Feature 2: 10th anniversary of Japan Transport Safety Board — Future Direction of Priority Activities

Direction of Our Focused Commitments with an Eye toward the Next 10 Years

In October 2008, the Japan Transport Safety Board was set up based on Article 3 of the National Government Organization Act as a more independent accident investigation authority that was assigned the authority to investigate marine accidents in addition to aircraft and railway accidents, which had been investigated by the Aircraft and Railway Accidents Investigation Commission; the authority to make recommendations to parties concerned with causes as well as administrative agencies; and extended authorities to, for example, provide information to victims and their families or families of those who lost their lives in accidents.

Since being setup, the board has been working to help prevent accidents and reducing damage by investigating aircraft, railway, marine accidents and incidents and tracking down the causes of them to the last extremity and by requesting parties concerned to take necessary measures and/or actions through communication of recommendations and suggestions.

With its missions and an action guideline declared in March 2012 as indicated on the first page of this annual report, the Japan Transport Safety Board has got down to conducting scientific and objective investigations while paying attention to organizational problems and other backgrounds of accidents and incidents, as well as, for prompt announcements that are easy to understand, improving the investigation manuals on a per transport mode (aircraft, railway, or marine), improving the description, shortening the time for translating accident or serious incident investigation reports, and applying special formats.

Having marked its 10th anniversary in October 2018, the board believes that its activities up to that point have yielded certain results, whereas it feels that more than ever, it must meet expectations and requests from many people including early release of accident or serious incident investigation reports and issuance of more effective preventive measures.

Specifically, we have been taking the expectations and requests made on us seriously and steadily are addressing them, and with the opportunity of the 10th anniversary, we are organizationally considering how we should proceed with an eye toward the next 10 years from the viewpoint of further promotion of safety of aviation, railways, and marine. At present, as the directions of the commitments we should focus on from now on, we have set up three functional pillars: enhanced analytical ability, enhanced communicativity, and enhanced internationality. We think that acquiring these abilities requires us to enhance the organizational strength and individual abilities, and thus we must continue to make efforts

with higher-quality goals set up.

Based on this idea, this special topic presents the directions of our future focused commitments with an eye toward the next 10 years as well as the recent efforts being made by the Japan Transport Safety Board.

Current Organisation of the Japan Transport Safety Board

[The Japan Transport Safety Board: Chairperson and board members**]**
The Japan Transport Safety Board consists of 13 people: a chairperson and 12 board members. The chairperson and board members are appointed by the Minister of Land, Infrastructure and Transport based on the Act for Establishment of the Japan Transport Safety Board, and specialize in many areas as shown below:

- ○ Common to all modes
  Laws (Anglo-American laws and evidence laws)
- ○ Aviation mode
  Aerospace engineering/strength of materials/composite material engineering, operation and maintenance of aircrafts, maneuvering of aircraft, aircraft guidance and control/flight dynamics, and ergonomics (human factors)
- ○ Railway mode
  Railway engineering/geotechnical engineering, dynamics of machinery/vehicle dynamics/railway vehicle engineering, structural engineering, and electrical engineering/traffic management (human interface)
- ○ Marine mode
  Ship operation/maritime traffic safety, marine engineering/naval architect, and safety ergonomics

[Secretariat]
The Japan Transport Safety Board has a secretariat for managing affairs of the board. For investigations at accident sites, accident investigators of respective modes (aviation, railway, or marine) are dispatched to conduct investigations and Director for Analysis, Recommendation and opinion and Director for coodination of the Accident Investigation are posted under Director for Management. In addition, a secretariat system is arranged that is supported by the general affairs section, which is responsible for such as international affairs and public relations.

The aircraft accident investigators consist of 25 experienced experts such as pilots, airworthiness engineer, inspector of airmen licensing, aircraft mechanics, and air traffic controllers. The railway accident investigators consist of 19 experts with experience in research and development of rail cars

and railway tracks, design and manufacturing of rail cars, directions and operation, inspection/maintenance, and analysis of weather conditions. The marine accident investigators consist of 23 experts, including experienced people such as captains, navigation officers, chief engineers, engineers, coast guard officers, and senior ship inspectors, and people with experience in, for example, actual investigation of accident sites.

The staff at the Director for Management (27 people) includes Director for Analysis, Recommendation and Opinion responsible for analyzing and statistically treating many accident and serious incident investigation reports publishing in the past and communicating a variety of safety measures through the Japan Transport Safety Board Digest, and other experts such as Director for Cordination of the Accident Investigation responsible for making coordination with organizations concerned in connection with investigations on accidents, etc. and providing victims with information. The General Affairs Division (24 people) embraces staff members responsible for Personnel Section, Accounts Office, Planning Section, General Affairs, and so on; the International Affairs Office responsible for making coordination for prompt and smooth investigations in partnership with accident investigation authorities in foreign countries and for coordinating collaboration with foreign countries; and the Public Relations Office responsible for communicating information by, for example, presenting information obtained through initial investigations or holding press interviews.

The Secretariat embraces eight regional offices (in Hakodate, Sendai, Yokohama, Kobe, Hiroshima, Moji, Nagasaki, and Naha with total 60 people), which are mainly responsible for investigating marine accidents and serious inccidents in their respective regions.

(All numbers of people are those as of April 1, 2019)

1 Enhancing the Analytical Ability

1-1 Enhancing the Ability to Conduct Scientific and Subjective Analysis

We need to conduct more reliable analyses and track down causes of accidents not only by gathering verbally expressed information from parties concerned but also by enhancing our ability to scientifically and subjectively analyze a variety of recorded data and video and weighing such analyses. For this reason, we will continue to enhance our analytical ability, the basis of accident investigations.

This section shows examples of investigations in which scientific and subjective analyses led to communication of recommendations and suggestions and presents the future directions for each of aviation, railway, and marine modes.

(1) Investigation of Aircraft Accidents and Serious Incidents

With the rapid development of aeronautical technology, we may be introduced to new safety

technologies that are beyond our knowledge and experience in a case, for example, where a new type of aircraft is being investigated; aircraft accident investigators are required to acquire new expertise and use it.

Under the situation, since a wide variety of data is now recorded when an accident or serious incident occurs, we track down causes by identifying how accidents occurred and making comparisons with other aircrafts using stored aircraft-specific data as well, and then collecting and analyzing video data recorded in external surveillance cameras installed at airports. In addition, we are improving our analytical ability by, for example, making it possible to reproduce the detailed environment at the time of accident occurrence using simulation programs, which are undergoing significant evolution.

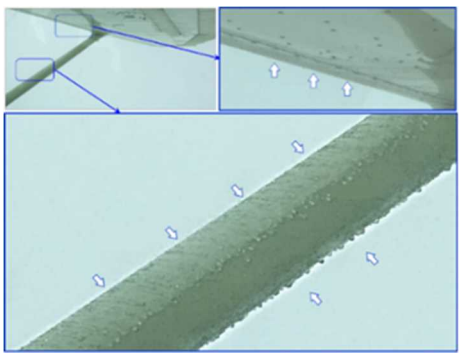
In conducting investigations of aircraft accidents, etc., there is no doubt that information recorded in flight recorders and records of communications is important for cause identification. Recently, information such as video and positional information may be recorded in smartphones and other electronic devices carried by individuals and therefore it is assuming importance to collect and analyze such records in investigating accidents involving light aircrafts or helicopters equipped with no flight recorder.

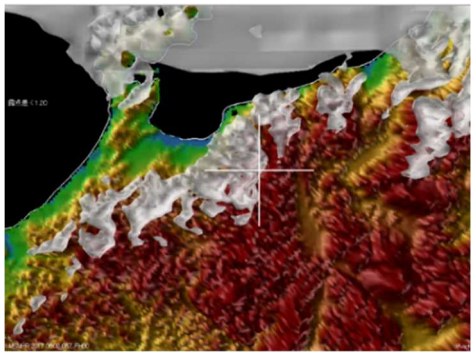
For field investigations of accidents in which aircrafts have crashed into steep mountains or when aircraft components are widely scattered, we are starting to use drones with excellent mobility.

○ Analysis of accident causes based on meteorological analysis using video analysis and a supercomputer (Aviation mode)

> On June 3, 2017, a Cessna 172P flying from Toyama Airport toward Matsumoto crashed into the vicinity of the top of Mt. Shishi-dake in the Tateyama mountain range (see Page 40).

For this crash accident, photos recorded in the smartphone of a person on board the same aircraft revealed that the aircraft was flying in clouds at that time and that the pilot did not wear a harness. In addition, analysis of photo data indicated that icing had been observed on the aircraft which destabilized the flight.





Furthermore, to identify the weather conditions around the peaks of the Tateyama mountain range in the time frame when the accident occurred, we asked Tokai University Research & Information

Center to conduct numerical analysis, using a supercomputer, based on the numerical prediction model provided by the Meteorological Agency in order to visualize at high resolution the wind conditions and cloud amount at that time around the Tateyama mountain range. These analyses revealed that aircraft had flown in clouds, which had caused ice to form on a wing, resulting in significant degradation in flight performance.

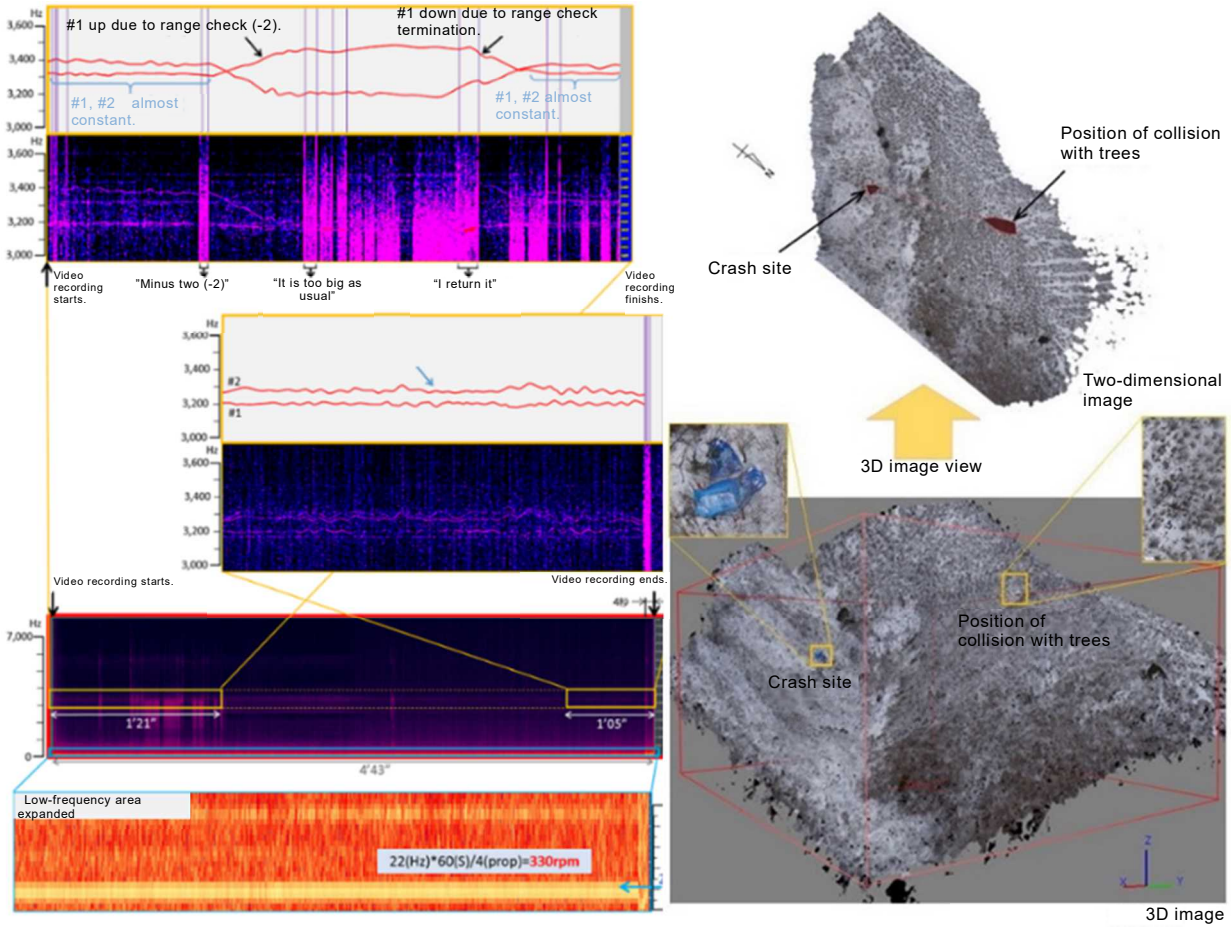
Based on these findings, the board made recommendations to the Minister of Land, Infrastructure and Transport, requiring safety measures that prohibit light aircrafts or the like incapable of in-cloud flight from flying into clouds.

○ Estimation of the conditions at the time of accidence based on analysis of video and acoustic data and use of drones (aviation mode)

On March 5, 2017, a bell-type 412EP, a fire-fighting disaster-relief helicopter, flying from Matsumoto Airport toward a temporary helipad in the mountains, Shiojiri City, Nagano Prefecture crashed onto the mountain's slope on Mt. Hachibuse in Matsumoto City (see Page 39).

For this crash accident, we analyzed video data recorded in a video camera attached to the helmet of a person on board the same helicopter to estimate the flight path, speed, and altitude of the aircraft. We also analyzed the acoustic data in the video camera to estimate the conditions of the engine operation and part of the conversation between the persons on board.

These analyses revealed that there had been nothing wrong with the aircraft until it collided with a



tree; that it was operated by one pilot; that the pilot had not stated his conditions correctly when applying for aviation medical certification; and that none of those on board had responded to the coming danger.

With these facts, the Fire and Disaster Management Agency decided to require fire-fighting disaster-relief helicopters to be crewed by two pilots and is trying to enhance the safety management system, training programs, and so on. In addition, the board required the Minister of Land, Infrastructure and Transport to instruct aircraft crews to report their health conditions correctly.

The accident occurred at a place located deep in mountains in Nagano Prefecture, which was covered with snow at the time of the accident. It was difficult to identify the geographic features of the site and the conditions of trees, and hence, using a drone, we took pictures of the site and areas around it (to collect data on geographic features and others) and made a three-dimensional topographical map to estimate the flight path right before the crash.

○ Analysis of electronic data retrieved from damaged electronic equipment (aviation mode)

On October 15, 2017, a serious incident occurred in which a Beechcraft A36 flying from Niigata Airport toward Fukui Airport made a forced landing and ditched in the river near Fukui Airport (see Page 118).

In this serious incident, an aircraft continued to fly using the fuel in only one fuel tank without switching between the fuel tanks provided on both of the right and left sides, which caused a fuel shortage and a subsequent engine stop, resulting in a forced landing and ditched in the river and the submersion of the aircraft.

The JTSB took out the GPS receiver and drive recorder from the aircraft and retrieved recorded electronic data in an intact state from the submerged disabled devices (for information about the retrieval of data from damaged electronic devices, see Page 127). We analyzed the electronic data and determined the flight conditions and the problem with the engine of the aircraft to track down the cause.

Addressing Domestic Jetliners

With an eye toward future commercial flights of domestic jetliners (SpaceJet), in order to fulfill its obligations, theJTSB must enhance its investigation ability so that as the accident investigation agency in a state of aircraft design, it can, for example, undertake detailed investigations on the design and manufacturing of the aircrafts concerned. We must, we believe, enhance our analytical ability in the design area, in particular; concrete measures are described in Feature 1: 3 Concerning efforts after the revision of the Establishment Act (see Page 3).

(2) Investigations of Railway Accidents and serious incidents

In the railway mode as well, the development of simulation technology greatly helps analyze the conditions at the time of accident occurrence and track down causes. The implementation of simulation analyses requires the theory and relevant data that are required to construct a model as sophisticatedly as possible as well as equipment for simulations. For this reason, we will try to work together with the Railway Technical Research Institute and other external organizations with expertise and rich experience in these areas so that we can conduct more reliable analyses.

To conduct more accurate analyses, we have started using video data from video recording apparatuses equipped with an onboard camera installed at the head of trains in addition to data from operation condition recorders and other devices, which we have been using so far. For an investigation of a level crossing accident that occurred at a level crossing without a automatic barrier machine, checking such video data reveals how the automatic barrier machine passerby concerned behaved (whether or not he or she stopped before the automatic barrier machine and checked that no train was coming, and at what speed he or she crossed the railroad), leading to suggestions about effective preventive measures.

○ Simulation analysis on a crack in a flatcar of a shinkansen (railway mode)

On December 11, 2017, a serious incident occurred in which a crack was found in a flatcar of a shinkansen.

This is a serious incident in which a crack was found in a flatcar frame mounted with wheels that support shinkansen cars, a motor for driving, and other devices.

To identify what caused the crack in the flatcar in the investigation, we conducted fatigue and breaking tests using a test specimen, a simulation analysis to estimate how the crack developed, and a simulation analysis to estimate the points of the flatcar where a high level of stress is generated. In addition, from a new viewpoint, we analyzed the effect of the deformation and other factors of the flatcar frame based on the air pressure inside the air spring unit recorded in the rail car data recorder to present a technique for estimating the development of cracks.

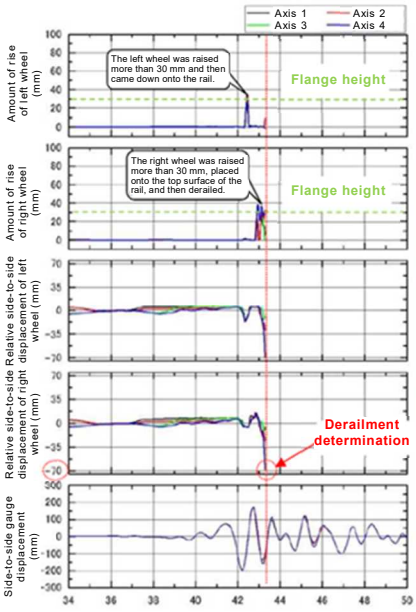
These analyses revealed that the crack had been caused by improper treatment during the manufacturing of the flatcar frame and that the crack had developed in a period shorter than the duration of the rail car life.

Based on these results, the board requested the Minister of Land, Infrastructure and Transport to ensure that necessary actions are taken in each stage of the manufacturing and design/verification processes of flatcar frames. Specifically, we requested the minister to ensure that manufacturing is thoroughly managed and that when a problem and/or difficulty arises in manufacturing, the effect of the measures against them on the safety is evaluated (see Page 77).

○ Simulation analysis on the behavior of shinkansen based on seismic vibration (railway mode)

On April 14, 2016, a shinkansen was derailed by the seismic vibration of the Kumamoto earthquake (a foreshock).

For this derailment accident, we decided to use a simulation to identify the cause of the derailment by reproducing the conditions of the rail cars derailed by the seismic vibration. In addition, to validate the execution conditions and results for each stage of the simulation, we appointed expert board members with knowledge about special fields (earthquake, structure, and rail car) to enhance the analytical system and asked the Railway Technical Research Institute for cooperation.



In the simulation, based on the seismic vibration observed when the earthquake occurred and the conditions of the ground, we estimated the earthquake wave immediately below the structure (elevated bridge) where the train was derailed and even estimated the vibration on the elevated bridge to analyze the behavior of the rail cars.

Based on these analysis results, the board requested in the accident investigation report further promotion of measures against derailment and deviation as preventive measures. The railway operators that run shinkansen are conducting studies to promote measures against earthquakes with preventive measures taken into account.

(3) Investigation of Marine Accidents and incidents

In the marine mode, for more scientific and subjective investigations of accidents and others, we retrieve data from nautical instruments such as voyage data recorders (VDRs), automatic identification systems (AIS's), and electronic chart display and information systems (ECDIS's).

In recent years, with some vessels, such as passenger boats, being equipped with a video recorder at the front window of their steering house, there are cases where conditions and other information at the time of accident are clearly recoded as video data. For collision and other accidents, we more subjectively analyze the conditions of, for example, ship handling and communication using such scientific data to look into the causes of accidents in greater depth for a higher level of investigations of accidents, etc.

In addition, we entrust investigations to the National Maritime Research Institute under the National Institute of Maritime, Port and Aviation Technology, which is a core research institution with expertise and skills about maritime/marine engineering, to have them conduct analyses of, for example, AIS data and impact simulation in further greater depth.

For further increased safety in vessel traffic, we have made a marine accident hazard map and

published it with the objective of calling attention to those concerned by indicating past accidents on this map along with their details (investigation reports on accidents, etc.) and having risks associated with each sea area overlap accident sites. At the beginning, the map was available only in Japanese, which became subsequently available in English and global versions. Recently, we also made a database of the past results of investigations of accidents, etc. and published it as an Engine Trouble Search System. We are widely making information known and promoting the use of it by, for example, making best use of these tools and clearly explaining the important points in preventing accidents at a variety of meetings and outreach lectures.

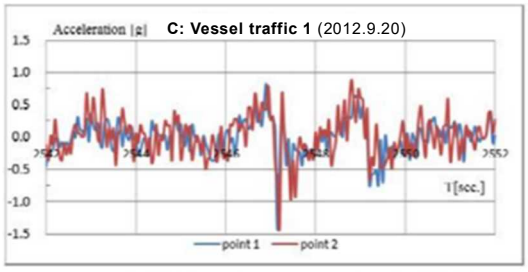
○ Evaluation of the dangers posed to passengers based on impact simulation (marine mode)

On June 24 and 26, 2012, passengers on board two passenger boats were injured off the southern coast of Iriomote Island, Taketomi Town, Okinawa Prefecture, when they were violently shaken by waves.

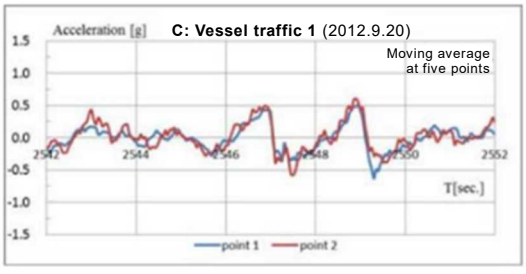
All of the passengers injured in this accident were seated in seats in the front part of the front cabin; they suffered lower-back injuries because of the impact they received when they were lifted by the shake and then dropped. For this reason, we measured and estimated the up and down accelerations at their seating positons. In addition, we compared the up and down accelerations at the various points between the two boats to evaluate the risk of lumbar fracture and reviewed accident prevention measures (safety of seats, seat belts, and others).

Based on these analyses, we presented preventive measures, such as guiding passengers to seats in the rear part of the vessel, ensuring proper usage of seat belts, and cushioning seats.

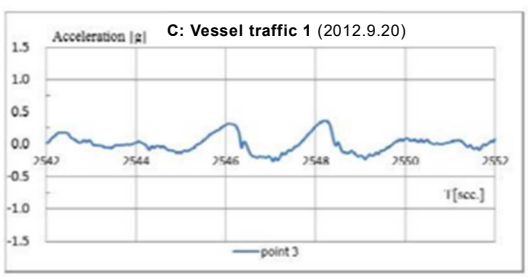
Under the situation, we made recommendations to the Minister of Land, Infrastructure and Transport, requiring the minister to ensure, for example, that small high-speed vessel operators



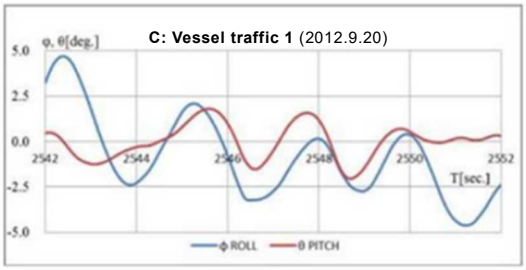
(a) Up and down accelerations at Points 1 and 2



(b) Up and down accelerations at Points 1 and 2 (smoothed)



(c) Up and down accelerations at Point 3



(d) Rolling φ and Pitching θ at Point 3

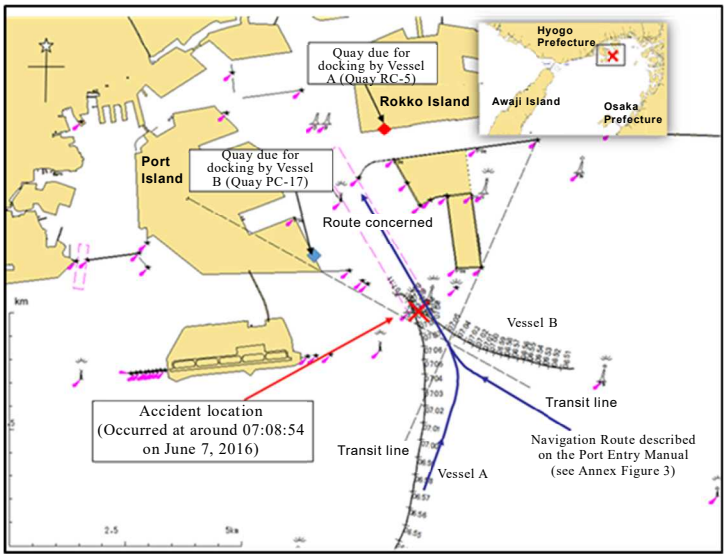
follow the manual for safe operation in stormy weather; that passengers are guided to seats in the rear of the vessel, which are less affected by shakes, and that passengers properly use seat belts.

○ Evaluation of collision risks based on analysis of AIS data (marine mode)

On June 7, 2016, a container ship (Vessel A with a gross tonnage of 170,794 tons) collided with another container ship (Vessel B with a gross tonnage of 9,948 tons) in the Kobe area of Hanshin Port (see Page 49).

For this collision accident, the collision risk was evaluated based on the AIS data of both vessels, which quantitatively indicated that the vessels had been in a dangerous state.

This evaluation was conducted with assistance from the National Maritime Research Institute under the National Institute of Maritime, Port and Aviation Technology and the navigation conditions were also analyzed based on the number of vessels called at the port.



Location of Accident Occurrence and Navigation Route

Vessel A

Vessel B

In combination with CREAM, one of the techniques for human factor analyses to be described later, these results help determine accident causes with a higher accuracy.

1-2 Enhancing Human Factor Analysis

Taking into consideration the fact that systematic analysis of human factors in accidents, etc. helps determine causes and develop preventive measures, the Japan Transport Safety Board has been enhancing human factor analysis. Through the collaboration with external organizations and training sessions, we are trying to deepen our understanding of characteristics of human capability, psychological disposition, and others and to incorporate techniques for human factor analysis

appropriate for each case, and working toward increasing our ability for investigation, including hearing of oral statements, and ability to identify factors behind accidents, etc. We will focus on human factors, which represent important factors in analysis, as well as studies on new analytic theories.

Here, some cases are shown where in background analysis, we used, among the techniques for human factor analysis, analysis on presence/absence of psychological dispositions called the normalcy bias and confirmation bias and the cognitive reliability and error analysis method (CREAM).

○ Operation was continued with irregularities observed such as unusual noises and a strange smell (railway mode)

(See "Simulation analysis on a crack in a flatcar of a shinkansen (railway mode)" on Page 12.)

On December 11, 2017, a serious incident occurred in which a crack was found in a flatcar of a shinkansen.

・Outline of the serious incident

While an attendant noticed irregularities such as unusual noises and a strange smell caused by a crack in a flatcar frame of a shinkansen, no underfloor inspection was conducted and the train continued to run a long distance at normal speed for the reasons there was a difference between the attendant and the dispatcher in understanding of the necessity of rail car underfloor inspection and each thought that the other would determine whether or not to continue the operation.

・Analysis of incident factors from the viewpoint of human factors

With focus placed on human psychological dispositions, we analyzed why they were unable to determine that there had been a problem with the train operation while they noticed irregularities such as unusual noises and a strange smell. People have a psychological disposition called the normalcy bias that makes you determine that any abnormal situation that occurs is a normal situation and try to remain calm (a psychological disposition that makes you think that there is no problem with the train operation and use wording that induces continuation of the train operation). People also have a psychological disposition called the confirmation bias that makes you choose and place importance on information that supports your wish or belief and disvalue and exclude information that goes against such information (a psychological disposition that makes you look at only the information that supports your idea to convince yourself that the idea that you do not want to stop the train is correct). In this case, we analyzed that the persons concerned had been unable to determine that there had been a problem with the train operation because these psychological dispositions affected them without them knowing it.

・Preventive measures from the viewpoint of human factors

Based on these analyses, we presented preventive measures assuming that people have the above psychological dispositions; we pointed out that it is important to modify the regulations and

other requirements to require the persons concerned to stop trains to check safety when one cannot know what is happening or has difficulty in making a determination and to make this requirement universally known to the employees.

This serious incident reassures that it is important to stop trains to check safety with top priority placed on safety in a case where a situation occurs that is not mentioned in the manual or other requirements or not in line with the regulations.

○ Two vessels collided with each other without the wrong recognition of both crews corrected (marine mode)

(See "Evaluation of collision risks based on analysis of AIS data (marine mode)" on Page 16.)

On June 7, 2016, a container ship (Vessel A with a gross tonnage of 170,794 tons) collided with another container ship (Vessel B with a gross tonnage of 9,948 tons) in the Kobe area of Hanshin Port (see Page 49).

・Application of the CREAM

For this collision accident, with assistance from the National Maritime Research Institute under the National Institute of Maritime, Port and Aviation Technology, we analyzed the factors that had caused the accident using the CREAM, one of the techniques for human reliability analysis, to (1) evaluate the work environment (evaluate the contribution to unsafe actions for each of three elements: individual, skill, and organization) and (2) identify the background factors (identify unsafe actions based on the ship handling record, oral statements, and other information to analyze the causes).

・Causes of the accidents identified through this analysis

The board used the CREAM for the first time to identify the (unsafe) actions that should be noted and the background factors. This resulted in the findings that information had not been smoothly shared because of the difference in the languages used and insufficient inboard/outboard communication, which caused the crews of both vessels to incorrectly think that their vessels had priority over the other, leading to the collision.

・Advantages of this analysis technique

This analysis method provides multifaceted analysis of multiple elements, leading to higher level analysis of causes of accidents. In conducting analyses, accident investigators gather verbally expressed information from boat controllers with attention paid not to fail to catch a variety of information; the CREAM is also useful in appropriately collecting information in the initial stage of the investigation because, for example, the use of the CREAM helps accident investigators standardize the information to be gathered in advance.

We believe that storing cases of investigations of accidents, etc. reveals the factors behind accidents, etc., enabling us to present more effective preventive measures.

Outline of the CREAM

- This technique is roughly divided into two stages. In the first stage, the work environment is evaluated and in the second stage, the background analysis of human actions is conducted.
- In the stage of work environment evaluation, the work environment at the time of the accident occurrence is evaluated from multiple viewpoints, such as the safety control system, including watching, and the validity of the vessel handling procedure, etc. at the time of port entering, with focus placed on the three elements (individual, skill, and organization) that affect human behavior, to determine whether or not the work environment was likely to cause crews to make errors of some kind.
- In the stage of background-factor analysis, information is collected such as the vessel handling record from the voyage data recorder and voice record of instructions, and information about actions that may compromise safety identified, for example, through the interview with the captain or the like. Then, the background of the actions, etc. is looked into in depth to identify and analyze the background factors that led to the accident.
- With similarity in direction, these evaluation and analysis results may be analyzed together with the above mentioned evaluation of collision risks based on analysis of AIS data (see “Evaluation of collision risks based on analysis of AIS data (marine mode)” on Page 16) to verify the analysis results, which accurately identify the cause of the accident.

1-3 Enhancing Multifaceted Analysis That Leads to Actions for True Prevention of Reoccurrences

To track down the causes of accidents, etc. and the causes of damage triggered by accidents, we will conduct not only “point” analysis, which addresses only individual accidents, etc., but also “multifaceted” analysis, which is conducted from various viewpoints such as changes in the social situation and comparisons with same-type and similar cases, including collection of information about, for example, similar cases and examples of measures that actually prevented accidents from the database of accident investigations disclosed so far. Based on the results of such analyses, we will suggest safety measures that more effectively help prevent reoccurrences.

This section describes cases where attempts were made to enhance the multifaceted analysis.

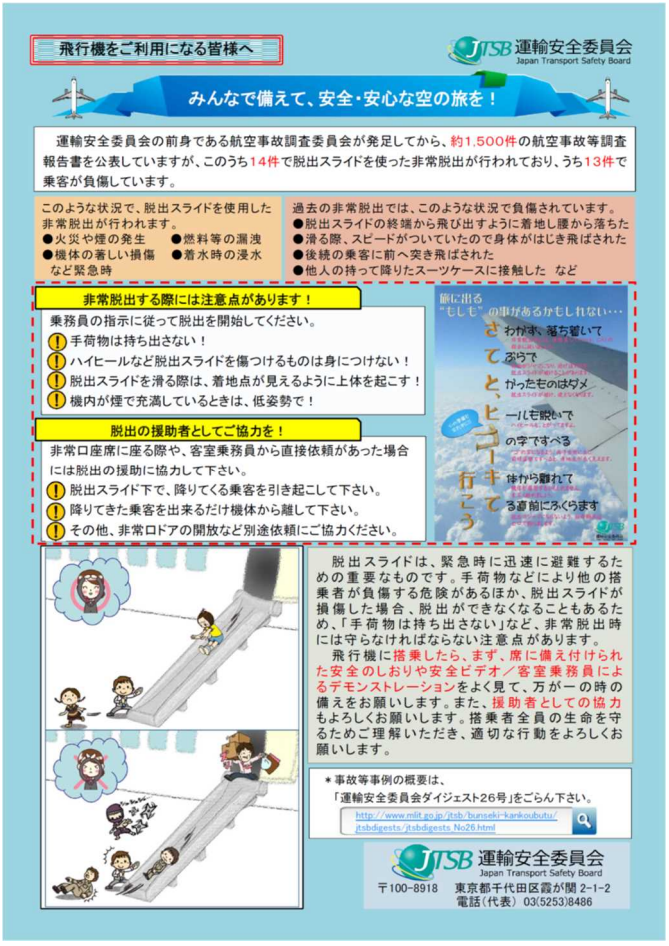
○ Measures for decreasing the number of injured passengers under emergency escape situations (aviation mode)

* Japan Transport Safety Board Digest No.26

Topic about injuries, etc. caused by the use of emergency escape slides

・On February 23, 2016, passengers were injured when they made an emergency escape from a Boeing 737-800 at the New Chitose Airport because of, for example, flames observed coming from an engine of it.

In this accident that occurred on February 23, 2016, many passengers made emergency escapes with baggage in their hands despite the instructions of the cabin attendants.



Escaping with baggage held in passengers' hands may delay the escape down the narrow aisles in aircrafts and such baggage may even hit other passengers and injure them or damage an escape slide, making it impossible for passengers to escape.

For this reason, using leaflets and posters prepared besides investigation reports, and the mail magazine issued by the board and other media, we are widely calling on general users to increase their understanding and recognition about the safety under emergency escape situations by telling them not to bring baggage when making an emergency escape.

We also published the Japan Transport Safety Board Digest No.26 (Japanese and English editions), which contained the results of analyses on past accidents of the same type. This digest presents statistics about emergency escapes and past cases as well as considerations (for example, about the importance of assistance from passengers under an emergency escape situation) based on experience in training on emergency escapes.

With the considerations, we concluded that:

- Many passengers were injured when they escaped using escape slides, meaning that it is possible to decrease the number of inured passengers if assistance from supporters is available under escape slides;

- Baggage brought by passengers when they try to escape may damage escape slides and other passengers;
- Baggage brought by passengers when they try to escape makes cabin attendants spend time handling it, hindering them from giving directions about the escape and helping passengers escape; and
- Cabin attendants alone can provide limited assistance for escapes and assistance from passengers prevents injury under an emergency escape situation.

However, ordinary citizens have almost no opportunity to experience an escape slide, meaning that they will experience a slide for the first time when they are in an accident or the like, and thus they may not appropriately give assistance. To obtain assistance from passengers, i.e., to ensure that they bring no baggage under an emergency escape situation and that they provide support other passengers under escape slides, it is also important that operators make further efforts to communicate the importance of such actions to passengers. Under the circumstances, it is desirable to ensure that ordinary citizens be able to appropriately assist escaping and provide support in the future by, for example, giving an explanation about emergency escapes at occasions such as events by operators or the like for ordinary citizens.

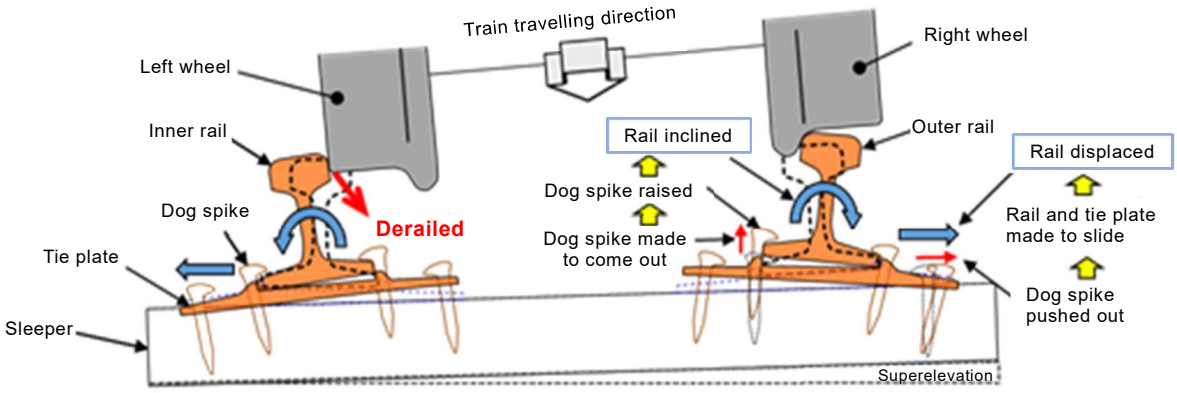
○ Measures for avoiding derailment due to widened track gauges (railway mode)

* Japan Transport Safety Board Digest No.28 (see (2) on Page 196)

Points in maintenance and management of track gauges toward preventing derailment accidents

- Ichihashi line of Seino Railway, on October 6, 2016
- Kishu Railway line of Kishu Railway Co., Ltd. on January 22, 2017
- Fujisaki line of Kumamotodentetsu Co., Ltd. on February 22, 2017
- Watarase Kiekoku line of Watarase Keikoku Railway Co., Ltd. on May 22, 2017

The railway accidents investigated by the Japan Transport Safety Board include four derailment accidents due to widened track gauges, which occurred between October 2016 and May 2017. These accidents seem to have been caused by the distance between the rails widened by rails inclined when a train passed because of successional problems with wooden sleepers and rail



Derailment due to widened track gauge

fasteners.

While the cause of widened track gauges varies from accident to accident, many factors are common to local railways. Based on the findings from the investigations of these accidents we determined, from the viewpoint of preventing similar accidents from occurring in local railways or the like, the following three key points to note, including the use of the existing public support systems and technical support systems (see Page 63).

(1) In inspecting and maintaining sleepers and rail fasteners (dog spikes), it is required to pay attention to the continuity of problems as well as give priority to sharp curves.
(2) To prevent derailment accidents caused by winded track gauges, track gauges should be appropriately maintained according to the gauge displacement situation. For this reason, the time limit for maintenance should be desirably clearly defined.
(3) Compared with wooden sleepers, sleepers made of concrete or similar material are durable and easy to maintain. It is desirable to systematically replace wooden sleepers with concrete sleepers (includes partial replacement to replace one in a few).

To address the appropriate maintenance of track gauges according to the trail displacement situation pointed out in (2), we communicated the fact that the Railway Technical Research Institute is developing a simplified measuring device mountable to commercial rail cars for measuring gauges and twist; it is expected that this device, if commercialized and introduced, will improve the accuracy in gauge measurement and help engineers in shortage.

Increasingly more derailment accidents caused by widened track gauges occur on local and other railways. It seems that, behind this situation are the facts that the number of passengers is decreasing, which is making it difficult to make investments in facilities and is thus promoting aging of facilities, and that the aging of employees and engineers is causing shortages of engineers, which is thus making it difficult to hand down technological skills.

○ Disclosure of examples of measures for preventing accidents involving an anchor dragging and measures for avoiding collision accidents (marine mode).

- On September 4, 2018, an oil tanker dragged its anchor off the southeastern coast of Kansai International Airport Island and collided with the connection bridge (see Page 163).
- On October 1, 2018, a cargo ship dragged its anchor in the Kawasaki area of Port of Keihin and collided with a quay (under investigation).

So far, the board has been investigating mainly vessels that have been in accidents and the like. On September 4, 2018, very strong Typhoon No. 21 passed the Osaka Bay. We conducted questionnaires about the situation when the typhoon was approaching and passing and the actions that were taken that did not prevent the accidents; we also conducted such questionnaires on vessels that had successfully avoided accidents. The survey on vessels that did not get in accidents

was a first attempt and a breakthrough.

With detailed analysis of the answers to the questionnaire, AIS data, and so on, we indicated as follows the important points in preventing accidents involving an anchor dragging under a situation affected by a very strong typhoon:

(1) When a vessel is anchored, basically two anchors must be used and all possible measures must be taken to, for example, ensure that anchors and anchor cables provide secure sufficient anchor-holding power with the anchor cables extended as long as possible. How to anchor the vessel and how long the anchor cable should be determined according to the vessel conditions and the anchorage environment on a vessel-by-vessel basis.

(2) It must be ensured that with the engine placed in a standby state, the output is appropriately adjusted by continuously using the engine according to rapidly changing wind directions and velocities so that anchor dragging will not be caused.

(3) An anchorage must be chosen so that no important facilities will be located on the leeward side of the anchorage and that sufficient distances to other vessels will be secured.

(4) Since the wind direction and velocity rapidly change when a typhoon is passing, it is required to acquire information about the latest weather and hydrographic (typhoon) conditions and accurately forecast the weather and hydrographic conditions. In conducting each action, it is critical to determine when to conduct it.

For the accident involving an oil tanker colliding with a bridge, a marine accident investigation report was published, which contained (1) to (4) above as preventive measures and indicated that the best evacuation place should be chosen by the captain, ship owner, and operator after consultation.

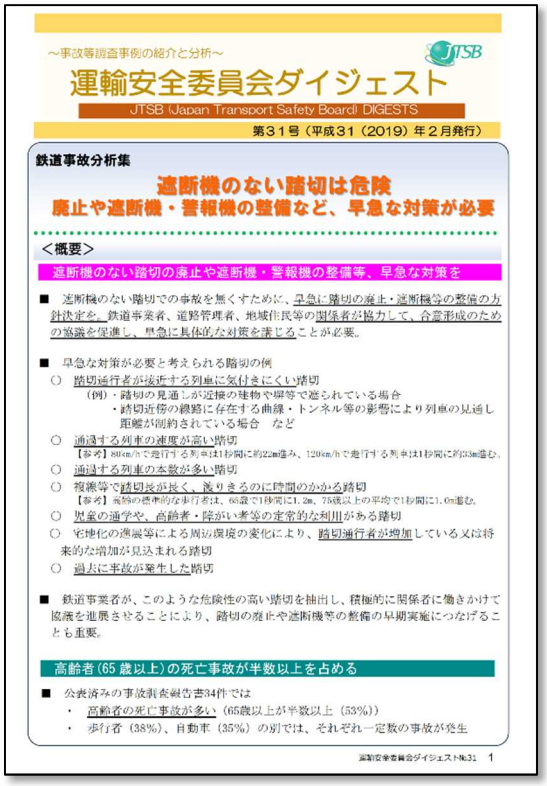
In addition, the report implied that a disaster that has reached an unprecedented level cannot be countered with only past experience and knowledge.

To appropriately cope with such a situation, we believe that the training sessions should be enhanced for enhancing the skills of the captain, the responsible person at the site, and crew and that the entire land-side organization including the parties concerned with operation should build a safety support system.

○ Response to an accident that occurred at a level crossing without automatic barrier machine (railway mode)

* Japan Transport Safety Board Digest No.31: Level crossings without automatic barrier machine are dangerous. They must be urgently addressed; for example, they must be abolished or equipped with automatic barrier machine and/or road warning device.
- Uchibo line of East Japan Railway Company, on September 27, 2016
- Gantoku line of West Japan Railway Company, on March 6, 2017 (see Page 142)
- Nishikyushu line of Matsura Railway Co., Ltd., March 23, 2017
- Rumoihonsen line of Hokkaido Railway Company, June 20, 2017

In April 2014, we added, to the list of accidents, etc. subject to investigation, level crossing obstacle accidents involving loss of lives at level crossings (class-3 and -4 level crossings) without automatic barrier machine, which have a high risk of accident.


～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31号（平成31（2019）年2月発行）

鉄道事故分析集

遮断機のない踏切は危険

廃止や遮断機・警報機の整備など、早急な対策が必要

<概要>

遮断機のない踏切の廃止や遮断機・警報機の整備等、早急な対策を

■ 遮断機のない踏切での事故を無くすために、早急に踏切の廃止・遮断機等の整備の方針決定を、鉄道事業者、道路管理者、地域住民等の関係者が協力して、合意形成のための協議を早進し、早急に具体的な対策を講じることが必要。

■ 早急な対策が必要と考えられる踏切の例

○ 踏切通行者が接近する列車に気付きにくい踏切
（例）・踏切の見通しが近接の建物や塀等で遮られている場合
・踏切近傍の線路に存在する曲線・トンネル等の影響により列車の見通し距離が制約されている場合　など

○ 通過する列車の速度が高い踏切
【参考】80km/hで進行する列車は1秒間に約22m進み、120km/hで進行する列車は1秒間に約33m進む。

○ 通過する列車の本数が多い踏切

○ 複線等で踏切長が長く、渡りきるのに時間のかかる踏切
【参考】高齢の標準的な歩行者は、65歳で1秒間に1.2m、75歳以上の平均で1秒間に1.0m進む。

○ 児童の通学や、高齢者・障がい者等の定常的な利用がある踏切

○ 宅地化の進展等による周辺環境の変化により、踏切通行者が増加している又は将来的な増加が見込まれる踏切

○ 過去に事故が発生した踏切

■ 鉄道事業者が、このような危険性の高い踏切を抽出し、積極的に関係者に働きかけて協議を進展させることにより、踏切の廃止や遮断機等の整備の早期実施につなげることも重要。

高齢者（65歳以上）の死亡事故が半数以上を占める

■ 公表済みの事故調査報告書34件では
・ 高齢者の死亡事故が多い（65歳以上が半数以上（53%））
・ 歩行者（38%）、自動車（35%）の別では、それぞれ一定数の事故が発生

運輸安全委員会ダイジェストNo.31　1

After that, 39 accidents that fall under this category occurred until January 2018. Under the situation, we analyzed railway accident investigation reports published so far, and in February 2019, we put together measures taken for accident prevention in the Japan Transport Safety Board Digest No.31.

In this process, we analyzed multiple accidents from various viewpoints to provide the following suggestions about measures required to prevent accidents, which we had been unable to do with individual investigation reports on accidents and serious incident.

- Elimination of accidents at level crossings without automatic barrier machine requires measures such as elimination of level crossings and maintenance of automatic barrier machines and other equipment. In particular, highly dangerous levelcrossings which, for example, trains pass at high speed require immediate measures.
- This requires the parties concerned, such as railway operators, road administrators, and local residents, to work together to promote consultations toward abolishing level crossings or construction of automatic barrier machine and other equipment.

This digest also indicates concrete cases that led to abolition of level crossings along with the points concerning abolishing level crossings.

The board will conduct field surveys on level crossings without automatic barrier machine and interview operators concerned to identify the actual conditions of level crossings and ensure that measures are implemented toward abolishing level crossings and building safety appliances of level crossing. The levelcrossings on which we will conduct field surveys will be selected based on the characteristics of each level crossing, such as train speed, number of trains, and road traffic, and such investigations will be conducted with the objective of searching for clues for accelerating the efforts by the parties concerned through evaluation of risks associated with the levelcrossings.

The interviews with the parties concerned will be conducted with focus placed on cases where level crossings without automatic barrier machine were abolished and level crossings became equipped with automatic barrier machine, aiming to build up and use know-how for promoting consensus formation among the parties concerned about individual concrete safety measures for level crossings. By aggressively making such efforts, the board is determined to contribute to further development of safety measures for level crossings.

○ Respond to shipboard fire and loss of power (marine mode)

・On July 31, 2015, a fire occurred on a passenger ferry off the southern coast of Tomakomai Port (see Page 48).
・On April 24, 2017, a fire occurred on a cargo ship at Hakata Port (see Page 51).
・On November 8, 2018, a cargo ship lost power and had a collision at Mizushima Port.

For the fire on the passenger ferryboat, it is deemed that when the fire started in a ship-borne truck, the crew did not appropriately extinguish the fire or prevent the fire from spreading, causing it to develop into a large-scale fire. For the fire on the cargo ship as well, a fire started from scrap in the cargo space and the crew did not appropriately extinguish the fire, using water instead of a carbon dioxide fire extinguisher. This spread the fire, causing the vessel to sink on the following day.

It is deemed that for both vessels, the captains or crews had not been sufficiently provided with practical training sessions that allow them to take required actions when they actually are faced with an emergency.

For the accident in which the vessel collided with breakwater because it had been made uncontrollable by a blackout caused by stoppage of the onboard generator motor, the vessel lost power because it had used fuel oil with water mixed in it and the emergency measures, including emergency anchorage, for a case where onboard power is completely lost were insufficiently established, resulting in a collision.

These cases indicate that the response in an emergency, if improper, does not reduce damage but leads to larger-scale damage. To counter this situation, we suggest operators and other organizations should be required to provide captains and crews with practical training repeatedly to maintain an organizational safety control system that allows for appropriate responses.

1-4 Summary of Suggestions from Accidents That Seem to Be Useful in Responding to the Social Situation and the Like

Recent years have seen accidents associated with traffic and transport, which have large impacts on society including peoples' life and the economy, and incidents that require reconsideration of how traffic operation (operators) should be. These accidents, etc. include many cases that seem to be affected by changes in the social situation, etc., such as the decreasing population/declining birthrate and aging population/shortage of people who shoulder responsibilities, increasingly more serious disasters, and aging infrastructures as shown in (1) to (3) below, and many other cases that seem to be associated with rapid development of technological innovation as shown in (4). Bearing these changes in mind, we will make efforts so that we can analyze causes and preventive measures in greater depth.

In addition, we believe that it is critical to comprehensively analyze the investigation reports on accidents, etc. published so far, with consideration that they are a valuable database, to ensure that as many as accidents as possible are prevented in early stages and to communicate the analysis results along with factors behind the changes in social situation, etc. and other suggestions beyond the boundaries among the modes of aviation, railways, and marine so that that they will be reflected in your actions for preventing accidents.

Considering that in responding to changes in social situation, cases of past accidents will act as useful clues, we are determined to communicate the suggestions mentioned above through the Japan Transport Safety Board Digest and other media not only to the operators that are directly related to accidents but also to the entire industries affected and even industries in the other segments so that we can make efforts that will lead to actions for avoiding accidents.

Below are examples of important suggestions derived from actual accidents.

Examples of important suggestions derived from actual accidents

(1) Decreasing population, declining birthrate and aging population, and shortage of people who shoulder responsibilities

i. Sharing and handing down of technological skills

In the fields of traffic and transport, security experts, who were commonly present at sites, are decreasing in number due to generation changes and other reasons, the skills associated with important directions and know-how to ensure security are not being sufficiently shared or handed down. Examples of recent accidents caused by this factor include accidents (such as the oil taker accident (see Page 163), the crack in a flatcar of a shinkansen (see Page 12), and the crash of a disaster-relief helicopter (see Page 39)) that were caused by insufficient understanding of important directions and know-how within the business unit concerned and/or involvement of

workers with insufficient proficiency and skills and that would later had a significant impact on entire society. In the future, it will be required to organizationally evaluate safety with reliability instead of leaving it to on-site workers so as to ensure that proficiency and skills of the staff involved in operation are maintained at high levels and that the safety system for operation and the like is secured.

ii. Implementation of practical training sessions

To minimize the damage associated with accidents, it is critical to respond smoothly and promptly under emergency situations. To respond under emergency situations, truly practical training sessions and lectures should be provided to a degree that allows crews to respond appropriately when an emergency occurs. However, an accident occurred (passenger ferry accident (see Page 48)) in which the fire was not organizationally extinguished in a prescribed procedure because the captain and crew were insufficiently trained and are thus unfamiliar with emergency deployment, fire extinguishing equipment, and machinery and materials. In the future, the organizations concerned and operators will be required to always make efforts to enhance training programs not only by always securing sufficient opportunities for training but also by establishing a system that ensures that the proper actions are implemented when an actual emergency occurs.

iii. Making the importance of the training for preventing accidents known to on-site staff (occurrence of similar accidents encountered by the same operator)

In recent years, there are cases where similar accidents are repeatedly encountered by the same operator and where accidents ascribable to violations of laws and regulations are repeatedly encountered (e.g., a serious incident in which Tosaden Traffic violated requirements for the security method (partially under investigation) and a violation of the obligations of see-route compliance after passenger ship “Sora” collided with a lighthouse (see Page 52)). These cases seem to have been caused by the fact that it is difficult to make results of investigations of accidents, etc. known to on-site staff. Under the circumstances, we believe that it is required to collect information about the latest cases associated with training for preventing accidents based on lessons learned from investigations of accidents, etc. and communicate such information to the industries not only in the fields affected but also in the other fields.

(2) Increasingly more serious disasters

In recent years, it is becoming more and more conspicuous that disasters are becoming increasingly more serious; recent serious disasters such as heavy rain and typhoons jeopardize safe and stable transport and prominently increase the risk of serious accidents.

The actual examples include an accident (an oil tanker accident (see Page 163)) in which a vessel anchored for evacuation from a typhoon was pushed by pressure and collided with the airport connection bridge, significantly affecting the airport functionality and other means of transport. To

prevent accidents by typhoons of this scale, the most important point is that the onsite staff appropriately prepare for disasters while it is also important that the staff concerned at the home office provide the onsite staff with concrete suggestions and information required for the onsite staff to make an appropriate determination as well as support that substantially increases the number of options from which the onsite staff can choose from; the involvement of the home office is also required instead of leaving it to the on-site staff. These measures are expected to provide effective responses conducted by the staff at the home office and onsite staff as a unified whole to avoid accidents.

(3) Necessity to maintain and repair infrastructures in anticipation of aging

The infrastructures in the traffic/transport filed are one of important elements that provide the basis of safe, stable transport. If they are not sufficiently maintained or repaired and thus the functionality that should be provided by them is lost, accidents can occur. The actual examples include derailment accidents caused by widened track gauges experienced by more than one railway operator and an accident experienced by Nankai Electric Railway in which bridge piers sank and a train is derailed. In these cases, the facilities were insufficiently maintained and repaired and the functionality that should be provided by infrastructures was lost, leading to accidents.

To prevent accidents caused by a malfunction of infrastructure due to insufficient maintenance and/or repair, it is required to properly inspect facilities on a daily basis and promote systematic repair and reinforcement of them if any abnormality is found. In addition, evaluations associated with the necessity of the above mentioned repair and reinforcement must be conducted subjectively and multifacetedly without any subjective views.

In preventing the accidents above, it is also effective to introduce new technologies such as a system that uses an onboard system for measuring track gauges while the train is running and a system that uses a sensor, such as an angle meter, installed on a bridge to monitor the conditions.

(4) Introduction of new technologies based on IoT, AI, or the like

With accelerations in the decrease in population and decrease in birthrate and aging of population, the problems associated with the shortage of security experts and manpower due to the shortage of people who shoulder responsibilities are expected to become increasingly more serious in the future. The introduction of new technology that use IoT, AI, or the like are important in that they may act as one of the measures against and support for the problems associated the shortage of people who shoulder responsibilities. The introduction of IoT and AI with sufficient consideration given to operation characteristics will produce positive impacts, i.e., enabling labor savings and efficiency improvement and improving work environments and increasing earning power.

On the other hand, in introducing new technologies that use IoT, AI, or the like, it is also critical to

sufficiently take their characteristics into account and allow check functions to work instead of entirely relying on them. An accident occurred (see Page 50) that seemed to be caused by a night-duty alarm (an anti-dozing device) installed on a vessel which did not activate because of an improperly installed sensor and thus allowing the person affected to fall asleep. It is required to regularly identify the actual operation after the installation and accurately detect a problem or a sign of a problem, if any, as well as share information among the parties concerned and take complete measures to prevent any problems.

In addition, technologies based on IoT devices must be used on the precondition that with sufficient consideration given to the fact that the devices are connected to the Internet and the security risk associated with it, it is ensured that latest measures are taken to minimize the risk. In preparation for a possible system failure, the system must include a built-in mechanism for sufficient checks and accident prevention that minimizes the damage by, for example, detecting failures in early stages, ensuring security, identifying the actual conditions of operation, sharing information among the parties concerned, and promptly performing correction.

Considering the situations stated in (1) to (4) above, to ensure safe, stable transport in future years, it is critical to work toward maintaining and enhancing the credentials of the parties concerned in the traffic/transport fields. Among others, to clear the problems one by one that the people who shoulder responsibilities for are lacking, those with insufficient proficiency and skills may be involved, natural disasters are becoming more serious, and infrastructures are aging, it is important to keep the system maintained so that it will allow the onsite staff to appropriately respond even if unusual situations occur. From these viewpoints, it is first required to secure opportunities for training sessions and lectures for safe, stable transport and make maximum use of them to prevent accidents; however, achieving this absolutely requires not only efforts at the level of individual operators but also a belief that the industry will work as a unified whole and involve players in the other industries to produce effects.

With this consideration, we believe that it is strongly required to:

- Apply best practices, manuals, and check systems established in excellent companies to other company; and
- Systematically make efforts to secure safety on an industry-wide basis or beyond the boundaries of industries to devise a mechanism that produces sufficient results.

It is deemed that in building safe, stable traffic/transport services, it is also important that users, operators, and administrative agencies collaborate with one another to make sustainable, effective efforts. To promote these efforts, the board is determined to consider in greater depth ideal accident-preventing activities with certain effectiveness based on data and subjective facts.

2 Enhancing Communicativity

(1) Appropriate communication of recommendations, suggestions, safety recommendations, and others

In the period from being setup to June 2019, the Japan Transport Safety Board worked on the identification of the causes of 279 aircraft accidents, 193 railway accidents, and 11,439 vessel accidents and published investigation reports on these accidents, etc. When it is deemed that measures or actions for preventing accidents, etc. and reducing damage are required, it has been making recommendations and suggestions for drafting safety measures and policies; specifically, in parallel with the publication of investigation reports on accidents, etc. it has been making recommendations[1] to the Minister of Land, Infrastructure and Transport and the parties concerned with the causes; making suggestions[2] to the Minister of Land, Infrastructure and Transport and the heads of the administrative agencies concerned, and/or making safety recommendations[3] to organizations concerned in foreign countries.

In the period from being setup to June 2019, the board made 14 recommendations, six suggestions, 11 safety recommendations in the aviation mode, five recommendations and five suggestions in the railway mode, and 15 recommendations, 16 suggestions, and 25 safety recommendations in the marine mode. We will continue to make recommendations and suggestions when it is deemed that measures and/or actions are required for preventing accidents or reducing damage.

(2) Quick provision of appropriate information to victims, etc.

As our action guidelines require consideration to victims, we are determined to quickly and appropriately provide information about accident investigations with sufficient consideration given to the feelings of victims and their families or families of those who lost their lives and to respectfully respond to their views.

To appropriately address victims and others, we set up the Victims and their Families Liaison Office in April 2012. Through this office, we are trying to achieve interactive communication by

1 Based on results of investigations of accidents, etc. the board can make recommendations to the Minister of Land, Infrastructure and Transport and the parties concerned with the causes to require them to implement measures that should be taken for preventing accidents, etc. The Minister of Land, Infrastructure and Transport is obliged to report what measures the minister has taken based on the recommendations to the Japan Transport Safety Board. If any party concerned with causes has not taken the measures associated with the recommendations, the board may disclose that fact.

2 The Japan Transport Safety Board may make suggestions to the Minister of Land, Infrastructure and Transport and the heads of the administrative agencies concerned to request them to implement measures that should be taken for preventing accidents, etc. when such measures are determined to be necessary based on results of an investigation of accidents, etc. or an investigation under way or results of multiple past investigation results.

3 For aircraft and marine accidents, in any stage of an investigation for accidents, etc., the Japan Transport Safety Board may require based on an international treaty, as necessary, organizations concerned in foreign countries to implement actions that should be immediately taken for securing higher-level safety.

providing information to victims and their families and families of those who lost their lives as well as respectfully listening to the views, including findings, of victims so that we can use them as clues for improving accident investigation activities (see Page 207).

(3) Early publication of investigation reports on accidents, etc.

Under the current conditions, a certain duration is required to put together investigation results into a report because doing so requires, for example, sophisticated analyses of data and hardware, interviews with a wide variety of parties concerned along with analysis of the findings, repeated discussions by task forces, and inquires to parties concerned for their views (for interviews with parties concerned for their views, the period for interview is defined, and for aircraft accidents, etc., in particular, a 60-day inquiry period must be given to the organizations concerned in foreign countries according to an international treaty). Our mission is to track down the causes of accidents, prevent reoccurrences of accidents, and reduce damage and we are aware that it is critical to achieve early publication of investigation results on accidents, etc. from the viewpoint of prevention of accident reoccurrences.

Based on such idea, we want to achieve early publication of investigation reports on accidents, etc. by sophisticating our investigation capability through enhancement of the training sessions and lectures provided to accident investigators and by adaptively and intensively deploying accident investigators according to the case. Two recent examples of early publication of reports are shown below:

○ Case of a houseboat fire

On March 27, 2019, a fire occurred in a houseboat made of FRP. We published an accident investigation report on June 27, 2019 in as short as three months before the busy period in summer, recommending the installation of equipment such as a gas stove equipped with a top burner temperature control or the like or an automatic-dispersion-type dry chemical extinguisher based on the fact that it is difficult to extinguish the fire unless it is extinguished before the FRP starts to burn because burning FRP continuously produces combustible gas.

○ Case of an anchor dragging caused by a typhoon (an oil tanker collided with an airport connecting bridge (see Page 163))

On September 4, 2018, when a very strong typhoon was passing the Osaka Bay, an accident occurred in which an anchored oil tanker dragged its anchor and collided with the connection bridge of Kansai International Airport. This accident caused the closure of the bridge, which isolated the airport, having a significant social impact. For this accident, we also published the accident investigation report as early as on April 25, 2019, eight months after the accident, in a shorter time than before.

(4) Progress reports and active communication of facts

In a case where a serious accident has occurred that has a particularly significant social impact or important information is found that must be made known in early stages to call attention and encourage inspection, the Japan Transport Safety Board reports the progress[4] and provides information[5] even before the publication of the investigation report on that accident.

We make it a rule to make progress reports in cases where it is determined that doing so is required because, for example, it is difficult to finish the investigation within a year. For the accident mentioned above in which an anchor dragging was caused by a typhoon (accident in which an oil tanker collided with the airport connection bridge), we made a progress report on December 20, 2018, three months after the accident, and published "Measures against Accidents Caused by Anchor Dragging for a case of a Very Strong Typhoon (intermediate report)," a report on examples of accident preventing measures for the other vessels anchored nearby, to provide information to the parties concerned (see Page 190). For an accident in which a cargo ship collided with a beam of the Oshima-Ohashi bridge on October 22, 2018, which caused a water pipe to break and resulted in the suspension of the water supply for longer than a month in almost all areas of Suo-Oshima town (see Page 163), we made a progress report on March 28, 2019, covering the progress of the accident, conditions at the time of navigation planning, and other information.

Such information is provided to the heads of the administrative agencies concerned when it is determined during the investigation that the information is useful in preventing accidents and reducing damage. One concrete case is a serious incident in which a large aircraft was stopped because its main landing gear was damaged at Narita International Airport on June 29, 2018, for which we provided information about the damage on the 24th of the following month (see Page 126). For a serious railway incident (facility failure) in which a signal post collapsed within the yard of Shin-Sapporo Station on November 14, 2018, we provided information about facts associated with the condition of the installed anchor bolts 5 days after the accident (see Page 149). In addition, for a railway accident resulting in injury or death in which a train car collided with a bumping post in the Yokohama Seaside line on June 1, 2019, we provided information about the records of disconnection and operation of equipment 13 days after the accident.

We will provide information about progress and facts more actively and faster, with the consciousness that in the future, we will be able to make recommendations even before completion of investigations because of the partial revision to the Act for Establishment of the Japan Transport Safety Board as described in Feature 1 (see Page 3).

4 Progress reports are made in cases where it is determined that doing so is required because, for example, it is difficult to finish the investigation within a year. Although preparation of progress reports requires a certain duration because it requires the same procedure as for publishing reports on analyses, oral statements, task force discussions, reference to views, etc., we will try to publish progress as early as possible as required.

5 Information is provided to the heads of the administrative agencies concerned when it is determined during the investigation that the information is useful in preventing accidents and reducing damage.

(5) Active communication of safety measures derived from multifaceted analysis and suggestions derived from accidents that seem to be useful in responding to the social situation and the like

Toward developing an awareness of prevention of accidents and their reoccurrences, we conduct not only "point" analysis, which addresses only individual accidents, etc., but also "multifaceted" analysis, which collects information about similar cases and examples of measures that prevented accidents from the database of accident investigations disclosed so far to achieve analysis from various viewpoints such as changes in the social situation and the like. As part of such efforts, we publish the Japan Transport Safety Board Digest; so far we have published 32 issues.

Recent issues of the Japan Transport Safety Board Digest deal with subjects such as "Passengers Who Were Injured When They Used Escape Slides Under an Emergency Escape Situation" (see Page 20 of the of Japan Transport Safety Board Digest No.26), which is an analysis of measures for decreasing the number of passengers who are injured when they escape from aircrafts, and "Important Points in Maintenance and Management of Track Gauges toward Preventing Derailment Accidents" (see Page 21 of the Japan Transport Safety Board Digest No.28), which is an analysis of derailment caused by widened track gauges.

As stated above, we will continue to actively communicate, through the Japan Transport Safety Board Digest and other media, safety measures derived from multifaceted analysis and suggestions useful in addressing the social situation and others, derived from, for example, comparisons among past cases of the same type and similar cases and then we will use such information in holding symposia beyond the boundaries of the aviation, railway, and marine modes, hold meetings with operators for exchanging opinions, and share it with investigation organizations in foreign countries.

3 Enhancing Internationality

(1) International cooperation in conducting accident investigations

The Japan Transport Safety Board must arrange an environment that allows it to cooperate with accident investigation organizations in foreign countries to swiftly and smoothly conduct investigations and prepare appropriate investigation reports on accidents, etc.

i. Building and enhancing the relationships with the countries involved in aircraft design/manufacturing, countries where our jetliners will be in service, or the countries above which our jetliners fly, with an eye toward future commercial flights of domestic jetliners.

In the mode of aviation, when commercial flights of domestic jetliners come into service and if

they should cause an accident or the like in a foreign country, Japan must immediately contact the authority in that country as the country involved in the design and manufacturing of the jetliner and then participate in the investigation by, for example, dispatching aircraft accident investigators. For this reason, we must build an international network with authorities in foreign countries and enhance it with an eye toward, for example, the development of future commercial flights of domestic jetliners.

To this end, we are required to:

- Conclude in order cooperation agreements for smooth implementation of investigations with authorities in foreign countries to confirm the intention to cooperate with each other in investigating accidents, share emergency contacts, and cooperate in investigations in the manners compliant with the requirements defined in an annex to the agreement, with the objective of speedily and smoothly implementing an accident investigation when an accident occurs in a foreign country (so far we have concluded agreements with authorities in eight countries and areas). Considering the level of impact of modern day accidents for international flights in particular, we must conclude agreements with countries with many international flights in service;
- Build collaborative relationships with countries involved in aircraft design/manufacturing, such as the U.S.A., and France, in addition to the countries where commercial flights of domestic jetliners are expected to be in service by concluding agreements with them and enhance the collaborative relationship with other countries involved in aircraft design/manufacturing by, for example, holding periodic meetings and meetings for exchanging opinions with them;
- Develop and enhance personal connections and build trust-based relationships by making maximum use of international conferences such as conferences by the International Society of Air Safety Investigators (ISASI) and ICAO Accident Investigation Panel to mix with and have meetings with other countries involved in aircraft design/manufacturing and countries with which Japan has concluded agreements;
- Aim to play a leading role in and contribute to accident investigations in the future, based on the fact that countries involved in aircraft design/manufacturing hold important posts in major internal conferences associated with accident investigations held by the international association of investigations on aircraft accidents and other organizations, by holding an important post in international conferences as other countries of design/manufacturing do and playing an important role; and
- As a country involved in aircraft design, make efforts to develop human resources that are able to appropriately cope with international investigations by providing sufficient opportunities for training on design and manufacturing of domestic jetliners, such as training based on a flight simulator, classroom lectures on design concepts and other subjects, training on maintenance and verification of actual aircrafts.

ii. Building a system associated with information exchanges in conducting international investigations on marine accidents

For international investigations of marine accidents, if an accident occurs in Japan or a foreign country, the investigation authorities in the coastal state and the country in which the vessel concerned is registered must contact each other and work together to proceed with an investigation according to the International Convention for the Safety of Life at Sea. To this end, in preparation for future serious accidents around Japan involving foreign-registered vessels or Japanese-registered vessels, we must build a network with the authorities in (coastal states) along which routes important for Japan run and in countries in which vessels that are likely to enter ports in Japan are registered and enhance this network. In light of this situation, we will:

- Hold periodic meetings and sessions for exchanging opinions with the authorities of Singapore and other important countries based on bilateral frameworks such as cooperation agreements (concluded only with Singapore at present) in order to build a system for more swift and smooth information exchanges;
- Try to develop and enhance personal connections with countries in which vessels are registered and build trust-based relationships with them by making use of international multinational conferences (such as accident investigator meetings); and
- Aim to hold an important post in international conferences associated with global standardization to be a world leader and contribute to accident investigations in the future.

(2) Building a network toward playing a leading role in global standardization

We will actively participate in conferences for global standardization of accident investigations held by the ICAO (International Civil Aviation Organization)[6] and the IMO (the International Maritime Organization)[7] and improve our presence in the conferences of international and Asian accident investigation organizations.

For the framework for global standardization associated with aircraft and marine accident investigations, we participate in:

- The working group of ICAO Accident Investigation Panel in the aviation mode; and
- The correspondence group of the subcommittee of IMO rule implementation in the aviation mode.

6 ICAO (International Civil Aviation Organization) carries out a variety of activities such as drawing up of treaties on air transport operations and aviation security issues, including measures against hijacking; monitoring of the safety monitoring systems of the countries to treaties; and coping of environmental issues, with the objective of developing the rules and technology for international aviation and promoting planning and development of international air transport. As of March 31, 2018, the number of member countries is 192.

7 IMP (International Maritime Organization) was set up in 1958 as a specialized agency. It carries out a variety of activities that are mainly associated with maritime safety of human life and technical and legal issues associated with safety of vessel navigation, etc., such as promotion of intergovernmental cooperation, development of effective safety measures, and drawing up of treaties. As of March 31, 2018, it consists of 173 member countries and three associate member areas.

In addition, to allow our presence to be improved in the conferences of international and Asian accident investigation organizations, we participate in:

- The International Transportation Safety Association as a multimode framework (where the managers of accident investigation organizations gather);
- International association of aircraft accident investigators and Asian association of aircraft accident investigators in the aviation mode; and
- International conferences of marine accident investigators and Asian Conferences of marine accident investigators in the marine mode.

In addition, as trips by international cruise ships increase, it will be more important to share information among countries concerned. We believe that it is required to raise issues about this situation with an eye on setting up a platform for discussing the problems to be encountered in responding to accidents associated with international cruise ships as well as how the framework for international collaboration should be.

(3) International collaboration mainly among Asian countries

We will support development of human resources in the accident investigation field in the countries and areas in which we will introduce our infrastructures.

In the railway field, in particular, it is required that the government and private sector work together on the development of human resource as a unified whole as support for the development of human resources in the railway accident field through JICA and other projects. Under the situation, it is becoming obvious that with export of Japanese-made rail cars, Japan is increasingly more requested to support the development of human resources to be involved in the safety of the railway that supports the technological capability and brand power. In this field, it is also required to promote self-sustained and continuous development in the target countries so that the safety quality will take root in the organizations concerned in foreign countries; it is becoming critical to build a cycle in which causes are tracked down through investigations of accidents, etc. and implementation of safety measures. For this reason, in the future, the board must urgently enhance its capability to develop human resources so that it can constantly provide high-quality training sessions in response to requests for support from the countries that handle rail cars and the like made in Japan. From this viewpoint, we will:

- Identify the concrete needs (needs associated with support) of the target countries (such as countries to which our support will be provided) through JICA projects and others; and
- Develop training programs and learning materials that reflect our know-how in each of the technical areas such as rail cars, track gauges, and signal systems so that the board can provide higher-quality training sessions according to the needs of target countries; in doing so, we will make use of external resources.

4 Enhancing the Organizational Strength and Individual Abilities

We are placing more focus on the enhancement of organizational strength and individual abilities because it is, we think, absolutely required by the achievement of the enhanced analytical capability, enhanced communicativity, and enhanced internationality mentioned so far.

(1) Enhancing the organizational strength

The Japan Transport Safety Board has been providing training aiming to increase mainly individual abilities. As a result, we recognized the importance of free and open-minded exchanges of views that activate the entire organization and we believe that we are required to have a common understanding of the latest conditions and problems at present and make efforts that help build an organization. In addition, we will consider promoting mutual understanding between accident investigators and administrative officials and increasing personnel exchanges between them.

Furthermore, we will try to enhance the management functionality and coping ability so that we can appropriately make an organization-wide response when a big accident or an accident involving more than one mode occurs or even a disaster occurs. From this viewpoint, we will improve the operation environment and develop human resources so that the entire organization–not only the headquarters (in Tokyo) of the board but also the local offices that provide support in the initial stage of investigations–can deliver its collective strength as a unified whole.

(2) Enhancing the individual abilities

We believe that in combination with the enhancement of the organizational strength above, we must continue to work on the enhancement of the abilities of individual staff members. For highly professional engineers, among other efforts, we are reviewing concrete measures that allow us to strategically procure and develop human resources over the long term. In addition, we will further increase the opportunities for training sessions and lectures that allow all of the accident investigators and administrative officials to advance their knowledge based on the situation in which they are placed and the roles they are expected to play and help enhance cooperation within the organization.

Summaries of major aircraft accident and serious incident investigation reports (case studies)

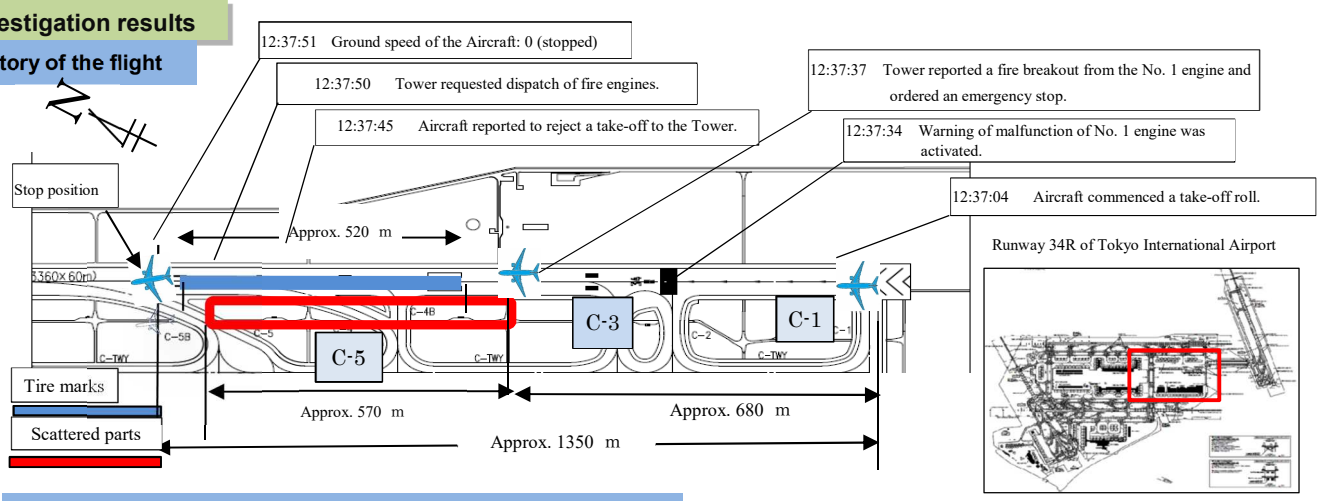
Fire during take-off roll

KOREAN AIR LINES CO., LTD. BOEING 777-300, HL7534

Summary of the Accident: On Friday, May 27, 2016, a Boeing 777-300, registered HL7534, operated by Korean Airlines Co.,Ltd, as the scheduled Flight 2708 of the company, flight crew had a rejected takeoff on runway 34R at the Tokyo International Airport during a takeoff roll to Gimpo International Airport, because there was a warning to indicate a fire from the No.1 (left-side) engine activated at around 12:38, the flight crew stopped the aircraft on the runway, and conducted an emergency evacuation. There were 319 people in total on board, consisting of the PIC, sixteen other crew members, and 302 passengers. Among them, 40 passengers were slightly injured.

Investigation results

History of the flight



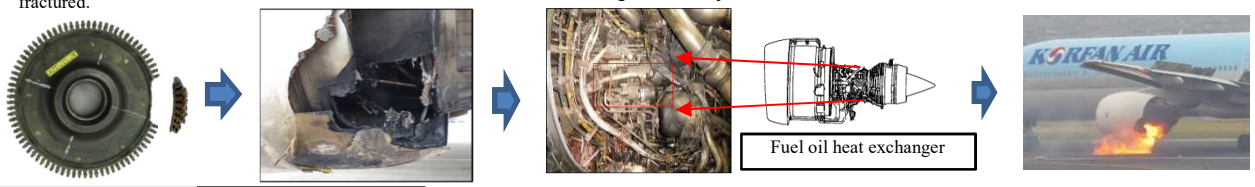
Fracture of 1st stage high pressure turbine disk (HPT disk)

(1) Due to low-cycle fatigue, a crack propagated and fractured.

(2) The fractured part penetrated through the engine case.

(3) A crack occurred in the fuel oil heat exchanger due to impact, etc.

(4) Fuel and engine oil that leaked through the crack ignited.

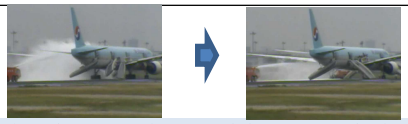


Background of fracture and fire

○ The U-shaped groove on the aft side of HPT disk had a step, but it was not noticed and the product was shipped out before any action was taken.
← Mistake in manufacturing and confirmation failure of inspector (the area was not specified as a critical location to be inspected)
○ A crack generated in the HPT disk. <- As a result of repetitive stress at every cycle
○ The crack was not detected by fluorescent penetrant inspection. (-> Crack propagated.)
← It is possible that the operators and inspector focused on the priority locations and as a result overlooked the step in the U-shaped groove.

Fracture of the rim of HPT disk → Damage of HPT case → Crack generated in the outer case of fuel oil heat exchanger.

Fuel, etc. that leaked out touched the heated area of No. 1 engine. → Fire occurred.



Action taken during emergency evacuation (No. 2 engine side)

○ Action taken by flight crew: Before the No. 2 engine stopped, the crew gave an instruction of emergency evacuation. The No. 2 engine stopped about 28 seconds after the crew opened the first door.
← The captain told the copilot to give an emergency evacuation order, but the copilot could not find the emergency evacuation checklist of QRH (quick reference hand book). As a result, it is somewhat likely that the copilot could not read out the checklist right away.
○ Deployment of evacuation slide: Due to the effects of resultant wind caused by the 20-kt wind and 37.5-kt engine exhaust from the No. 2 engine, the slide folded and slipped under the rear end of the Aircraft while it deployed. It could not return to the normal standing position spontaneously.

Probable Causes (Summary): It is highly probable that the causes of this accident were the fracture of the high pressure turbine (HPT) disk of the No.1 (left-side) engine during the takeoff ground roll of the HL7534, the penetration of the fragment through the engine case and the occurrence of subsequent fires.

For details, please refer to the accident investigation report. (Published on July 26, 2018)
http://www.mlit.go.jp/jtsb/eng-air_report/HL7534.pdf

In addition to the responses to technical issues related to the manufacturer and user of the engine, it is desired that the documents to be placed on the aircraft be properly managed and that passengers be thoroughly informed of appropriate action to be taken in the case of emergency evacuation.

Collision with trees and crash as a result of avoidance maneuver not taken even when getting close to trees

NAGANO FIRE AND DISASTER PREVENTION AVIATION CENTER BELL 412EP (ROTORCRAFT), JA97NA

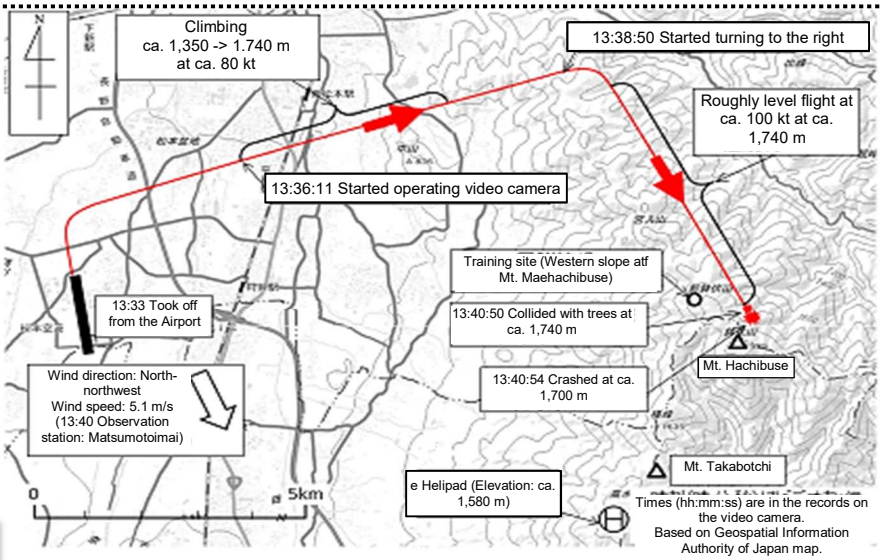
Summary of the Accident: On Sunday, March 5, 2017, at 13:33 Japan Standard Time (JST: UTC + 9 hours; all times are indicated in JST on a 24-hour clock), a Bell 412EP, registered JA97NA, operated by the Nagano Fire and Disaster Prevention Aviation Center took off from Matsumoto Airport and was flying toward a temporary helipad in the mountains, Shiojiri City, Nagano Prefecture to conduct rescue training. At around 13:41, it collided with trees and then crashed onto the mountain's slope on Mt. Hachibuse, Matsumoto City, Nagano Prefecture.

There were nine persons on board the helicopter, consisting of a captain, eight others and all of them suffered fatal injuries.

The helicopter was destroyed, but there was no outbreak of fire.

Investigation results

Estimated flight route



Situation when getting close to the ground

○ It is highly probable that the helicopter did not take either the avoidance route at a constant altitude by directly heading for the destination or the avoidance route by climbing, and that the helicopter continued to fly toward Mt. Hachibuse at a constant altitude until it approached the ground.

Reason for not taking avoidance maneuver when getting close to the ground

○ It is possible that the captain could not recognize the dangerous situation and so did not take any avoidance maneuvers because he was in a state where the arousal level was lowered with microsleep, and so on, due to the effects of fatigue and time difference. However, it was not possible to clarify whether he was actually in such a state.

Captain's conformity to the standards for aviation medical examinations

○ It is highly probable that the captain had a past medical and surgical history and was under treatment with medication. However, it is certain that the captain obtained the medical aviation certification without making a self-report on his medical information.

Regarding CRM during the flight

○ The mechanic did not warn the captain of the approaching danger.

→ The leadership of captain is required to establish the CRM appropriately based on the flight operations

Regarding ELT

○ There was no information concerning the receipt of a radio signal.

→ Possibility of G switch being stuck, and importance of periodic inspections

Regarding flight recorders

○ Aircraft are required to fly within small safety margins.

⇒ It is desired that flight recorders be installed in aircraft.

Contributes to analyzing/evaluating circumstances, understanding flight operations, identifying causes of accidents, and developing reoccurrence prevention

Probable Cause: It is highly probable that in the accident occurred, while flying in a mountainous region, the helicopter collided with trees and crashed, because the helicopter did not take avoidance maneuver even getting closer to the ground.

Regarding the helicopter's not taking avoidance maneuver even getting closer to the ground while flying in a mountainous region, it is somewhat likely that the captain could not recognize the dangerous situation because the captain was in a state where the arousal level was lowered, however, it was not possible to clarify whether he actually fell into such a state.

For details, please refer to the accident investigation report. (Published on October 25, 2018)
http://www.mlit.go.jp/jtsb/eng-air_report/JA97NA.pdf

The Japan Transport Safety Board has stated opinions to the Ministry of Land, Infrastructure, Transport and Tourism.

For details, please refer to "Chapter 1: Summary of recommendations and opinions issued in 2018 (page 60) ".

It is desired, among others, to ensure appropriate captain leadership, establish the CRM responding to flight operations, introduce a two-pilot system with the difficulty level of flight operation taking into account. Flight crew are required to correctly report their health conditions when applying for a medical aviation certification.

Crash into the vicinity of the mountaintop as the aircraft went into clouds during vfr flight

NEW CENTRAL AIRSERVICE CO., LTD. CESSNA 172P, JA3989

Summary of the Accident: On Saturday, June 3, 2017, a Cessna 172P, registered JA3989, operated by New Central Airservice Co.,Ltd., took off from Toyama Airport, while flying to Matsumoto Airport, at around 14:50 Japan Standard Time (JST: UTC+9 hours, unless otherwise stated all times are indicated in JST), it crashed into the vicinity of the top of Mt. Shishi-dake (elevation about 2,700 m) in the Tateyama Mountain Range.

There were four people on board the Aircraft consisting of a PIC, a pilot and two passengers and all of them suffered fatal injuries .

The aircraft was destroyed but there was no outbreak of fire.

Investigation results

History of the flight

Circumstances after takeoff from Toyama airport up to flying over the mountains

- It is somewhat likely that the aircraft was navigated not by the captain (who held an Instrument Flight Certificate) but by another pilot in the aircraft.
- It is considered that the VMC were maintained while the aircraft was climbing from Toyama Airport toward the Tateyama Mountain Range.

→ The aircraft changed to go on a southerly route. (It is assumed that the mountains were covered with clouds.)

→ It is possible that, in a state of low visibility (see the photo outside the window), the pilot might fly the aircraft with advice from the captain or the captain might take control of flying the aircraft.

Flight situation of the aircraft after deciding on turning back (Point d in the estimated flight route map)

→ It is likely that because the aircraft went into in-cloud flight and the pilots also noticed ice build-up on the aircraft, they tried to go back. (It is somewhat likely that the flight performance deteriorated extremely due to ice build-up and the aircraft became unable to maintain its altitude.)

→ It is probable that the aircraft was flying while looking for clouds rifts.

→ It is probable that it became difficult for the pilot to grasp its own position and surroundings, causing the Aircraft to crash into the mountain surface near the top of Mt. Shishi-dake

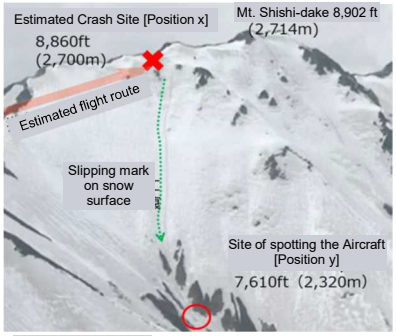
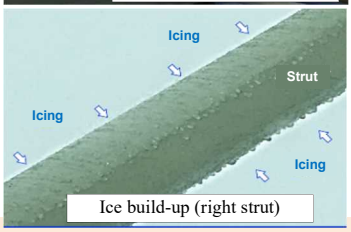


Photo of accident site

Photo outside the window



Ice build-up (right strut)

Probable Cause: It is probable that as the Aircraft got into clouds during VFR flight over the mountain region, it became difficult for the PIC and the Pilot to grasp its own position and surroundings by confirming visually the terrain, then, the Aircraft approached the vicinity of the mountaintop and crashed into it.

It is somewhat likely that the Aircraft approached the vicinity of the mountaintop and crashed into it due to loss of visual contacts making the crash unavoidable, or due to failure to maintain minimum safe altitude caused by the Aircraft icing or stalled condition, or due to encountering a severe turbulence. However, it could not be determined, since the PIC and all members on board suffered fatal injuries .

Concerning the fact that the Aircraft came to fly into clouds, it is probable that the PIC and the Pilot had not confirmed thoroughly the weather forecast for the mountainous region before departure and they delayed in making a decision to turn back during flight.

For details, please refer to the accident investigation report. (Published on August 30, 2018)
http://www.mlit.go.jp/jtsb/eng-air_report/JA3989.pdf

The Japan Transport Safety Board has stated recommendations to the Ministry of Land, Infrastructure, Transport and Tourism.
For details, please refer to “Chapter 1: Summary of recommendations and opinions issued in 2018 (page 54).

It is desirable to provide weather forecasts with safety first and ensure an appropriate decision to go back during in-cloud flights. The aircraft not certificated for flight in icing conditions must not fly under the weather conditions where icing is predicted. Also it is required that pilots be instructed to fasten their seat belts and other safety equipment and that the ELT be installed and operated appropriately.

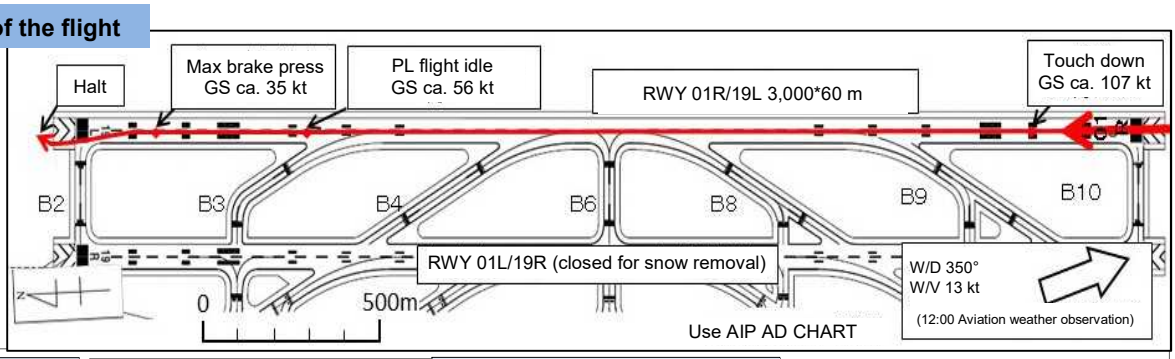
Overran and stopped on a snow-covered grassland

BOMBARDIER DHC-8-402, JA461A

Summary of the Serious Incident: On Thursday, January 19, 2017, a Bombardier DHC-8-402 registered JA461A, operated by ANA Wings CO., LTD. took off from Akita Airport as a scheduled flight 1831 of ALL NIPPON AIRWAYS CO., LTD. as the joint undertaking for transport with ANA Wings, overran and came to a halt at the snow covered grassland at around 11:58 Japan Standard Time (JST: UTC +9 hours, all times are indicated in JST on a 24-hour clock) when landing at New Chitose Airport.

Investigation results

History of the flight



Medium (Values measured by Bombardier with FDR, etc.)	Medium to good (Values measured immediately after the incident occurrence)	Good (Values measured immediately after the incident occurrence)	Good (Values measured immediately after the incident occurrence)

Braking action during braking maneuver

It is probable that the conditions around the end of the runway and overrun area, such as snow coverage, was poor.

* "Braking action" is the classification of friction factor on runways using the terms "Good", "Medium to Good", "Medium", "Medium to Poor", "Poor", or "Very poor" from large values.

Aircraft that overran

Condition of runway on the north side

Condition of runway on the south side

Delay in the start of braking by the captain

- It is highly probable that the captain, who was instructed by the air traffic controller to vacate from taxiway B2 at the end of runway, tried to vacate the runway in a short time by delaying the braking operation start and high speed rolling on the runway.
- The incident is contributed to the captain's judgment failure of Taxiway B3 where he just started to vacate as Taxiway B4.

Operation of power lever (PL)
(Failure to obtain sufficient braking force required for deceleration because the PL was not set to the Disc position during the time from touchdown to stop of the aircraft

- It is probable that the PIC mistook the PL position during the time from touchdown to stopping of the aircraft and did not check it in the meantime.
- It is probable that the co-pilot did not realize that the intentions of the captain differed from his own.

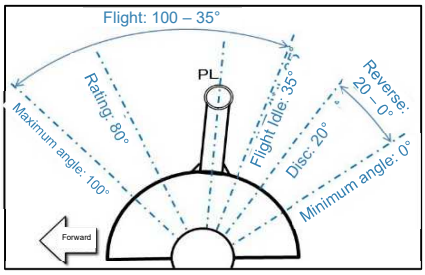


Figure 2. PLA

Probable Cause (excerpt): In this serious incident, it is highly probable that the aircraft overran the runway because the aircraft could not obtain the braking force due to the delay of braking operation start by the PIC and PL (Power Lever) was not set at the Disc position. Moreover, it is somewhat likely that the bad conditions with snow fall around the end of the runway and the overrunning zone contributed to the aircraft overrunning.

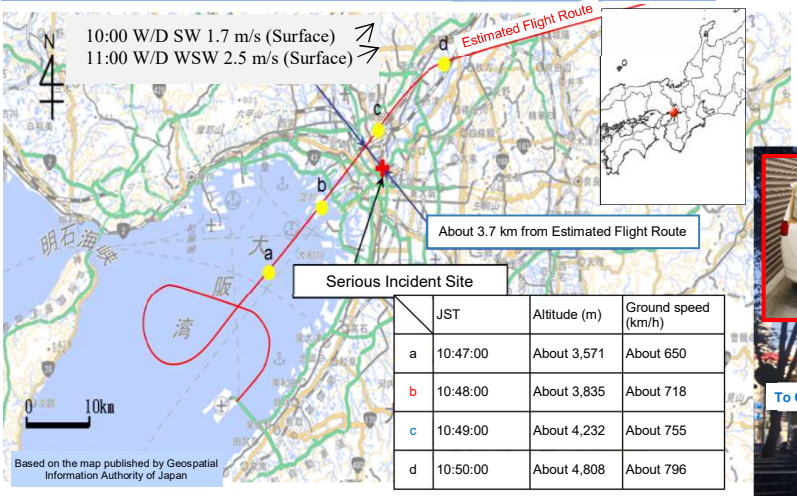
For details, please refer to the accident investigation report. (Published on February 22, 2018)
http://www.mlit.go.jp/jtsb/eng-air_report/JA461A.pdf

Parts fallen from aircraft hits vehicle on the ground
KLM ROYAL DUTCH AIRLINES BOEING 777-200, PH-BQC

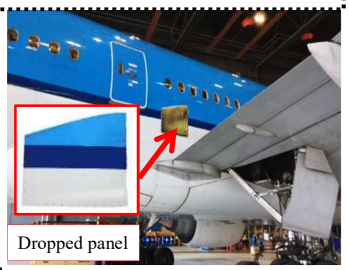
Summary of the Serious Incident: On Saturday, September 23, 2017 a Boeing 777-200, registered PH-BQC, and operated by KLM Royal Dutch Airline, took off from Kansai International Airport for Amsterdam Schiphol International Airport on a scheduled Flight 868 of the Operator. A right aft wing-to-body fairing panel was dropped from the aircraft climbing while accelerating over Osaka city. The dropped fairing panel collided with a vehicle driving on a road in Kita-ku, Osaka City.

Investigation results

Circumstances of the flight and falling parts



	JST	Altitude (m)	Ground speed (km/h)
a	10:47:00	About 3,571	About 650
b	10:48:00	About 3,835	About 718
c	10:49:00	About 4,232	About 755
d	10:50:00	About 4,808	About 796



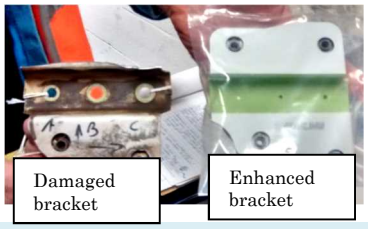
Damage condition of the bracket used and falling panel

○ The bracket (a part for securing the panel to the body) was a pre-enhancement bracket.

- It is probable that the Panel was not fitted tightly to the fuselage.

- The preload that forced the forward upper corner of the Panel down was weak or had weakened due to aging degradation

- Marks caused by fatigue fracture were left on the broken Bracket's fractured surfaces



○ The part had not been replaced with an enhanced bracket.

After the incidents of damaged pre-enhancement bracket and panel dropping, the aircraft's manufacturer issued two service bulletins, but not for the 777-200 aircraft.

Load caused by aerodynamic force from the panel's exterior

Load placed by the air flowing inside the panel

→ Repeatedly acted on the flange part of the bracket as bending stress which resulted in fatigue fracture.

Damage of bracket → A large gap was formed between the forward upper corner of the panel and the fuselage. → Pressure and vibration of inflow air → Panel dropped

Probable Cause: It is certain that this serious incident occurred when the departed right aft wing-to-body fairing panel struck and damaged a moving vehicle, while the aircraft was climbing and passing over the city of Osaka after takeoff.

Regarding the departure of the Panel, it is highly probable that the Bracket that secured the Panel's forward upper corner by holding it to the Aircraft's side broke, a gap was occurred between the Panel's forward upper corner and the fuselage, and the Panel departed due to the pressure of inflowing air and vibration.

For details, please refer to the accident investigation report. (Published on November 29, 2018)
http://www.mlit.go.jp/jtsb/eng-air_report/PHBQC.pdf

Summaries of major railway accident and serious incident investigation reports (case studies)

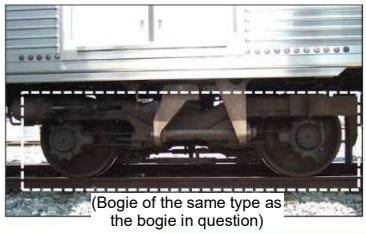
Derailment due to a crack at the side beam of the bogie, leading to the increase of the wheel load unbalance, etc.

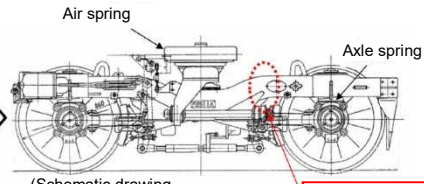
Train derailment, in the premises of Naka-itabashi Station, Tojo Main Line, Tobu Railway Company

Summary: On Wednesday, May 18, 2016, the train, composed of 10 vehicles, departed from Naka-itabashi station on schedule. After the train had operated in powering operation, the driver of the train shifted the notch off to operate in coasting operation until the rearmost vehicle passed the turnout in the premises of Naka-itabashi station.
When the train driver accelerated the train in powering operation again, after the train had passed the turnout, he noticed that the emergency button in the cabin was operated, then applied the emergency brake to stop the train.
After that, the conductor checked the status of outside train and found that all two axles in the rear bogie (the bogie question) of the 5th vehicle were derailed to the right.
There were about 400 passengers, the train driver and conductor onboard the train, but no one was injured.

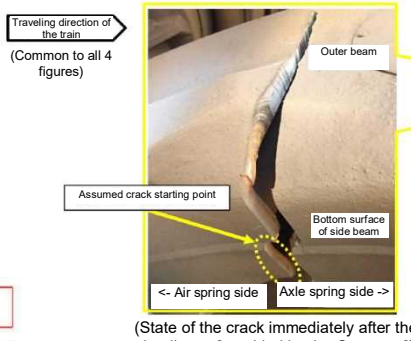
Investigation results

It is probable that, before the derailment, the crack already extended from the bottom plate to around the upper part of the side surface of the side beam in the right side of the bogie, and that the wheel load of the front axle right wheel of the bogie was decreasing, causing wheel load unbalance exceeding the control value.

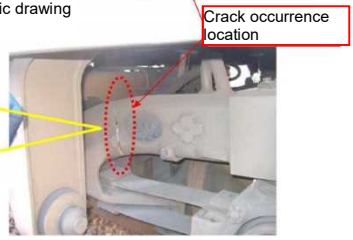

(Bogie of the same type as the bogie in question)



(Schematic drawing of bogie)

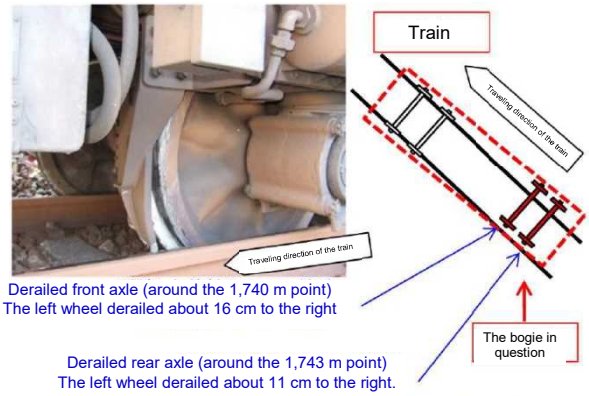


(Common to all 4 figures)
(State of the crack immediately after the derailment [provided by the Company])



(Crack occurrence location on the bogie)

It is probable that, because in this state the 5th vehicle entered the left curving track of 178 m radius, the lateral force of the front axle right wheel of the bogie in question increased, causing the wheels to climb up the right rail of the curve.



Based on the facts that oil-like substance was adhered on the right rail up to the rear axle gear case of the bogie in question and that the gear case was damaged, it is probable that the train was running while the gear case kept in contact with the right rail.

The conductor of the train told that he noticed a burnt odor and white smoke after the occurrence of the accident. Concerning the burnt odor, it is probable that the odor was generated when the oil leaking from the damaged gear case evaporated due to the heat caused by the contact between the gear case and the rail. Concerning the white smoke, it is probable that the smoke was generated because of the derailed wheels running on the PC sleepeers and ballasts, since the smoke had disappeared when the conductor made a check.

Probable Causes (excerpt): It is probable that the right wheel of the front axle in the rear bogie in the 5th vehicle of the train climbed up the right rail and derailed to right, because the wheel load unbalance had been enlarged as the wheel load of the right wheel of the front axle had decreased due to the crack, existing from the bottom plate to upper part of the side surface of the side beam in right side of the rear bogie, and the lateral force of the right wheel of the front axle had increased when the rear bogie had entered the left curved track of 178 m radius, in the accident.

For details, please refer to the accident investigation report. (Published on January 25, 2018)
http://www.mlit.go.jp/jtsb/railway/rep-acci/RA2018-1-1.pdf

Derailment due to gauge widening caused by failures of sleepers and rail fastening devices

Train derailment, between Hanawa station and Mizunuma station, Watarase Keikoku Line, Watarase Keikoku Railway Co., Ltd.

Summary: On May 22, 2017, the driver of the train, the electric and track inspection cars composed of three vehicles, felt a shock just after the train had passed through the 160 m radius right curved track, between Hanawa station and Mizunuma station, at about 36 km/h, then applied an emergency brake to stop the train.
After the train had stopped, the driver checked the situation and found that all axles in the front bogie of the 2nd vehicle had derailed to left.
There were 7 persons, i.e., the train crews and the staff in charge of railway facilities etc., onboard the train, but no one was injured.

Investigation results

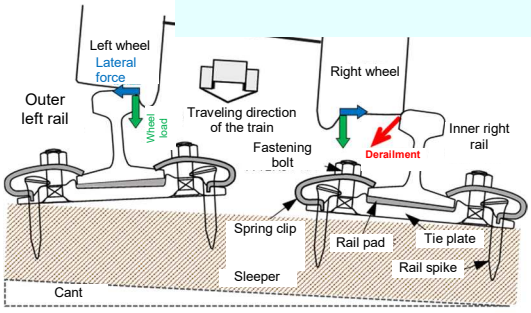
At around the starting point of derailment, failures of sleepers were continuing and the lifting of rail spikes of the rail fastening devices was continuously occurring.

The irregularity of gauge at around the starting point of the derailment measured just before the occurrence of the accident significantly exceeded the maintenance standard value.

It is desirable to develop a management system to ensure reliable checks and maintenance for sleeper corrosion, rail spike lifting, etc.
Measures are required to give priority to maintenance in the case of continuous occurrence of sleeper corrosion, rail spike lifting, etc. and for sharp curves with a large slack.

It is desirable to determine the maintenance deadline, etc. in case that the track irregularity exceeds the maintenance standard value, to ensure that track maintenance is reliably implemented. Also, it is desirable to determine how to handle the operation rules and track maintenance, etc. in the case that significant track irregularity is found during track inspection/measurement, so that they can be reliably implemented.

It is desirable to replace wooden sleepers with sleepers made of concrete or equivalent materials, which have higher durability and maintainability than wooden sleepers (including partial replacement where every several sleepers are replaced).



Probable Causes: It is probable that the accident occurred as the right wheel in the 1st axle of the front bogie of the 2nd vehicle fell off to the inside of the gauge and continued running being spread gauge, and then the left wheel flange in the front bogie climbed up to outer left rail and derailed to left, because the gauge was widened while the train, the electric and track inspection cars, was passing in the 160 m radius right curved track.

It is probable that the gauge widening was caused by the rail tilting etc., due to lateral forces accompanied with train running in the curved track where the continuous defective sleepers and rail fastening devices were existed.

It is somewhat likely that the existence of significantly large gauge widening to cause derailment was related with that the proper track maintenance had not been implemented because the danger against gauge widening by the continuous defective sleepers and rail fastening devices had not been recognized in the periodic inspection etc., and the proper operation control and the track maintenance had not been implemented even though the remarkably large irregularity of gauge had been detected in the measurement by the track inspection cars just before the accident.

For details, please refer to the accident investigation report. (Published on June 28, 2018)
http://www.mlit.go.jp/jtsb/railway/rep-acci/RA2018-4-1.pdf

Regarding the fact that four train derailment accidents occurred due to gauge widening, including this accident, between October 2016 and May 2017, the Japan Transport Safety Board has stated opinions to the Ministry of Land, Infrastructure, Transport and Tourism.
For details, please refer to “Chapter 1: Summary of recommendations and opinions issued in 2018 (page 62)”.

For the occurrences of train derailment accidents due to gauge widening, there are factors common to the local railroads with severe business conditions. To prevent such accidents, the followings are effective: (1) to pay attention to the continued failures of sleepers, etc. in the track maintenance and pay particular attention to sharp curves with a large slack; (2) to determine the track maintenance standard value with the safety limit taken into consideration and clarify the maintenance deadline; (3) to replace the sleepers with concrete sleepers that have a superior durability and can reduce the burden of maintenance. For the track maintenance, understanding the track conditions using dynamic track irregularity measurement is effective. It is desirable to facilitate the cost reduction and widespread of track condition monitoring equipment with commercial trains, the practical use of which is currently being promoted.

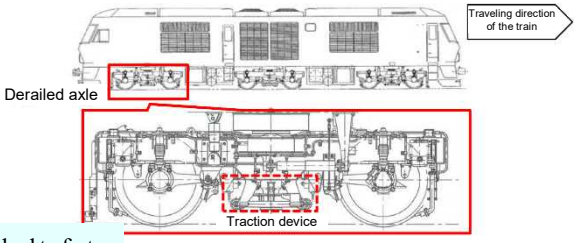
Derailment after the fitting bolts, etc. separated, causing the traction device to hang down and hit the lead rail
Train derailment, in the premises of Kita-Irie signal station, Muroran Line, Japan Freight Railway Company

Summary: On February 23, 2017, the outbound freight train, composed of 19 vehicles, departed from Goryokaku station on schedule. While the train was running in the premises of Kita-Irie signal station at about 54 km/h, the driver of the train stopped the train by the emergency brake as he felt abnormal vibration, and operated the train protection radio. After he had reported the situation to the train dispatcher, he checked the vehicles and found that the 5th and 6th axles in total six axles of the front, middle and rear bogies of the 1st vehicle, i.e., the locomotive, had derailed to right side of the direction of the train. Then, he reported the situation to the train dispatcher.

There was the driver onboard the train, but he was not injured.

Investigation results

It is probable that the traction device broke because the device hit the left guard rail in the Iriechou level crossing after the vehicle parts, such as the fitting bolts and retainers, fell away during running and the traction device hung down.



It is possible that the tightening torque was insufficient for both two bolts attached to fasten the center pin and traction device.

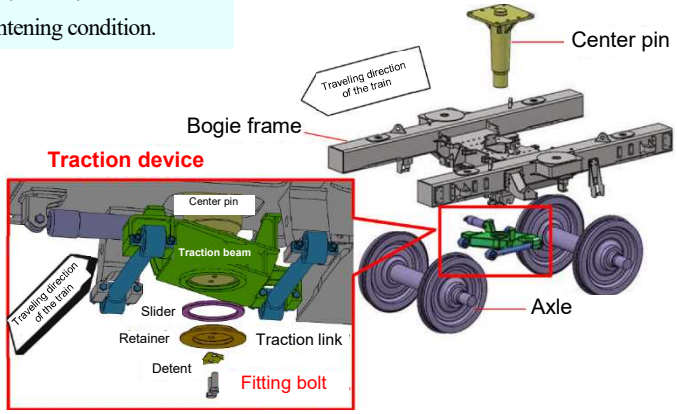
It is probable that, as a result, the fitting bolts fell away due to vibrations, etc. during train running.

Concerning the insufficient tightening torque of the fitting bolts, it is somewhat likely that the workers finished the important parts inspection before fastening the fitting bolts with the specified tightening torque (i.e. leaving the bolts fastened only temporarily), and that the fitting bolts came looser due to vibration etc., during the subsequent train running.

Traction device (damaged)

It is somewhat likely that the workers finished the work before fastening the fitting bolts with the specified torque because, among others, the work procedures, including the task assignment for each worker and the work result checking method, were not properly clarified for the body-bogie connection work of the important parts inspection, and so, the workers did not use the torque wrench during bolt tightening or checking the tightening condition.

It is possible that the loosening of the bolts could not be found during the operation check or the regular inspection because no measures, such as matching marks, were provided to facilitate the detection of loosening by visual inspection, and also partly because, although a hammering test was performed, the bolts were placed in such a position that changes in the hitting sound were difficult to catch due to the load acting on the bolts.



Probable Causes (excerpt): It is probable that the accident occurred as all axles, i.e., the 5th and 6th axles, in the rear bogie in the 1st vehicle, i.e., the locomotive, of the freight train derailed because the traction device had hung down due to the removal of two fitting bolts fastening the center pin and the traction device in the rear bogie during running operation, following the process described in below.

(1) The left traction link broke when the traction device hit the left guard rail in the Iriechou level crossing.

(2) The wheels in all axles, i.e., the 5th and 6th axles, in the rear bogie derailed to right due to the lateral force in right direction acted on the traction device, as the traction device, hanging more after broken, hit the lead rail of the turnout in the premises of Kita-Irie signal station.

It is somewhat likely that the fitting bolts of the traction device fell away because the fitting bolts had come looser due to vibration etc., during train running after finished the important parts inspection, in which the work to connect bogie and vehicle body had finished in the status that the fitting bolts had fastened temporarily, i.e., the fitting bolts had not been fastened with the determined fastening torque.

For details, please refer to the accident investigation report. (Published on July 26, 2018)
http://www.mlit.go.jp/jtsb/railway/rep-acci/RA2018-5-1.pdf

Shunting vehicles collided with the car stop and derailed before disturbing the main line, resulting in a minor collision with another shunting vehicle

Heavy property loss without casualties, in the premises of Nogata Station, Chikuho Line, Kyushu Railway Company

Summary: On September 18, 2017, the driver of the shunting vehicles for the inbound Electric 6620M train, composed of two vehicles, started the shunting operation in the route from track 25 to the east lead track No.1 via track 15 in the premises of Nogata station. After that, the vehicles collided with the car stop installed in the end edge of the east lead track No.1 and destroyed it, furthermore, all two axles in the front bogie of the front vehicle derailed to right by the shock and the vehicle body of the front vehicle disturbed the main line in the up track.

As the measures such as train protection etc., accompanied with disturbing main line in the up track had not been implemented, the inbound Electric 6520H train and the shunting vehicles for outbound Deadhead Diesel 1533D train were passing through the disturbed track, and the car side pilot lamp of the shunting vehicle of the outbound Deadhead Diesel 1533D train contacted with the right edge of the front head of the shunting vehicle of the inbound Electric 6620M train and both vehicles were damaged.

There was a driver boarded on the shunting vehicles for the inbound Electric 6620M train and the shunting vehicles of the outbound Deadhead Diesel 1533D train, each, but no one was injured.

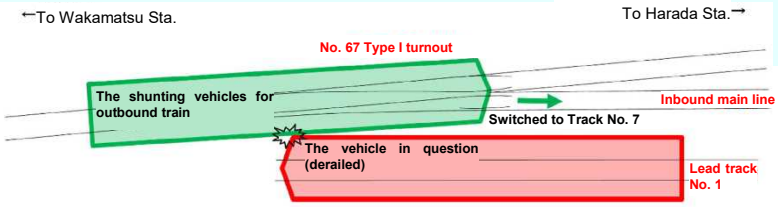
Investigation results

It is somewhat likely that the driver in question temporarily mistook the east leading track No. 2, whose stopping point is located further closer to Wakamatsu Station, for his route.

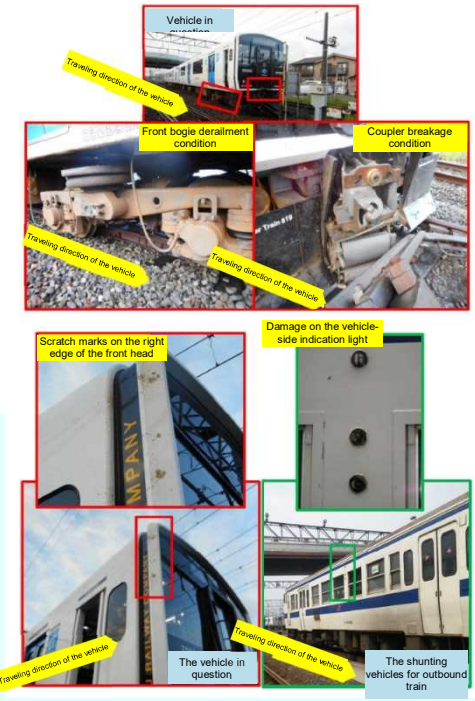
The driver operated the emergency brake only after the vehicle reached about 19 m from the car stop. At this point, the train had passed the target stop position (about 47 m from the car stop).

Based on the above, it is probable that the shunting vehicles collided with the car stop and derailed due to the impact.

It is somewhat likely that, although the driver noticed that the shunting vehicle derailed, he did not recognize the need to take train protection measures because the driver did not feel a large impact when the train collided with the car stop, and so the driver thought that the derailment was not significant and that the situation was not so serious as that the train could disturb the adjacent main line in the up track.



* Concerning the outbound deadhead train, the figure above shows only the first vehicle to describe the contact situation.



It is somewhat likely that the shunting vehicle in question hit another shunting vehicle because the other shunting vehicle had, among others, a larger displacement amount during curve passing than up-trains and also had a large maximum width.

Probable Causes: It is highly probable that the heavy property loss was induced in the railway facilities and the vehicles in the accident, as the vehicle collided with the car stop installed in the end edge of the track because the driver operating vehicles in shunting operation in the premises of Nogata station missed the timing of the braking operation, and the vehicle passing in the main line in the up track contacted with the vehicle derailed by the shock of the collision with the car stop and disturbed the main line in the up track.

It is somewhat likely that the driver missed the timing of the braking operation related with temporary misunderstanding of the shunting route for the other vehicles as the route for his vehicles as he did not concentrate awareness to confirm safety of his route in the shunting operation.

It is probable that the derailed vehicle contacted with the vehicle passing the main line in the up track in relation with that the procedure of train protection was not implemented promptly after the derailment had occurred.

It is somewhat likely that the train protection procedure was not implemented promptly even though the derailed vehicle had disturbed the main line in the up track after the derailment, because the driver of the derailed vehicle had considered that the derailed vehicle was not in the situation as to disturb the neighboring main line in the up track as the deviation was not so large, although he had noticed the fact of the derailment.

For details, please refer to the accident investigation report. (Published on July 26, 2018)
http://www.mlit.go.jp/jtsb/railway/rep-acci/RA2018-5-2.pdf

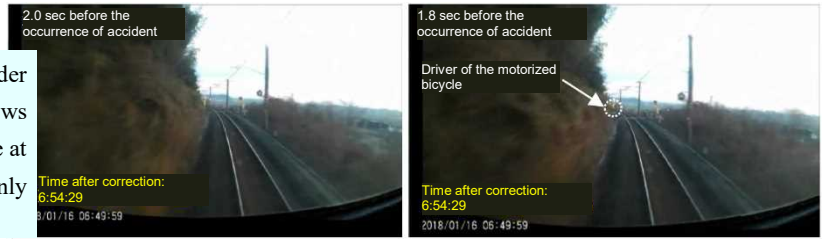
Train collided with a motorized bicycle entering a class 4 level crossing

Level crossing accident, between Idagawa and Kasado Stations, Kansai Line, Central Japan Railway Company

Summary: On Tuesday, January 16, 2018, while the four-car train was running at about 82 km/h between Idagawa station and Kasado station, the driver of the train noticed the motorized bicycle entering Bozuyama level crossing, class 4 level crossing, then applied emergency brake and sounded a whistle, but the train collided with the motorized bicycle.
The driver of the motorized bicycle was dead in the accident.

Investigation results

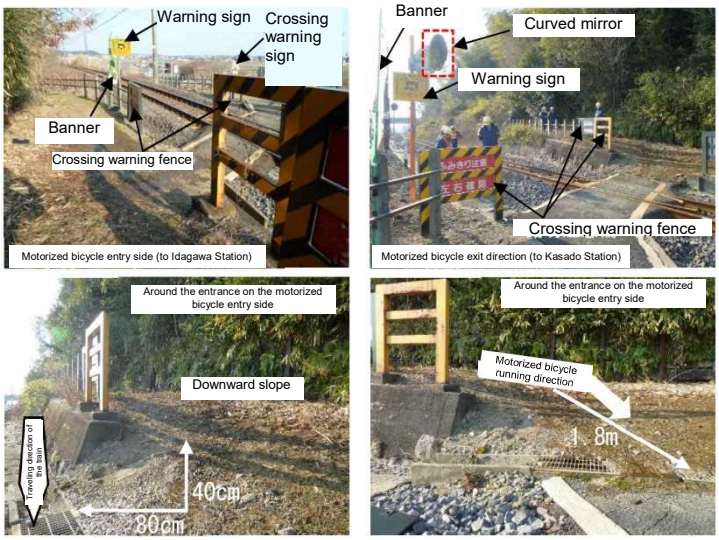
The images captured by the video recorder equipped with the lead vehicle of the train, shows the figure of the driver of the motorized bicycle at around the left-side entrance of the crossing only about 1.8 seconds before the collision.



It was not possible to confirm, from the images of the recorder, that the driver of the motorized bicycle stopped in front of the crossing, or looked at the curved mirror, to check for a train.

It is probable that, although the driver of the train applied the emergency brake, braking could not prevent the collision because the motorized bicycle entered the crossing only 1 to 2 seconds before the collision.

Concerning the visibility during passing of the inbound train, the front marker light of the train would start to be seen on the curved mirror only about 7 seconds before the train reached the crossing. If directly seen with the eyes, the train would start to be seen about 2.5 seconds before the train reached the crossing, due to the land features, etc. Based on the above, it is considered that this crossing is in a state where one will find it difficult to secure enough time from when one notices that a train is coming until when the train arrives.



Probable Causes: It is probable that the accident occurred as the train collided with the motorized bicycle at Bozuyama level crossing, class 4 level crossing without automatic barrier machine nor road warning device, because the motorized vehicle had entered the level crossing in the situation that the train was approaching.
It could not be determined the reason why the motorized bicycle had entered the level crossing in the situation that the train was approaching, because the driver of the motorized bicycle was dead in the accident.

For details, please refer to the serious incident investigation report. (Published on September 27, 2018)
http://www.mlit.go.jp/jtsb/railway/rep-acci/RA2018-6-1.pdf

Class 4 level crossings without automatic barrier machines nor road warning devices should be abolished or be provided with crossing security equipment. Concerned parties, such as railway business operators, road administrators (local governments) and local residents, should actively hold talks for that purpose to determine a policy as soon as possible and proceed with concrete efforts. However, there are cases where the talks take long time, during which another accident may occur. JTSB will work to provide information useful to eliminate class 4 level crossings as early as possible, by investigating and analyzing concrete cases associated with the elimination of class 4 level crossings, including providing nearby class 1 level crossings with a sidewalk to improve safety of pedestrians, and abolishing dangerous class 4 level crossings.

Summaries of major marine accident investigation reports (case studies)

A Fire Broke Out and Spread from a Vehicle on a Ferry, One Crew Member Died and the Ship was Abandoned

Fire on Passenger Ferry SUN FLOWER DAISETSU

Summary: While **passenger ferry SUN FLOWER DAISETSU (the Vessel, 11,401 gross tons)** with the Master, 22 crew members, 71 passengers and load of 160 vehicles on board left Oarai Port, Oarai Town, Ibaraki Prefecture, sailing north off to the south of Tomakomai Port, Tomakomai City, Hokkaido, toward Tomakomai Port at around 17:10 on July 31, 2015, a fire broke out on the 2nd deck.

The fire spread in spite of firefighting efforts by the crew, and the Master ordered everyone to abandon ship. All the passengers and crew except a 2nd Officer were rescued by a passenger ferry and others that had arrived to provide assistance.

The 2nd Officer, who had been missing, was found on the 2nd deck at around 11:01 on August 3, and was confirmed dead.

After that, the Vessel was towed to Hakodate port, Hakodate City, Hokkaido, and firefighting by injection of carbon dioxide gas was conducted. The fire was confirmed extinguished at around 14:53 on August 10.

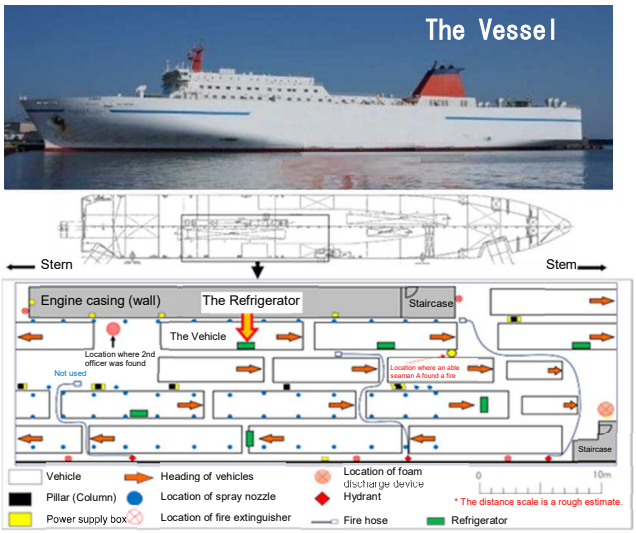
The Vessel has damage from the fire on the center of the starboard deck on the 2nd to 4th decks and to ship structures like the plating shell, as well as to vehicles loaded on the 2nd and 3rd decks.

At around 17:10 on the bridge, a fire detection device with a location identification function issued a preliminary fire alarm which changed to a fire alarm around 17:13. The crew found that the vicinity of the in-vehicle refrigerating unit (the Refrigerator) on a track (the Vehicle) loaded in the center of the starboard side to the engine casing in the starboard midship on the 2nd deck was glowing orange and a fire spread to the bridge.

The crew tried to extinguish the fire on the 2nd deck with fire extinguishers but were unsuccessful. The fire spread to vehicles loaded adjacent to the starboard of the vessel and the force of the fire increased to spread to the 3rd deck.

The Chief Officer abandoned continuation of firefighting efforts and ordered crew members engaged in firefighting to leave the site, but could not find the 2nd Officer.

Order to leave ship (around 18:30), 2nd Officer died



Situation on the 2nd deck when the Accident occurred)

(Summary of the Analysis (excerpt))

(Factors of the fire)

- It is probable that the fire broke out due to electrical factors such as cuprous oxide propagation exothermic phenomenon, poor contact, or a short circuit due to a motor wiring connection method that is prohibited in the Service Manual of the Refrigerator.

(Firefighting by crew)

- It is probable that the fire could not be extinguished because the origin of the fire was inside the cover of the Refrigerator and the crew could not effectively discharge fire-extinguishing agent to the origin of the fire when the fire was found. It is also probable that the fire had spread to the left side of the Vehicle while some crew were fighting the fire with 16 fire extinguishers without using fire hoses while wearing fireman outfits.
- It is probable that fire extinguishing and prevention of the spread of fire from the Vehicle to the adjacent vehicles by spraying water were not possible because the crew did not take systematic fire-fighting activities and because they did not know enough about the usage of water spray devices to spray the 5 sections that exceeded the capacity of the pressurized water spray pump.

Probable Causes (excerpt): It is probable that the Accident occurred because a fire broke out from the Refrigerator on the Vehicle loaded on the 2nd deck while the Vessel was proceeding north toward Tomakomai Port off to the south of Tomakomai Port and firefighting efforts and prevention of the fire spreading by the crew was not adequate.

It is probable that the crew could not extinguish the fire with fire extinguishers when the fire was found because the origin of the fire was inside the Refrigerator cover and the crew could not spray the fire-extinguishing agent effectively on the origin of the fire.

It is probable that the crew could not extinguish the fire or prevent the spread of the fire appropriately because practical education and training given by Company A to its crew was not sufficient.

For details, please refer to the accident investigation report. (Published on September 27, 2018)
http://www.mlit.go.jp/jtsb/ship/rep-acci/2018/MA2018-9-1_2015tk0005.pdf

To prevent similar accidents, it is desirable to develop and educate fire-extinguishing activity procedures assuming a fire and to build a system of safe and appropriate fire-extinguishing activities by crew.

Container Ships Entering the Passage to Hanshin Port at Almost the Same Time Collided
Collision between Container Ship ESTELLE MAERSK and Container Ship

Summary of the Accident: While **the container ship ESTELLE MAERSK (Vessel A, gross tonnage: 170,794 tons)**, with the Master, 27 crew members and a pilot on board, was proceeding north toward the South Entrance of Kobe Chuo Passage in the Kobe Section of Hanshin Port under escort by the pilot, and **the container ship JJ SKY (Vessel B, gross tonnage: 9,948 tons)**, with the Master and 21 crew members on board, was proceeding west-northwest toward the South Entrance of Kobe Chuo Passage, the two vessels collided near the South Entrance of Kobe Chuo Passage at around 07:08:54 on June 7, 2016.

The Vessel A sustained abrasion damage on the shell plating of her starboard bow, while the Vessel B sustained a pressure collapse on part of her bridge port-side wing. However, there were no casualties or fatalities on either vessel.、

Vessel A

Pilot A was piloting Vessel A and was informed by Port Radio at around 06:43 that several vessels were due to enter the Passage in the same time band.

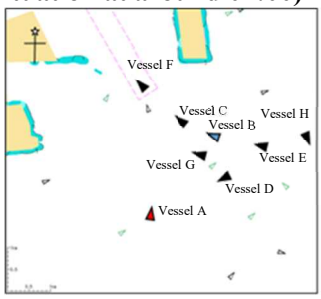
Pilot A thought that Vessel A would be given priority when entering the Passage because (1) Vessel A is a large vessel in the 400m class and (2) he had made a request for the order of Passage entry via Port Radio, and (3) Vessel D accepted this and decided on entering the Passage after Vessel A, he set the main engine to slow ahead at around 07:01 in order to enter the Passage at the scheduled time.

At around 07:03, Master A asked Pilot A about the movement of Vessel B, but did not instruct Pilot A to give way as Pilot A had explained that, as a large Vessel, Vessel A would be given priority by passage control.

Pilot A could not change course to starboard because several vessels on the starboard side were navigating there in succession toward the Passage, and so, with the intention of heading toward the western end of the South Entrance of the Passage on the port side, he instructed rudder 10° to port at around 07:05 followed by rudder 20° to port, then at around 07:06 instructed rudder midships and proceeded north.

Pilot A instructed rudder hard to port at around 07:07:35 and subsequently instructed slow astern followed by full astern, because Vessel B was approaching ahead to starboard.

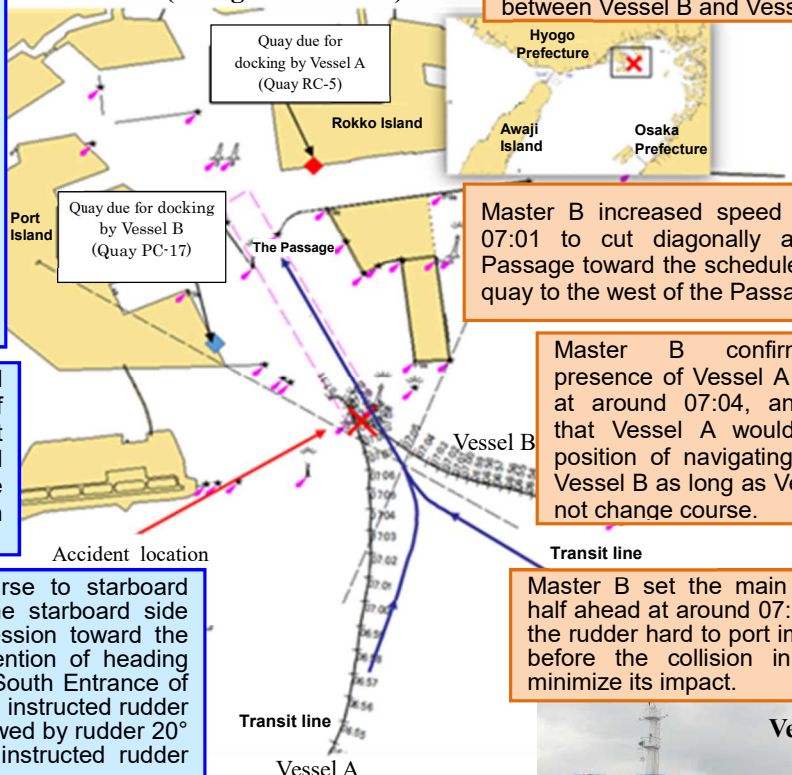
(Situation at around 07:00)



On the Vessel B, Master B and Officer B were keeping lookout by eyesight and radar, and first noticed Vessel A by radar at around 06:50.

Master B thought that Vessel A would navigate astern of Vessel B because he had heard the communication “Follow Vessel B” between other vessels on VHF at around 07:00, and moreover because the distance to Vessel C which was navigating ahead of Vessel B was about 0.3M, and he therefore thought that it would be dangerous for Vessel A to pass between Vessel B and Vessel C.

(Navigation Routes)



Master B increased speed at around 07:01 to cut diagonally across the Passage toward the scheduled docking quay to the west of the Passage.

Master B confirmed the presence of Vessel A with radar at around 07:04, and thought that Vessel A would be in a position of navigating astern of Vessel B as long as Vessel A did not change course.

Master B set the main engine to half ahead at around 07:08 and set the rudder hard to port immediately before the collision in order to minimize its impact.

Collision (at around 07:08:54)

Probable Causes (excerpt): It is probable that this accident occurred because, while the Vessel A was proceeding north and the Vessel B west-northwest toward the Passage in the Kobe Section of Hanshin Port in a state whereby they would both enter the Passage at about the same time, Pilot of Vessel A thought that Vessel A would be given priority when entering the Passage and thus continued to proceed north toward the South Entrance of the Passage, while Master of JJ SKY, thinking that Vessel A would navigate astern of Vessel B, increased speed in an attitude of cutting diagonally across the Passage toward the scheduled docking quay to the west of the Passage, as a result of which the two vessels collided.

For details, please refer to the accident investigation report. (Published on February 22, 2018)
http://www.mlit.go.jp/jtsb/eng-mar_report/2018/2016tk0008e.pdf

Inadequate Installation of Bridge Navigation Watch Alarm System Caused Collision with Another Ship

Collision between Cargo ship GENIUS STAR VIII and cargo ship TOKUHOUMARU No.11

Summary: Cargo ship GENIUS STAR VIII (Vessel A, 9,589 gross tons), with a master (Master A) and 17 other crew members on board, was drifting for time adjustment off to the south-southwest of Cape Ashizuri of Kochi Prefecture, while Cargo ship TOKUHOUMARU No.11 (Vessel B, 498 gross tons), with a master (Master B) and other 4 crew on board, was sailing east-northeast, both vessels collided at around 10:50 on March 24, 2018.

Vessel A sustained a breach on the port rear side-plating and Vessel B had her stem collapsed.

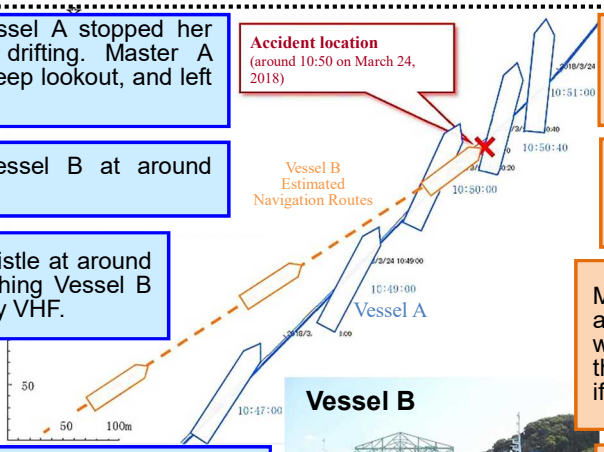
There were no casualties on both vessels.

At around 02:00, Vessel A stopped her engine and started drifting. Master A instructed Officer to keep lookout, and left the bridge.

Officer A noticed Vessel B at around 10:20.

Officer A blew the whistle at around 10:45 to the approaching Vessel B and called Vessel B by VHF.

Hearing the whistle sound of Vessel A, Master A ran up to the bridge and called Vessel B by VHF at around 10:49 along with a continuous whistle. As there was no response from Vessel B, Master A ordered engine personnel on duty to stand by engine.



In Vessel B, Master B alone assumed lookout on the bridge and the vessel was sailing east-northeast at around 14kn with the auto pilot.

As there was good visibility, Master B set the radar to the stand-by condition and kept visual lookout.

Master B confirmed the vessel position at around 10:30, and sat on a chair while on duty with the auto pilot. As he thought that the alarm would work even if he slept, he dosed off due to fatigue.

Woken up by the whistle sound of Vessel A, Master B recognized the port side hull of Vessel A approaching ahead to starboard, and set the propeller pitch to full astern.

Collision (at around 10:50)

Recurrence prevention measures: Any vessel with a watch alarm system shall not put too much confidence in the system and shall try to avoid dozing off at the wheel and (a) keep the system active at all times while sailing, (b-1) check its operating condition extensively at departure, (b-2) adjust sensor mounting angle adequately and (b-3) set the quiescent time to as short a time as possible (3 to 5 min).

Accidents of vessels of 150 gross tons or more with watch alarm system due to dozing off

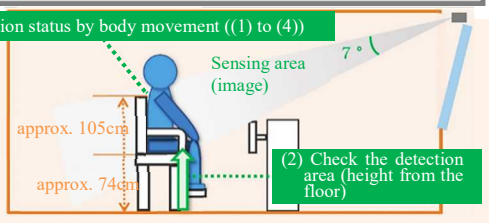
Accidents due to dozing off (since July, 2011)		55 cases
(a) System power OFF		16 cases
(b) Power is ON but no alarm	(1) System failure (2) Sensor detects action (3) Dozing off while the system is quiescent	33 cases

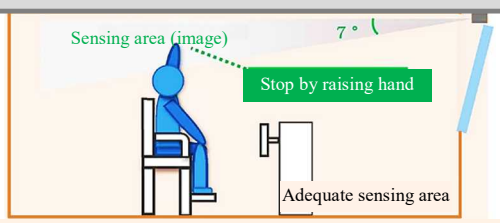
The watch alarm system of Vessel B was set as the alarm would be issued only if the sensor did not detect movement of the watchkeeper for 4 min. As the sensor was oriented to a position lower than the manufacturer recommended mounting location, it is probable that the alarm was not triggered because the sensor detected the movement of the body or leg of Master B.

Adequate sensor angle (recurrence prevention measures against b-2)
For mounting the sensor of the watch alarm system, the sensing area should be adjusted to the position and angle where raising your hand is required to stop the alarm, with the top of the head of watchkeeper as the lowest limit.

(1) Investigate the detection status by body movement ((1) to (4))

(1) If no movement, alarm triggered in around 4 min.
(2) If the head moved, alarm triggered in around 4 min.
(3) If the hand moved, alarm triggered in around 4 min.
(4) If the leg moved, no alarm.





Probable Causes (excerpt): It is probable that this accident occurred because, while Vessel A was drifting for time adjustment off to the south-south west of Cape Ashizuri, while Vessel B was sailing toward east-northeast, Vessel B collided with Vessel A as Master B on duty alone on the bridge fell asleep. It is probable that the system detected the movement of the body or leg of Master B and did not trigger the alarm, which may have caused the accident.

For details, please refer to the accident investigation report. (Published on March 28, 2018)
http://www.mlit.go.jp/jtsb/ship/rep-acci/2019/MA2019-3-2_2018tk0019.pdf

It is necessary to note that systems brought about by new technologies effective for safer navigation do not mean reduction of primary duties required for the bridge watchkeepers, and using the systems adequately so that their performance is fully realized is imperative.

A Fire Broke Out on a Vessel Docked at Hakata Port, Sank and Oil Spill

Fire on Cargo Ship TAI YUAN

Summary of the Accident: At around 13:20 on April 24, 2017, as **the cargo ship TAI YUAN (the Vessel, gross tonnage: 1,972 tons)**, with a master and ten other crew members aboard, was waiting to begin loading of waste metal and other miscellaneous scrap at the No. 16 Berth of Hakozaki Wharf, Hakata Port, Fukuoka City, Fukuoka Prefecture, a fire broke out in the aft cargo hold.

At around 04:54 on the following day, April 25, the Vessel foundered during firefighting and became a total loss. An oil spill occurred, but there were no fatalities or injuries.

From around 09:00 on April 21 to the morning of April 22, the Vessel loaded scrap into her aft cargo hold and fore cargo hold, and in the afternoon, the Vessel loaded scrap into her fore cargo hold.

At around 08:00 on April 24, the Vessel began loading the scrap into the fore cargo hold and work was then discontinued at around 12:00, at which point the fore cargo hold had been loaded to approximately 80% and the aft cargo hold had been loaded to around 50%.

One of the workers of the shipper and loading business (Company A) saw a small amount of white smoke rising from within the scrap in the port aft section of the aft cargo hold at around 13:20.

The Vessel's crew members and Company A's workers conducted firefighting efforts by spraying water using fire hoses connected to the Vessel's fire hydrants and a water truck.

The Fire Company arrived at the Vessel, took over firefighting, and used a firefighting tactic centered on protein foam spraying, and as it prepared for the spraying, it sprayed water at the aft cargo hold and plating shell to suppress the force of the fire.

• The Vessel listed to port and the fire spread to the fore cargo hold.

• While observing the circumstances of the Vessel's listing and foundering and the fire's force, the Fire Company continued protein foam spraying and spraying water into the cargo holds and spraying cooling water onto the plating shell; however, it could not extinguish the fire and the fire's force did not abate.

The Vessel foundered from her port bow side. She settled on the bottom with only her wheel house above the water. The fire was extinguished (at 04:54 on April 25).

Circumstances of the fire of the vessel

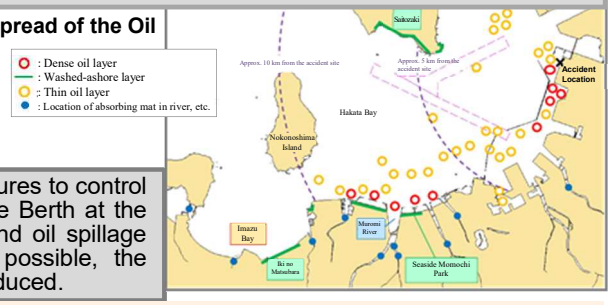
(Circumstances Leading up to the Fire)

It is somewhat likely that a spark created by contact between metal objects, a battery, etc., in the scrap was the source of the fire, and that the source ignited insulation material, plastic, rubber, vinyl, wood chips, pieces of paper, or combustible material mixed in the scrap.

(Analysis of the Spread of Fire and the Vessel's Foundering)

- It is probable that the insulation material and other combustible items with low specific gravity floated in a burning state even when the water level in the cargo holds rose due to the continuous spraying of water and continued to burn on the water's surface.
- It is probable that the fire spread when combustible material in the fore cargo hold caught fire because the combustion heat of the aft cargo hold passed through the bulkhead and to the fore cargo hold.
- It is probable that the Fire Company continued spraying water into the cargo holds while observing the circumstances of the Vessel's listing and foundering and the fire's force because it thought that it could not reduce the danger that fuel oil would ignite and burn.
- It is probable that the effect of water accumulated in the cargo holds led to the Vessel's foundering from her port bow side because no damage that could cause flooding had occurred.

The Spread of the Oil



(Analysis of Measures to Reduce Damage caused by Spreading Oil)

It is somewhat likely that had the readiness to implement measures to control oil, such as deploying oil fences and other equipment near the Berth at the time that the possibility the Vessel would founder emerged and oil spillage was anticipated been developed to the maximum degree possible, the amount of damage caused by spreading oil could have been reduced.

Probable Causes (excerpt): It is probable that the accident occurred when, as the Vessel was moored for the purpose of cargo-handling at Hakata Port, a fire that broke out within the scrap loaded into the aft cargo hold spread because firefighting by water-spraying was ineffective and appropriate firefighting methods using the Vessel's carbon dioxide gas firefighting equipment were not employed.

It is probable that effective firefighting methods using the carbon dioxide gas firefighting equipment were not employed because the Master did not think of using the carbon dioxide gas firefighting equipment.

It is probable that the Master did not think of using the carbon dioxide gas firefighting equipment because he did not have experience with fire drills for a fire in the Vessel's cargo holds and because the Vessel and Company A did not share information on effective firefighting methods for times of fire.

For details, please refer to the accident investigation report. (Published on October 25, 2018)
http://www.mlit.go.jp/jtsb/eng-mar_report/2018/2017tk0007e.pdf

A Passenger Ship Hit a Light Beacon, 25 Passengers Seriously or Slightly Injured

Passenger ship SORA contacted with an approach light beacon

Summary: Passenger ship SORA (the Vessel, 84 gross tons) with its master (Master), chief engineer and 29 passengers on board, left the Kaijo Access Terminal in Senshu Port, sailing north toward a pier of Kobe Airport Kaijo Access Terminal (the Pier) in Kobe Section No.5 of Hanshin Port, collided against the east approach light beacon (the Approach Light Beacon) of Kobe Airport in Hanshin Port, Kobe Section No.6 at around 21:29 on July 26, 2017.

The Vessel had 4 passengers seriously injured, 21 passengers and 2 crew members slightly injured, and the stem on the port-side of the ship collapsed. The Approach Light Beacon had scratches on the base.

The Vessel started navigation to the north at approx. 27 kn at around 21:04:53 with manual steering by the Master.

At around 21:05:49, the steering was switched from the Master to Chief Engineer, and the Chief Engineer changed the course to the port side, trying to avoid two vessels passing ahead of the Vessel.

The Master, having entrusted the steering to the Chief Engineer, while chatting and using a smart phone, kept navigation at around 27 kn.

After two vessels had passed ahead of the Vessel at around 21:11:52, the Chief Engineer continued sailing north toward the light of the signal from the Kobe No.2 signal house.

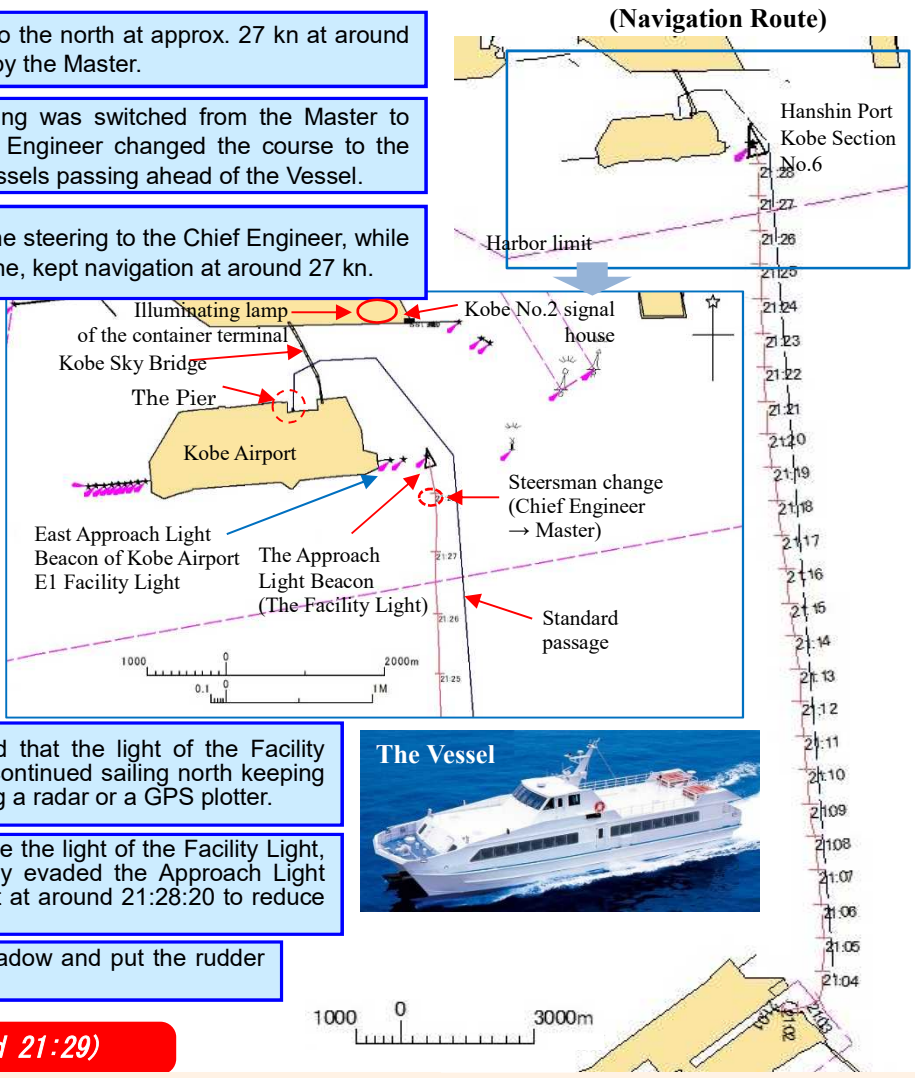
After the Chief Engineer had steering taken over by the Master at around 21:27:52 without giving information on the East Approach Light Beacon E2 Facility Light of Kobe Port (the Facility Light), he was checking entries in the engine log book.

Though the Master understood that the light of the Facility Light is hard to recognize, he continued sailing north keeping only visual lookout without using a radar or a GPS plotter.

As the Master could not observe the light of the Facility Light, he thought that he had already evaded the Approach Light Beacon, and he steered to port at around 21:28:20 to reduce the navigation distance.

The Master noticed a black shadow and put the rudder hard to starboard.

Collision (at around 21:29)



Probable Causes (excerpt): It is probable that the Vessel collided with the Approach Light Beacon because the Master did not notice that the Vessel was proceeding toward the Approach Light Beacon as the Master kept only visual lookout without using a radar and GPS plotter while the Vessel was sailing north in Kobe section of Hanshin Port toward the Pier, under the condition where the light of the Facility light was hard to observe at night due to the masking of the light of the container terminal in the Port Island behind the Facility Light.

It is probable that Master did not use a radar and a GPS plotter because he had been chatting with the chief engineer and he could have observed the Approach Light Beacon till then if he came near the beacon.

For details, please refer to the accident investigation report. (Published on December 20, 2018)
http://www.mlit.go.jp/jtsb/ship/rep-acci/2018/MA2018-12-1_2017tk0010.pdf

JTSB had made recommendations to OM KOBE CO., LTD. for securing transportation safety.
For details, please see Chapter 1 “Summary of recommendations and opinions issued in 2018” (page 56).

To prevent similar accidents, it is desirable to make the contents of Safety Management Rules fully known by the crew, to keep adequate lookout all the time, to educate them on the importance of navigating standard routes, and to train them on adequate ship handling.