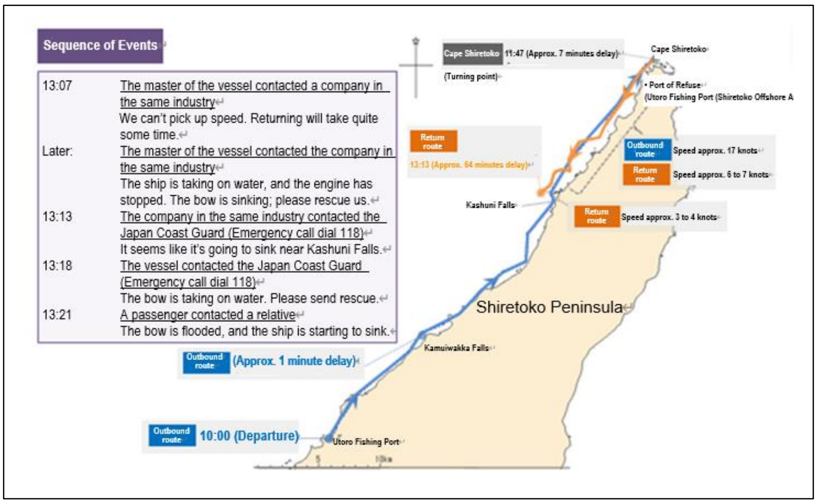
Major activities in the past year

1. Publication of the investigation report on the foundering of the passenger ship *KAZU I*

On April 23, 2022, the passenger ship *KAZU I*, a sightseeing vessel observing the scenic spots and wildlife along the western coast of the Shiretoko Peninsula from the sea, was navigating the waters off the western side of the Shiretoko Peninsula with 24 passengers onboard, along with the master and one deckhand. The vessel took on water and sank off the coast of the Kashuni Falls on the western side of the same peninsula.

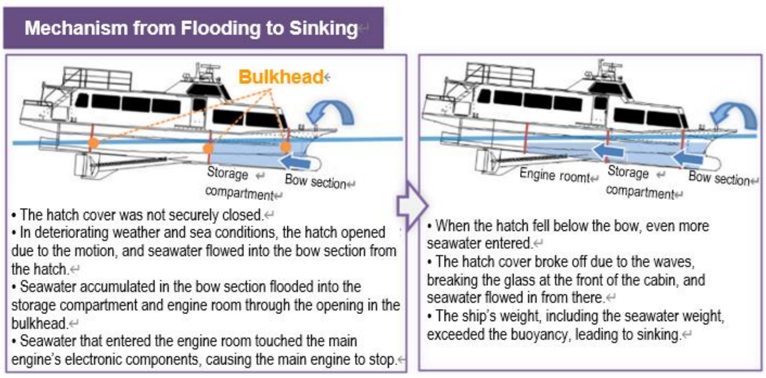
As a result of this accident, 18 passengers, the master, and the deckhand lost their lives, and six passengers remain missing (as of the publication of the report).

On the day of the accident, the vessel departed from Utoro Fishing Port at around 10 AM for a Shiretoko Cape course, a three-hour round trip to and from Shiretoko Cape. The vessel turned around at the cape at around 11:47 AM. However, due to the passage of a cold front, which caused high waves to spread, the vessel could not make speed on the return trip. Subsequently, the main engine stopped due to flooding, and the vessel began to list. Although a distress call was made, the vessel sank shortly after 1:26 PM on the same day.



The JTSB dispatched marine accident investigators to the site the day after the accident to begin the investigation. In July 2022, when the vessel was salvaged and a hull inspection became possible, marine accident investigators and committee members with specialized knowledge boarded the vessel and conducted the investigation.

Although it was difficult to obtain direct information on the circumstances leading to the vessel's flooding and foundering in this accident, data from the location information service of a passenger's mobile phone revealed that the vessel turned around at the tip of Shiretoko Cape and did not use the sheltering ports on that day. Furthermore, the hull inspection results indicated that seawater entered through the hatch on the bow deck and spread to various compartments below the upper deck through bulkhead openings.



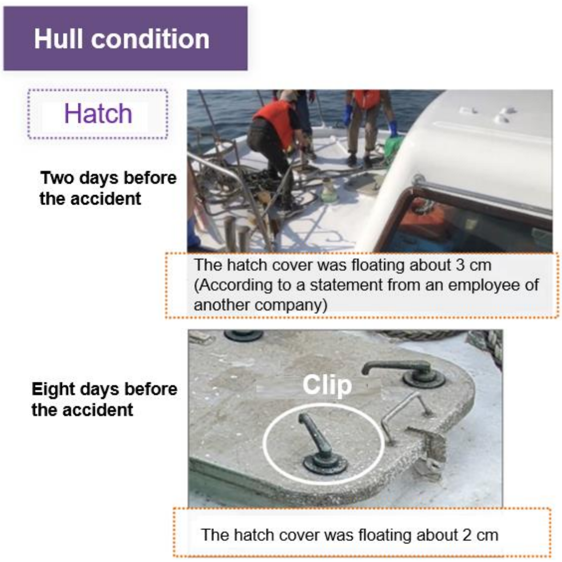
As a result, by commissioning the Japan Weather Association and the National Maritime Research Institute (NMRI) of the National Institute of Maritime, Port and Aviation Technology, the JTSB clarified the mechanism of the vessel's flooding and foundering through weather analysis and calculation of hull inclination due to flooding.

Based on these findings, on December 15, 2022, the JTSB reported to the Minister of Land, Infrastructure, Transport and Tourism on the progress of the accident investigation up to that point, including the mechanism leading to the foundering of the vessel. Additionally, as urgent measures, the JTSB offered “opinions” on inspecting the bow openings of small passenger ships, utilizing sheltering ports, and considering the watertightness of bulkheads on small passenger ships.

Meanwhile, detailed investigations and further analysis were conducted on the cause of the accident and damage mitigation, such as issues with the decision to depart and continue navigation, compliance with safety management regulations, and the effectiveness of audits of the operating company and inspections of the vessel.

Regarding the hatch on the bow deck, identified in the progress report as the starting point of the flooding route into the vessel, investigations, and analyses were conducted on the possibility of the hatch opening and allowing water ingress.

It was found that the hatch cover had defects that prevented it from being securely fixed, based on the condition of the clips and the floating state of the cover before the accident.



According to the numerical analysis results from NMRI, under the wave conditions on the day of the accident, the hatch cover, which was not secured by clips, could open due to the vessel’s motion, and waves could break over the bow deck.

From these findings, it was analyzed that on the day of the accident, the hatch cover opened early on the return trip from Shiretoko Cape due to the vessel’s motion, and frequent waves broke over the deck under high wave conditions. This led to the progressive loss of buoyancy due to the expanding ingress of water, the main engine’s stoppage, and the vessel’s eventual foundering as the hatch cover, struck by waves, broke the windows of the passenger cabin.

Regarding the navigation decisions made by the vessel’s master, it was revealed that while a former master of the vessel indicated that three years of deckhand experience was necessary to understand the characteristics and regional features of navigating the waters off the western side of the Shiretoko Peninsula, the master of the vessel had become the master after only a few months of deckhand experience following his employment. It was also revealed that among small sightseeing vessel operators in the Utoro area, there were cases where departures were made based on a practice different from the established operational standards, departing with the assumption of assessing weather and sea conditions after departure and deciding to turn back if conditions were expected to worsen.

Based on these findings, it was analyzed that on the day of the accident, the master decided to depart with the awareness that strong wind and wave warnings had been issued, which would normally preclude departure according to operational standards. He planned to return if weather and sea conditions worsened en route. However, he continued navigating without accurately judging the timing to turn back, despite being aware of the presence of sheltering ports.

Regarding the company's operation management system, it was found that the president, who also served as the safety general manager and operation manager, lacked knowledge about ships and rarely worked in the office of the operation company. Additionally, there was no assistant to act on his behalf. Furthermore, in terms of safety management, since the fiscal year 2020, experienced masetrs have been laid off, resulting in the absence of personnel who had practically performed the duties of the safety general manager and operation manager and those who could educate successor masters. Additionally, issues with the hatch and communication equipment were identified.

Based on these findings, it was analyzed that the company lacked a substantial operation management system. On the day of the accident, the inexperienced master was forced to make operation decisions alone, leading to the accident. Furthermore, it was analyzed that the company did not have a safety management system, which significantly impacted the background of the accident.

Regarding the Hokkaido Transport Bureau, it was found that they had not verified the qualification requirements when receiving notifications of changes to the safety general manager and others and that their checks during special audits were insufficient. As a result, the company was operating without a substantial safety management system. Additionally, regarding the Japan Craft Inspection Organization (JCI), it was found that during the inspection shortly before the accident, they judged the hatch cover to be in good condition based on a visual inspection only and omitted the opening and closing test, which failed to identify and rectify the hatch's defects.

Due to the significant loss of life in this accident and high public interest, the JTSB held its first public hearing since its inception, and the final report was compiled based on the opinions received from experts.

Based on these investigation and analysis results, the probable causes of the accident were identified as a combination of factors.

The direct cause was that the vessel departed with the bow deck hatch cover not securely closed despite expected worsening sea conditions and continued navigating without evacuating to a sheltering port. This led to the hatch cover opening due to the vessel's motion, allowing seawater to flow in, expand to compartments below the upper deck, and eventually sink the vessel.

Hardware issues included inadequate maintenance of deteriorating and loose hatch components, JCI's visual-only inspection of the hatch shortly before the accident, and the vessel's structure lacking watertight integrity due to bulkhead openings.

Software issues included the company's deviation from operational standards by departing with the assumption of assessing conditions after departure and deciding to turn back if they worsened, the captain's lack of necessary knowledge and experience, the absence of a substantial operation management system, and inadequate communication means preventing the captain from receiving advice, the appointment of an unqualified safety general manager, inadequate safety management, JCI's acceptance of mobile phones with limited coverage, and the Hokkaido Transport Bureau's failure to improve the safety management system through inspections and audits.

Regarding the factors contributing to the loss of life, the seawater temperature at the time of the accident was about 4°C, making it extremely unlikely for passengers to be rescued alive unless they were rescued immediately after immersion. It was estimated that the Japan Coast Guard would have difficulty arriving near the accident site quickly. However, it was pointed out that strengthening the search and rescue system with optimal personnel and equipment and reviewing and enhancing coordination among rescue agencies was necessary.

Following the accident, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) decided to implement 66 measures, including amendments to the Maritime Transportation Act, based on the findings of the Review Committee on Countermeasures for the Shiretoko Sightseeing Boat Accident. These measures include the accident's identified causes and derived recurrence prevention measures.

The process leading to the accident revealed that safety nets, including the effectiveness of inspections and audits, were not functioning adequately.

Therefore, the report emphasizes the need for the thorough implementation of and adherence to the 66 measures by the MLIT, ensuring measures are rigorously implemented at the field level and striving for personnel training and understanding of on-site conditions.

Additionally, the report touches on the operators' need to foster a safety culture and the effectiveness of safety management activities through regional cooperation, including other operators and administrative and rescue agencies.

For a summary of the accident investigation report, please refer to Chapter 5 (page 104).

2. Investigation of accidents involving pilotless aircraft and unmanned aircraft begins

In June 2023, the JTSB dispatched aircraft accident investigators to investigate an accident of a pilotless aircraft*1, and in July 2023, to investigate an accident of an unmanned aircraft*2.

Until now, the JTSB has not investigated pilotless aircraft or unmanned aircrafts. Therefore, the above accidents mark the first time the JTSB has investigated these types of aircraft.

This section provides an overview of the current investigations into these accidents.

(1) Accident of a pilotless aircraft shortly after takeoff from Shimojishima Airport

[Summary]

On June 28, 2023, a pilotless aircraft on a flight test experienced a malfunction in the radio communication between the ground control station and the aircraft shortly after takeoff from Shimojishima Airport in Okinawa Prefecture. The aircraft switched to autopilot and continued flying. However, as the likelihood of deviating from the designated flight test area increased, the flight termination system automatically activated, causing the aircraft to land on the sea surface and to have been destroyed.

[Investigation implementation status]

The JTSB is conducting interviews with the operator and manufacturer, verifying the aircraft's system and flight modes, and analyzing the factors that triggered the activation of the autopilot mode's termination function.

(2) Accident of an unmanned aircraft in Kusu District, Oita Prefecture

[Summary]

On July 14, 2023, during a training session for pesticide spraying, an unmanned aircraft collided with a utility pole and then struck the operator, resulting in serious injuries.

[Investigation implementation status]

The JTSB is conducting interviews with the operator and manufacturer, verifying the aircraft's system and flight modes, and analyzing the flight records.

*1. Pilotless Aircraft: An aircraft which can be used for air navigation with a person on board, equipped with apparatus which enables it to fly without being boarded by a pilot and fly without being boarded by a pilot.

*2. Unmanned Aircraft: An aircraft can be used for air navigation without a person on board and, and capable of being flown by remote control or autopilot. Drones fall under this category.

3. Investigation of large aeroplane turbulence accidents

Between 2022 and early 2023, seven accidents involved passengers or cabin crews injured by the turbulence of a large aeroplane, significantly higher than the usual number of such accidents. Over the past ten years, turbulence accidents have accounted for approximately 60% of accidents involving large aeroplane. Most accidents with serious injuries involving large aeroplane were due to turbulence.

This section introduces two accidents from the six turbulence accident investigation reports published in 2023.

(1) An accident where a passenger was injured over Kurashiki City, Okayama Prefecture

[Summary]

On January 16, 2022, an aircraft took off from Tokyo International Airport. While flying for Kitakyushu Airport, the aircraft was shaken, and a passenger was seriously injured.

[Probable causes]

It is probable that in this accident, when encountering clear air turbulence created due to the jet stream, the Aircraft was shaken to the left, therefore, the passenger hit their right side against the armrest on the right side of the seat, resulting in a serious injury.

(2) An accident where a cabin crew member was injured over Nakatsugawa City, Gifu Prefecture

[Summary]

On March 26, 2022, an aircraft took off from Tokyo International Airport and flew to Oita Airport, where the aircraft encountered turbulence and a flight attendant was injured by falling down.

[Probable causes]

It is probable that the aircraft was shaken as it encountered turbulence that was difficult to predict, therefore the flight attendant working in the aft galley probably lifted into the air, lost her balance, and fell, resulting in injuries.

Turbulence accidents occur due to turbulence in cloudless areas or air disturbances caused by convective clouds such as cumulonimbus clouds. To prevent such accidents, it is necessary to obtain and analyze weather information before the flight to select appropriate flight routes and to monitor changes in weather conditions during the flight, ensuring early use of seat belts and safely avoiding air disturbances.

To prevent injuries of passengers, cabin crew should advise that passengers always wear their seat belts low and tight while seated. Cabin crew should also ensure that passengers are using their seat belts properly, taking into account their body shapes and other factors.

To prevent injuries of cabin crews, it is important to share information about turbulence between flight crew and cabin crew and train cabin crew to secure themselves when turbulence occurs.

Each airline has implemented measures in response to past accidents. However, given the continued occurrence of turbulence accidents, airlines, aviation authorities, and the JTSB need to cooperate in continuing efforts to prevent recurrence by re-communicating the lessons learned from these accidents to all relevant parties.

4. Publication of accident investigation report: The helicopter crashed while flying in a mountain region under strong wind conditions

[Summary]
On December 30, 2020, a helicopter encountered turbulence while flying over a mountain region under strong wind conditions, became uncontrollable and crashed. Only a captain was on board the helicopter, and fatally injured in the crash. The helicopter was destroyed, but there was no outbreak of fire.

[Probable causes]
It is probable that during flight in a mountain region under strong winds, when the helicopter encountered a downdraft caused by a roll-shaped thermal convection and fell into a low-G condition, it is highly probable that the helicopter was resulted in the mast bumping*1 and the loss of flight control failure when the aircraft's attitude was not properly controlled, it crashed. The mast bumping occurred leading to the loss of flight control failure was probably because the helicopter continued flying due to encountering turbulence while maintaining airspeed.

In the investigation of this aircraft accident, it was considered that the helicopter experienced sudden attitude changes over the mountainous region, possibly influenced by mountain waves. The Atmosphere and Ocean Research Institute, the University of Tokyo conducted detailed weather simulations to investigate the impact of mountain waves at the time of the accident. The results were compared with information from witnesses and GPS devices to analyze the events leading to the accident.

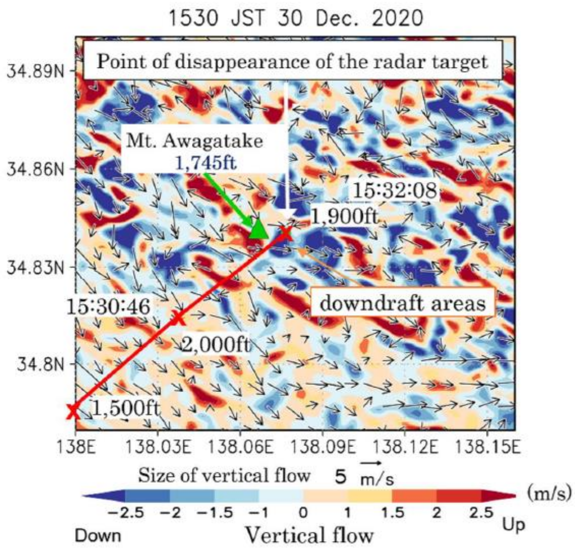


Fig. 1: Vertical flow at 600 m altitude (color) and horizontal wind deviation from the

As a result, the JTSB concluded that while flying at an altitude of approximately 2,000 ft at maximum cruising speed, the aircraft encountered a localized downdraft near the point where the radar target disappeared (Fig. 1). During the low-G flight condition (a state of reduced gravitational forces), the aircraft's attitude was not properly controlled, resulting in mast bumping, where the main rotor blade attachment contacted part of the main rotor drive shaft. This most likely led to a loss of control and a subsequent crash.

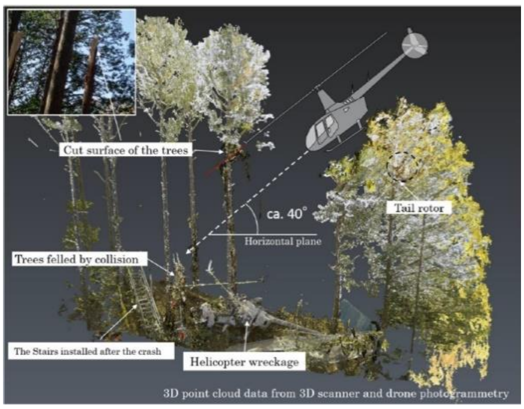


Fig. 2: Estimated approach angle at the time of the crash

In this investigation, to accurately measure the contact position with trees and the wreckage location at the time of the crash, 3D images were taken from above using a drone, and further measurements were made around the wreckage using a 3D laser scanner. By combining these data, the situation near the accident site was represented as a 3D image (Fig. 2). This investigative method will be used for accident analysis as needed in the future.

Based on the results of this investigation, one measure considered necessary to prevent recurrence is to inform pilots of semi-rigid rotor helicopters[*2] about precautions to prevent mast bumping, which can lead to loss of control, and to ensure that they obtain necessary weather information before departure. If adverse weather conditions are expected, pilots should either cancel or conduct the flight with a safe flight plan (see Chapter 3, page 44).

*1 "Mast bumping" is a phenomenon where the main rotor blade spindle (or main rotor hub for Bell Helicopter type) strongly contacts or bumps the main rotor drive shaft when a helicopter (usually often for two-bladed helicopter) having semi-rigid rotor systems enters a low-G condition out of the normal condition of 1G and the attitude is not properly controlled.

*2 "Semi-rigid rotor type" refers to a rotor system in which the blades are fixed to the hub, but flapping and feathering are flexible, such as teeter ring type and under sling (seesaw) type.

5. Publication of the derailment accident investigation report of a new transit system due to an earthquake

[Summary]

On October 7, 2021, a train leaving from Nippori Station bound for Minumadai Shinsui Koen Station derailed at a junction within the premises of Toneri Koen Station. An earthquake with a maximum seismic intensity of upper 5 had occurred with an epicenter in the northwestern part of Chiba Prefecture immediately before the accident. Incidentally, eight of 29 passengers were injured in this accident.

[Probable causes]

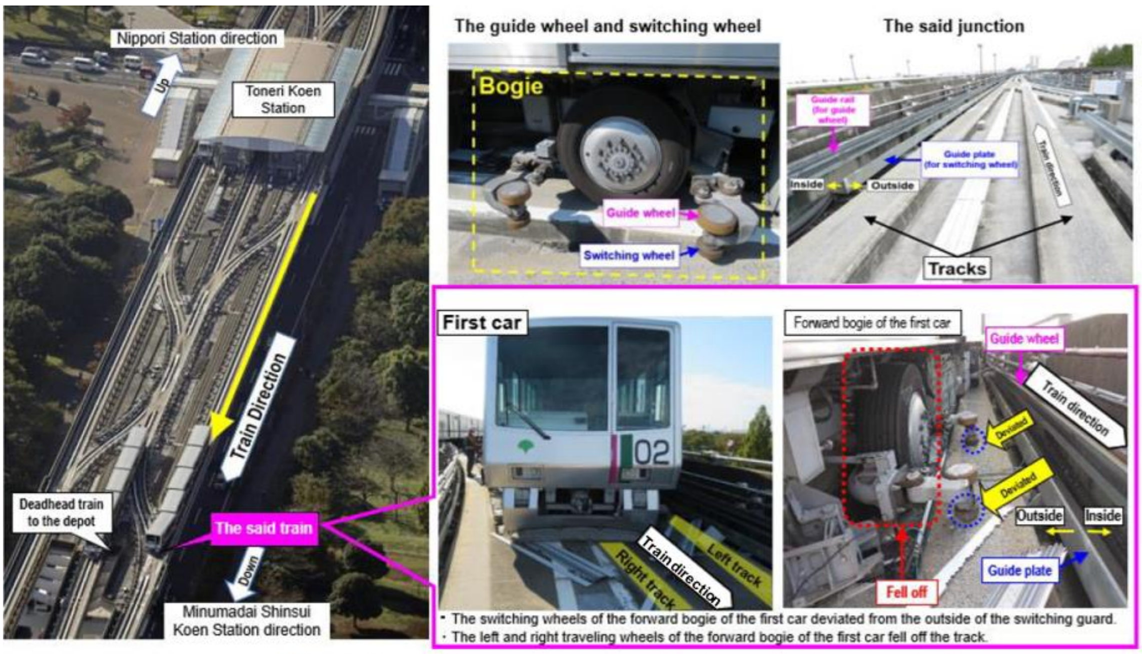
It is probable that the train was significantly shaken in the roll direction due to seismic motion, causing the right-side switching wheel of the bogie to ride up onto the guide rail. As a result, the guide rail detached, and the bogie ran towards the right side of the track. Subsequently, the left-side switching wheel of the bogie deviated outside the fixed guide board installed on the left side of the track ahead, resulting in derailment.

The investigation analyzed the relationship with the earthquake just before the accident. The main findings were:

- •The seismic amplification characteristics of the ground near the accident site may have influenced the occurrence of this accident.
- •The natural frequencies of the structures near the accident site in the direction perpendicular to the track and the vehicle's roll direction were around 1.0 Hz, which likely amplified the vehicle's rolling during the earthquake.
- •The structures near the accident site exhibited rotational behavior during the earthquake, likely contributing to the vehicle's rolling.

Additionally, during the evacuation of passengers after the accident, re-electrification was conducted without confirming the train's derailment status, resulting in sparks from the overhead wire.

Based on the investigation results, the Tokyo Metropolitan Bureau of Transportation was recommended to take measures to prevent recurrence, such as preventing the guide wheels and switching wheels from riding up onto the guide rail during earthquakes and organizing evacuation guidance methods and procedures that prioritize passenger safety.



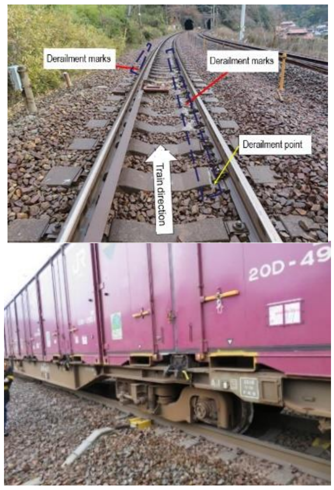
*The leftmost figure was created using a photo provided by Kyodo News.

Situation of the accident site

6. Publication of the derailment investigation report due to uneven loading of cargo

[Summary]

On December 28, 2021, a 25-car freight train traveling from Hiroshima Freight Terminal to Tokyo Freight Terminal, with an additional locomotive connected to the rear due to steep gradients, was traveling at approximately 52 km/h after passing Seno Station when the brakes were applied, and the train came to a stop. When the driver of the front locomotive got off to inspect the train, it was found that all two axles of the front bogie of the 12th car had derailed to the left. There was one driver on the front locomotive and one on the rear auxiliary locomotive, but no injuries occurred.



Situation near the accident site

[Probable causes]

It is probable that the derailment occurred when the first axle of the front bogie of the freight car experienced a reduction in the wheel load on the outer rail while passing through a right curve with a radius of 300 meters.

The reduction in the wheel load on the outer rail is thought to be due to the imbalance of the wheel load being exacerbated by the cargo in the container being unevenly loaded towards the inner rail side*.

The uneven loading of the cargo in the container was due to:

(1) Lack of information sharing regarding uneven loading among related companies such as the transport service provider, the shipper, and the loading company.

(2) Inadequate verification system for checking the uneven loading of cargo.

(3) Lack of a mechanism to investigate the cause and take recurrence prevention measures when uneven loading was identified. These factors collectively contributed to the accident.

*Several containers loaded on the train exceeded the management target guideline of a 10% lateral load imbalance for a single container.

The investigation into this accident thoroughly analyzed factors related to operational handling, vehicles, tracks, and loading. The results revealed that the primary cause was uneven loading of the cargo. Further analysis was conducted on the factors leading to the uneven loading.

Condition of the cargo in the 12th freight car

The published accident investigation report includes recommendations for recurrence prevention, such as (1) Ensuring that important information, such as the container loading guidelines, is fully shared and disseminated among companies involved in cargo transportation, (2) Establishing a system to thoroughly understand and address the actual loading practices and prevent uneven loading in advance, (3) Developing a mechanism for investigating the cause and taking recurrence prevention measures in cooperation with related companies, such as transport service providers and loading companies, when uneven loading is identified, and (4) Early enhancement of hardware measures to detect uneven loading effectively.

7. Publication of the "JTSB Digests" for the prevention of accidents of small aircraft

～事故等調査事例の紹介と分析～

運輸安全委員会ダイジェスト

JTSB (Japan Transport Safety Board) DIGESTS

第42号（令和5（2023）年8月発行）

航空事故分析集

小型飛行機等の事故防止に向けて

～簡易型飛行記録装置（FDM）をご存じですか～

第1章　はじめに

航空事故の発生件数は全体としてやや減少傾向にありますが、過去10年間（2013年1月～2022年12月）に航空事故は162件発生しています。このうち、小型飛行機、ヘリコプター及び滑空機（但し、超軽量動力機等に類するものを除く、以下「小型飛行機等」という。）の事故は100件であり、全体に占める割合は6割を超えています。小型飛行機等でも近年の事故発生件数は減少傾向にありますが、全体に占める割合は高く、また、事故が発生しなかったという年はありません。

通常エアラインの機体を始めとする大型機の場合は、飛行記録装置（FDR）や操縦室用音声記録装置（CVR）の装備が義務付けられており、事故等調査においては、これらの装置（以下「フライトレコーダー」という。）から取得したデータが活用されています。ところが、小型飛行機等には、航空運送事業に使用される等の一部の機体を除き搭載義務はなく、多くの機体には装備されていません。しかし、最近

図1　FDM

運輸安全委員会ダイジェスト42号　1

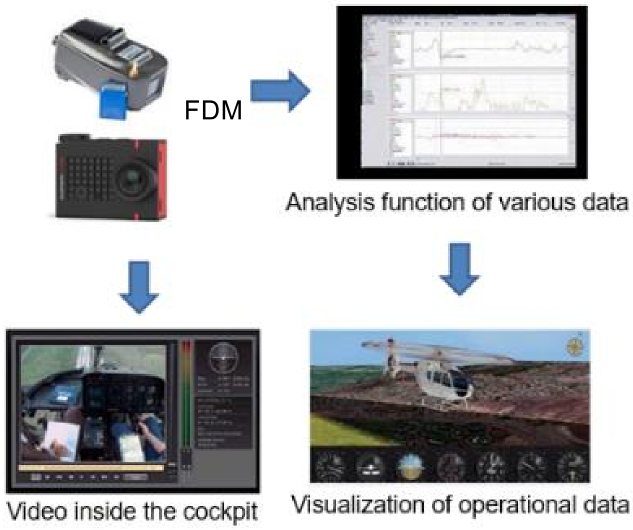
The JTSB publishes the JTSB Digests, which analyzes the contents of similar accidents and incidents, and includes preventive measures. In August 2023, the JTSB Digests titled "For Prevention of Accidents of Small Aircraft: Do You Know flight data monitoring device (FDM)?" was published, emphasizing the necessity of equipping small aircraft with flight data monitoring devices to prevent accidents.

FDM refers to a simple device capable of recording information such as the position, altitude, and other data of an aircraft, as well as audio and video inside the cockpit, primarily targeting small aircraft that do not have flight data recorders (FDR) or cockpit voice recorders (CVR). It is expected to be utilized to reduce the safety risks associated with the operation of small aircraft.

Looking at aircraft accidents over the past ten years, about 60% involved small aircraft. Additionally, over 80% of these accidents were related to human factors, many of which could have been prevented with proper risk management. If FDM devices were equipped, it would allow for regular analysis of data obtained from the FDM device, improving pilot skills and enabling effective risk management. Furthermore, the data would be crucial for the investigations conducted by the JTSB.

The usefulness of FDM devices have been highlighted in several JTSB investigation reports, and overseas accident investigation agencies have also emphasized its necessity. The Ministry of Land, Infrastructure, Transport and Tourism's Civil Aviation Bureau has also recognized FDM as a safety measure in the Small Aircraft Safety Promotion Committee. After several years of verification surveys, the "Guidelines for Introduction of FDM for Small Aircraft," including points to consider when installing FDM devices, were formulated in August 2023 to promote the introduction of FDM in small aircraft. Given the shared recognition of FDM's usefulness between the JTSB and the Civil Aviation Bureau, the JTSB have decided to collaborate for its promotion, issuing this Digest in alignment with the Bureau's guideline formulation (for details, see Chapter 6, page 111).

By referring to this Digest, the JTSB hopes to increase understanding of the effectiveness of FDM devices, leading to more aircraft being equipped with FDM devices and enhancing aviation safety.



Overview of FDM functions

8. Training for railway accident investigators in Singapore

The JTSB conducts training and other human resource development programs in various countries to enhance global railway accident investigation capabilities and support overseas infrastructure development through soft infrastructure cooperation.

In response to the request from the Transport Safety Investigation Bureau (TSIB) of Singapore, which included railway accidents as a subject of investigation from April 2020, the JTSB conducted a five-day training program for railway accident investigators on-site in Singapore from Monday, July 31, to Friday, August 4, 2023.

The training was conducted using the following program. The program was created based on requests from the TSIB collected from 2022 until the training was conducted, ensuring it aligned with their needs as much as possible.

[1] Overview of Japan’s railway transportation
[2] Overview of JTSB activities and key points of accident investigations
[3] Case studies of accident investigations (signal, track, vehicle, and human factors)
[4] Special expert lectures (signal, track, vehicle, and human factors)
[5] Group work (case studies of past accident investigations)

The training participants included TSIB railway accident investigators, other TSIB staff led by the director, and representatives from government agencies, public transportation operators, and accident investigation organizations within Singapore and internationally, representing various countries and perspectives.

The training covered a wide range of topics, from an overview of Japanese railways and railway accident investigations to detailed case studies and academic content in each specialized field. Following the lectures, there were active question-and-answer sessions with the participants.

After the training, the TSIB expressed deep gratitude for the profound understanding and insights that the participants gained regarding railway accident investigations. The TSIB also appreciated the efforts of the JTSB in designing and preparing the training program to suit the local context of Singapore based on on-site surveys.

The JTSB intends to continue sharing knowledge, experience, and technology related to railway accident investigations with the TSIB, based on the revised Statement of Intent (SOI) signed in March 2023, to enhance these capabilities mutually.

Training session (Q&A)

Presentation of a commemorative plaque from TSIB’s Director Chong (right) to JTSB’s Director of Railway Committee Okumura (left)