～ Introduction and analysis of accident investigation cases ～

JTSB Digests

JTSB (Japan Transport Safety Board) DIGESTS

No.42 (Issued in August 2023)

Digests of aircraft accident analysis

For Prevention of Accidents of Small Aircraft

～ Do you know flight data monitoring device (FDM)? ～

1. Introduction

Although the number of aircraft accidents has slightly decreased as a whole, 162 accidents occurred in the past 10 years (January 2013 ~ December 2022). Out of them, 100 accidents were caused by small aeroplanes, helicopters, and gliders (excluding those similar to ultra light planes, etc., hereinafter referred to as “small aircraft”), accounting for over 60% of the total number of accidents. The number of accidents involving small aircraft,. has decreased in recent years, but it still accounts for a high percentage. Moreover, there is no year in which an accident involving small aircraft did not occur.

Large aeroplanes such as airliners are usually obliged to be equipped with flight-data recorders (FDR) and cockpit voice recorders (CVR). Data obtained from these devices (hereinafter referred to as “flight recorders”) is utilized in accident investigations. However, since small aircraft are not obliged to be equipped with flight recorders except those used for air transport services, not many of them are equipped with them. On the other hand, a flight data monitoring device capable of recording

Figure 1: FDM

information such as the positions and altitudes of aircraft in flight and cockpit audio and image (hereinafter referred to as "FDM", See Figure 1) has been developed recently, although it is small, light, and low price. FDM is expected to be utilized not only for accident investigations but also for the reduction in safety risks by operators.

The utilization of FDM by other countries as a safety measure has been discussed at the "Small Aircraft Safety Promotion Committee" held regularly by the Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism. As a result of conducting substantive investigations (collection and analysis of operational data and evaluation of equipment) for several years, FDM was found to contribute to the improvement of safety of small aeroplanes. Therefore, it was decided to facilitate its introduction.

The Digests present how information obtained from FDM contributes to safe operations of aircraft in terms of the improvement of skills of pilots including training and risk management by extracting near-miss incidents in daily operations. Moreover, the importance of objective information is explained by introducing what type of information is collected and how it is utilized when JTSB creates investigation reports based on accident investigation reports published in the past. Also, how enhancement of objective information can contribute to preventing accidents from recurring by installing FDM on many aircraft will be explained.

2. Data of recent aircraft accidents

1. Data of aircraft accidents

This figure shows the details of 162 accidents occurred in the past 10 years by year. The number of accidents involving small aircraft varies between 4~20 (See Figure 2).

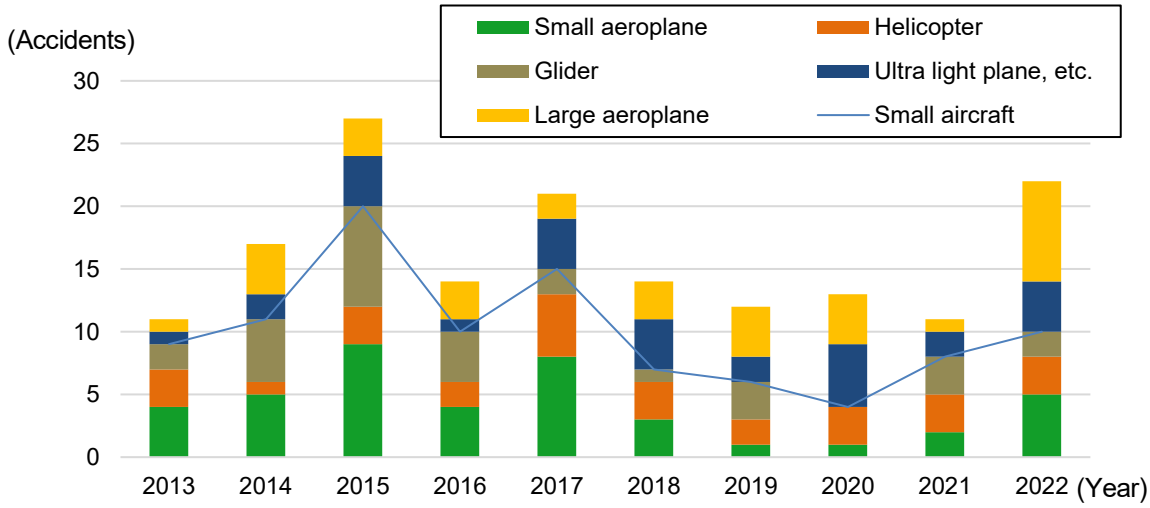


Figure 2: Number of aircraft accidents by year (2013~2022)

The following figure shows the number of accidents in the past 10 years by type of aircraft. The number of accidents of small aircraft is 100 and accounts for approximately 60% of the total number of accidents (Figure 3).

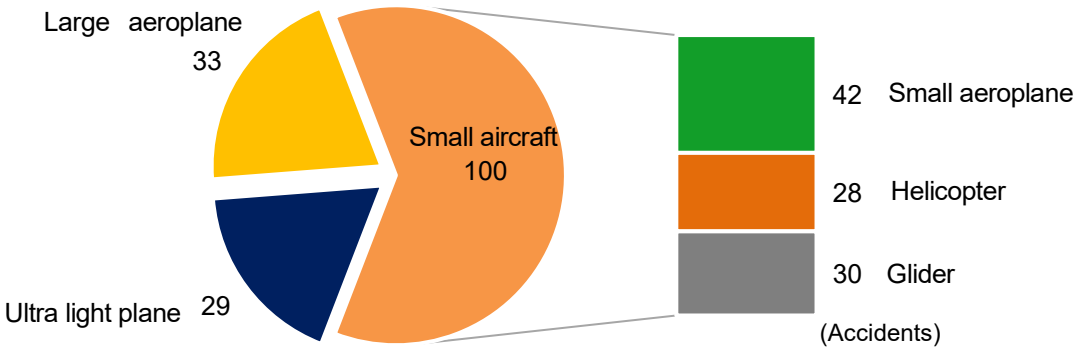


Figure 3: Number of aircraft accidents by type of aircraft (2013~2022)

2. Data of fatal accidents

The number of fatal accidents in the past 10 years is 31, while the number of fatalities is 70 persons. No fatal accident involving large aeroplanes has occurred, while 24 out of 31 accidents (77%) were caused by small aircraft. The number of fatalities caused by accidents involving small aircraft is 61 out of 70 (87%). Helicopters claimed many casualties (30 persons (43%) died in 9 accidents (29%)). Two accidents involved in large helicopters for disaster prevention activities in which 9 persons on board died. Furthermore, 7 accidents (about 23%) involving small aircraft claimed 19 lives (27%), while 8 accidents (26%) involving gliders claimed 12 lives (17%) (See Figure 4).

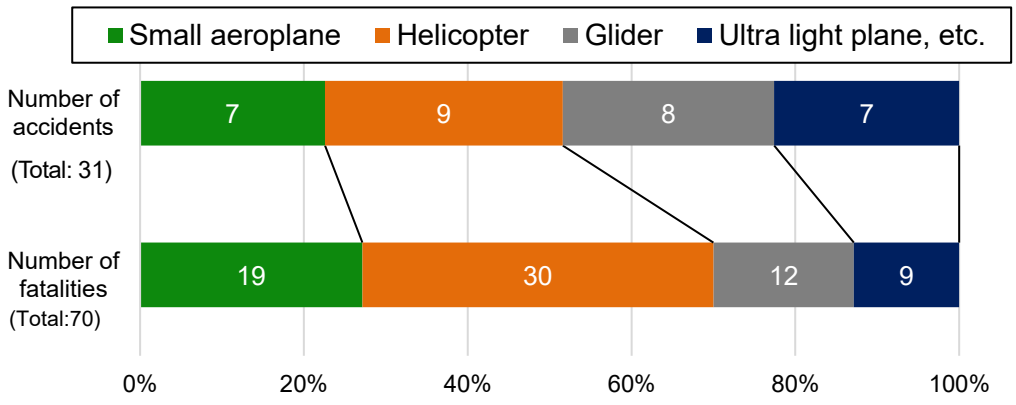


Figure 4: Number of fatal accidents and fatalities by type of aircraft

These data indicate that reducing in the number of accidents involving small aircraft is directly linked to the reduction in victims. Therefore, preventive measures are very important.

3. Data of accidents by cause

The following graph categorizes the causes of accidents in accident investigation reports of small aircraft, published in the past 10 years (January 2013 ~ December 2022). The most common cause is "human factors" which include operations of pilots, etc., accounting for 37 out of 95 accidents (39%). Then, 25 accidents (26%) were caused by human factor and environmental factor (meteorological conditions, etc.). These two causes account for 65% of the total number of accidents. Furthermore, human factors involve in over 80% of accidents (a total of 83 accidents), if "human factor + mechanical factor (equipment failure, etc.)" and human factor + organizational factor (safety management system, etc.)" are included (See Figure 5).

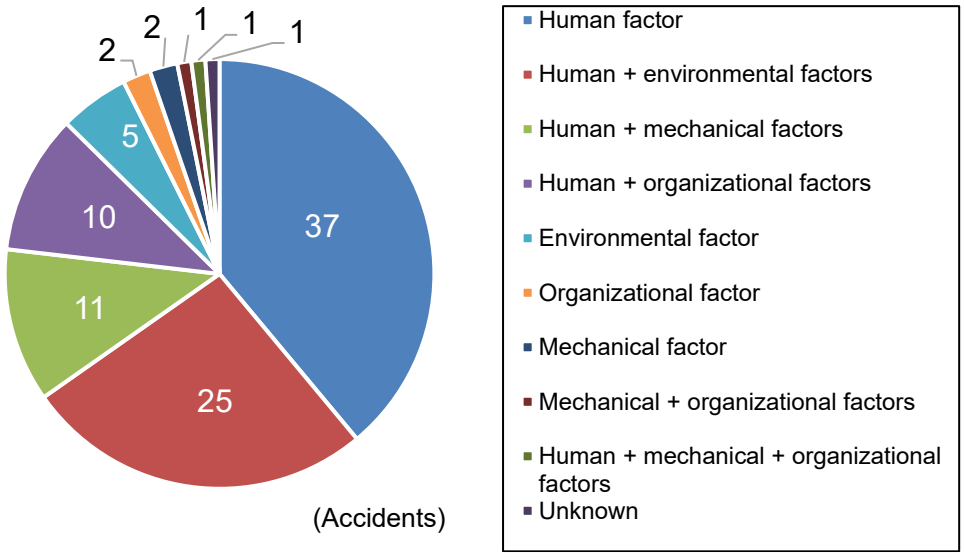


Figure 5: Number of accidents by cause

As far as this figure shows, we can see that human factors involve in many accidents. Moreover, when we analyze accidents caused by human factors in more detail, there are cases that could have been avoided by appropriate risk management such as "an aircraft in flight by visual flight rules entered into flight in the clouds", "an aircraft crashed into trees or transmission lines due to the lack of visibility", "an aircraft was not controlled appropriately due to the lack of necessary knowledge or skill", or "necessary safety check was omitted".

To prevent accidents involving small aircraft that show the above-mentioned tendencies, it is certainly important to ascertain the causes of accidents and the factors of damages from investigation reports published by JTSB and other sources to prevent similar accidents from recurring. It is also important to identify any indication of accident in daily operations such as near-miss incidents and deviation from standard procedures which is not perceived by oneself, carry out risk management based on such information, and take preventive measures for improving safety. A method of risk management to prevent accidents by collecting as many unsafe events (factors) as possible and taking their preventive measures is adopted not only in aircraft operations but also in a wide range of areas.

First of all, it is important to accurately identify the state of an aircraft when an unsafe event occurs based on objective flight data and investigate the cause in order to translate risks collected by the above methods into the prevention of accidents. Once what happened is found out by analyzing objective flight data obtained, it becomes feasible to take more effective preventive measures and initiatives.

In the next chapter, we introduce flight data monitoring device (FDM) equipped with the functions of collecting flight operational data necessary for reducing safety risks through preventive measures and of utilizing such data for training programs for pilots and the preservation of their skills.

3. What is flight data monitoring device?

Flight data monitoring devices (FDM) are a collective term of devices capable of recording information such as the positions and altitudes of aircraft in flight, cockpit audio and image, etc. for the purpose of flight data monitoring*1. In the Digests, FDM refers to all devices installed on aircraft the aim of recording flight conditions other than flight recorders (See Figure 6) mandated to be installed under the provisions of the Civil Aeronautics Act. Since flight recorders are installed for the purpose of conducting accident investigations, high resistance to impact, fire, and water pressure is required. It is not that straightforward for an operator to use a recorded data for analysis of flight conditions. On the other hand, FDM is less resistant to impact than flight recorders, but operators can use objective information (data) recorded for various purposes (See Table 1 for recordable data).

Large aeroplanes such as airliners are equipped with quick access recorders (QAR) capable of recording broader data than FDR so that operators can collect available data in the same way as FDM. Operators monitor the status of operations of aircraft on a regular basis using data sent from QAR and utilize it for risk management and safe operations.

Figure 6: Flight recorders (Left: FDR, Right: CVR)

＊1 “Flight Data Monitoring”

This is a system to detect unsafe factors (operational risks) in flight and take measures before an accident occurs by recording and analyzing data of aircraft in cockpit audio and image. Daily operations are monitored to improve and ensure safety. FDM aims to acquire data in flight and records cockpit audio and image. Moreover, it records the positions, altitudes, ground speeds, triaxial speeds, triaxial acceleration, flight courses, etc. Furthermore, software that animates data obtained is used to review daily operations together with aircraft movements and cockpit image.

Table 1: Comparison of FDM and flight recorders

	FDM	Simple type FDM	FDR	QAR
Appearance				
Recorded data	・Latitude, longitude, GPS altitude, triaxial speed, triaxial acceleration, in addition, the following data is calculated based on the above measurement data; ground speed, rate of climb, traveling direction, pitch angle, roll angle (14 parameters: internal sensor + GPS) ・Cockpit audio and image are recorded	・Latitude, longitude, GPS altitude, pressure altitude, triaxial speed, triaxial acceleration, triaxial magnetic field (13 parameters: internal sensor) ・Cockpit audio and image are recorded	・Positions, altitudes, speeds, angles, acceleration, rudder control, status of equipment such as engines, alarms, etc. are directly recorded (78 parameters (Type IA))	・More than 2,000 parameters are recorded ・It is feasible to obtain data at short intervals and to record longer hours than FDR ・Cockpit audio and image are not recorded
Remarks	・Power source: Supplied from aircraft’s power source ・Impact resistance: Compliant with safety standards for the time of shock/crash of equipment installed on aircraft ・Fire resistance: Compliant with standards required for in-flight accessories	・Power source: Powered by own battery	・Impact resistance, fire resistance, and water pressure resistance are designed to be able to endure severe situations caused by accidents	・Impact resistance, fire resistance, and water pressure resistance are lower than FDR

(FDM listed here is some examples. We do not necessarily recommend the use of the same products. Please see also the “Guidelines for Introduction of FDM for Small Aircraft” created by the Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism.)

4. Utilization of information stored in FDM by operators for safe operations

The advantages of utilizing objective information obtained from FDM for operators include the improvement and preservation of skills of pilots and efficient risk management in daily operations by reviewing such information. The information obtained can be utilized in the following ways.

(1) Improvement and preservation of skills of pilots

It is feasible to effectively identify the operational procedures of each pilot in accordance with operational form and any unaware habit by reviewing data after flight, comparing trajectory records with past trajectory records of pilots and standard flight routes and by playing cockpit video. Furthermore, advice from flight instructors helps individual pilots improve their skills, thereby increasing flight safety and preventing accidents.

The utilization of analysis tools that visualize data in that process brings about a benefit that pilots can have better understanding of their own flight style as well as other benefits, because movements of aircraft can be checked visually from an outside perspective.

Playback cockpit image

Visualization of flight data

(2) Monitoring of operations

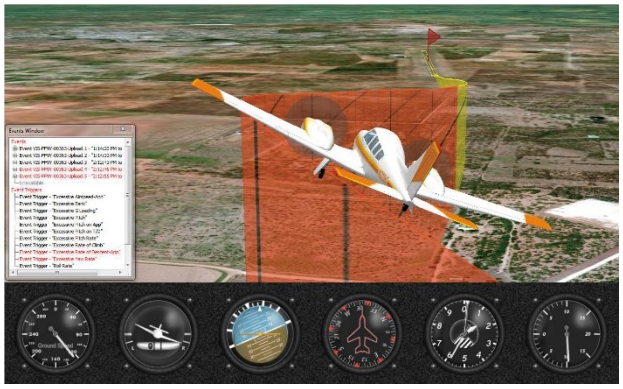
Air transport operator should manage its operations of aircraft under the flight dispatcher. Air carrier that operates large aeroplanes manages from the preparations for departure to the reporting of operation status after arrival. If any failure is found, information is shared among parties concerned to ensure safety. On the other hand, it is difficult for individual air transport and flight operators to ensure such a system and identify the status of each flight.

It is difficult to identify any deviation from standard procedures in such a system or pilots themselves may not be aware of risky flight. In such a case, data from FDM can help instructors give a pilot advice based on the results of check and verification of the status of each flight.

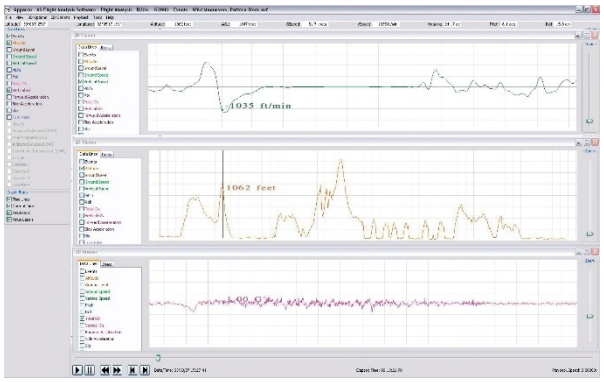
This data can also be utilized by an aviation operator to investigate the cause of near-miss incidents and to formulate appropriate preventive measures more promptly. Furthermore, it becomes feasible to eradicate any indication of future accidents by extracting risk factors such as near-miss incidents in daily

operations using analytical tools as well as to efficiently bring out the safety management function by incorporating it to safety management system (SMS) of aviation operators.

In daily risk management, it is important to improve flight safety by addressing each individual flight risk in a non-punished environment without accusing the responsibility of a pilot. FDM is very useful in this sense, since it can obtain and analyze objective information.



Application of analytical tool (display of flight route)



Analytical function of various data

(3) Monitoring of aircraft failure

It is feasible to identify the status of aircraft based on various recorded data and utilize it for the prevention of failure.

5. Importance of objective information in terms of accident investigations

When an aircraft accident occurs, accident investigators are sent to an accident site to collect information necessary to investigate its causes. In this process, the discovery of flight recorders (also called “black box”) draws the attention of the press in the case of a large aeroplane, but small aircraft are rarely equipped with this type of equipment. If small aircraft are equipped with FDM explained in Chapter 3, more than 10 parameters can be obtained from internal sensor, etc. and very useful information becomes available to investigate the causes, although the number of parameters is fewer than flight recorders. Moreover, if cockpit images which are usually not contained in flight recorders are recorded, it is very useful to investigate the accident, because the control of devices and external information can be obtained.

The next section presents the sources of data used in accident investigation reports by JTSB to consider how objective information obtained from FDM can be utilized to improve safety.

1. Status of on-board FDR and FDM in accidents involving small aircraft

The next graph shows the number of aircraft that had data from FDR or FDM in creating investigation reports on small aircraft published in the past 10 years (January 2013 ~ December 2022).

Among 95 accidents involving small aircraft (97 aircraft involved), 3 aircraft were equipped with FDR, while 1 aircraft equipped with FDM (See Figure 7).

When we pay attention to 20 aircraft involved in fatal accidents of pilots, no aircraft was equipped with any of this equipment.

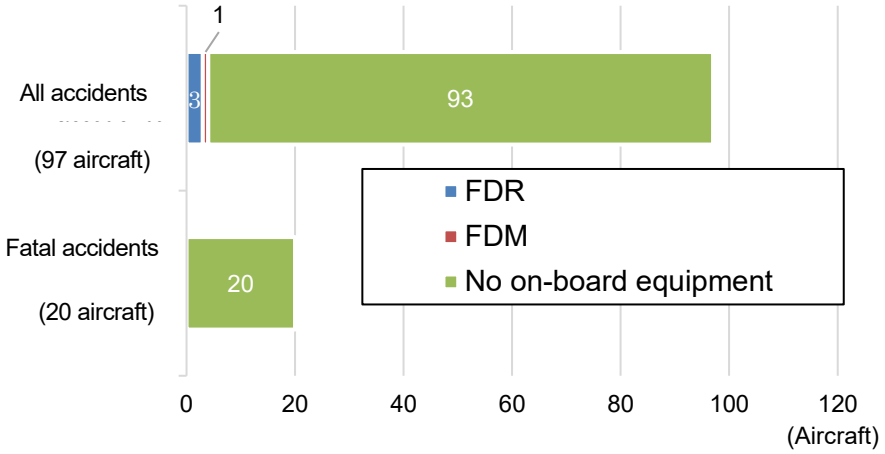
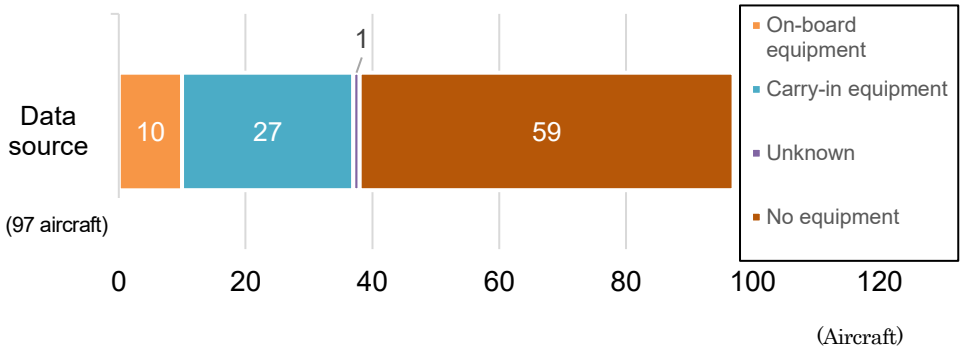


Figure 7: Status of on-board FDR/FDM in accidents involving small aircraft

2. Information on positions and altitudes of aircraft

The fact is that not many small aircraft are equipped with a flight recorder, because there is no obligation to do so, although it depends on when an airworthiness certificate or type certificate was granted or whether a small aircraft carries human beings or cargos for fee. Therefore, when an accident investigation is conducted, anything that contains data is used after checking if the positions of the aircraft are recorded in various navigation equipment for aircraft operations, equipment used for special services such as monitoring of transmission lines, etc. Moreover, we take the initiative to obtain and utilize data from portable GPS receivers brought in by pilots, etc. for secondary use, and video cameras or smartphones for business or personal use (if any), under the cooperation of their owners.

The next graph shows the number of aircraft from which on-board data could be collected to verify their positions, etc. in accident investigations. Out of 97 aircraft investigated, we could collect data from on-board equipment from only 10 aircraft (10%). Even if carry-in equipment such as portable GPS receivers are included, we could obtain data from only 37 aircraft (38%). The truth is that it is not feasible to obtain information on aircraft positions, etc. from approximately 60% of all accidents (See Figure 8).



※"No equipment" includes aircraft that had on-board equipment but no data was recorded

Figure 8: Status of positional information of small aircraft

It should be noted that, in an actual accident investigation, the aircraft position is identified by utilizing information recorded by ground facilities in addition to airborne data.

For example, ground facilities can provide information on positions and altitudes from aircraft control radars, videos from various security cameras installed inside and outside airports, videos recorded by drive recorders installed on airport service vehicles and public vehicles. Particularly, aircraft control radars can provide much information. Information from them is used in approximately 20% of investigation reports, but aircraft attitudes, etc. cannot be verified.

The following shows specific data utilized by JTSB other than FDR and FDM and use cases. Investigation reports are created by selecting necessary information from available information.

Integrated instruments

If any information is recorded in navigation instruments equipped for aircraft operations and various systems that control and display aircraft and engines, it is extracted.

Equipment for special duties

This equipment is installed for special duties. Data recorded there in is obtained and utilized. Some of examples are shown below.

- Dynamic management system (positional information obtained from GPS systems installed on helicopters, etc. is transmitted via satellites for search and rescue services so that the ground side can capture the positions on a real-time basis and share it with on-board equipment)
- Transmission line route mapping system (This system is used to patrol transmission lines, and information on positions and altitudes are recorded every second)
- Airborne image transmission system (Videos taken by visible cameras and the positional information from GPS systems are sent to the ground side for recording)

Portable GPS receiver

A portable GPS receiver is brought in by a pilot for duty or reference of aircraft operations. The precision of positions and a recording method vary.

Video camera

Videos and voice recordings taken by a video camera brought in by a pilot for his/her duty or personal use

Other on-board equipment

GPS information of smartphones brought in by pilots

Voice recordings of IC recorders brought in for training purposes

Aircraft control radars

These radars are under the jurisdiction of the Ministry of Land, Infrastructure, Transport and Tourism and the Ministry of Defense for aircraft control and can obtain information on aircraft positions, altitudes, and routes. However, information cannot be obtained if an aircraft flies in the shade of a mountain or at a low altitude, because reflected waves (response waves) emitted from radars are used.

Airport security cameras, etc.

Surveillance camaras at runways and parking aprons of airports, various security cameras installed for various purposes, and videos provided by spectators.

Drive recorders

Videos of drive recorders installed on airport service vehicles and public vehicles

3. Information inside the aircraft's cockpit

The next graph shows the number of aircraft which provided on-board data for verifying the situations in cockpits (See Figure 9). If a cockpit voice recorder (CVR) is installed, communications with air traffic control authorities, equipment control noise, operating noise, warning alarms, and surrounding noise, etc. However, currently, cockpit images are not recorded except some aircraft, even in the case of large aeroplanes. On the other hand, FDM has the function of recording readings of instruments in cockpits and external sceneries. Even if this equipment is not installed, we take the initiative to obtain and analyze visual recordings of equipment capable of recording videos such as on-board professional cameras and personal video cameras for the purpose of investigating the causes of accidents.

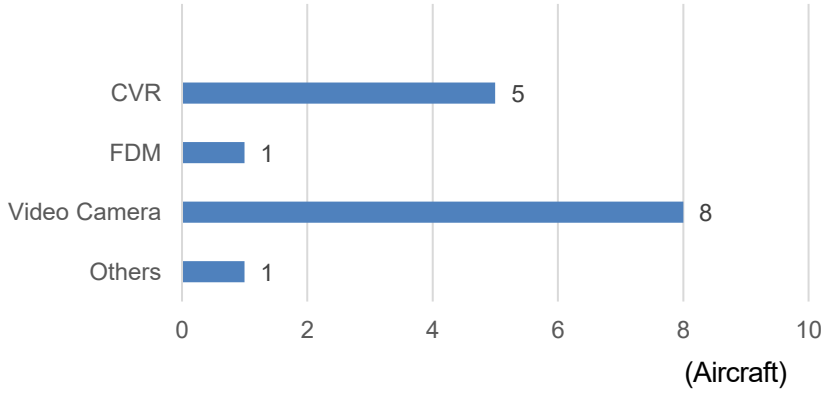


Figure 9: Information used to identify the situations in cockpits of small aircraft

4. Utilization of objective data from FDM and its effect

In order to investigate the causes of accidents, it is important to collect all objective information available in the first place. As described above, we conduct investigations based on information recorded not only in on-board equipment such as flight recorders but also in various devices such as drive recorders and smartphones. Collecting as much information as possible is the first step of accurate investigations of causes and adequate prevention of accidents.

It is not feasible to obtain statements about how an aircraft resulted in an accident especially in cases where passengers including a pilot seriously injured. Therefore, it is of extreme importance to investigate the causes based on diverse data contained in on-board equipment. It is not always feasible to obtain positional information from aircraft control radars or statements from witnesses. If an aircraft crashes in the mountainous area, it is difficult to identify a flight route without positional information, etc., causing headaches for accident investigators. In such a case, devices such as FDM capable of collecting and recording objective data are extremely useful, because they clarify the causes of accidents and more safety is ensured by sharing preventive measures among all operators of small aircraft.

The same principle applies to safety management activities of aviation operators such as collection and analysis of near-miss incidents. It is not practical to collect information from ground facilities, etc., especially in these activities. However, if devices such as FDM are installed, analysis and assessments can be made based on objective information recorded therein, contributing to the improved quality of safety management. Moreover, in the case of a private aircraft, it becomes feasible to objectively review the flight process of near-miss incident so that flight safety is ensured by improving pilot's own skills.

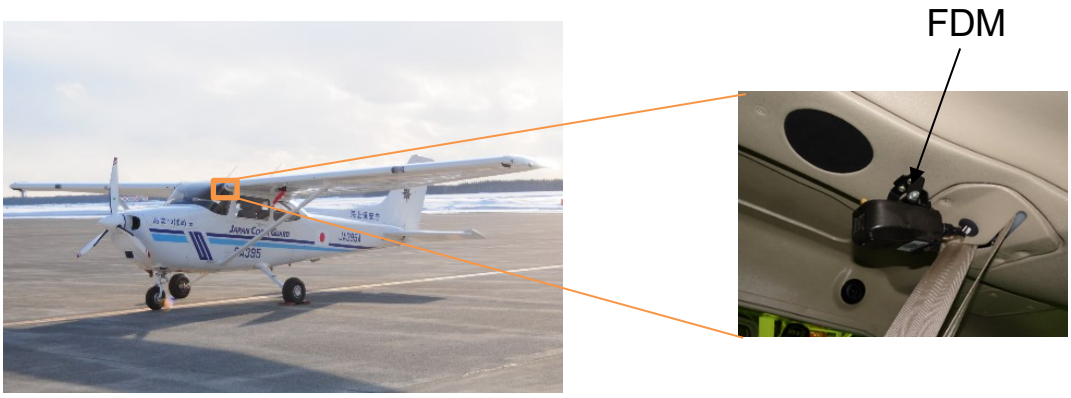
6. Usefulness of information in accident analysis

Based on the information explained so far, Chapter 6 will present what type of information is utilized to create investigation reports by taking aircraft equipped with FDM as an example as well as how objective information that was available for analysis is utilized to estimate the processes leading up incidents and accidents, the causes of accidents, and factors involved.

1. Example of an accident analyzed by on-board FDM

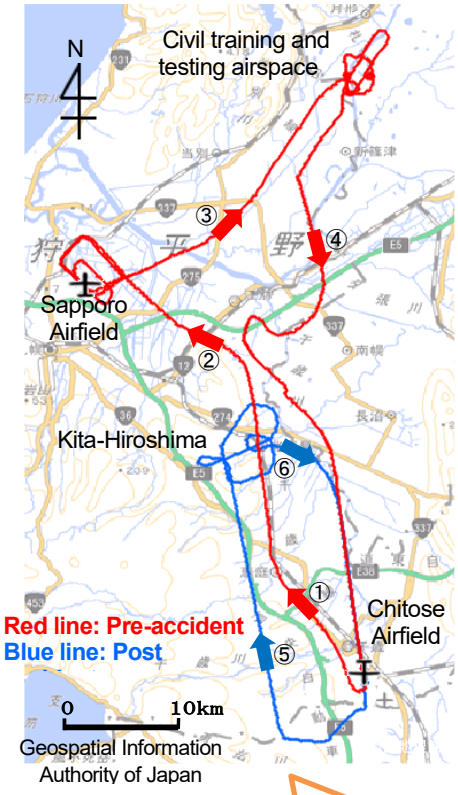
Time and date of the accident: August 21 (Tuesday), 2018, around 13:22 p.m.
Type: a Textron Aviation 172S
Outline of the accident:
The aircraft took off from Chitose airfield for the practical pilot competence examination flight associated with the rating change for pilot certificate, after completing examination in subjects associated with take-off and landing at Sapporo airfield, the aircraft conducted other examination subjects in civil training and testing airspace, and then headed for Chitose airfield. This aircraft suffered damage to the airframe by the touchdown accompanying a severe impact when landed at Chitose airfield.

The aircraft and FDM installed thereon



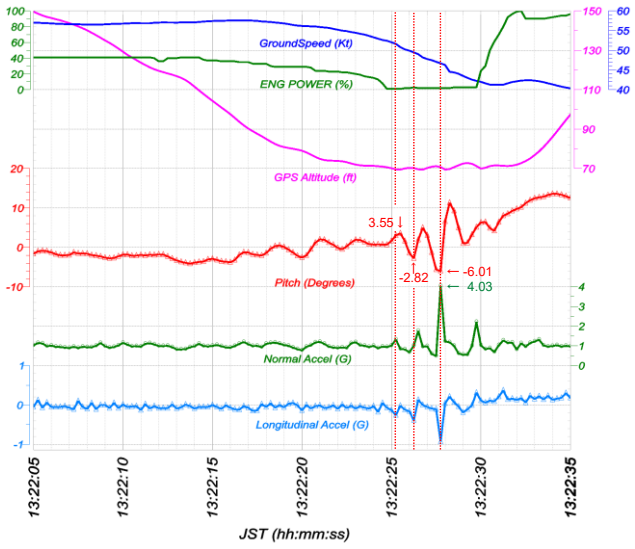
Records of FDM

Estimated flight route



The flight route of the aircraft was analyzed based on flight records in FDM

Various flight data such as altitudes and speeds



The altitude, speed, pitch angle, acceleration, and engine output were analyzed based on flight records in FDM

Records used to analyze the flight status in the investigation report

FDM data → Movements of the aircraft and the in-flight status such as pilot's control at the time of the accident, touchdown noise, engine output

Oral testimonies from the instructor and the pilot → Response to pilot's control including mental conditions of the pilot

Records from the drive recorder of commercial vehicle → Status of the aircraft's bouncing at the touchdown

Based on the above records, the situations described on the left-hand side were found out and led into the analysis on the right-hand side.

Process leading up to the accident	Analysis of probable causes
After completing the practical pilot competence examination flight associated with the rating change for pilot certificate in the training and testing airspace, etc., the examinee commenced the descent from a pressure altitude of 1,500 ft at an approach angle of 2.7 by Runway 18L at Chitose airfield, had the runway in sight at a pressure altitude of about 500 ft and passed over the runway threshold (THR) at an airspeed of about 72 kt with full flaps.	It is highly probable that the aircraft passed over the runway threshold at an airspeed of about 72 kt and was descending at an unstable pitch angle.
The first grounding The examinee kept the engine power to some extent, delayed the timing to close the throttle than usual and performed a flare maneuver. The aircraft touched down on the main landing gear at an air speed of about 62 kt and bounced after the touchdown.	The aircraft started increasing its pitch angle about 3 seconds before its first touchdown followed by decreasing its pitch angle about 2 seconds before its touchdown, then it touched down at around airspeed of 62 kt with increasing its pitch angle again about 0.5 seconds before its touchdown. From the above it is highly probable that the aircraft bounced because it touched down with abruptly raising its attitude to a landing attitude immediately before its touchdown with high airspeed.
The second grounding The examinee continued landing, landing presuming that the bounce of the nose at the second touchdown would subside, although the nose bounced.	It is highly probable that the examinee was unable to control the nose down properly, touched down on the nose gear and continued landing, that led the aircraft to enter porpoise condition where bounces were repeated because the pitch angle changed from 3.55 to –2.82.
The third grounding The examinee executed a go-around because the nose bounced more severely than the second touchdown. The examinee applied the engine maximum power to establish climb attitude and retracted the flaps.	The aircraft entered porpoise condition at the second touchdown, then –6.01 of the pitch angle, +4.03 of the vertical acceleration (G) and the loud sound of the landing gear were recorded at the third touchdown, therefore, it is highly probable that the airframe was damaged by severe touchdown of the nose gear in pitch down attitude (an attitude of the nose downward than the horizontal plane) at the third touchdown.
The examinee requested air traffic control for radar vector and landed at Chitose airfield at around 13:58 by Runway 18L approach after holding over Kita-hiroshima City as instructed by air traffic control.	

Probable causes of the accident

In this accident, it is highly probable that the aircraft suffered damages because it entered porpoise condition after the bounce at the first touchdown, and touched down hard on the nose gear in pitch down attitude at the third touchdown.

Since this aircraft was equipped with FDM and objective data such as the positions, altitudes, speeds, attitudes, etc. of the aircraft could be obtained, it was feasible to analyze how the accident happened in detail as described above. It is easier to comprehend a specific situation where the aircraft was damaged by comparing the situations when this accident happened and after the go-around (after the touchdown) based on data in FDM in analysis. Moreover, if an aircraft is equipped with FDM, the operator can obtain the same data as the one used to create the above investigation report. Therefore, this data contributes to the prevention of accidents in the future by making a comparative study with other flight cases and sharing its results with pilots.

The effectiveness of FDM is presented also in Chapter 3 (Analysis) of the investigation report.

The accident aircraft was equipped with FDM, its record was useful to analyze the flight situation of the accident aircraft in detail in this accident investigation. FDM stores various kinds of flight data and the cockpit audio and image, and it is probable that the extraction of unsafe factors in regular flights and the confirmation of the training results and others are able to be done by analyzing such data.

Furthermore, an accident investigation report of an aircraft which was not equipped with FDM (a helicopter crashed the mountain slope in Nagano prefecture in March 2017) mentions the importance of objective information including simple type flight recorders and the importance of equipment as shown below.

The helicopter was not required to be equipped with a flight recorder and was not equipped with one. In this accident, although all of the rescuers aboard the helicopter died, it was feasible to make use of video camera images taken by a rescuer as objective data to verify factual information and analyze the causes. However, it is probable that had the images not been available, scientific analysis of the accident would have been extremely limited in scope. For aircraft that are required to fly within small safety margins, such as in severe weather conditions or at low altitude for firefighting, disaster management, or other activities involving lifesaving and the like, the installation and utilization of a flight recorder, including the simple type can prove useful in better understanding of the characteristics and flight operations of an aircraft for special flight services by regularly analyzing and evaluating the flight conditions in ordinary flight operations, and if an incident or an accident occurs, it will contribute significantly to precisely identifying its causes and developing effective recurrence prevention measures.

Accordingly, equipping such aircraft with flight recorders is considered as high priority and it is desired to study for its realization and promotion with the cooperation of relevant parties.

2. Usefulness of FDM in accident investigations, etc.

In some cases, sufficient objective flight data may not be available in accident investigations even now. If those cases are eliminated as much as possible and the probable causes can be investigated more accurately based on scientific analysis, operational safety will improve. Since FDM is a very useful device in this sense, we expect FDM to be adopted more broadly.

7. Trends of overseas investigation authorities

Overseas accident investigation authorities are also interested in equipment such as FDM. In this Chapter, the trends of the National Transportation Safety Board (NTSB) and the Australian Transport Safety Bureau (ATSB) will be presented. Both accident investigation authorities state that equipping aircraft not mandated to be equipped with flight recorders with devices capable of recording flight data and image will help the prevention of future accidents. This point of view matches the purport of the Digests.

Websites of investigation authorities

NTSB https://www.ntsb.gov/advocacy/mwl/Pages/default.aspx

ATSB https://www.atsb.gov.au/safety-issues/AO-2017-118-SI-03

NTSB (United States) 2021-2022 MOST WANTED LIST

In the MOST WANTED LIST, NTSB publishes that it is requesting to the Federal Aviation Administration (FAA) that small aircraft used to transport passengers should be equipped with devices capable of recording flight statuses. Moreover, the effectiveness of FDM is mentioned in an individual investigation report cited as an example.(the partial excerpt is as follows)

Request of NTSB	The NTSB believes other types of passenger-carrying commercial aircraft such as charter planes and air tours, should be equipped with data, audio, and video recording devices. These operators should also have programs in place that analyze the data derived from these devices. Recorders and flight data management programs would not only help investigators solve accidents, but they would also help aircraft operators prevent crashes in the first place by allowing crew actions to be evaluated regularly.
Example of description in relevant report (AAR-21-01)	The value of crash-resistant flight recorder systems in preventing future accidents
	Certain circumstances of this accident could not be conclusively determined, including the visual cues associated with the adverse weather and the pilot's focus of attention in the cockpit following the flight's penetration of clouds and entry into IMC. A crash-resistant flight recorder system capable of capturing audio and

	images could have provided this valuable information, possibly enabling the identification of additional safety issues and the development of safety recommendations to prevent similar accidents.

ATSB (Australia) Aviation Safety Issues and Actions

ATSB issues recommendations to aviation authorities about the installation of recording devices on small aircraft (the provisional translation of the partial excerpt is as follows).

Recommendation of ATSB	Australian civil aviation regulations did not mandate the fitment of flight recorders for passenger-carrying aircraft under 5,700 kg. Consequently, the determination of factors that influenced this accident, and other accidents, have been hampered by a lack of recorded data pertaining to the flight. This has likely resulted in the non-identification of safety issues, which continue to present a hazard to current and future passenger-carrying operations. The following recommendation was issued, since aviation authorities did not take safety actions.
	Civil Aviation Safety Authority consider mandating the fitment of onboard recording devices for passenger-carrying aircraft with a maximum take-off weight less than 5,700 kg.

8. Summary

The JTSB (Japan Transport Safety Board) Digests covers “flight data monitoring devices (FDM)” this time. We should understand that FDM does not directly prevent accidents of small aircraft from occurring. However, aviation safety is expected to improve from the following perspectives, once FDM is widely adopted and data obtained therefrom can easily be utilized.

Utilization to preserve and improve the skills of pilots

Pilots can review their own flight by making use of visualization tools, etc. based on data obtained after the flight. This will result in the prevention of accidents by helping the pilot to effectively maintain and improve skills.

Utilization of flight monitoring

An operator can prevent accidents by utilizing data for training and examinations through an advanced analytical technique and by extracting operational risks such as the deviation from standards, etc.

Utilization for monitoring of aircraft failure

It is feasible to identify the state of an aircraft based on data recorded and prevent its failure.

Utilization for aircraft accident investigation

It is feasible to accurately investigate the causes utilizing objective information obtained and to formulate preventive measures.

The following points should be taken into account as to the handling of FDM and information obtained therefrom.

Appropriate installation to aircraft

Equipment installed on or brought in aircraft including FDM should be used without affecting operational safety in accordance with related laws and regulations and safety standards for on-board equipment specified by related authorities. It should not be allowed to install or bring in non-conforming equipment without any justifiable reason.

Handling of information obtained

Since image information obtained from FDM may be privacy sensitive, it is necessary to take care of the handling of information from the perspective of protecting information sources. An aviation operator that handles this information also needs to protect data or limit the scope of information handled.

It is concerned that an aviation operator may utilize information obtained from FDM to monitor employees or pursue their responsibility. Therefore, it is important to clarify that information is not used other than for safety management purposes and handled under the principle of non-punishment, thereby ensuring psychological safety of employees as to the utilization of information.

Although FDM is a simple recording device, it can be an important tool that creates an environment where aviation safety is assisted by utilizing its data.

We expect that the Digests help you recognize the value of FDM and it would be installed on more aircraft including small aircraft.

The Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism, has published "Guidelines for Introduction of FDM for Small Aircraft" describing precautions about installation of FDM, actual installation examples, and methods of utilization of data obtained. You can find the Guidelines from the following (https://www.mlit.go.jp/koku/koku_tk10_000095.html (only available in Japanese)).

Comment from Director of the Analysis, Recommendation and Opinion Office

When we look into the causes and factors of accidents, human factors such as assumption, insufficient check, poor judgment, inappropriate control and operation, etc. involve in more than 80% of cases. On the other hand, other multiple factors such as natural phenomena and organizational structures involve in accidents in many cases. The most important thing in complex accident investigations is objective data such as information on the aircraft positions and altitudes that corroborates situations where accidents happened. Small aircraft are not obliged to be equipped with flight recorders and mainly use visual flight (a pilot visually judges the aircraft position). In addition, they do not receive ground flight control services on mid-flight routes in many cases, so objective information indicating flight courses tends to be insufficient. FDM was mentioned in the Digests as one of valuable solutions which brings about many advantages to operators. I expect you to read the Digest and recognize the value of FDM for improvement of your skills as pilots and safety management activities in risk analysis so that more small aircraft are equipped with FDM.

For prevention of aircraft accidents

Other than the Digests, please refer to investigation reports on accidents and serious incidents announced by the Japan Transport Safety Board for your case study. Moreover, the Civil Aviation Bureau uploads information on the safety of small aircraft including the Guidelines for Introduction of FDM. For more details, please see the following information.

Safety information of small aircraft, Ministry of Land, Infrastructure, Transport and Tourism

https://www.mlit.go.jp/koku/15_bf_000061.html (only available in Japanese)

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We welcome your comments on "JTSB Digests" and requests for outreach lecturers


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