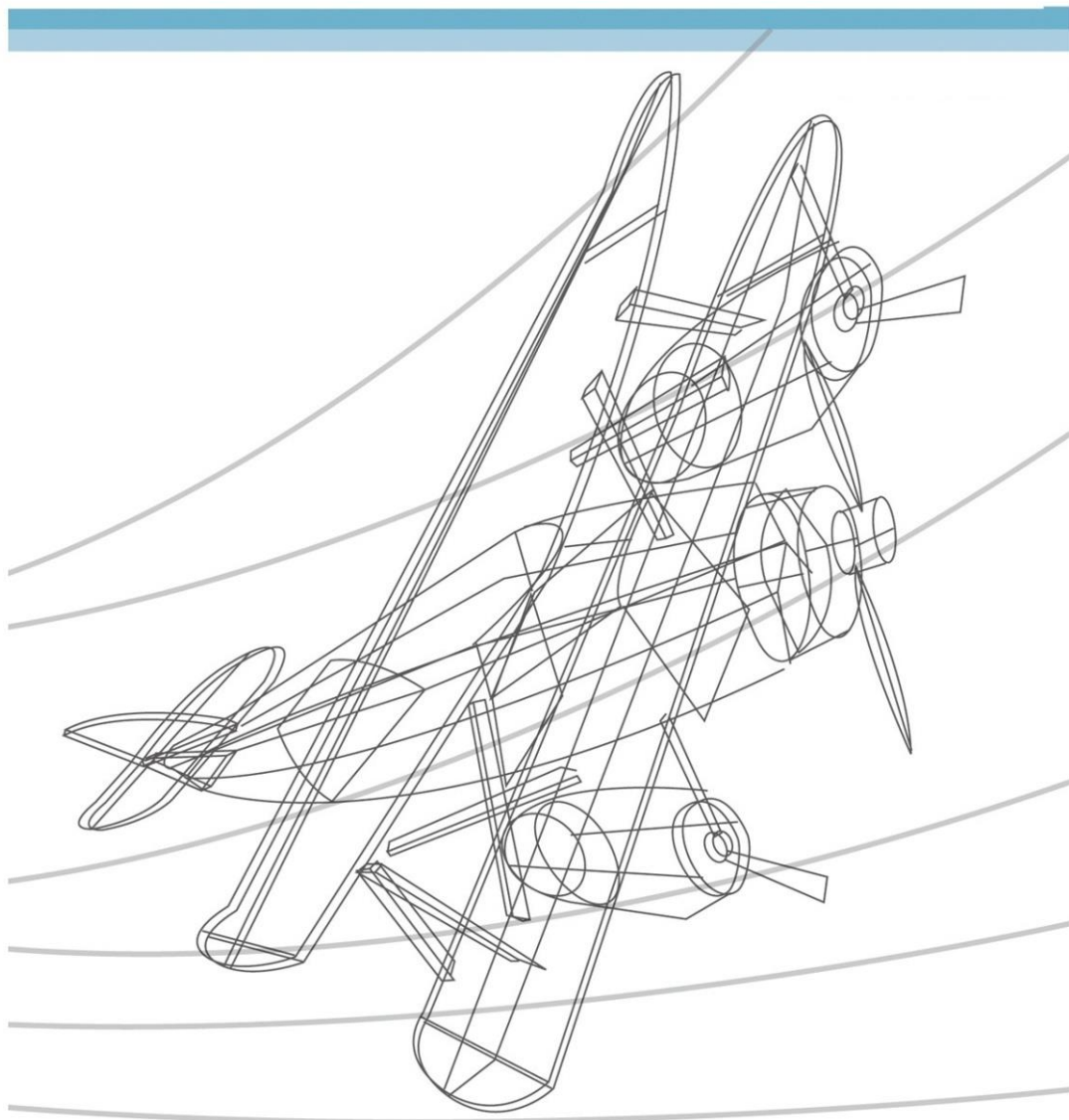


Taiwan Aviation Occurrence Statistics 2009 to 2018



Taiwan Transportation Safety Board

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Abstract

Over the past decade (2009-2018), the domestic and international transportation services showed different trends to the civil aviation industries. There was a significant increase on international air transport. The number of passengers increased 80.9 percent, the cargo increased 59.7 percent, and the numbers of flights increased 64.3 percent over the period. Meanwhile, on domestic air transport, the number of passengers increased 26.7 percent, the number of flights increased 10.0 percent, and the number of cargo services decreased 30.7 percent over the past decade.

From 2009 through 2018, there were 83 aviation occurrences in Taiwan totally, including those Taiwan air carriers' aircraft occurred outside the country. Transportation category aircraft occurrences accounted for the most (47). The remaining 36 occurrences were general aviation, public aircrafts, ultra-light vehicles or foreign-registered aircrafts. Of those 83 occurrences, 124 fatalities were resulted. There were 13 aviation occurrences occurred in 2018, including 4 national civil aviation transportation category aircrafts, 2 general aviation category aircraft, 3 public aircraft and 4 ultra-light vehicles. Of those 3 public aircraft occurrences, 1 hull loss and 8 fatalities. Four ultra-light vehicles occurrences all resulted in hull losses and resulted in 2 fatalities.

According to the occurrence rates for the airplanes in civil aviation transportation category over the last 10 years (2009-2018), the average rate of hull loss occurrences on commercial jet was zero. In addition to that, the hull loss occurrence rates on turboprop airplanes were 3.75 per million flight hours or 3.21 per million departures. Based on the 10-year moving average of hull loss occurrence rates on civil aviation transportation category, the hull loss rates on commercial jet decreased gradually. The rates on turboprop airplanes rose due to 2 hull loss occurrences in 2014 and 2015.

When focusing on the accident rates for each phase of flight, defined by International Civil Aviation Organization (ICAO), there were totally 47 aviation occurrences happening at different flight phases over the last decade. Among all these accidents, 20 of them took place at landing phase, as the most prevalent, followed by 12 occurrences at cruising phase.

In accordance with the occurrence category used by ICAO, among all 47 civil transportation category airplane occurrences over the past ten years, the runway excursions overall were the most frequent with a total of 15 reported occurrences. The second most frequent occurrences were the SCF-NP (system/component failure or malfunction/ non-powerplant), accounting for 11.

The National Transportation Safety Board uses the personnel, environment, and aircraft related factors to classify occurrence cause and contributing factor. By using the similar approach to classify the civil transportation category airplane occurrence over the past ten years in Taiwan, personnel was cited as

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a cause/factor in 65.9 percent (63.4 percent related to pilots, 2.4 percent related to maintenance/ATC personnel), of those occurrences as the largest percentage, following by aircraft related in 43.9 percent and environment related in 26.8 percent.

There were 14 general aviation occurrence from 2009 to 2018. The rate of general aviation occurrence was 38.46 per 100,000 flight hours, fatal occurrence rate was 13.74 per 100,000 flight hours and hull loss occurrence rate was 16.48 per 100,000 flight hours. The fatal occurrences occurred in 2009, 2012, 2013, 2015 and 2017 respectively.

There were 8 occurrences involving public aircrafts during the period of 2009 to 2018. Of these occurrences, among the 8 occurrences, 4 occurrences repair cost exceeding the cost of the aircraft (3 was fatal) and 2 were personnel injuries occurrences. There was 3 public aircraft occurrence in 2018.

According to the formal records of ultra-light vehicles occurrence, there were 13 occurrences from 2009 to 2018, including 5 fatal occurrences which resulted in 7 fatalities. The 13 occurrences were all hull losses. There was 4 ultra-light vehicle occurrence in 2018.

There were 147 occurrence investigations since the establishment of the Taiwan Transportation Safety Board to the end of 2018, preclude those foreign and Mainland China agencies investigated occurrences (20) and incidents (2), totally 112 occurrence investigations were closed. The Taiwan Transportation Safety Board had issued 1,035 safety recommendations during the period from April, 1999 to December, 2018 after the investigations. And there were totally 539 action plans being submitted by related Taiwan government agencies in accordance with the Council's safety recommendations. At the time of this publication, the numbers of accepted action plans proposed to government related departments and others were 510 which account for 94.6 percent, while the numbers of plans/proposals still under supervision were 29 which account for 5.4 percent.

Introduction

The first part of the report introduces general status of domestic civil/public aircrafts. Briefly reviews last year's (2018) status of civil aviation operations. And then reviews the status of civil aircrafts, public aircrafts and ultra-light vehicles of last decade.

The second part of the report includes the statistics/analysis of aviation occurrences and safety recommendations. In order to give readers the general understanding of aviation occurrences statistics, the article will first introduce the basics and definition of statistical data, categorization of occurrence aircrafts, Taiwan Transportation Safety Board's (TTSB) investigation procedure and classification of occurrences. Then the report will focus on the statistics of aviation occurrences, including the overview of occurrences happened over the last decade, and different types of aircraft occurrences: the civil aviation transport category occurrences, general aviation occurrences, helicopter occurrences, public aircraft occurrences, and ultra-light vehicle occurrences. Then the data and analysis related to the civil aviation transport category airplane which includes safety recommendations made by the TTSB and the status of its follow-up.

Several terminologies are used throughout this report that relate specifically to the civil aviation or International Civil Aviation Organization, for definitions of those terms, please refer to the Definitions of Terms as shown in the attachment.

The Operation of Civil Aircraft and Public Aircraft in Taiwan¹

The Overview of Civil Aviation Operation, 2018 and the latest decade

The number of civil aviation companies in Taiwan was 8 in 2018. Among them, China Airlines, EVA Airways and Taiwan Tigerair specialize in international routes. Mandarin Airlines, Far Eastern Air Transport and Uni Airways operate international and domestic routes. Daily Air operates non-scheduled helicopter services and off-island routes with fixed-wing aircraft. Emerald Pacific Airlines operates domestic helicopter transportation. The number of air carriers in the general aviation industry was 10². Total number of aircraft operated in transport category and general aviation was 274³ in 2018.

In year 2018 the transportation category air carrier in Taiwan carried a total of 37,930,000 passengers, a 3.4 percent higher than that in 2017. Among those, 84.8 percent were international passengers, 3.2 percent increased over the previous year, 17.2 percent were domestic passengers with a 4.4 percent increase when compared to the year before. The total weights the air cargo carried in 2018 were 2.23 million tons, a 3.2 percent higher when compared to 2017. Among them, the international air cargo accounted for 98.4 percent of the total weight in 2018, increased by 3.5 percent from 2017. The domestic air cargo accounted for 1.6 percent of the total weight, increased 2.6 percent from 2017 to 2018. There were a total of 266,121 flights in the whole year, including 34.1 percent domestic flights, a 13.9 percent increase compared to the year before. International flights accounted for 65.9 percent of the total number of flights, 4.3 percent increase over the previous year.

It was demonstrated from previous data that in 2018, the passenger/cargo traffic of international and domestic routes increased slightly. The general aviation had a total of 4,765 flight hours. The index of overall operations of national air carriers over the past ten years was showed in Appendix 1.

Civil Aviation Transportation Category

As shown in Figure 1, the number of air carriers operating in civil air transportation category was 7 in 2009. After some variations of aviation market, the number of carriers was 8 in year 2018. Among those, the Far Eastern Airlines ceased its operation in May 17 of year 2008 and reopened in year 2010. In year 2014 two low cost carriers, V Air and Taiwan Tigerair, commenced operations in Taiwan. V Air is a domestic low cost airline based in

¹ The listed statistical data mainly came from "CAA 2018 Annual Report".

² Daily Air Corporation, ROC Aviation Company, Emerald Pacific Airlines, Great Wing Airline, Aerospace Industrial Development Corporation, Win Air Business Jet, Executive Aviation Taiwan Corporation, Avanti Aviation, EVA Airways (general aviation business was added in 2013) and Sky Rainbow Airlines.

³ One fixed wing airplane of the CAA was not counted.

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Taipei. It is a franchise subsidiary of TransAsia Airways. Taiwan Tigarair was owned by China Airlines. Sunrise Airlines handed over its civil aviation operation licence on November 4, 2015, and cancelled the general aviation operation license on June 7, 2017. V Air suspended operations on October 1, 2016, and cancelled the civil aviation operation license on December 7, 2017. TransAsia Airways suspended operations on November 22, 2016 and was declared bankruptcy in June 2018. Emerald Pacific Airlines obtained the civil aviation operation license on July 7, 2018. As for the number of airworthy aircrafts, a fluctuating variation was shown in the early stage as shown in Figure 2. The number of registered aircrafts was the lowest at 182 in year 2010 and increased annually and increased to 274 in year 2018. The reasons were due to the purchase of new aircrafts of some Airlines and the introduction of large numbers of hot air balloons.

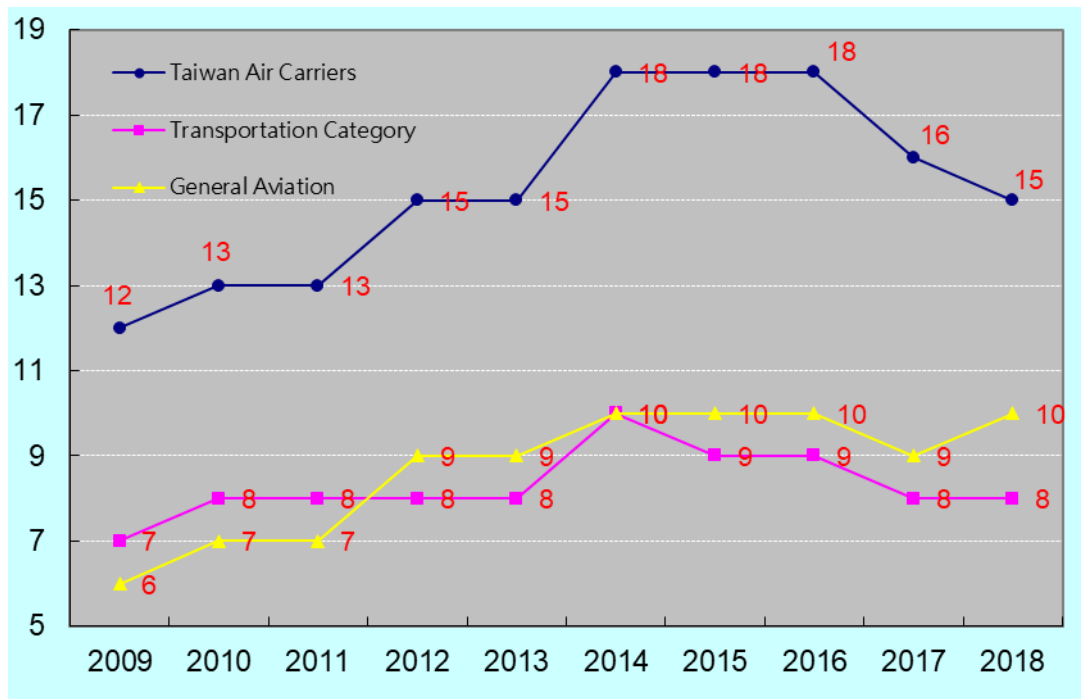


Figure1 : Taiwan air carriers, transportation and general aviation category, 2009-2018

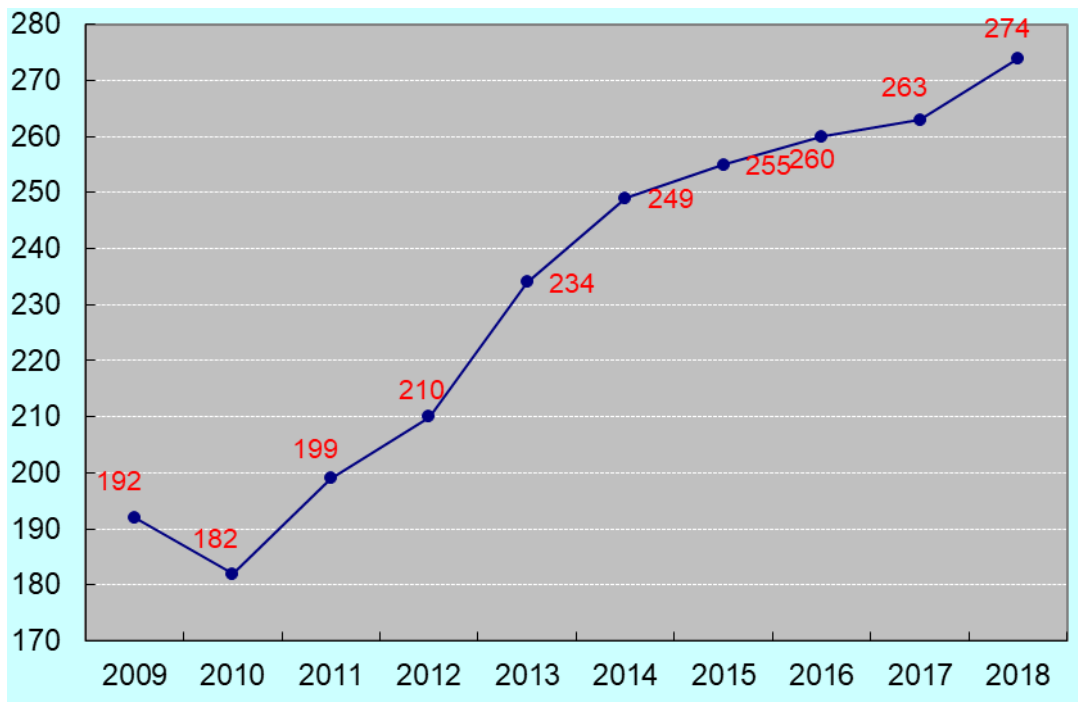


Figure2 : Taiwan airworthy civil aircraft, 2009-2018

For the numbers of passengers (Figure 3), the international air carriers and domestic air carriers showed two different trends. On international routes, numbers of passengers were 17,775,000 in 2009 and increased gradually over the years, and reached the highest 32,147,000 in 2018. It showed an 80.9 percent increase over the past 10 year. Differently from the international routes, the number of domestic passengers was the lowest at 4,565,000 in 2009, and it began to increase gradually from 2010 to 5,784,000 in year 2018. Over the decade, the rate of increase of passengers was about 26.7 percent.

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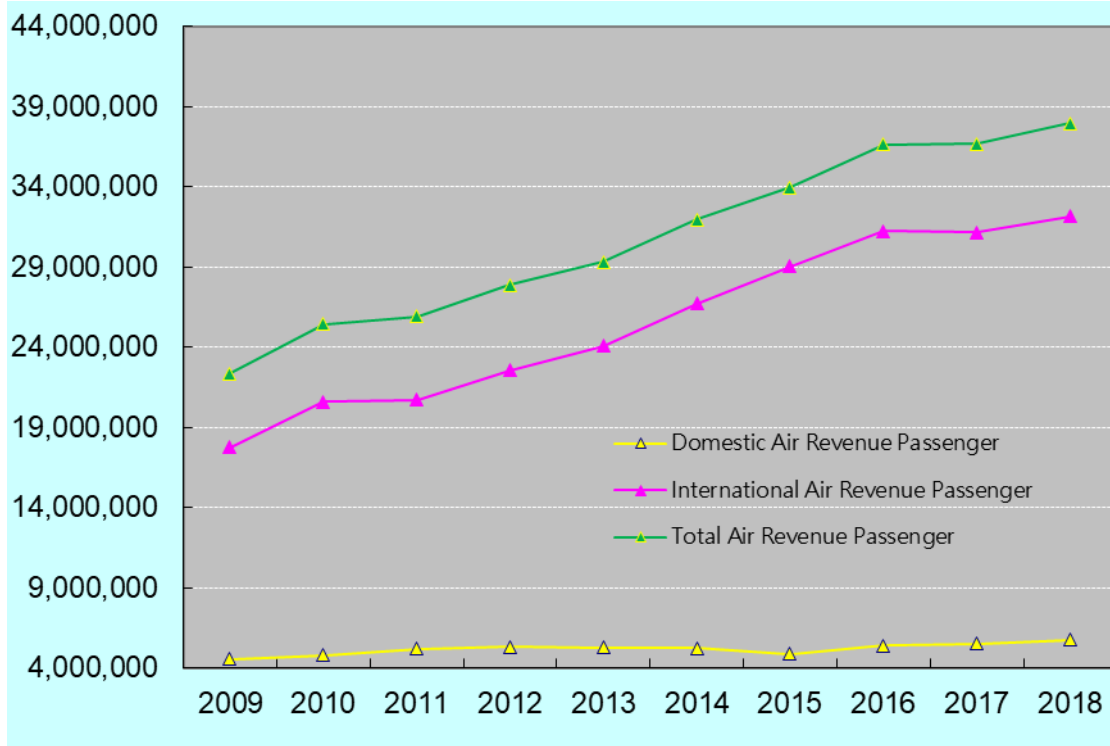


Figure3 : Taiwan air carriers revenue passengers of transportation category, 2009-2018

In terms of the air cargo, the international air cargo was more than domestic one. In the past ten years, the international air cargo took up more than 98 percent of the total amount. The international air cargo increased significantly from a minimum of 1.39 million tons in 2009 to 2.20 million tons in 2018. Accordingly, the number of air cargo increased about 59.7 percent over the decade. As for the domestic air cargo, the numbers decreased from 51 thousand tons in 2009 to 35 thousand tons in 2018, about 30.7 percent in 10 years. Taiwan air freight of transportation category air carrier over the period from 2009 to 2018 is shown in Figure 4.

Taiwan Transportation Safety Board

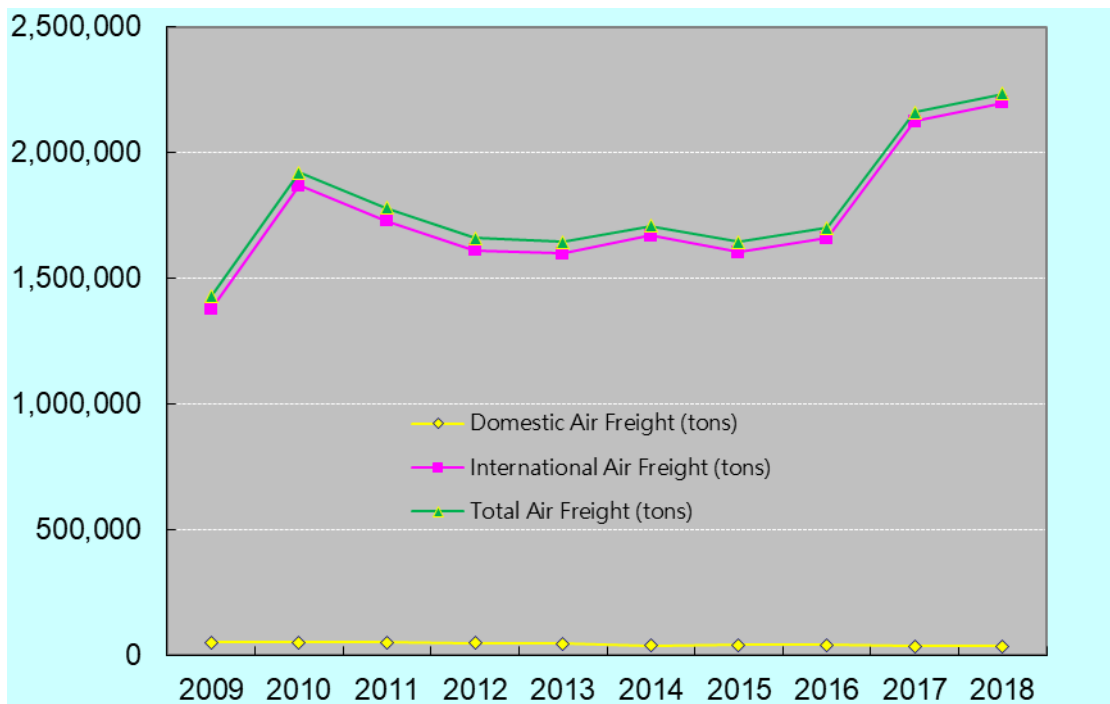


Figure4 : Taiwan air freight of transportation category air carrier, 2009-2018

In terms of the number of flights, the domestic flights increased from 82,000 flights in 2009 to 91,000 flights in 2018, an increase of nearly 10.0 percent. Differently from the domestic routes, international airlines increased from the number of 107,000 flights in 2009 to 179,000 flights in 2016, a 67.5 percent growth. The increase of international flights was due to the open routes cross straits. The international routes was 175,000 flights in 2018. Taiwan flight departures of transportation category airplanes over the period from 2009 to 2018 are shown in Figure 5.

Overall speaking, the domestic and international transportation services showed contradictory trends to the civil aviation industries over the period from 2009 to 2018. The number of passenger of international flights increased 80.9 percent, the cargo increased 59.7 percent, and the numbers of flights increased 64.3 percent over the period. Meanwhile, the number of passengers of domestic flights increased 26.7 percent, the numbers of flights increased 10.0 percent, however the numbers of cargo services decreased 30.7 percent.

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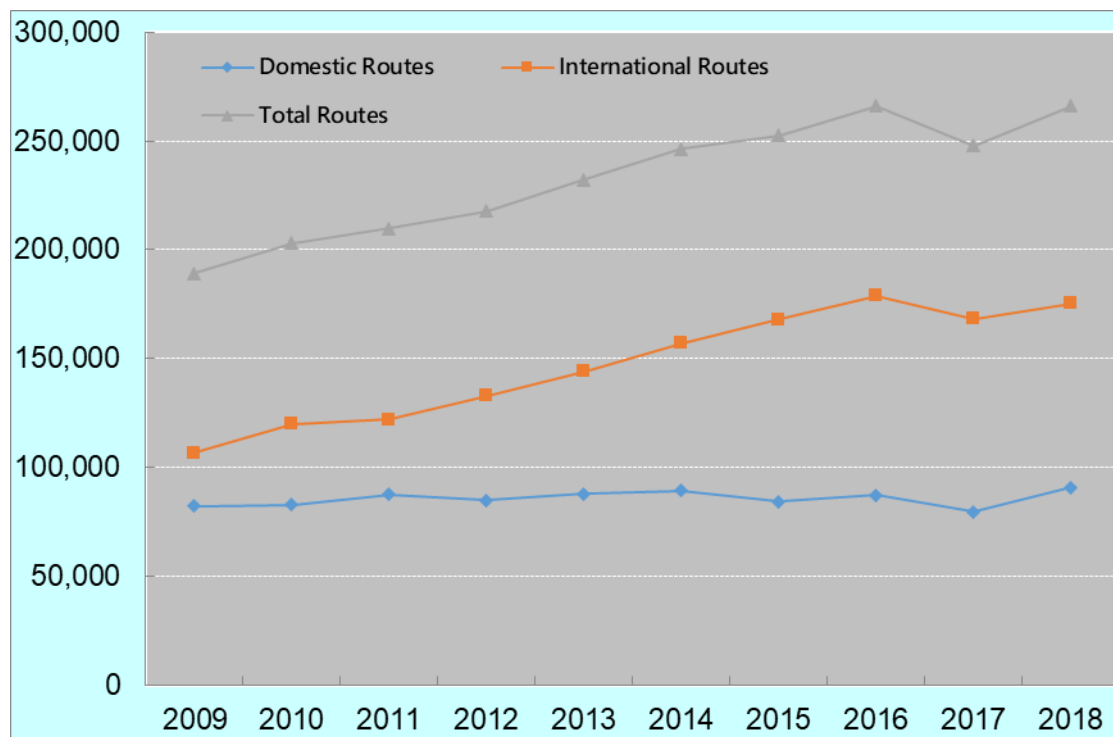


Figure5 : Taiwan flight departures of transportation category, 20089-2018

General Aviation

As shown in Figure 1, air carriers running the general aviation were varied from 6 to 10 over the past ten years. The total flight hours of general aviation were 4,589 hours in 2009 and 4,765 hours⁴ in 2018. The variations of flight hours over the period from 2009 to 2018 are shown in Figure 6.

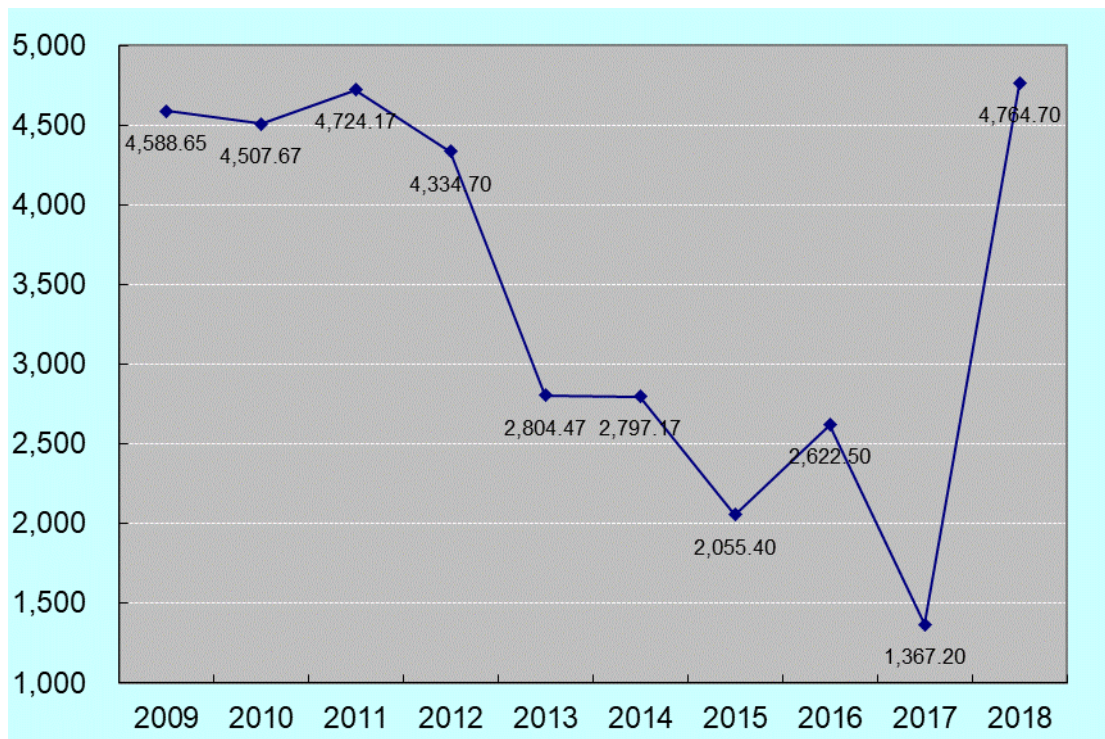


Figure6 : Taiwan air carriers flight hours of general aviation, 2009-2018

⁴ In 2017, only helicopter flight hours of Daily Air and Emerald Pacific Airlines were recorded.

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Public Aircraft

Due to different requirement of assignments, public aircraft in the old days were under different units: the Aviation Team of Civil Aeronautics Administration (CAA) of Ministry of Transportation and Communications, the Airborne Squadron of National Police Agency, the Preparatory Office of the Airborne Fire Fighting Squadron of National Fire Agency and the Air Patrol Squadron of the Coast Guard Administration, Executive Yuan.

After the promulgation of Aviation Occurrence Investigation Act on June, 2004, investigations of public aviation aircrafts were then officially the responsibility of Taiwan Transportation Safety Board, Executive Yuan. On June, 2005, the Organization Act of Airborne Services Corps of the Ministry of the Interior was passed, and National Airborne Service Corps (NASC) of the Ministry of the Interior was finally officially established. After the merging, there were 35 helicopters and 2 fixed wing aircrafts under the NASC command. Till the end of year 2018, there were 17 helicopters and 1 fixed wing aircraft totally 18 aircrafts currently running by the NASC. There were 3 newly added UH-60M helicopters in 2015, 2⁵ in 2016 and 4 in 2017. In addition, the CAA owned 1 light aircraft in order to assist the airport navigation facilities flight test.

According to the operation data (Appendix 2) of NASC, the total numbers of flights were plotted against the total flight hours in recent years as showing in Figure 7. From the graph, the total flight hours almost reached 10 thousand hours in 2009. The total flight hours declined to 6,490 hours in 2018.

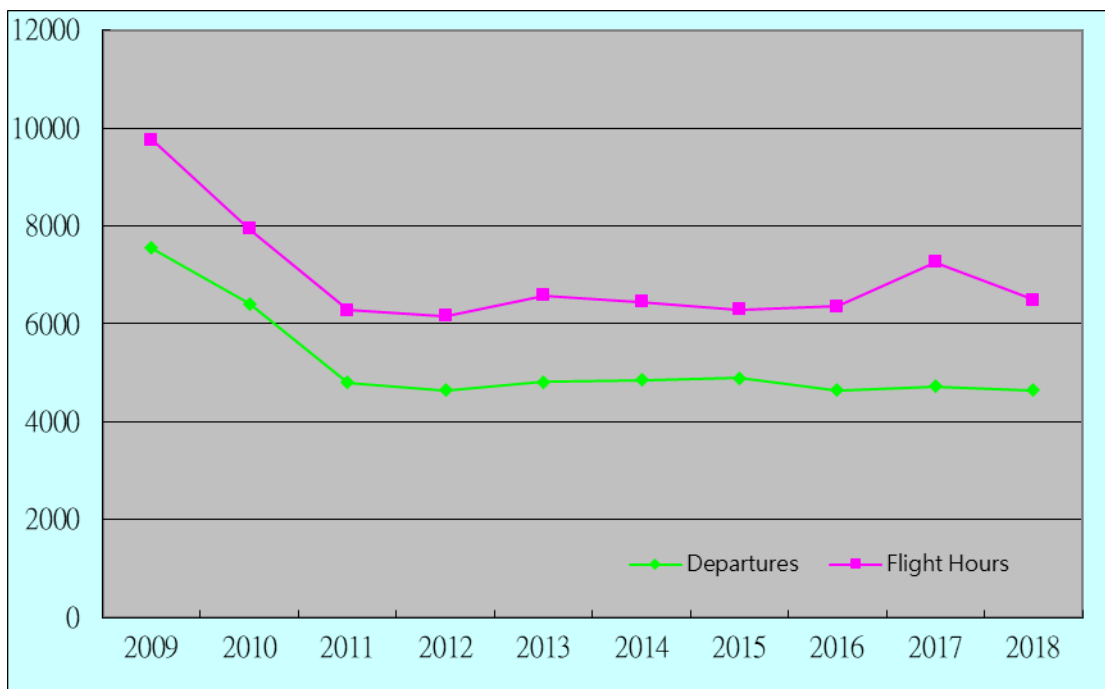


Figure7 : Total flight numbers and total flight hours of National Airborne Service Corps, 2009-2018

⁵ One of the UH-60M helicopters was lost in an accident on February 5, 2018.

Activities of Ultra-Light Vehicle

The Ministry of Transportation and Communications added related provisions to civil aviation acts in 2003, concluded “Ultra-light Vehicle Regulation” in the following year, ultra-light vehicle then formally under CAA’s supervision. Furthermore, according to the CAA data, till the end of year 2018, there are 22 available airspaces nowadays, and 10 of them were legal airspaces. Five airfields (Wuri, JaieHaour, HuaLien, Matai’an and WanAnn activity field) could legally carried out ultra-light vehicle activities. There are 7 activity guidance manuals of ultra-light vehicle parties been approved by CAA. At present time, these 7 parties (Chinese Taipei Aviators League, R.O.C. powered parachute association, HuaLien aeronautical association, HuaLien ultra-light sports association, Kaixiang aviation activity enhancement association, Taiwan Taiya aeronautical tourism and development association and Taiwan recreational aviation association) can carry out activity legally.

Activities of Free Balloon

Free balloon (including free air balloon and hot air balloon) is defined as a vehicle that can carry passengers which derived its support from the reactions of the air in the atmosphere other than the reactions propelled by machine. As international rule, free balloon is regarded as a “standard aviation vehicle”. According to the characteristics of operations, free balloon operations divide into “free balloon flight operation” and “free balloon tethered activity” that specified in “Aircraft Flight Operation Regulations” of the CAA. To fulfill public people's recreational requirements of free balloon, the CAA has commenced survey and amended related regulations since year 2012. Free balloon related organizations and operators were invited to attend meetings and discussion twice. Totally 9 related regulations were revised and drafted through public hearing processes.

Till the end of year 2018, the total number of registered hot air balloons was 19 which included 7 of Sky Rainbow, 7 of Taitung County government, 1 of Asia-Pacific Institute of Creativity, 2 of Hug Cloud Flying Media and 2 of Luxi Management Consulting Company.

The Establishment of Flight Training Center

APEX Flight Academy, established on September 24, 2014, is the first flight training academy that passed the 5-stage review by the CAA. APEX's flight training and maintenance facilities are based in Taitung FongNien airport. The training flight imported including single and twin engines airplane. In addition, there are training classrooms and a Fixed Base Trainer which can provide ground and flight training courses to training students.

Statistics and Analysis of Aviation Occurrence data, 2009-2018

Introduction to Aviation Occurrence Data

Data Source

The contents presented in this chapter are a statistical compilation of the Taiwan air carriers' operation and aviation occurrences. Major data sources include the statistics of operation/flight safety from CAA, the Taiwan Transportation Safety Board aviation occurrences investigation reports, and the data from the National Airborne Service Corps. The government official documents and press accounts provide additional information of the few aviation occurrence statistics on the early days.

Definitions and Categories

The statistics released by the ICAO covers a wide range of aircraft, including those of various maximum takeoff weight, number of engine installed, types of engine thrust, scheduled and non-scheduled, and General Aviation. The focus, however, is on the fatal accidents of scheduled and non-scheduled flights of transport category aircraft.

The statistics data of the International Air Transport Association (IATA) was based on a maximum takeoff weight of more than 5,700 kg for turbine powered aircraft to calculate single year and 5 years moving average hull loss and fatal occurrence rates per 1,000,000 departures⁶.

The Boeing Company and the Airbus Company have presented statistical summaries of commercial jet airplane accident rates per 1,000,000 departures worldwide. The statistics are confined to western-built commercial jet airplanes that were heavier than 60,000 pounds (or 27,000 kg) maximum gross weight, or above 40 passengers respectively.

The Taiwan CAA publishes hull loss occurrence rate by referring to the IATA, but 1,000,000 flight hour statistics data also included. The TTSB adopted the same classification of aircraft weight and flight data of CAA except that the TTSB calculated 5 years moving average fatal and hull loss occurrence rates and 10 years moving average hull loss occurrence rate.

Judging from the above information, global aviation accident data mainly focus on the large aircrafts. For Taiwan aviation accident data statistics, all size of aircrafts are accounted and categorized. Taking advantage of sharing the same pool of flight operation data from CAA, the statistics of this report adapts the definition of aircraft category used by CAA. The aviation occurrence data presented in this report are confined to all Taiwan domestic aircraft (except

⁶ IATA hasn't provided flight hour data since 2015.

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military airplanes and unmanned aerial vehicles), including:

- Aircraft of transportation category
 - Commercial Jet airplanes (models listed in Table 1)
 - Turboprop airplanes (models listed in Table 2)
- General Aviation (models and hot air balloons are listed in Table 3)
- Public aircrafts (models listed in Table 4)
- Ultra-light vehicles
- Private owned vehicle
- APEX training academy (models listed in Table 5)

A glossary of aviation and technical terms used in this document can be found in appendix 1. The major references are from the Civil Aviation Act of the Republic of China, Aviation Occurrences Investigation Act (AOIA), Regulations Governing the Investigation of Aviation Occurrence of Civil and Public Aircraft, the Aviation Occurrence Investigation Standard Operation Procedure, and ICAO publications etc.

Table 1 : Types of Taiwan commercial jet airplanes

BOEING	AIRBUS	EMBRAER	Gulfstream
737	A320	ERJ-190	G280
747	A330		
777	A340		
MD-80	A350		

Table 2 : Types of Taiwan commercial turboprop airplanes

ATR	DORNIER	DE HAVILLAND
ATR72	Do-228	DHC-6

Table 3 : Types of Taiwan general aviation aircrafts

Bell 206	BK117	BN-2	Hawker 400XP
EMB-135	EMB-505	P68C TC	DA40NG
Censna-208	GV-SP	GVI	ASTRA SPX
AW169	BD-700	400A	Ultramagic F36
Ultramagic M-77	Ultramagic M-120	Cameron Z-90	Cameron Z-120
Cameron Z-140			

Table 4 : Types of Taiwan public aircrafts

AEROSPATIALE	SIKORSKY	BEECH	Hot Air Balloon
AS-365	UH-60M	BE200	Ultramagic F-26
			Ultramagic M-105
			Ultramagic M-120
			Cameron C-90
			Cameron SB-105
			Cameron Z-160

Table 5 : Types of APEX training academy aircrafts

DA40-NG	DA42-NG
---------	---------

TTSB Definition and Classification of Occurrences

Aviation occurrence of the Aviation Occurrences Investigation Act is defined as an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, in which A person sustains death or serious injuries, The aircraft sustains substantial damage or missing; or an occurrence of the aircraft nearly occurred.

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Overview of Taiwan Aviation Occurrences

From 2009 through 2018, the total number of aviation occurrences in Taiwan was 83, including those Taiwan air carriers' aircraft occurred outside the country. In general, transportation category aircraft occurrences accounted for the most (47). The remaining 36 occurrences were general aviation, public aircrafts, ultra-light vehicles or foreign-registered aircrafts. Of those 83 occurrences, 124 fatalities were resulted. The details were shown in Table 6.

Table 6 : Aviation occurrence statistics in Taiwan, 2009-2018

	Number of Occurrence			Fatalities	
	Total	Fatal	Hull Losses	Total Fatalities	Aboard
Commercial Jet airplane	38	0	0	0	0
Turboprop airplane	9	2	2	91	91
Civil Aviation Transport Category in total	47	2	2	91	91
General Aviation Aircraft	14	5	6	13	13
Public Aircraft	8	5	3	13	13
Ultra-light vehicle	13	5	13	7	7
Occurrences related to Sabotage, hijacking or terrorism	0	0	0	0	0
Foreign-Registered Aircraft Occurrence in Taiwan/ Occurrences Investigated by TTSB	1	0	0	0	0
Total	83	17	24	124	124
Note : When an occurrence involved two aircraft, for example: midair collision, airprox, or ground collision; although it was one occurrence investigation, would be counted twice when compiled the statistical data.					

Fatal/ Hull Loss Aviation Occurrences in Taiwan, 2018

As shown in the Table 7, the Taiwan Transportation Safety Board conducted totally 13 aviation occurrence investigations in 2018, including 4 local civil aviation transportation category aircrafts, 2 general aviation category aircraft, 3 public aircraft and 4 ultra-light vehicle. Of the 3 public aircraft occurrences, there was 1 hull loss and 8 fatalities. Four ultralight vehicles occurrences caused 2 fatalities. The details were shown in Table 7.

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Table 7 : Aviation fatal/ hull loss occurrence statistics in Taiwan, 2018.

	Number of Occurrence			Fatalities	
	All	Fatal	Hull Loss	Total Fatalities	Aboard
Commercial Jet airplane	2	0	0	0	0
Turboprop airplane	2	0	0	0	0
Civil Aviation Transportation Category in total	4	0	0	0	0
General Aviation Aircraft	2	0	1	0	0
Government Aircraft	3	3	1	8	8
Ultra-light Aircraft	4	2	4	2	2
Occurrences of Foreign-Registered Aircrafts Occurred in Taiwan	0	0	0	0	0
Total	13	5	5	10	10

For transportation category aircraft, none of the occurrence in 2018 resulted in crew/passenger fatal or injured, as shown in the Table 8.

Table 8 : Fatalities or injuries caused by transportation category aircrafts in Taiwan, 2018

Injuries Level	Flight Crew	Cabin Crew	Passengers	Other	Total
Fatal	0	0	0	0	0
Serious	0	0	0	0	0
Minor	0	0	0	0	0
Total	0	0	0	0	0

Note: According to the ICAO definition, number of fatality is counted as the death within 30 days after the occurrence.

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Occurrences Involving Civil Transportation Aircraft

The cumulative numbers of passengers over the past 10 years were 310 million passengers. Of the passengers on board, 83 passengers were reported fatal.

Number of Passenger Fatalities

Cumulative data of fatal occurrences, fatalities and injuries of passenger involving transportation category aircraft in Taiwan have been listed and summed over the last decade (2009-2018), as shown in Table 9. The fatality rate involving transportation category aircraft occurrences was 0.27 fatalities per million passengers over the past decade.

Table 9 : Aviation safety performance of transportation category aircraft in Taiwan

Year	Fatalities	Serious Injured	Total Aboard (Millions)	100 million Passenger-km	Death/Million Passenger Aboard	Death/100 million passenger-km
2009	0	0	22.3	569.2	0	0
2010	0	0	25.4	600.5	0	0
2011	0	0	25.9	601.2	0	0
2012	0	0	27.9	638.7	0	0
2013	0	0	29.3	676	0	0
2014	44	10	32	727.2	1.38	0.06
2015	39	13	33.9	800.5	1.15	0.05
2016	0	0	36.6	893.4	0	0
2017	0	0	36.7	931.7	0	0
2018	0	0	37.9	977.5	0	0
Total	83	23	308.0	7416.0	0.27	0.01

Note: Fatalities not including flight crew and cabin crew.

Fatal Occurrence Rate with 5-year Moving Average

The 5-year moving average occurrence rates of local turboprop airplanes of civil transportation category airplane were all zero from year 2009 to 2013. The rates were increased to 3.15 and 6.22 per million departures in 2014 and 2015 respectively. In 2018, the rate was 6.33. The 5-year moving average occurrence rates of turbojet airplanes were all zeros per million departures from the year 2009 to 2018. Figure 8 is a 5-year moving average of fatal occurrence rate by million departures of Taiwan transportation category airplanes. From the figure, it showed clearly the fatal occurrence rates per million departures of domestic transportation category airplanes over the past decade.

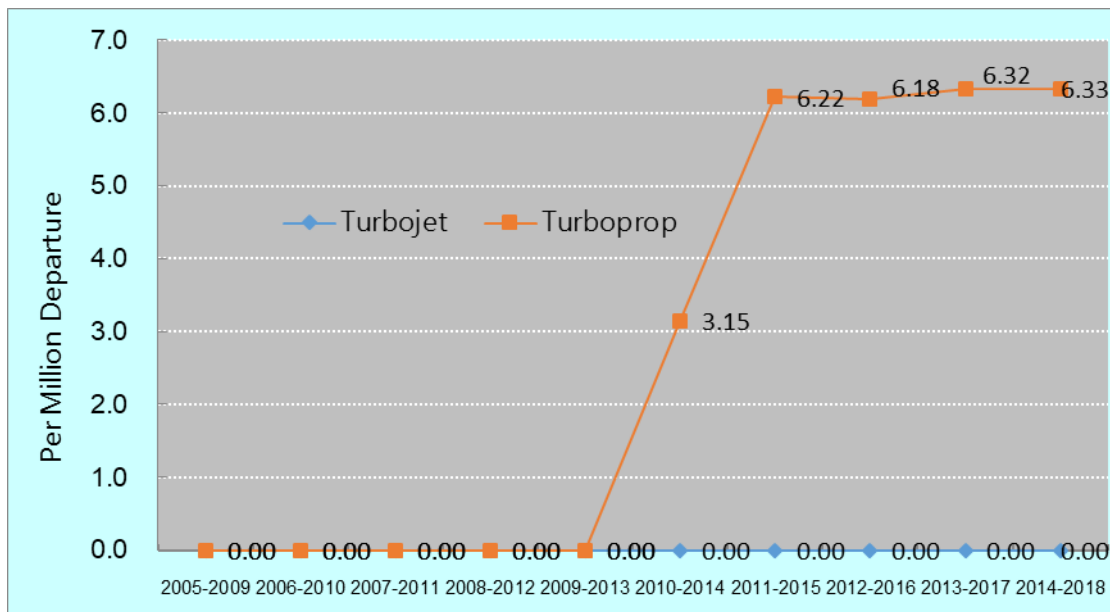


Figure8 : 5-year moving average fatal occurrence rate by million departures, Taiwan transportation category airplane, 2009-2018

Hull Loss Occurrence Rate with 5-year Moving Average

From 2009 through 2013, 5-year moving average hull loss occurrence rate of turboprop airplanes in Taiwan were all zeros. The rates were increased to 3.15 and 6.22 per million departures in 2014 and 2015 respectively. The rate was 6.33 per million departures in 2018. The commercial jet airplanes had a higher hull loss occurrence rate than fatal occurrence rates. This difference suggested that there were some occurrences where commercial jet airplanes occurrence resulted in hull loss, but without fatality. The 5-year moving average hull loss occurrence rate of turbojet airplanes was 1.26 in year 2011, and declined to zero from year 2012 to 2016. The 5-year moving average hull loss occurrence rate of Taiwan transportation category airplanes from 2009 to 2018 was shown in Figure 9.

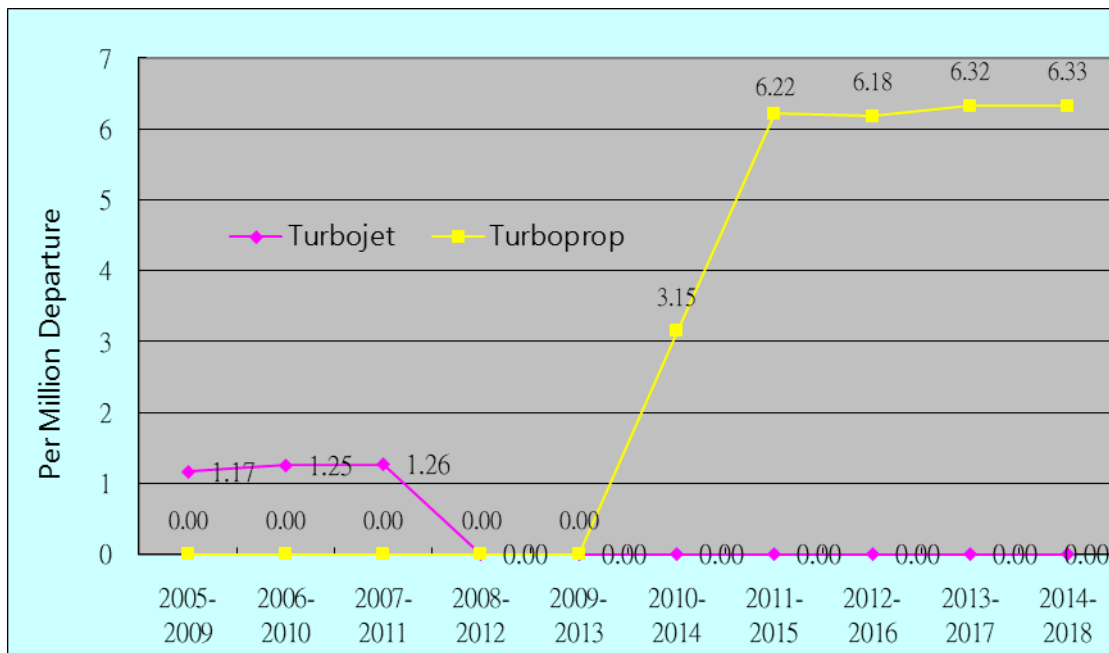


Figure9 : 5-year moving averages hull loss occurrence rates by million departures, Taiwan transportation category airplane, 2009-2018

Hull Loss Occurrence Rate with 10-year Moving Average

The 10-year (2009-2018) moving averages hull loss occurrence rates of transportation category airplanes were illustrated in Figure 10. In recent 10 year, the hull loss occurrence rate of commercial jet airplane was 0. In figure 11, the 10-year moving average hull loss occurrence rate of turboprop airplane were 3.75 per million flight hours or 3.21 per million departures. From 2009 to 2018, the hull loss occurrence rate of commercial jet airplane decreased annually. The 10-year moving average hull loss occurrence rates of turboprop airplanes were increased due to two hull loss occurrences in 2014 and 2015⁷.

⁷ The annual flight hours and flight departures data of turboprop aircraft with maximum takeoff weight more than 5,700 kg were revised by CAA in 2016. The revised database only included flight data after year 2002. Flight data before 2002 was referenced to those of old database.

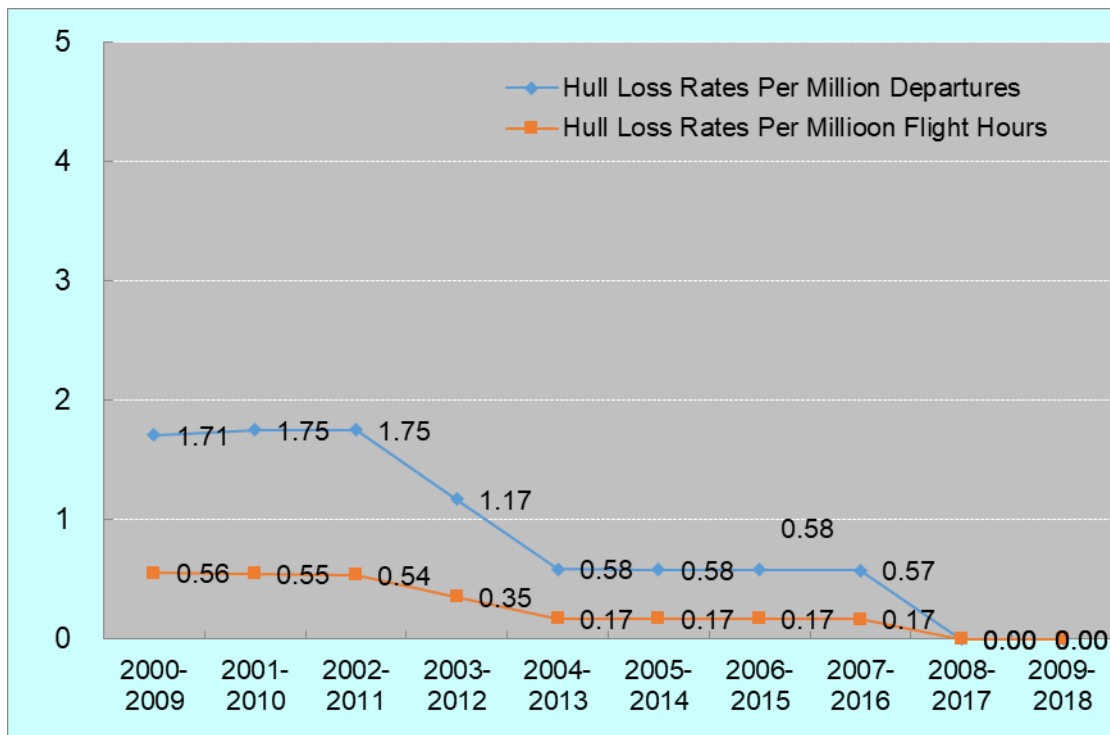


Figure10 : 10-year moving averages hull loss occurrence rates of Taiwan commercial jet airplanes

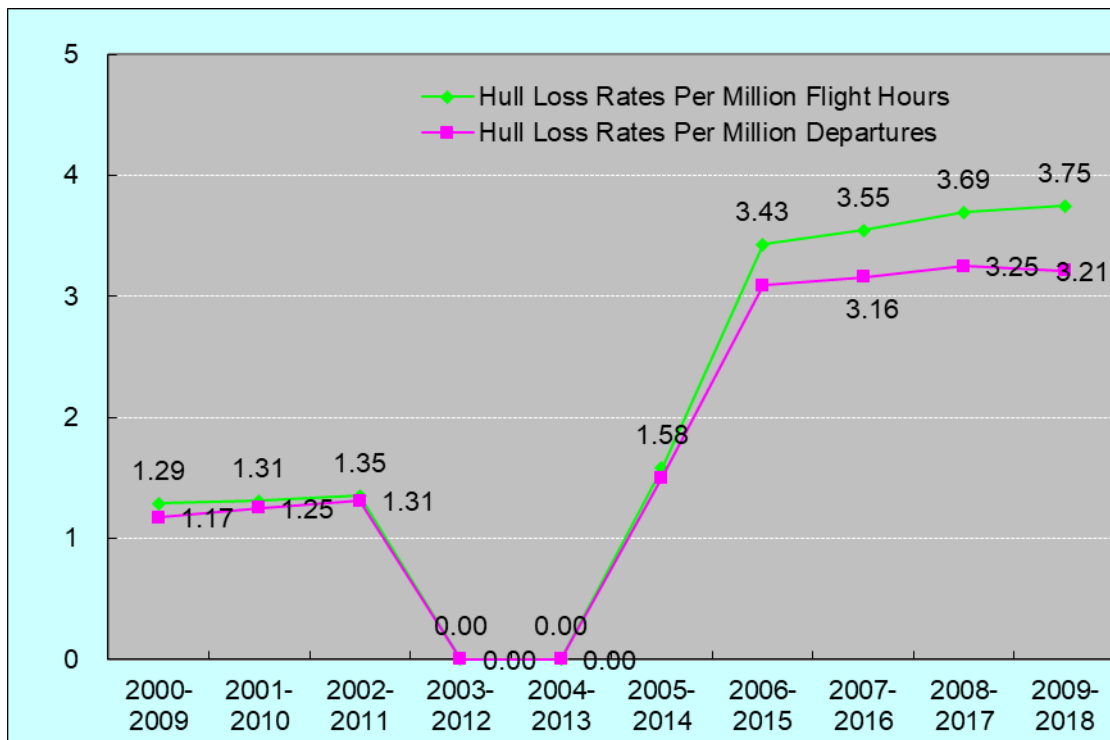


Figure11 : 10-year moving averages hull loss occurrence rates of Taiwan turboprop airplanes

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Aviation Accident Rate (by ICAO Definition)

Referring to the “Accident” definition of ICAO, the number of aviation accidents involving transportation category airplane in Taiwan was 9⁸ over the past 10 years (2009-2018). The average accident rate was 1.33 per million flight hours, or 3.66 per million departures. The yearly number and rate distribution of accidents was shown in Figure 12.

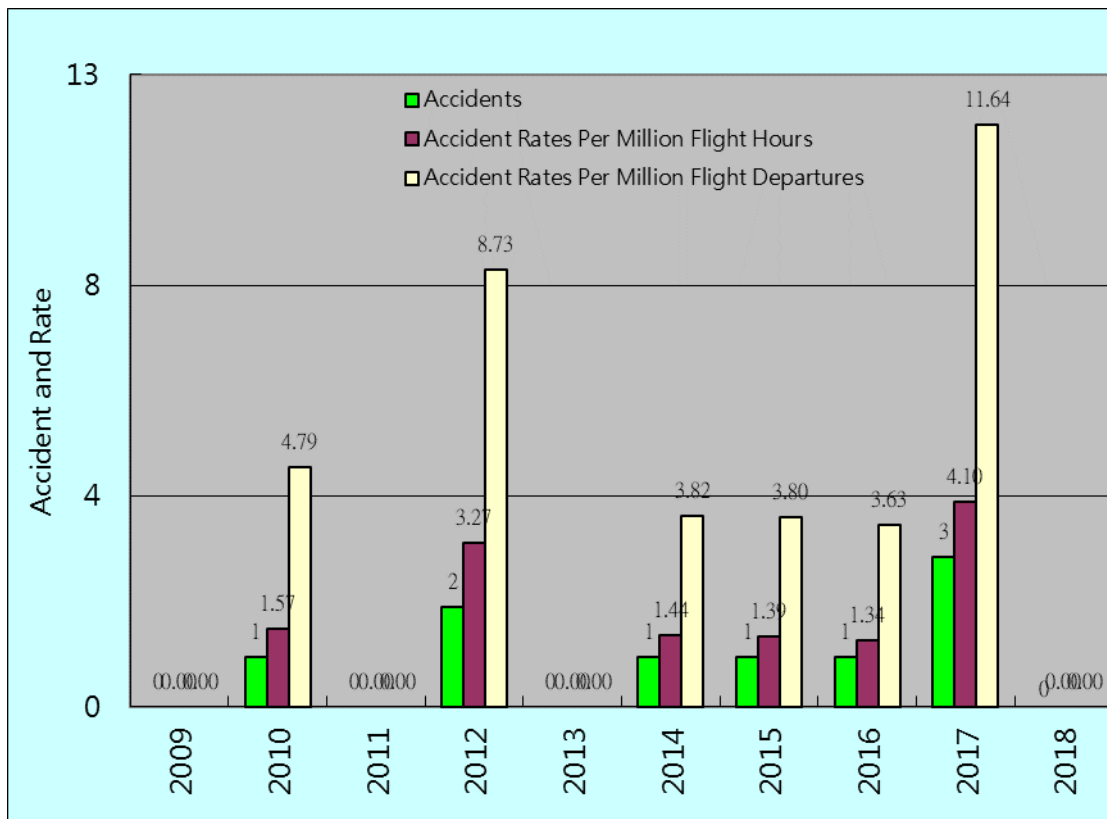


Figure12 : Numbers and rates of transportation category airplane accidents (ICAO definition), 2009-2018

Of the total 9 domestic accidents (ICAO definition) during the period 2009 to 2018, 5 of them were related to commercial turbojet airplanes. There were 4 accidents involving turboprop airplanes. Of the turboprop accidents, 2 resulted in hull loss and fatalities. The details were shown in Table 10.

Table 10 : Number of transportation category airplanes accidents (ICAO definition), 2009-2018

	Total number of accidents	Numbers of hull loss or fatal accidents	Fatalities
Commercial turbojet airplanes	5	0	0
Commercial turboprop	4	2	91

⁸ Include those occurrences of domestic aircrafts occurred outside the territory and investigated by foreign agencies.

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airplanes			
Total	9	2	91

From the severity level of injury and aircraft damage, a total of 8 accidents were distributed to different levels of severity. Most of the occurrences during that period were “injuries w/o aircraft substantial damage” and “aircraft substantial damage without injuries and fatalities”, which included 1 and 6 cases respectively. There were 2 “hull loss with injury and fatality” accidents over the past decade.

Statistical Analysis of Transport Category Occurrences

Phase of Flight

When focusing at the occurrence numbers for each phase of flight, which was defined by ICAO, there were totally 47 transportation category occurrences happening at different phases over the last decade as shown on Figure 13. Among all these occurrences, 20 of them were the most prevalent cited occurrences taken place at landing phase. The second most were taken place at cruising phase which accounted for 12 cases.

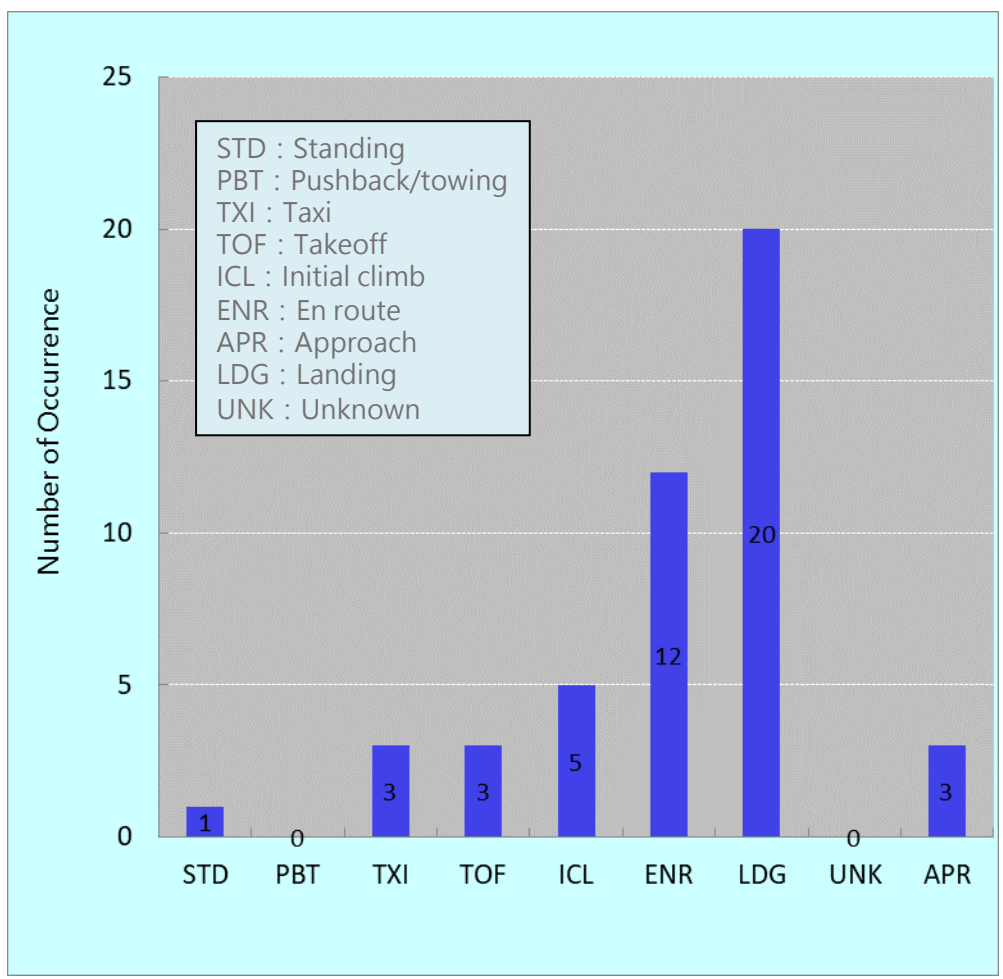


Figure13 : Occurrences distribution of transportation category airplane 2009-2018 by flight phase

Occurrence Category by ICAO Definition

There were totally 47 transportation category national airplane occurrences happening over the last ten years as shown in Figure 14. The runway excursions overall were the most frequent and a total of 15 occurrences were reported. The second most frequent occurrences were the SCF-NP (system/component failure or malfunction/ non-powerplant), accounting for 11.

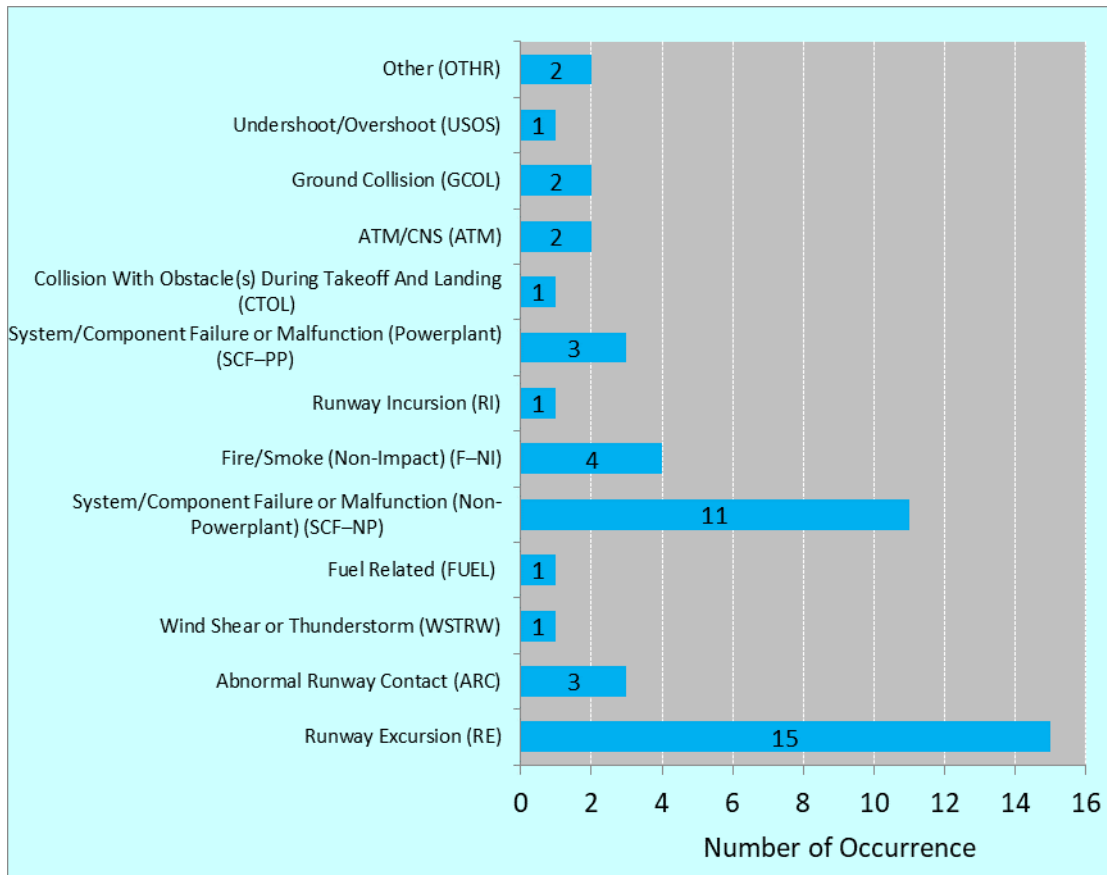


Figure14 : Occurrences distribution of transportation category airplane 2009-2018 by ICAO occurrence category

Causes/Factors of Occurrences

The National Transportation Safety Board (NTSB) often established more than one cause or factor to an aviation accident using three broad categories: personnel, environment, and aircraft related. Personnel related classification included pilot and other personnel such as: maintenance personnel, air traffic controller, and management personnel. Environmental related categories included those causes related to weather, airport facilities, air traffic facilities, time of the accident (day or at night), and terrain conditions. Then in the category of aircraft related cause or factors, failures of aircraft system and equipment, engines, and structure or performance of the aircraft were all belonging to this category.

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According to the findings of TTSB’s investigation reports and referencing to NTSB’s cause/factor classifications, there was at least one cause that explained why the occurrence had happened within each occurrence, and some might have two or even more causes and factors. Personnel were cited as causes/factors in 65.9 percent (63.4 percent were pilot related, 2.4 percent were other personnel such as maintenance personnel and air traffic controller related), followed by 43.9 percent of aircraft-related causes/factors and by 26.8 percent of environment-related causes/factors. Broad causes and/or factors for airplane of transport category occurrences over the last ten years were shown in Figure 15.

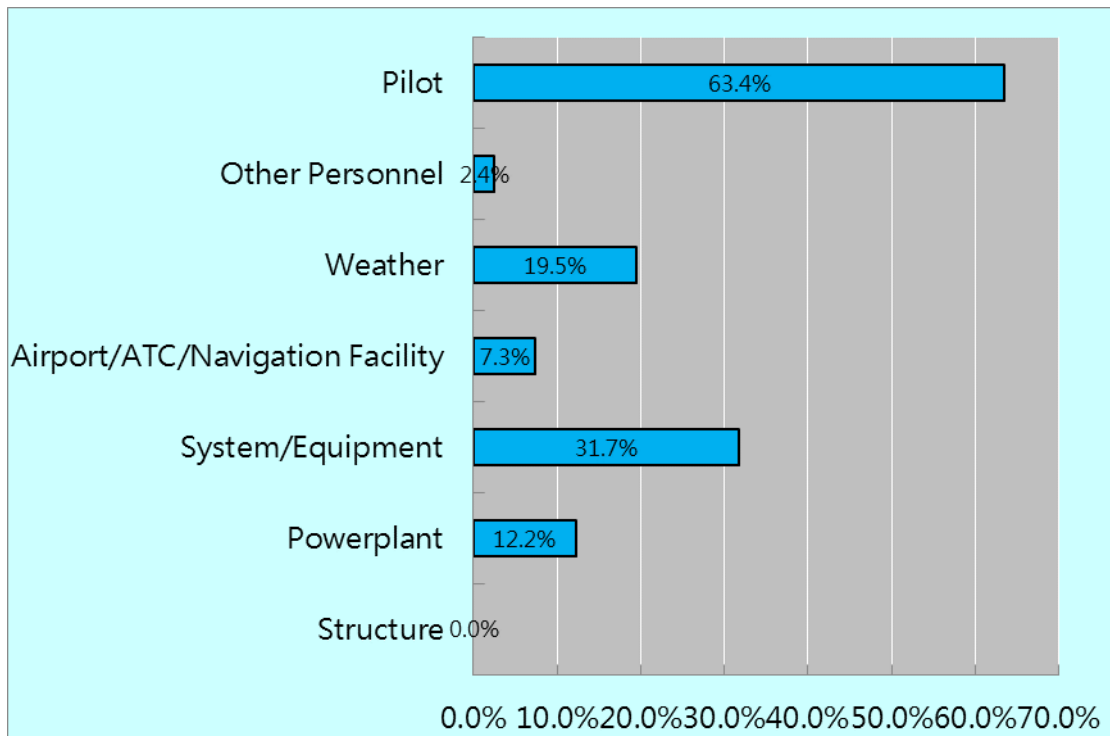


Figure15 : Broad causes/factors for airplane of transport category, 2009-2018.

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Occurrences Involving General Aviation and Helicopter

In the general aviation (GA) industry, the majority of operation is carried out by helicopters with the exception of few propeller airplanes. The TTSB classified the occurrence of general aviation aircraft as Class IV occurrence. At present time, only Daily Air Corporation provides both transportation service and GA service. The following statistics were all related to general aviation service aircraft and helicopters. As indicated in Table 11, 14 general aviation / helicopter of transport category occurrences occurred over the past ten years, 5 of them were fatal occurrences which resulted in 13 fatalities. Of those 5 fatal occurrences, 4 were helicopters and 1 was fixed wing airplane. Totally 13 fatalities were resulted. This then led to an average of 38.46 occurrences per 100 thousands hours, 13.74 fatal occurrences per 100 thousands hours and 16.48 hull loss occurrences per 100 thousands hours over the past decade. The fatal occurrences occurred in 2009, 2012, 2013, 2015 and 2017 respectively.

Table 11 : Occurrence rate of general aviation / helicopter of transport category, 2009-2018

Year	Number of occurrences			Aboard Fatalities	Total Flight Hours	Accident Per 100 Thousands Hours		
	All	Fatal	Hull Losses			Accident Rate	Fatalities Rate	Aircraft Hull Loss Rate
2009	1	1	1	2	4,859	20.58	20.58	20.58
2010	0	0	0	0	4,753	0.00	0.00	0.00
2011	0	0	0	0	4,956	0.00	0.00	0.00
2012	1	1	1	3	4,478	22.33	22.33	22.33
2013	1	1	1	3	2,892	34.58	34.58	34.58
2014	4	0	0	0	2,964	134.95	0.00	0.00
2015	3	1	1	2	2,193	136.80	45.60	45.60
2016	1	0	0	0	2,770	36.10	0.00	0.00
2017	1	1	1	3	1,579	63.33	63.33	63.33
2018	2	0	1	0	4,958	40.3	0.00	20.2
Total	14	5	6	13	36,402	38.46	13.74	16.48

Occurrences Involving Public Aircraft

From 2009 to 2018, there were a total of 8 public aircraft occurrences, which resulted in 5 fatal occurrences and 4 hull loss (including 3 fatal occurrences) occurrences. There were 2 occurrences related to personnel injuries. The statistics chart was shown as Figure 16.

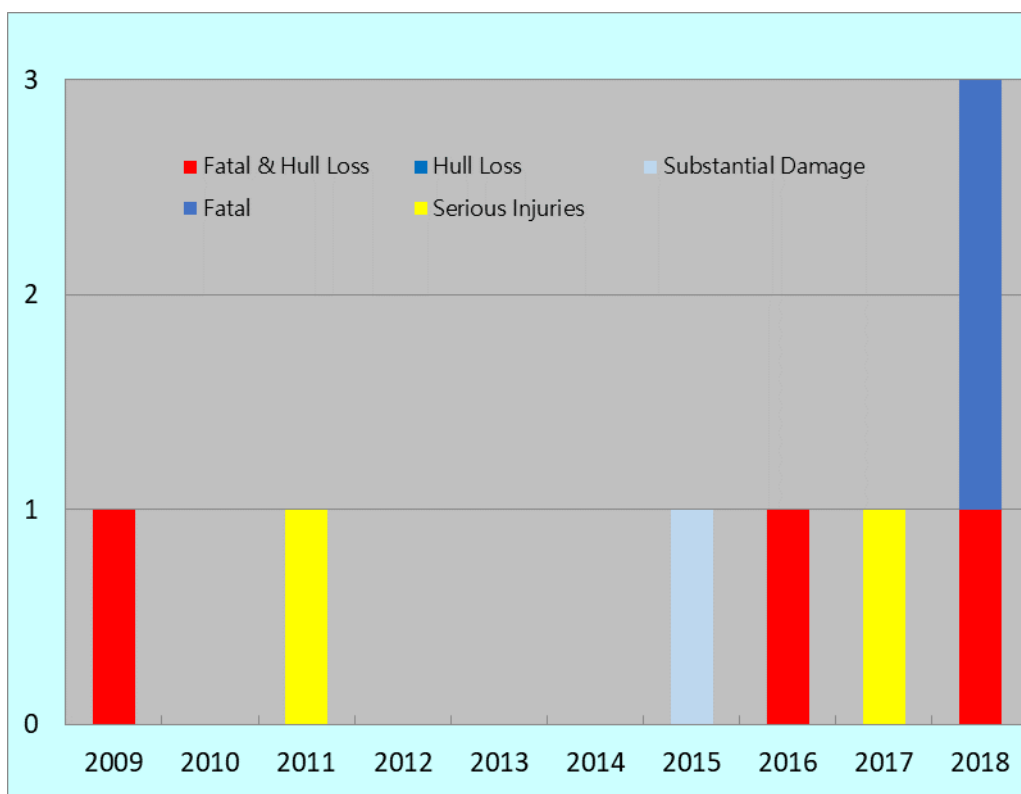


Figure16 : Occurrences statistics of public aircrafts, 2009-2018

Ultra-light Vehicle Occurrences

The ultra-light vehicles were not under supervision of Civil Aviation Act of the Republic of China until 2004. Later in the same year of 2004, in June, the investigation of any occurrences of ultra-light vehicle has formally been part of the investigation scope of Taiwan Transportation Safety Board. There were only limited documented accident data on ultra-light vehicle and the official record on ultra-light vehicle accidents only showed the data from 2004 to 2018. As indicated in Table 12, a total of 13 occurrences occurred during the past decade, and 5 of them were fatal accidents resulting in 7 fatalities. All 13 occurrences were resulted in hull loss. There was no ultra-light vehicle occurrence from year 2012 to 2014. The details are shown in Table 12.

Table 12 : Ultra-light vehicle occurrences, 2009- 2018

Year	Number of occurrences	Fatal occurrences	Hull losses occurrences	Fatalities
2009	1	1	1	2
2010	1	0	1	0
2011	2	1	2	1
2012	0	0	0	0
2013	0	0	0	0
2014	0	0	0	0
2015	2	1	1	2
2016	2	0	2	0
2017	1	0	1	0
2018	4	2	4	2
Total	13	5	13	7

Status of Tracking Safety Recommendations and associated action plans

Safety Recommendations Statistics

The purpose of the safety investigation for aviation occurrences is to prevent similar occurrences from happening again. When probable causes and contribution factors of occurrences were found through systematic investigation, the council would provide appropriate recommendations to each associated units. The recommendations recipients would draft corrective actions and execution plan to solve potential safety problems.

From the establishment of Aviation Safety Council (the predecessor of TTSB) at 1999 to the end of 2018, there were 147 aviation occurrences investigated. Preclude those foreign and Mainland China agencies investigated occurrences (20) and incidents (2), a total of 112 occurrence investigations been closed. In total, the council has issued 1,035 aviation safety recommendations. Within these recommendations, a maximum of 52.1 percent were issued to associated organizations of Taiwan government agencies, approximately 36.8 percent were presented to aviation industries, and approximately 11.1 percent were presented to foreign associated organizations (as shown in Figure 17).

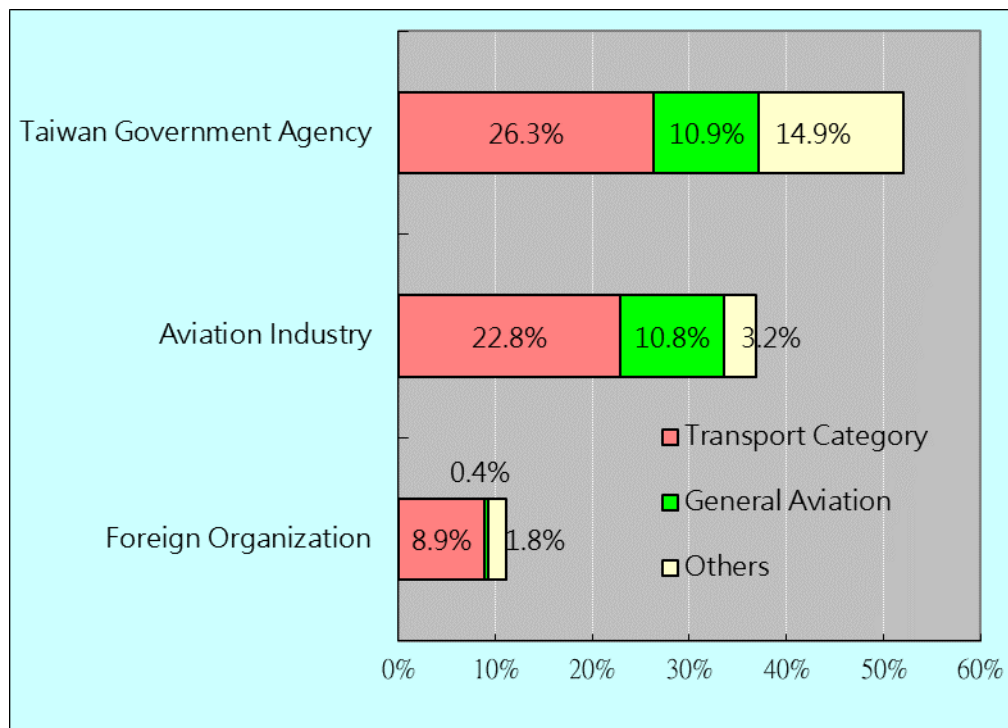


Figure17 : Statistics of aviation safety recommendations, 1999-2018

Tracking of Action Plans/ Proposals for Aviation Safety Recommendations

In order to positively solve the investigation discovered aviation safety issues, if the safety recommendation recipient was part of Taiwan government, the recipient should then establish corresponding action plans and/or proposals. These action plans/ proposals will be supervised by the Executive Yuan. The tracking and reviewing of those action plans/proposals were done by TTSB.

After reviewing each action plan/ proposal, TTSB will then categorize these plans into three statuses: “accepted”, “under supervision”, and “under evaluation”. TTSB then will submit the different review status to the Executive Yuan. Action plans with profound content and already been taken after the Council’s reviewing, the plan will be classified as “accepted”. If the action plans required longer time, usually over years, to complete, the Council will recommend the Executive Yuan classified the item as “under supervision” and continuously supervised by the Executive Yuan and tracking every six months until the item was closed. For the rest of the plans/ proposals, during the process of examination or organizing by other associated units, these plans will be labeled as “under evaluation”.

The Statistics of Action Plans Status

From April 1999 to December 2018, there were totally 539⁹ action plans being submitted by related Taiwan government agencies in accordance with the Council’s safety recommendations. Of all the plans, 510 (94.6 percent) plans were classified as “accepted”. 29 (5.4 percent) were classified as “under supervision”. The statistics is shown in Figure 18.

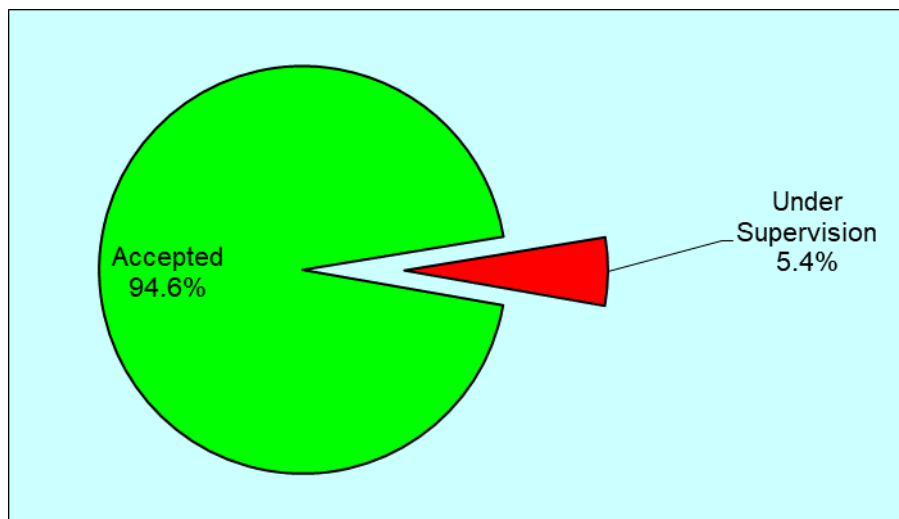


Figure18 : Statistics of action plans status

⁹ A total of 1,035 safety recommendations were made by TTSB. These safety recommendations were issued to Taiwan government agencies, aviation industries and foreign organizations.

Definitions of Terms

Definitions of Civil Aviation Legal Terms

Aircraft : Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface

Aeroplane : A power-driven heavier-than-air aircraft, deriving its lift in flight chiefly from aerodynamic reactions on surfaces which remain fixed under given conditions of flight.

Helicopter : A heavier-than-air aircraft supported in flight chiefly by the reactions of the air on one or more power-driven rotors on substantially vertical axes.

Civil Air Transport Enterprise : An enterprise engaged in the carriage of passengers, baggage, cargo and mail with civil aircraft to earn profits. (Here in this document the aircraft operated by Civil Air Transport Enterprise is used to called "transport category aircraft" or "transportation category aircraft")

General Aviation Enterprise : An enterprise engaging in the aviation business other than Civil Air Transport Enterprise for compensation, including aerial tourism, survey, photographing, fire-fighting, searching, paramedic, hauling and lifting, spraying and dusting, drone-hauling service, business charter, as well as other authorized aviation service.

Ultra-light vehicle : A powered airplane, powered glider, gyroplane, powered glider/parachute and weight-shift-control aircraft (commonly called trikes), which is used for manned operations and meets the following criteria:

- (1) Single reciprocating engine.
- (2) A maximum takeoff weight not exceeding six hundred kilograms.
- (3) A maximum seating capacity not exceeding two persons, including the pilot.
- (4) A maximum airspeed in level flight with maximum continuous power not exceeding two hundred and twenty two kilometers per hour under standard atmospheric conditions at sea level.
- (5) A maximum stalling speed, without use of lift-enhancing devices, not exceeding eighty three kilometers per hour at the aircraft's maximum certificated takeoff weight.
- (6) A fixed or ground-adjustable propeller other than a powered glider. A fixed or feathering propeller system if a powered glider.
- (7) A fixed-pitch, teetering and semi-rigid two-blade rotor system, if a gyroplane.
- (8) A non-pressurized cabin, if equipped with a cabin.
- (9) Fixed landing gear, if installed, other than a powered glider.

Accident : An aircraft accident means an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, in which such person is fatally or seriously injured or in which the aircraft is substantially damaged or missing.

Serious Incident : A serious incident means an occurrence associated with the

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operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, which may cause aviation accidents.

Incident : Any events associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, and are not belong to aircraft accident or serious incident mentioned above.

Definition of Terms in Transportation Occurrence Investigation Act and TTSB internal Standard Operation Procedures :

Aviation occurrence: An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, in which

- (1) A person sustains death or serious injuries;
- (2) The aircraft sustains substantial damage or missing or
- (3) Death or serious injuries of a person or substantial damage of the aircraft nearly occurred.

Investigation Report : A report prepared by the Investigator-in-Charge (IIC) compiling submissions from all technical sub-groups in accordance with the format administered by the International Civil Aviation Organization (ICAO), containing factual information, analysis, conclusions, and aviation safety recommendations reviewed and approved under this Act.

Aviation Occurrence Investigation : A process consisting of aviation occurrence identification, gathering, compiling, and analysis of factual data, probable causes identification, submission of safety recommendations, and investigation report preparation

Civil aircraft : An aircraft that is used for the purposes of civil air transportation services or general aviation services has completed the process of registration and airworthiness inspection in the civil aeronautics administration authorities.

Public Aircraft : An aircraft owned or used by a government agency to carry out official duties, excluding the military aircraft administered by the Ministry of Defense.

Terms in Aviation Occurrence Investigation Standard Operation Procedures for Civil Aircraft and Public Aircraft :

Death or serious injuries : A person is killed or injured as a result of any of the following :

- (I) Person being in the aircraft;
- (II) Person directly contacts with any part of the aircraft, including the parts that have been detached from it, or
- (III) Person directly exposed to jet blast,

With exception when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew.

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Injury : Any of which in the following :

- (I) Requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received;
- (II) Results in a fracture of any bone (except simple fractures of fingers, toes, or nose);
- (III) Causes severe hemorrhage, nerve, muscle, or tendon damage;
- (IV) Involves any internal organ;
- (V) Involves second- or third-degree burns, or any burns affecting more than 5% of the body surface;
- (VI) Proved to be exposed to radiation, or contaminated with radioactive material.

Substantial Damaged : Damage or Failure which adversely affects the structural strength, performance, or flight characteristics of the aircraft, and which would normally require major repair or replacement of the affected component. Engine failure or damage limited to an engine if only one engine fails or is damaged, bent fairings or cowling, dented skin, small puncture holes in the skin or fabric, ground damage to rotor or propeller blades, and damage to landing gear, wheels, tires, flaps, engine accessories, brakes, or wingtips are not considered “substantial damage” for the purpose of this part.

Missing : When the official search, so designated by the TTSB, is terminated and the wreckage has not been located, or has been located but found to be inaccessible or impossible to retrieve the evidence essential to the investigation.

Accredited Representative, AR : A person who is designated by the foreign country to which the aircraft involved in an occurrence is registered, the country that owns the aircraft, the country where the designer and/or manufacturer of the aircraft is located, the country whose nationalities are casualties of the occurrence, or the country that in any case is involved in the occurrence to participate in the investigation led by ROC.

Definitions of Terms for Aviation Occurrence Investigation Standard Operation Procedures used by the Taiwan Transportation Safety Board :

Preliminary Report : The report written within 30 days of the occurrence, based on the data and limited information obtained during the early stages.

Factual Data Report : The report is the basis for follow-up analysis and composition of investigation reports. Factual data report is the factual information consented by the entire investigation team. The investigating director composed the report according to the information from each groups, and also integrating proposals by specialized conveners and the members of other investigation teams.

Preliminary Draft Report : It is the initial draft composed by the investigating director and it is the earlier stage of the final draft report. The content includes factual information, an analysis, and non-categorized conclusions. The purpose of this report is to organize the ideas and suggestions from the associated units for the final draft report.

Final Draft Report : After the investigation, the investigating director combines and organizes all the information proposed by each specialized teams. The content of this

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report includes several key subjects, such as factual information, an analysis, finalized conclusions, and a list of transportation safety recommendations.

Final Report : After the final draft report is approved by the council, it will become an official final report.

Interim Flight Safety Bulletin : For anything found during the process of investigation that affects the aviation safeties, which should be reported to the associated organizations and industries as soon as possible.

Finding : The conclusion acquired from the factual information and analysis of the investigation of aviation accidents.

Safety Recommendation : Recommendations which are based on findings of the investigation, may address deficiencies that do not pertain directly to what is ultimately determined to be the cause of the accident.

Findings related to Probable Causes : The findings related to probable causes identify elements that have been shown to have operated in the occurrence, or almost certainly operated in the occurrence. These findings are associated with unsafe acts, unsafe conditions, or safety deficiencies associated with safety significant events that played a major role in the circumstances leading to the occurrence.

Findings related to Risk : The findings related to risk identify elements of risk that have the potential to degrade aviation safety. Some of the findings in this category identify unsafe acts, unsafe conditions, and safety deficiencies including organizational and systemic risks, that made this occurrence more likely; however, they cannot be clearly shown to have operated in the occurrence alone. Furthermore, some of the findings in this category identify risks that are unlikely to be related to the occurrence but, nonetheless, were safety deficiencies that may warrant future safety actions.

Other Findings : Other findings identify elements that have the potential to enhance aviation safety, resolve a controversial issue, or clarify an ambiguity point which remains to be resolved. Some of these findings are of general interests that are often included in the ICAO format accident reports for informational, safety awareness, education, and improvement purposes.

Definitions of Terms Used by the International Civil Aviation Organizations :

Accident: An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, in which:

- a) A person is fatally or seriously injured as a result of
 - being in the aircraft, or- direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or
 - Direct exposure to jet blast,

Except when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew: or

- b) The aircraft sustains damage or structural failure which:

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- Adversely affects the structural strength, performance or flight characteristics of the aircraft, and
- would normally require major repair or replacement of the affected component,

Except for engine failure or damage. when the damage is limited to the engine, its cowlings or accessories: or for damage limited to propellers, wing tips, antennas, tires, brakes, fairings, small dents or puncture holes in the aircraft skin: or

c) The aircraft is missing or is completely inaccessible.

Note 1. For statistical uniformity only, an injury resulting in death within thirty days of the date of the accident is classified as a fatal injury by ICAO.

Note 2. An aircraft is considered to be missing when the official search has been terminated and the wreckage has not been located.

Causes: Actions, omissions, events, conditions, or a combination thereof, which led to the accident or incident.

Aviation Accidents Database of the International Civil Aviation Organization Has Categorized Each Aviation Process Into the Following :

- Standing (STD): Prior to pushback or taxi, or after arrival, at the gate, ramp, or parking area, while the aircraft is stationary.
- Pushback/Towing (PBT): Aircraft is moving in the gate, ramp, or parking area, assisted by a tow vehicle [tug].
- Taxi (TXI) : The aircraft is moving on the aerodrome surface under its own power prior to takeoff or after landing.
- Takeoff (TOF) : From the application of takeoff power, through rotation and to an altitude of 35 feet above runway elevation.
- Initial climb (ICL) : From the end of the Takeoff sub-phase to the first prescribed power reduction, or until reaching 1000 feet above runway elevation or the VFR pattern, whichever comes first
- En route (ENR) : From completion of Initial Climb through cruise altitude and completion of controlled descent to the Initial Approach Fix (IAF).
- Instrument Flight Rules (IFR): A set of rules governing the conduct of flight under instrument.
- Visual Flight Rules (VFR): From completion of Initial Climb through cruise and controlled descent to the VFR pattern altitude or 1000 feet above runway elevation, whichever comes first.
- Maneuvering (MNV) : Low altitude/aerobatic flight operations
- Approach (APR) Instrument Flight Rules (IFR): From the Initial Approach Fix (IAF) to the beginning of the landing flare. Visual Flight Rules (VFR): From the point of VFR pattern entry, or 1000 feet above the runway elevation, to the beginning of the landing flare.
- Landing (LDG) : From the beginning of the landing flare until aircraft exits the landing runway, comes to a stop on the runway, or when power is applied for takeoff in the case of a touch-and-go landing
- Emergency descent (EMG) : A controlled descent during any airborne phase in response to a perceived emergency situation.
- Uncontrolled descent (UND) : A descent during any airborne phase in which the aircraft does not sustain controlled flight.
- Post-impact (PIM) : Any of those portions of the Flight which occurs after

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impact with a person, object, obstacle or terrain.

- Unknown (UNK) : Phase of flight is not discernible from the information available.

Aviation Accidents Database of the International Civil Aviation Organization Has Categorized Each Accident Into the Following¹⁰:

- Abnormal Runway Contact (ARC)
- Abrupt Maneuver (AMAN)
- Aerodrome (ADRM)
- Airprox/TCAS Alert/Loss of Separation/Near Midair Collisions/Midair Collisions (MAC)
- ATM/CNS (ATM)
- BIRD (BIRD)
- Cabin Safety Events (CABIN)
- Collision With Obstacle(s) During Takeoff And Landing (CTOL)
- Controlled Flight Into or Toward Terrain (CFIT)
- Evacuation (EVAC)
- External Load Related Occurrences (EXTL)
- Fire/Smoke (Non-Impact) (F - NI)
- Fire/Smoke (Post-Impact) (F - POST)
- Fuel Related (FUEL)
- Glider Towing Related Events (GTOW)
- Ground Collision (GCOL)
- Ground Handling (RAMP)
- Icing (ICE)
- Loss of Control-Ground (LOC - G)
- Loss of Control-Inflight (LOC - I)
- Loss Of Lifting Conditions En Route (LOLI)
- Low Altitude Operations (LALT)
- Medical (MED)
- Navigation Errors (NAV)
- Other (OTHR)
- Runway Excursion (RE)
- Runway Incursion (RI)
- Security Related (SEC)
- System/Component Failure or Malfunction (Non-Powerplant) (SCF - NP)
- System/Component Failure or Malfunction (Powerplant) (SCF - PP)
- Turbulence Encounter (TURB)
- Undershoot/Overshoot (USOS)
- Unintended Flight In IMC (UIMC)
- Unknown or Undetermined (UNK)
- Wildlife (WILD)
- Wind Shear or Thunderstorm (WSTRW)

Definition of Other Terms :

Fatal Occurrence : Accidents where one or more passengers die during the flight from

¹⁰ The occurrence categories have been changed from the 2004 version to the 2017 version since 2018.

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causes of the following: a) a deliberate act by another passenger on the flight; b) a directly hit by any parts of the aircraft, including the sub-part of the aircraft body; c) a directly exposure to turbulent which was caused by the aircraft. These events exclude deaths due to natural factors, self-behavior, others invasion, or hidings of stowaways at non-passengers/crews area on the aircraft in order to travel without paying or without being detected.

Hull Loss Occurrence : An aircraft damaged to the extent that is not economically feasible to repair it. This would include aircraft that are Hull Loss or aircraft that are missing, including the wreckage of unknown position or wreckage that are seriously damaged and unreachable.

Free balloon flight operation: A flight carried out by free balloon involving the transport of passengers.

Free balloon tethered activity: A free balloon which is moored to the surface of the earth or an object.

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Appendix

Appendix1: The operations of airline companies in Taiwan, 2009-2018

Year		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	
The Nationality of Airlines	Number of Companies	12	13	13	15	15	18	18	18	16	16	
	Operations of Civil Aviation Transporting Industry	7	8	8	8	8	10	9	9	7	8	
	General Aviation Industry Operators	6	7	7	9	9	10	10	10	10	10	
	Number of Airworthy Aircrafts	192	182	199	210	234	249	255	260	263	274	
Aircraft of Civil Air Transport Enterprise	Domestic Passenger Flight	Passengers aboard	4564516	4824917	5192341	5,323,750	5,265,923	5,260,693	4,891,621	5,413,680	5,537,976	5,783,596
		Passenger- Kilometers	1268615	1238689	1361636	1,504,482	1,472,993	1,520,742	1,468,925	1,654,531	1,835,945	1,950,066
	International Passenger Flight	Passengers aboard	17775123	20603129	20708375	22,546,135	24,061,087	26,704,903	29,042,002	31,226,905	31,135,769	32,147,492
		Passenger- Kilometers	55649773	58812536	58761490	62,370,466	66,128,230	71,199,036	78,585,906	87,687,543	91,332,988	95,795,809
	Total Number of Passenger Flight	Passengers aboard	22339639	25428046	25900716	27,869,885	29,327,010	31,965,596	33,933,623	36,640,585	36,673,745	37,931,088
		Passenger- Kilometers	56918388	60051226	60123127	63,874,948	67,601,223	72,719,778	80,054,831	89,342,074	93,168,934	97,745,875
	Domestic Cargo Flight	Tonnage	51076	50981	51462	49,034	45,651	37,318	39,941	40,491	34,498	35,407
		Passenger- Kilometers	5626	5298	4886	4,916	4,687	4,675	4,436	4,121	3,756	3,830
	International Cargo Flight	Tonnage	1376553	1868875	1728436	1,610,732	1,597,279	1,670,959	1,603,637	1,660,477	2,125,051	2,198,730
		Passenger- Kilometers	8598983	11868040	10585121	9,338,588	9,190,938	9,438,501	9,073,577	8,933,389	9,388,123	9,593,500
	Total Sum of Cargo Flights	Tonnage	1427629	1919856	1779898	1,659,166	1,642,930	1,708,277	1,643,578	1,700,968	2,159,549	2,234,137
		Passenger- Kilometers	8604609	11873339	10590007	9,343,505	9,195,626	9,443,176	9,078,012	8,937,510	9,391,879	9,597,330
	Flight Routes	Domestic Routes	82447	83019	87703	84,933	87,939	89,316	84,455	87,257	79,638	90,731
		International Routes	106761	119982	121989	132,913	144,135	156,985	168,089	178,842	168,158	175,390
		Total	189208	203001	209692	217,846	232,074	246,301	252,544	266,099	247,796	266,121
Helicopter for Civil Air Transport Enterprise	Flight Hours	270.35	244.93	231.72	142.85	87.57	167.22	137.8	148.1	211.3	193.3	
	Number of Flights	630	484	67	364	184	440	383	468	646	246	
	Passengers Aboard	2709	2517	698	1,573	972	2,010	1,852	2,287	3,204	2,735	
Helicopter for General Aviation	Flight Hours	4588.65	4507.67	4724.17	4,334.70	2,804.47	2,797.17	2,055.4	2,622.5	1,367.2	4,764.70	

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Appendix2: The operation statistics of public aircraft, 2009-2018

Year	Government units	Types of Operation	Total flights	Total Flight Hours	Aircraft Type · Number of Aircraft
2009	National Airborne Service Corps (NASC) of the Ministry of the Interior	Search and Rescue, Disaster Relief, Emergency Medical Services, Reconnaissance and Patrol, and Transportation (Training)	7547	9756:15	AS-365 10, BE-200 1 BE-350 1, S-76B 2 B-234 2, UH-1H 15
2010			6408	7944:27	AS-365 10, BE-200 1 BE-350 1, S-76B 2 B-234 2, UH-1H 15
2011			4796	6285:50	AS-365 10, BE-200 1 BE-350 1, S-76B 2 B-234 2, UH-1H 15
2012			4645	6164:00	AS-365 10, BE-200 1 BE-350 1, S-76B 2 B-234 2, UH-1H 15
2013			4814	6579:55	AS-365 10, BE-200 1 BE-350 1, S-76B 2 B-234 2, UH-1H 13
2014			4847	6454:05	AS-365 10, BE-200 1 BE-350 1, S-76B 2 B-234 2, UH-1H 13
2015			4892	6297:05	AS-365 10, UH-60M 3 BEECH 2, S-76B 2 B-234 2, UH-1H 13
2016			4640	6360:50	AS-365 9, UH-60M 5 BEECH 2, UH-1H 6
2017			4717	7258:05	AS-365 9, UH-60M 9 BEECH 1, UH-1H 6
2018			4640	4690:10	AS-365 9, UH-60M 8 BEECH 1

Note :

- I. The National Airborne Service Corps (NASC) preparatory office is established on Mar 10, 2004 by merging 4 government agencies including the Air Patrol Corps of the Coast Guard Administration, the Aviation Corps of Civil Aeronautics Administration of Ministry of Transportation and Communications, the Aviation Police Corps of National Police Agency and the Aviation Fire Corps of National Fire Agency. The National Airborne Service Corps officially established on Nov 9, 2005 by the order of Executive Yuan.
- II. This statistical table does not include the number of flights and flying hours on helicopter rental by the Air Patrol Corps of Coast Guard Administration, Executive Yuan.
- III. Number of aircraft in 2018 only counted serviceable aircrafts.

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Appendix3: Aviation occurrences and rates (by flight hours) of civil aviation transport category airplane, 2009-2018

Year	Fatal Aviation Occurrences of Jet Transport Aircraft						Fatal Aviation Occurrences of Turboprop Aircraft						Fatal Occurrences for All Aircrafts in National Civil Air Transport Enterprise								
	Fatal Occurrence	Hull Loss Occurrences	Fatal/Hull Loss Occurrences	Flight Hours	Fatal Rate Per Million Flight Hours	Hull Loss Rate Per Million Flight Hours	Fatal/Hull Loss Rate Per Million Flight Hours	Fatal Occurrences	Hull Loss Occurrences	Fatal/Hull Loss Occurrences	Flight Hours	Fatal Rate Per Million Flight Hours	Hull Loss Rate Per Million Flight Hours	Fatal/Hull Loss Rate Per Million Flight Hours	Total Fatal Occurrences	Total Hull Loss Occurrences	Fatal/Hull Loss Occurrences	Flight Hours	Fatal Rate Per Million Flight Hours	Hull Loss Rate Per Million Flight Hours	Fatal/Hull Loss Rate Per Million Flight Hours
2009	0	0	0	369,210	0.00	0.00	0.00	0	0	0	61,167	0.00	0.00	0.00	0	0	0	579,593	0.00	0.00	0.00
2010	0	0	0	571,651	0.00	0.00	0.00	0	0	0	65,613	0.00	0.00	0.00	0	0	0	637,264	0.00	0.00	0.00
2011	0	0	0	550,665	0.00	0.00	0.00	0	0	0	40,902	0.00	0.00	0.00	0	0	0	591,567	0.00	0.00	0.00
2012	0	0	0	569,829	0.00	0.00	0.00	0	0	0	41,237	0.00	0.00	0.00	0	0	0	611,066	0.00	0.00	0.00
2013	0	0	0	613,012	0.00	0.00	0.00	0	0	0	55,096	0.00	0.00	0.00	0	0	0	668,108	0.00	0.00	0.00
2014	0	0	0	634,288	0.00	0.00	0.00	0	0	1	61,186	0.00	0.00	16.34	0	0	1	695,474	0.00	0.00	1.44
2015	0	0	0	667,450	0.00	0.00	0.00	0	0	1	52,096	0.00	0.00	19.20	0	0	1	718,151	0.00	0.00	1.39
2016	0	0	0	693,323	0.00	0.00	0.00	0	0	0	54,130	0.00	0.00	0.00	0	0	0	744,453	0.00	0.00	0.00
2017	0	0	0	688,789	0.00	0.00	0.00	0	0	0	42,794	0.00	0.00	0.00	0	0	0	731,583	0.00	0.00	0.00
2018	0	0	0	725,917	0.00	0.00	0.00	0	0	0	59,513	0.00	0.00	0.00	0	0	0	785,430	0.00	0.00	0.00
Total	0	0	0	6,231,955	0.00	0.00	0.00	0	0	2	533,734	0.00	0.00	3.75	0	0	2	6,762,689	0.00	0.00	0.30

Appendix4: Aviation occurrences/ rates (by departures) of civil aviation transport category airplane, 2009-2018

Year	Fatal Aviation Occurrences of Commercial Jet						Fatal Aviation Occurrences of Turboprop Aircraft						Fatal Occurrences for All Aircrafts in National Civil Air Transport Enterprise								
	Fatal Occurrences	Hull Loss Occurrences	Fatal/Hull Loss Occurrences	Number of Departures	Fatal Rate Per Million Departures	Hull Loss Rate Per Million Departures	Fatal/Hull Loss Rate Per Million Departures	Fatal Occurrences	Hull Loss Occurrences	Fatal/Hull Loss Occurrences	Number of Departures	Hull Loss Rate Per Million Departures	Fatal/Hull Loss Rate Per Million Departures	Total Fatal Occurrences	Total Hull Loss Occurrences	Fatal/Hull Loss Occurrences	Fatal/Hull Loss Occurrences	Number of Departures	Fatal Rate Per Million Departures	Hull Loss Rate Per Million Departure	Fatal/ Hull Loss Rate Per Million Departures
2009	0	0	0	136,526	0.00	0.00	0.00	0	0	0	58,515	0.00	0.00	0.00	0	0	0	195,041	0.00	0.00	0.00
2010	0	0	0	150,402	0.00	0.00	0.00	0	0	0	58,159	0.00	0.00	0.00	0	0	0	208,561	0.00	0.00	0.00
2011	0	0	0	180,667	0.00	0.00	0.00	0	0	0	61,016	0.00	0.00	0.00	0	0	0	241,683	0.00	0.00	0.00
2012	0	0	0	170,011	0.00	0.00	0.00	0	0	0	59,010	0.00	0.00	0.00	0	0	0	229,021	0.00	0.00	0.00
2013	0	0	0	175,518	0.00	0.00	0.00	0	0	0	69,615	0.00	0.00	0.00	0	0	0	245,133	0.00	0.00	0.00
2014	0	0	0	192,202	0.00	0.00	0.00	0	0	1	69,595	0.00	0.00	14.37	0	0	1	261,797	0.00	0.00	3.82
2015	0	0	0	200,610	0.00	0.00	0.00	0	0	1	62,389	0.00	0.00	16.03	0	0	1	262,999	0.00	0.00	3.80
2016	0	0	0	212,403	0.00	0.00	0.00	0	0	0	62,838	0.00	0.00	0.00	0	0	0	275,241	0.00	0.00	0.00
2017	0	0	0	205,955	0.00	0.00	0.00	0	0	0	51,841	0.00	0.00	0.00	0	0	0	257,796	0.00	0.00	0.00
2018	0	0	0	209,582	0.00	0.00	0.00	0	0	0	69,349	0.00	0.00	0.00	0	0	0	278,931	0.00	0.00	0.00
Total	0	0	0	1,833,876	0.00	0.00	0.00	0	0	2	622,327	0.00	0.00	3.21	0	0	2	2,456,203	0.00	0.00	0.81

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Appendix5: Aviation occurrences involving illegal actions in airlines (suicide, damaging on purpose, terrorists), 2009-2018

Category	Date	Place	Airline Companies	Total Fatalities	
				Total Number	Total Number
Civil Air Transport Enterprise	N/A	N/A	N/A	0	0
General Aviation Enterprise	N/A	N/A	N/A	0	0

Appendix6: Statistics of aviation safety recommendations, 1999-2018

Accepted by Type of Aircrafts	International Organization	Aviation Industry	Government Related Agency	Total	Percentage
Civil Air Transport Enterprise	92	236	272	600	58.0%
General aviation Enterprise	4	112	113	229	22.1%
Others	19	33	154	206	19.9%
Total	115	381	539	1,035	100%
Percentage	11.1%	36.8%	52.1%	100%	

Note : Others include public aircrafts and ultra-light vehicle etc.