, a comprehensive overview of aviation accidents for the given period and accompanying comments, reflections and partial statistical analyses. They were issued as a key classified internal material of the then CSLA to step up the air accident prevention.

The third group of information sources covers the period 1985-2021 and is represented by the electronic database of the military Information System of Logistics (hereafter "ISL") [11], where events can already be searched and filtered according to selected criteria.

The fourth and most important group of information sources consists of original investigation reports of aviation accidents, which were found in the Central Military Archives in Prague [5] and especially in the Administrative Archives of the Army of the Czech Republic in Olomouc [12].

The fifth – and the most interesting – group of information sources were the testimonies of dozens of living direct participants of the aviation accidents in question (crews of the crashed and damaged helicopters), who helped to complement some parts of the investigation reports with their comments and often still very clear memories. By and large, the most difficult information to access today is the information on damage-type aviation accidents.

3 Classification of Aircraft Accidents

The definition of the term "Aviation Accident" is currently set out in the Order of the Minister of Defence No. 13/2016 of the Journal [13]. According to this Order, the three previously distinguished types of aviation accidents (disaster, air crash and damage) are now merged under one common designation.

In this study, for better clarity and illustration of the principles in the root cause chains of accidents, the author has decided to use the former classification of aviation accidents pursuant to the Všeob-P-10 Flight Safety Regulation [14]. This formerly applicable regulation divided aviation accidents into *disasters* (an aviation accident involving loss of life of flight crews or other persons involved), *air crashes* (an aviation accident involving destruction of aircraft equipment without loss of life of crew members or other persons involved), and *damage* (an aviation accident involving repairable damage to aircraft equipment without loss of life of crew members or other persons involved). The reason for this decision by the author is the frequent distinct differences in the chains of causes in different types of aviation accidents.

4 Statistical Overviews

The statistical overviews below show graphs with total numbers of aviation accidents and historical dates important for helicopter flying (see Fig. 1), and then summaries of the number of aviation accidents of specific types (disasters, air crashes, damage) grouped by type of aircraft for the period 1956-2021 (see Figs 2 and 3). These are

followed by a summary of the number of helicopter crew members who were killed in or survived air disasters (see Fig. 5).

The summaries are timelined. In Fig. 2 they are broken down by type of aircraft and supplemented with totals for each type of helicopter and each year. The bottom left corners show the total of aviation accidents of a given type (see Figs 2-4) or the total of crew members killed and survivors for the helicopter types that were involved in air disasters (see Fig. 5). The numbers in parentheses in Fig. 5 represent the number of crew members who survived those air disasters.

The summaries also indicate the order in which each type of military helicopter entered service, the duration of service, and the total number of helicopters. The highlighted boxes indicate the types of helicopters that were involved in an aviation accident of that particular type and the corresponding years.

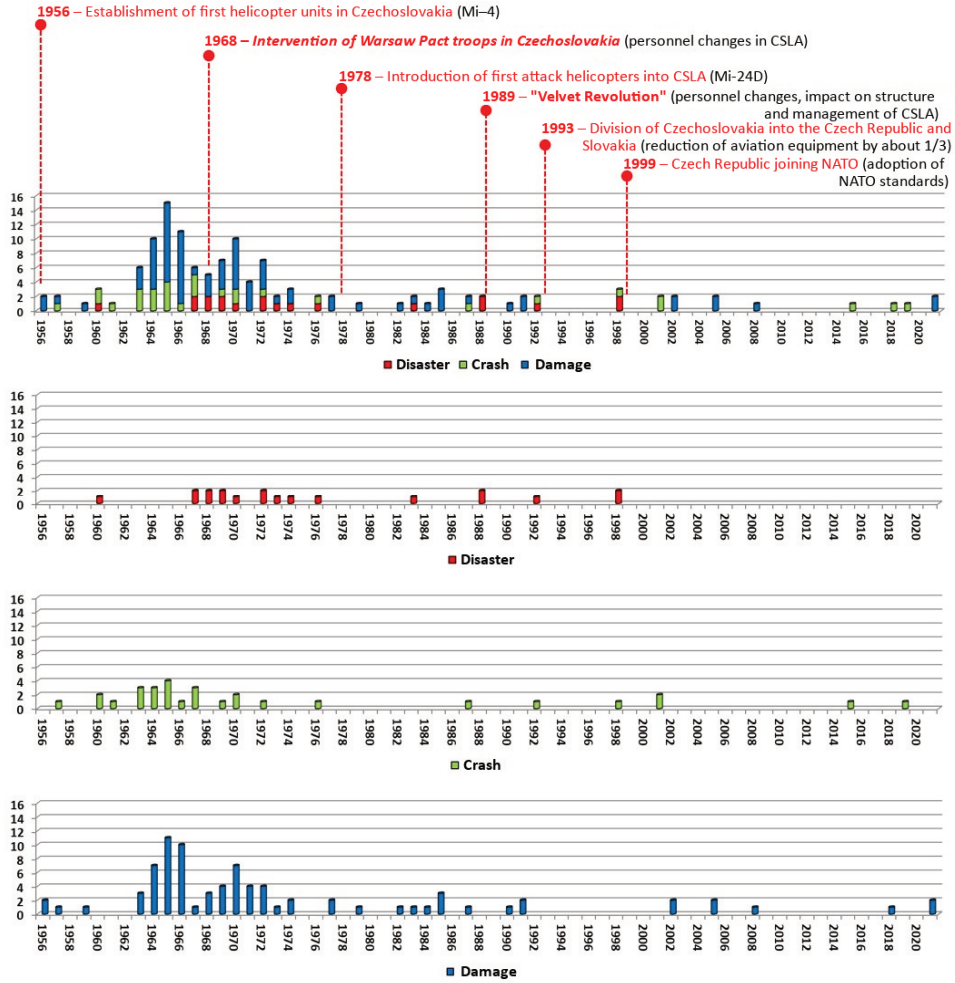

Fig. 1 Aviation accidents of military helicopters in the service of Czechoslovakia and the Czech Republic in 1956-2021 (timelined, grouped air accident types, with historical year dates important for helicopter flying and a short commentary) [1-12]

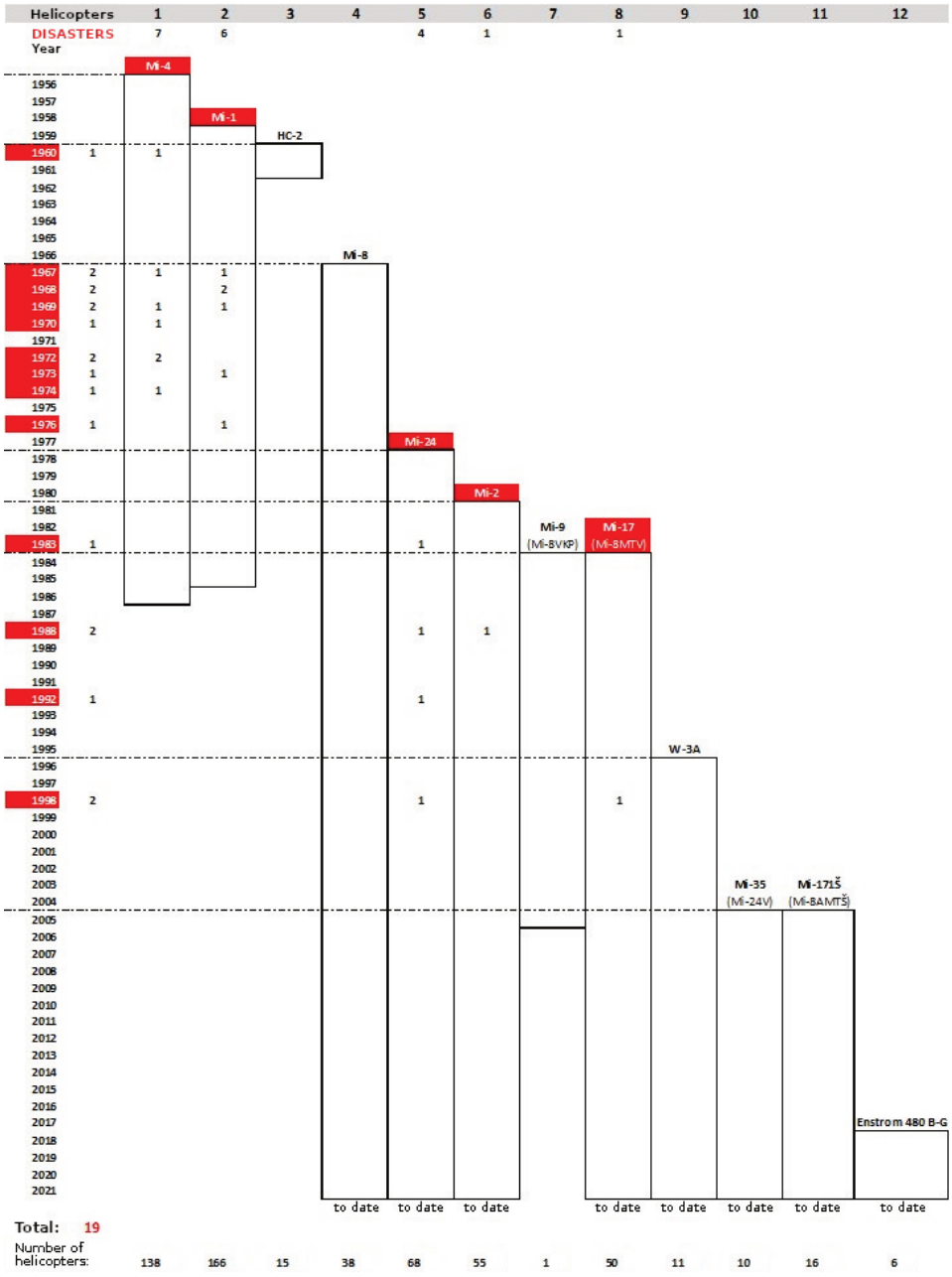

Fig. 2 Air disasters of military helicopters in the service of Czechoslovakia and the Czech Republic in 1956-2021 (grouped by helicopter types and their entry into service on the timeline) [1-12]

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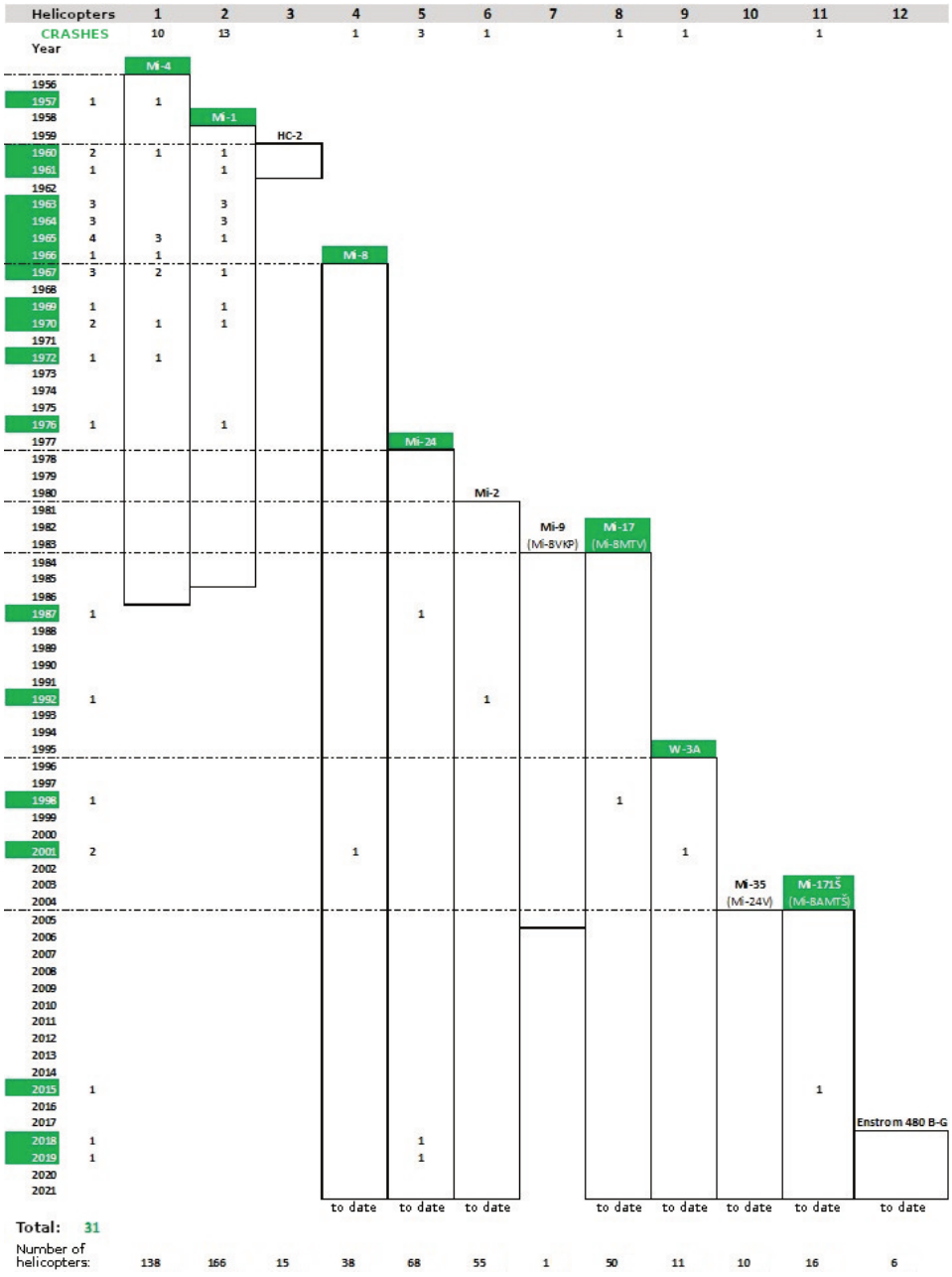

Fig. 3 Air crashes of military helicopters in the service of Czechoslovakia and the Czech Republic in 1956-2021 (grouped by helicopter types and their entry into service on the timeline) [1-12]

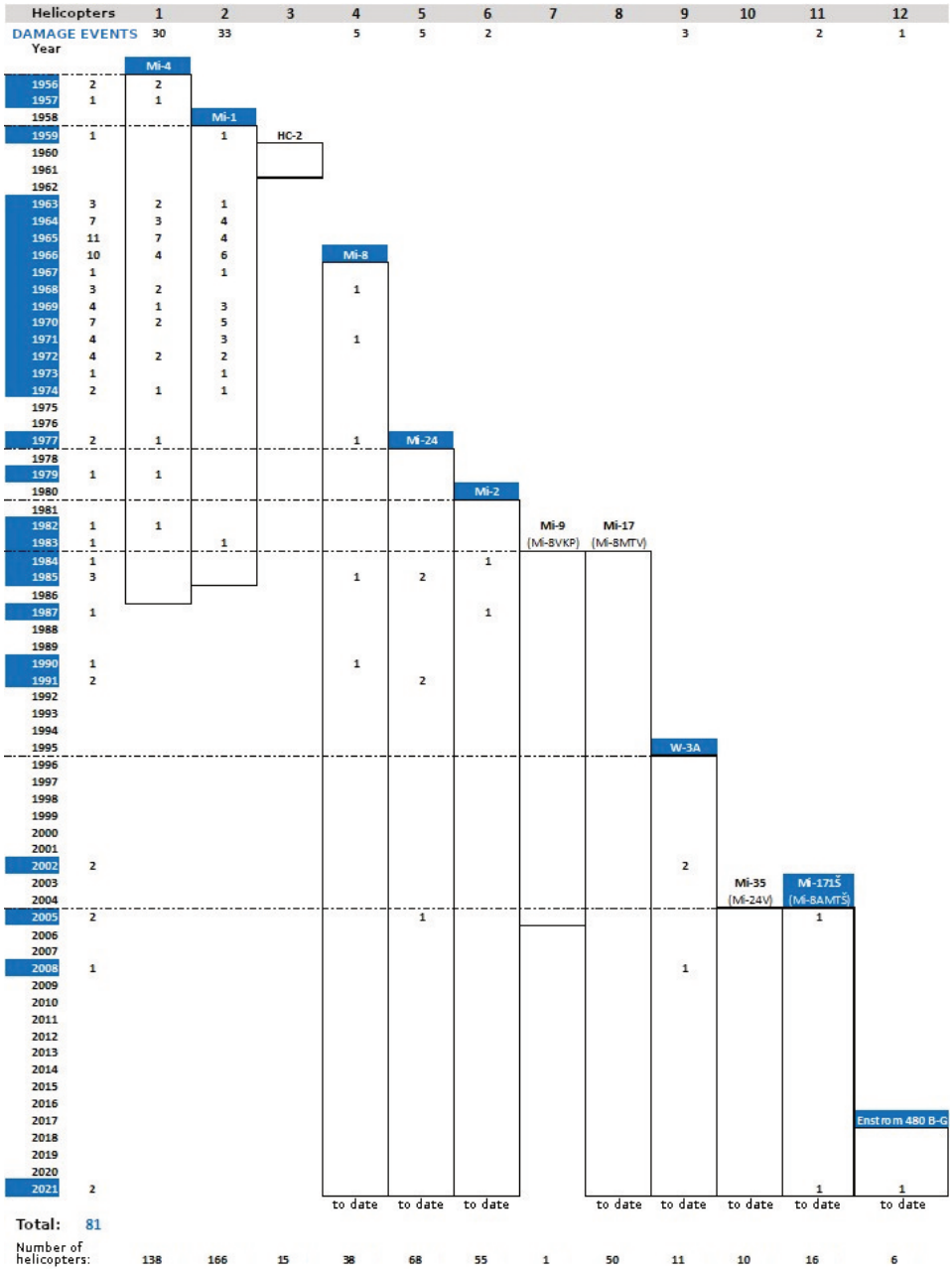

Fig. 4 Damage events of military helicopters in the service of Czechoslovakia and the Czech Republic in 1956-2021 (grouped by helicopter type and their entry into service on the timeline) [1-12]

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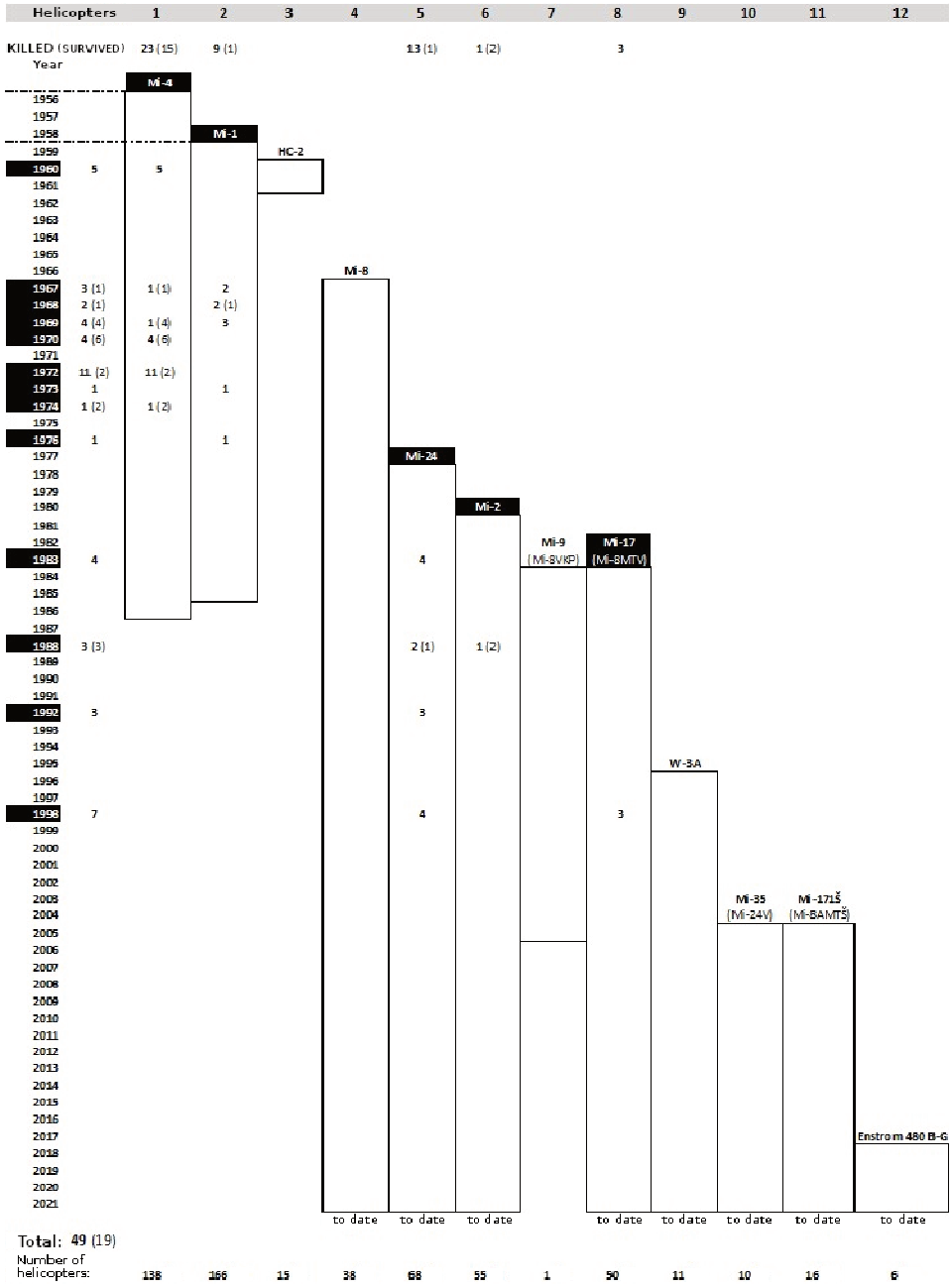

Fig. 5 Number of crew members who died vs. survived (in parenthesis) in air disasters of military helicopters in the service of Czechoslovakia and the Czech Republic in 1956-2021 (grouped by helicopter types and their entry into service on the timeline) [1-12]

5 Interesting Facts, Contexts and Development Trends

Statistical summaries expressed in numbers cannot suffice on their own without being considered in a sufficiently broad context, especially the historical context of the technical, military, geopolitical and social areas.

Any change in these areas affects over time not only the system of functioning of the military, but also the individuals who work within that system. This creates conditions for potentially recurring mistakes or emergence of entirely new ones. Such mistakes, in certain combinations, may create chains of causes for future aviation accidents. We are therefore trying to pay close attention to the historical context so that the true root causes of the problems can be identified and, on that basis, effective safety measures can be developed for the future.

5.1 Analysis of Aviation Accidents by their Type

Out of a total of 131 ascertainable aviation accidents (between 1956 and 2021), 19 disasters, 31 air crashes and 81 damage events were identified (operating a total of 574 helicopters – for more details see below).

The first disaster was recorded as early as in 1960 (28 March 1960, Mi-4 helicopter, technical failure: rotor blade lost in flight), and the last one so far was recorded in 1998 (10 November 1998, Mi-24V helicopter, cause not proven: probably spatial disorientation due to instrument failure during flight in difficult weather conditions at the day-night boundary). The highest number of disasters (12, i.e. 63 % of the total number of 19 aviation accidents of this type) was recorded between 1967 and 1976. The cause was typically:

- fatal technical malfunction of the aircraft (rotor blade loss, engine unit shutdown due to impurities in the fuel system, helicopter control shutdown due to mechanical failure, failure of some on-board instruments),
- difficult weather conditions (icing, low or no visibility on the flight path) often in combination with human error by the crew (misjudgment of the ability to complete the flight task under given conditions, piloting errors or non-compliance with flight rules by the crew),
- difficult terrain with obstacles (failure to maintain minimum safe flight altitude, collisions with power lines, etc.),
- purely deliberate or unintentional errors by the flight crew (piloting errors or non-compliance with flight rules).

In the 1960s and 1970s errors were often unavoidable because pilots were inexperienced with this (then relatively new and untested) aircraft technology and there was a lack of a sufficiently comprehensive, quality regulatory base. Later on, however, human error, indiscipline and inconsistency came into play, circumstances that were in most cases preventable. It would be misleading to assign specific examples of air accidents to the listed causes, since an air accident is usually caused by a chain of multiple causes.

For crashes and damage, the situation is slightly different. In this case, the level of damage to aircraft is often not determined by significant differences in the chain of causes, but rather by the terrain at the site of the forced landing or impact. This is mainly due to the type of landing gear on most of the types of helicopters operated. With the exception of the latest Enstrom 480B-G training helicopter, which is equipped with skids, the other 11 helicopter types in all their operational variants have

wheeled landing gears. Wheeled landing gears have a number of advantages, but also several pitfalls. The advantages include the possibility of surface taxiing and easy handling of the helicopter on sufficiently paved surfaces, rolling takeoffs (for example, when carrying heavy loads in hot thin air – see modified piloting techniques during the Afghanistan conflict in 1979-1989), roll-on landings (e.g. from autorotation mode), etc. The disadvantages include the tendency of any part of the landing gear to dig into soft grounds or mechanically lock up in rugged and sloping terrains (slopes, humps). Therefore, if a helicopter made an emergency landing in a difficult (i.e. sloping, rugged or soft) terrain, such a landing often resulted in a rollover, which then caused a crash rather than damage due to the extent of the damage incurred.

The first air crash was recorded as early as in 1957 (11 June 1957, Mi-4 helicopter, piloting error: pilot's inexperience with flying in wind) and the last one so far in 2019 (19 June 2019, Mi-24V helicopter, non-compliance with the rules by the flight crew: take-off with an overloaded helicopter).

The first damage was recorded even earlier, in 1956 (12 September 1956, Mi-4 helicopter, weather conditions: damage to the tail section by a rotor blade wobbling in gusty winds after landing) and the last one so far in 2021 (12 August 2021, Enstrom-480B helicopter, non-compliance with rules by the flight crew: pilot's inexperience in selecting the route, altitude and flight mode).

5.2 Distribution of Aviation Accidents by Type of Aircraft

The safety of operation of particular types of aircraft cannot be assessed solely on the basis of the number and causes of aviation accidents, but also other facts related to the operation of a given aircraft in a particular historical period must be considered. These can be divided principally into 4 groups:

- facts about aviation technology – *technical factors*
  (e.g. performance characteristics, operational limitations, type-specific defects, technical lifespan, flight hours flown, aerodynamic particularities, ergonomic features),
- facts about flight and non-flight personnel – *human factors*
  (e.g. quality of training, information support, performance motivation, theoretical knowledge, practical experience),
- facts about the flight activity environment – *environmental factors*
  (e.g. meteorological conditions, terrain, bird control),
- facts about the air traffic control and management – *organizational factors*
  (e.g. mode of operation – types of flight tasks: range of altitudes, speeds, maneuvers, flight times, operational load, number of years in active service with the military, numbers of units operated; mode and quality of maintenance; mode and quality of checks on real flight crew performance - effective objective control systems; quality of air traffic control, quality of regulatory base, training opportunities).

In terms of the total number of aviation accidents, 3 types of helicopters are predominant (see Figs 2-5): the Mil Mi-1 (52 aviation accidents: 6 disasters, 13 crashes, 33 damage; 9 casualties); Mil Mi-4 (47 aviation accidents: 7 disasters, 10 crashes, 30 damage; 23 casualties); and Mil Mi-24 (12 aviation accidents: 4 disasters, 2 crashes, 6 damage; 13 casualties).

Before we make an assessment of the operation safety of the 3 types of helicopters, let us try to put the figures into a broader context according to at least some of the above criteria.

The first fact is that the Mil Mi-1, Mil Mi-4 and Mil Mi-24 helicopters have been operated in by far the highest numbers compared to the other types, for a long period of time (roughly 30 to 40 years) and for a very wide range of flight tasks. Their number accounted for almost two thirds of the total number of all army helicopters of all types in the former Czechoslovakia and later the Czech Republic (372 out of the total traceable 574 army helicopters of all 12 types in all versions, i.e. about 65 %). This is also related to the by far highest number of flight hours flown.

The second fact is that all these three types of helicopters represented at their time either the advent of a completely new technology (as is the case with the Mil Mi-4 and Mil Mi-1 helicopters) or the advent of a new flight specialization (the "attack" specialization in the case of the Mil Mi-24 helicopter). The Mil Mi-4 and Mil Mi-1 helicopters were introduced into the former CSLA at the time when there was virtually no experience with the operation and piloting of helicopters in Czechoslovakia, there were almost no comprehensive training curricula, regulations or manuals for pilots and other personnel, the air traffic control system and maintenance and inspection system had a number of limitations and shortcomings, etc. It took full 20 years before helicopters became so well established and tested in the Czechoslovak military aviation that the accident rate in the statistics visibly decreased and one could start talking about the incipient birth of relatively functional flight safety rules. Therefore, most of the accidents in these types of helicopters were caused by: technical faults (approximately ¼ of all aviation accidents), pilot inexperience (approximately ¼ of all aviation accidents), flight indiscipline (pilots testing the capabilities of the helicopter or making ill-considered decisions under the influence of various undesirable motivations), inadequate maintenance, or imperfect repairs. Simply put, these two types of helicopters were used to build and test the system of military helicopter flying in Czechoslovakia, which resulted in a lot of damage and many casualties of the crews. The Mil Mi-24 helicopter was a landmark in the development of military helicopter units accompanied by the introduction of combat specialization into helicopter flying. Until then, all types of military helicopters had been used universally for all types of tasks (transport, reconnaissance, communications, medical assistance and, to a very limited extent, attack). This required a different way of flying and training, especially in difficult terrain and at ground or low altitudes, which entailed a number of specific risks.

The third interesting fact is that despite the number of air accidents, the number of casualties varies from helicopter to helicopter. For example, there are "only" 9 casualties in 6 disasters for the Mil Mi-1, while there are 23 casualties in 7 disasters for the Mil Mi-4. This is due to the different number of flight crew members in each type of helicopter, the capacity of the seats for transporting additional passengers (Mil Mi-1 crew: 1 pilot and max. 2 passengers; Mil Mi-4 crew: 2 pilots, 1 flight engineer and max. 12 passengers; Mil Mi-24 crew: 1 pilot, 1 pilot-operator, 1 flight engineer and max. 8 passengers) and also the existence of several customary rules that are still alive today.

The customary rules are: "No jumping from the helicopter..." and "Crews do not wear parachutes when flying with passengers...".

The first of these customary rules has the following two reasons:

- the ergonomic design of the crew compartment makes it very difficult to jump from the helicopter (little room to move around and many obstacles),
- there is an unwritten solidarity between crew members in case not all persons on board can use the parachutes.

It is a historical fact that in all the history of Czechoslovak and Czech military helicopter flying, no crew member has ever jumped out of a helicopter in an emergency situation for one of the reasons mentioned above, even though they could have.

The second of the customary rules is based on consideration for the passengers, who are usually not trained in the use of parachutes, and this would often unnecessarily undermine their confidence in the flight crews and the aircraft. When dealing with any in-flight emergencies, it is always better for the crew if the passengers do not interfere with the process and solution with their emotions. In addition, flying with passengers is usually conducted at low altitudes where safe use of a parachute in an emergency could be problematic.

Thus, if we try to assess the final safety or danger of each type of helicopter, we find that it does not have that much to do with the helicopters themselves. In fact, the level of air traffic safety is determined primarily by the experience and performance of the flight crews, the quality of maintenance of the aircraft and the quality of information for the preparation and conduct of the flight. From this point of view, helicopter flying can be considered very safe at present and it is highly probable that, with the current level of crew training, maintenance and air traffic control, it would have been safe (albeit performance limited) even on older types of aircraft.

5.3 Development Trend of Military Helicopter Aviation Accidents

The military helicopter aviation accident rate is clearly on a downward trend (since 2000 it "only" is: 5 crashes and 7 damage events), but this does not necessarily mean – nor does it imply – an extremely increasing level of safety culture. This is where understanding the context is essential for proper interpretation.

The primary reason for the declining aviation accident rate is the gradual reduction in the number of aircraft in the active service with the Czech Air Force, with a concomitant reduction in the number of actual flight hours flown. The number of helicopters in active service is usually lower than indicated by the sum of the numbers shown in Figs 2-5, as several helicopters have been inactive for some time, mainly due to maintenance, conversions or upgrades. Although the technical level of equipment and reliability of aircraft is gradually increasing over time, nothing can replace practical flight lessons in crew training, not even the best flight simulator. Even though the helicopter flight simulator facilities are run to high professional standards, they can effectively cover only a limited part of the necessary flight training (in-flight emergencies, emergency procedures, parts of tactical procedures).

Alarmingly, however, the root causes and chains of causes of military aviation accidents are changing, and this has been evident in the Czech Republic over the last 30 years. Flight personnel no longer face as many problems caused by technical unreliability of helicopters, lack of flight experience, or the absence of a comprehensive, high-quality regulatory base. Instead, they are forced to deal with information overload and fatigue, often growing into a more or less developed burnout syndrome, even at a very young age.

This is due to the changes in the human resource management system in the Army of the Czech Republic (hereinafter "ACR") after the Czech Republic joined NATO

and adopted its standards in 1999, and especially after the ACR went fully professionalized in 2005. The attractiveness of service in the ACR has gradually declined significantly for the young generation of applicants due to the societal changes since 1989 and the related changes in the overall social climate, which has very quickly been reflected in staff shortages in virtually all executive positions. With the effort to fulfil all tasks arising from international agreements and the Czech Republic's NATO commitments, and with the current long-term shortage of personnel throughout the ACR, the system is bound to become overburdened. For a number of people, this is an impulse to significantly push the boundaries of subjectively and objectively acceptable risks, primarily for financial and career reasons. Professional indiscipline and errors, often based on a lack of practical experience in the field and insufficient practical training, often replaced by administrative duties – especially at command levels – are thus proliferating.

In the author's subjective opinion, it is therefore necessary to view aviation accident statistics in this context in terms of the hazardous nature of root causes rather than simply in terms of frequency of accidents. Here we are no longer talking about the need for changes at a personal level, but at the level of the human resources management system, i.e. at the level of the entire organization of the ACR.

6 Conclusion

As it can be seen from the foregoing, the documentation on military helicopter accidents from various periods of Czechoslovak and Czech history is still largely accessible in military archives and can be effectively used to benefit the current flight safety.

The unique collection and processing of these archival resources now provides us with opportunities to examine flight safety trends in different time periods and the root causes of many technical, human or systemic problems.

To this end, the collected data has been processed and analyzed by different criteria (e.g. by type of aviation accident and its causes or by type of aviation technology, see above). Based on the change in the data visualized on a timeline that characterizes the evolution of flight safety in different historical periods (in particular the numbers and causes of aviation accidents), root causes of current and potential future problems at an army-wide system level were identified. These could make an interesting subject of future constructive discussions and solutions.

The author would like to thank all those who have contributed to the development in Czechoslovak and Czech military helicopter aviation safety and to pay tribute to all those who gave their lives for it in peaceful times of our history. Let us hope that their work and sacrifices were not in vain and will never be forgotten.

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