Accident Analysis Process

for a

Joint Helicopter Safety Analysis Team (JHSAT)

Revision 3

05/15/2012

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1. INTRODUCTION

This handbook details the results of a JHSAT process developed specifically to analyze helicopter accidents and make data-based safety recommendations. This process evolved from earlier processes developed by Boeing and a U.S. Commercial Aviation Safety Team (CAST) for analysis of commercial air carrier accidents. The U.S. Joint Helicopter Safety Analysis Team (JHSAT) has adapted the Boeing/CAST process for analysis of helicopter data. The first iteration of this process was accomplished using helicopter accident reports from the United States National Transportation Safety Board (NTSB). This handbook outlines the process developed for use with U.S. helicopter data by the U.S. JHSAT. It is offered as a baseline or starting point for data analysis purposes by other national or regional helicopter accident analysis programs. Given the variability in accident reporting and documentation in other regions, it is expected that regional analysis teams will need to modify this process. Regional teams are asked to not compromise three essential components of this process:

1. Solutions must be based on actual accident data, i.e., data-driven;

2. Helicopter community stakeholders from the region must perform the analyses; and

3. Implementation of the resulting safety improvement recommendations should be measurable.

Recognizing that helicopter accident rates are significantly higher than those of scheduled air carriers, the American Helicopter Society (AHS), the Helicopter Association International (HAI), manufacturers and other interested organizations, and the Federal Aviation Administration (FAA) joined together and formed the International Helicopter Safety Team (IHST). The IHST agreed to develop and implement a data-driven, benefit-focused safety program designed to continuously reduce the risk of helicopter accidents. It set an aggressive goal of reducing the worldwide helicopter accident rate by 80% in 10 years (by 2016). The IHST, in turn, chartered a Joint Helicopter Safety Analysis Team (JHSAT) to refine the Boeing/CAST JSAT process for use in analyzing helicopter accident data and to recommend safety enhancing interventions. The JHSAT membership consisted of key stakeholders in the helicopter design, manufacture, operation, training and regulatory communities.

This document contains information to allow regional teams working in concert with IHST to effectively analyze helicopter accidents, to make data-based safety recommendations, and to measure intervention recommendation in a manner contributing to the goals of the IHST's worldwide mandate.

The JHSAT is sponsored by the IHST per charter. Regional JHSAT activities shall be conducted in accordance with the IHST charter requirements. A sample of an approved IHST EXCOM JHSAT charter is available upon request.

The goal of the JHSAT is to:

1. Develop a process that allows detailed analysis of helicopter accidents from available public data (e.g. published studies, analyses, accident/incident reports, etc).

2. Promote worldwide government and industry teamwork to identify and mitigate helicopter safety issues.

3. Deliver safety recommendations to the IHST and JHSIT to serve as the basis for developing implementation actions to reduce worldwide helicopter accidents by 80% in 10 years.

The JHSAT recognizes that, since its analysis method is dependent on the quality of the data reports utilized; it is vulnerable to missing or incomplete data. Accordingly, the JHSAT has modified the original JSAT process to better account for helicopter accident data. General aviation accident report data is widely acknowledged to be considerably less detailed than commercial accident data. Several factors lead to this: lack of onboard data recording devices, lack of investigatory resources, and inability of survivors to accurately reconstruct the event sequences leading to the accident.

The U.S. JHSAT developed its analysis process to determine what went wrong and why it went wrong. Integral to that process was developing event sequences, problem statements and intervention strategies that corresponded to the problem statements. Economic feasibility of proposed intervention strategies was not considered by the U.S. JHSAT therefore the scoring was not accomplished; it is however a key consideration of the JHSIT.

2. Joint Helicopter Safety Analysis Team (JHSAT) Process Overview

Based on the work completed by the U.S. JHSAT and the lessons learned in the development of that process, the following process is recommended as a baseline for future JHSAT's (see Figure 1). This process was developed using accident report data, but it is recognized that there may be value in analyzing other data sources, such as incident reports and previously-performed helicopter safety studies.

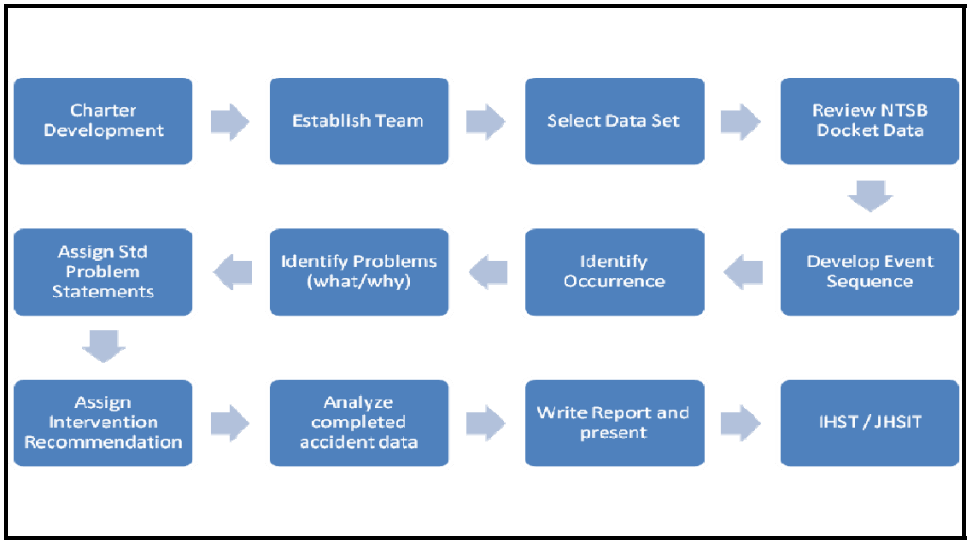


Figure 1 JHSAT Process

Note: Due to the efforts and the success of many international JHSAT teams, it is the position of the IHST EXCOM that future accident analysis be limited as an expansive effort has already been accomplished it may be faster for local Teams to proceed to the implementation initiative of the JHSIT toolkits for accident prevention measures. The IHST has determined that the existing accident analysis is considered to be highly representative of any new team's accident history and therefore would be considered repetitive in nature. Internationally the JHSATs have completed analysis on 800+ helicopter accidents.

If analysis is deemed necessary, please use existing JHSAT lists of Occurrence, SPS and IR determinations whenever possible. Additionally, it is important to note that any alteration of the JHSAT tools to include modifying the Occurrence, SPS and IR listings will complicate any effort to compile the data at an international level. Please do not alter if at all possible.

3. Charter Development:

The first step in chartering a JHSAT is to write the Charter Statement. It is important to ensure the charter statement for each of the follow-on teams is clear and well defined before proceeding. The charter statement should be reviewed with IHST members so that the expectations of the IHST and the JHSAT are consistent. The charter statement must clearly define the JHSAT tasks. The team tasks should be written so that those tasks enable the goals and objectives of the team.

The charter should also include a clear definition of the roles and responsibilities of the team members. Suggested roles and responsibilities:

Co-chairpersons:

- Coordinate between IHST and JHSAT
- Ensure adequate resources are assigned
- Coordinate between government and industry organizations
- Prepare meeting agendum and minutes
- Draft Charter
- Identify and selects team members
- Manage team members and participants
- Conduct meetings
- Produce JHSAT progress reports
- Provide oversight of JHSAT process
- Schedule meetings
- Set meeting agendas

Team Members:

- Attend all meetings
- Complete all assignments and duties on time
- Be respectful of other views and open to compromise and consensus
- Provide expertise in subject areas
- Demonstrated ability to work well with teams and groups

Subject Matter/technical experts:

- Supplement knowledge base of the JHSAT
- Review technical accuracy of problem statements and intervention strategies, as assigned

4. Establish Team:

The objective in establishing a JHSAT is to gather a group of experts who will be able to conduct analyses of helicopter accident data and make recommendations for accident intervention strategies. When establishing a JHSAT, it is important to define the expertise that will be needed. This expertise should include knowledge of helicopter design, training, operations, accident investigation, maintenance and regulatory oversight. Team members should be selected based on two requirements: the ability to provide needed expertise, and a willingness to participate cooperatively on a government/industry team.

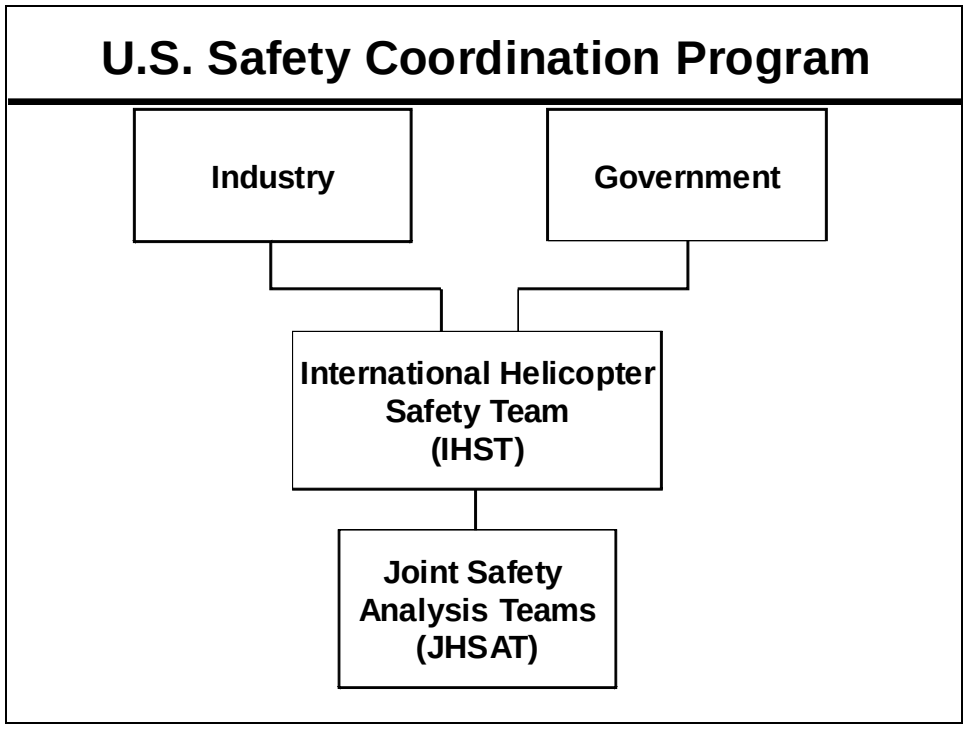


Figure 2 Example of U.S. JHSAT Industry and government participants

The following organizations and general disciplines should be considered, as well as specific expertise for certain accident type categories:

1. Manufacturers (Airframe and Engine)
2. Regulators, Certification and/or Standards
3. Human Factors
4. NASA
5. Pilots
6. Operators (training, pilots, maintenance, etc.)
7. Accident investigation experience
8. Any additional expertise predicated on accident category.

It is important that the team has a representative from as many of the chartering organizations as is reasonably possible to ensure broad based buy-in to the process and results. In addition, the organizations potentially affected by the outcome of the team should be strongly considered for membership.

If the team finds it necessary to divide into sub-teams for a portion of the process, care should be taken to include the needed expertise on each sub-team. Individuals with critical knowledge can also be shared by sub-teams as needed. The U.S. JHSAT did find significant benefit in productivity by dividing into sub-teams, but only after all members were proficient in executing the analysis process.

JHSAT composition may consist of core members, subject matter experts and support personnel. The core consists of the JHSAT leadership and members who will be responsible for the actual analysis. These members must be able to attend all meetings. It is critical that a consistent team membership be in place for an entire JHSAT effort.

A group of subject matter experts may be identified to participate on the JHSAT on an "as needed" basis. The subject matter experts will be used to:

1. Periodically review the JHSAT activities,
2. Provide expertise not found within the JHSAT membership, and
3. Provide additional expertise that was not identified when the JHSAT was chartered.

Specific support personnel should be part of the core team membership. These members could include: team facilitators, scribes to prepare meeting minutes, and computer support to maintain the analysis files. Consistency of support personnel throughout the team activities is desirable.

The following elements are essential to foster positive group dynamics and ensure team success:

1. Strong leadership from the member organizations to define goals and establish objectives, to reinforce the organizations' commitment to the team, and encourage participation.

2. Team members should disengage themselves from their personal or organizational objectives and be willing to share the benefit of their experience with the rest of the team. They should also be willing to analyze data objectively, to voice their opinions, to reach consensus, and to commit themselves to ownership of the process.

3. It is essential that team members have the full support of their organizations and supervisors to ensure that they will be allocated the time and resources necessary to complete the team objectives. This is a labor intensive task.

4. It is also essential that team members be involved in the process from its inception, and be committed to the process through delivery of the final product.

5. Select Data Set

This activity can be conducted concurrently with the establishment of the JHSAT.

Selecting the dataset is an important step in the process because it establishes the basis for subsequent analysis. A thorough review of the potential data for inclusion should be conducted. The dataset to be analyzed must be of sufficient quality to allow identification of Standard Problem Statements and to be able to subsequently target Interventions Recommendations that will result in accident reduction. The U.S. JHSAT chose to not include incident reports, as they were not accidents and due to lack of standards for their reporting. Analysis of incident reports is not recommended.

The dataset selected should be documented with a description of why the dataset will provide a good basis for analysis. The size of the dataset selected for analysis should take into consideration the size of the JHSAT and the required schedule. If the JHSAT plans to work in subteams to conduct some of the analysis, the datasets for the sub-teams should be representative of the overall dataset so each subteam will have similar learning experiences. The sample size should be large enough to adequately address the potential variables of equipment, location, and other elements. For many topics, the number of accidents is small enough to permit the analysis of all recent accident reports that meet the minimum data requirements.

The extent and accuracy of the data and information in each accident report has a direct bearing on the number and quality of problems and interventions a team can develop. The recommended standards for inclusion are the National Transportation Safety Board (NTSB) reports for U.S. accidents, and the similar accident investigation authority standards for accidents in other countries. Reports from organizations who participated in relevant accident investigations may be considered by the JHSAT if their relevance and accuracy can be reasonably established. Media reports should be used with caution as they may not possess the necessary detail or accuracy to be useable.

The size of the dataset to be analyzed must be carefully considered. Use of this analytical process is labor intensive and time consuming. Decisions must be made to strike a balance between quantity and quality of data to be analyzed, the time that the team can dedicate to analysis meetings, when a final report can be issued to fit the IHST's timing needs, etc. As an example, the U.S. JHSAT, with a group of 15 helicopter experts, worked four days per month for 16 months analyzing 197 NTSB

accident reports in its first dataset(CY 2000). In total the U.S. JHSAT has accomplished accident analysis on a total of 523 accidents.

6. Review Data:

In preparation for team analysis, each team member should study the accident reports identified in the dataset. Each team member should become familiar with the format, terminology and structure of the included dataset reports (such as but not limited to crash site documentation, witness accounts, system descriptions, technical examination and analysis reports, maps, photographs, and pathological reports). Depending on the team's experience with accident investigation and the JHSAT process, the team may want to begin the accident analysis as a group effort. This would provide an opportunity for the team to become familiar with the JHSAT process, make adjustments for unique situations, and then continue with the remaining reports.

7. Develop Event Sequence:

An event sequence is a timeline used to describe the events leading to an accident. It is used to structure the review and analysis of the selected accident. It also serves to bring all the team members to a common understanding of what occurred.

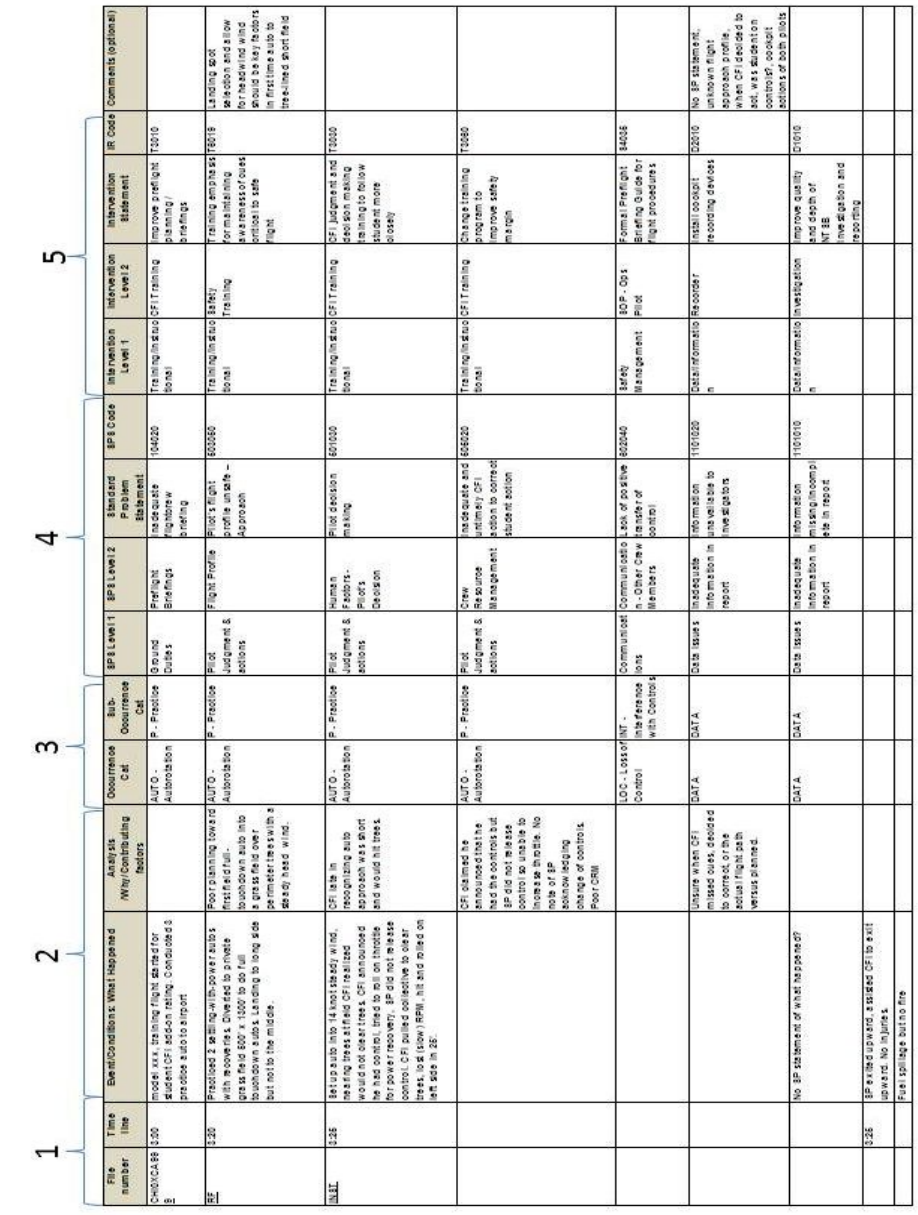
An event is defined as a decision made (by the crew, ATC, regulators, etc...), an action taken (or not taken), a system or equipment failure, etc., that contributed to the accident or that helps to explain the situation. If possible, events should be identified by a time mark, and listed in sequential order. For some accidents, a pre-flight event may be critical; for others, only the events that occurred immediately prior to the accident may be significant. Also, events can be added, as necessary, to promote understanding of the overall sequence. Actions that are not directly linked to an event, but are accident-related (e.g., blood-alcohol level), should be recorded at the end of the event sequence or as contributing factors along with the problems to which they relate. Events/precursors that represent significant safety risks or problems, even though they did not contribute directly to the accident being analyzed may be added. If there is a protracted discussion regarding whether or not an event or precursor is significant, it will usually be more efficient to include it and move on. Limit discussions on events that are included only to understand the sequence or that did not contribute directly to the accident being analyzed.

The event sequence will be used as a trigger to identify problems that may have contributed to the accident. An expanded detailed event sequence may be developed for any event the team wishes to explore further. This effort may be used to identify underlying contributory factors that led to the 'higher level' event. In the instance of a lack of quality of the available data, there may be an increased need to

use expert judgment to develop the event sequence. Avoid supposing and focus on factual details whenever possible.

Individual team members can be assigned a particular accident to review in detail to develop a draft event sequence. When the team or subteam convenes, the draft event sequence should be reviewed event by event. The use of large computer monitor or projector may help the group display information and arrive at a consensus on the sequence of events.

Each accident should be recorded on a spreadsheet. The accident should be identified, with a summary of general information, at the top of the spreadsheet, as shown below in Figure 3:



1		2		3			4						5		
File number	Time line	Event/Conditions: What Happened	Analysis: Why/Contributing factors	Occurrence Cat	Sub-Occurrence Cat	SPS Level 1	SPS Level 2	Standard Problem Statement	SPS Code	Intervention Level 1	Intervention Level 2	Intervention Statement	IR Code	Comments (optional)
CHECKA89	0:00	model xxx, training flight started for student CFI section rating. Conducted 3 practice autos to airport		AUTO - Autorotation	P - Practice	Ground Duties	Preflight Briefings	Inadequate flight/review briefing	104020	Training/instructional		improve preflight planning/ briefings	T30010	
RT	0:20	Practiced 2 selling-with-power autos with recoveries. Diverted to private grass field 600' x 1200' to do full touchdown auto into a grass field over perimeter trees with a steady head wind.	Poor planning toward first field full - touchdown auto into a grass field over perimeter trees with a steady head wind.	AUTO - Autorotation	P - Practice	Flight Profile	Pilot flight profile unsafe – Approach		600060	Training/instructional		Training emphasis for maintaining awareness of cues critical to safe flight	T60016	Landing spot selection and low for headwind should be key factors in first time auto to treelined short field
INIT	0:26	Set up auto into 14 knot steady wind, nearing trees at first CFI realized would not clear trees. CFI announced he has control, tried to pull on throttle for power recovery. SP did not release control. CFI pulled collective to clear trees, lost rpm, hit and rolled on left side in ditch.	CFI late in recognizing auto approach was short and would hit trees.	AUTO - Autorotation	P - Practice	Pilot Judgment & actions	Human Factors - Pilot's Decision	Pilot decision making	601000	Training/instructional	CRT training	CFI judgment and decision making training to follow student more closely	T30000	
			CFI claimed he announced that he had the controls but SP did not release control so unable to increase throttle. No note of SP acknowledging change of controls. Poor CRM	AUTO - Autorotation	P - Practice	Pilot Judgment & actions	Crew Resource Management	Inadequate and untimely CFI action to correct student action	606020	Training/instructional	CRT training	Change training program to improve safety margin	T30060	
				LOC - Loss of INT - Control		Communications	Communication - Other Crew Members	Lack of positive transfer of control	602040	Safety Management	SOP - Ops Pilot	Formal Preflight Briefing Guide for flight procedures	84006	
			Unsure when CFI missed cues, decided to correct or the actual flight path versus planned.	DATA		Data issues	Inadequate information in report	Information unavailable to investigators	1101020	Data/Information	Recorder	Install cockpit recording devices	D2010	No SP statement; unknown flight approach profile, when CFI decided to act, was student in control; conduct actions of both pilots
		No SP statement of what happened?		DATA		Data issues	Inadequate information in report	Information missing/incomplete in report	1101010	Data/Information	Investigation	Improve quality and depth of NTSB investigation and reporting	D1010	
	0:26	SP exited upwards, assisted CFI to exit upward. No injuries.												
		Fuel spillage but no fire												

Figure 3 Sample Spreadsheet

The events for each accident studied should be entered into the spreadsheet, with a column for the event number, time of occurrence, and the event, as shown below in Figure 4:

File number	Timeline	Event/Conditions: What Happened	Analysis /Why/Contributing factors
CHI0XCA999	3:00	model xxx, training flight started for student CFI add-on rating. Conducted 3 practice auto to airport	
RF	3:20	Practiced 2 settling-with-power autos with recoveries. Diverted to private grass field 500' x 1300' to do full touchdown autos. Landing to long side but not to the middle.	Poor planning toward first field full-touchdown auto into a grass field over perimeter trees with a steady head wind.

Figure 4 Event Identification Data

File number	Timeline	Event/Conditions: What Happened
CHI0XCA999	3:00	Model xxx, training flight started for student CFI add-on rating. Conducted 3 practice auto to airport
RF	3:20	Practiced 2 settling-with-power autos with recoveries. Diverted to private grass field 500' x 1300' to do full touchdown autos. Landing to long side but not to the middle.

Figure 5 Event Sequence

8. Identify Problems and Contributing Factors (what/why):

After the team or subteam has analyzed the event sequence for each accident, problem statements and any contributing factors should be drafted for the appropriate events. Problem statements are defined as statements that describe what went wrong and why it went wrong, they define an overall deficiency, or describe a potential reason something did or did not occur. Contributing factors are defined as factors both in the crew's environment and personal factors that help explain why a problem occurred.

The purpose of the following discussion is to provide a framework for the process of deriving problem statements and contributing factors from an event sequence.

Problem Statement Identification (what)

Problem statements, or what went wrong statements, i.e. may be inappropriate crew responses, equipment failures, maintenance or ATC errors, latent failures in management, policy or procedures at the organization or regulatory agency level, etc. These either will be obvious to all, or can be derived based on input from the appropriate experts on the team. Other problem statements may be developed based on latent failures in organizational management of flight operations and/or regulatory agency oversight or active failures by maintenance personnel or ATC controllers. The problem/contributing factor should be described without assuming the solution. Focus on the significant events/precursors because not all events warrant a problem/contributing factor statement.

There may or may not be a one-to-one relationship between problem statements and events in the event sequence. If more than one problem statement and any contributing factors pertain to an event in the sequence, the problem statements and their related contributing factors should be recorded on lines added within the event sequence spreadsheet. If this protocol is followed, it will be easy to relate events, problem statements, and contributing factors to relevant interventions in the spreadsheet.

Problem statements reflecting "latent failures" can be entered into the event sequence spreadsheet prior to listing the events. This illustrates their "precursor status" and may help identify relationships in the data that might otherwise have been missed.

Contributing Factors (why)

Contributing factors for a given problem statement, when considered together, provide the basis for an explanation of "why" the inappropriate response was made or the latent failure occurred or developed. Thus, contributing factors identify what can be fixed or modified and, if specific enough, can provide excellent guidance on how to go about fixing the problem; i.e. developing an intervention strategy. Typically, at least one contributing factor will accompany each problem statement; on occasion, several contributing factors may relate to a single problem statement. As with events in the event sequence, it is better to capture everyone's ideas initially and weed out patently irrelevant contributing factors later. Do not include contributing factors based on speculation alone (things that could have caused the problems, even though there is no evidence that they actually did). Don't spend a lot of time debating whether something is a "what" (a problem) or a "why" (a contributing factor). Write it down and move on!

When analyzing some accidents, professional or expert judgment may be required to identify the problem statements and contributing factors because of poor quality or absence of data.

The Appendix F list of "Why" Questions should be posted in a prominent location and used for guidance or reference during identification of the problem statements and contributing factors related to why a particular event occurred. Frequent reference to the "Why" Questions will help avoid being "trapped" by the first or most obvious contributing factor identified. Also, ask "why" more than once (often a contributing factor will have its own underlying causes that should be identified). The team needs to decide how far to pursue this, based on quality of the report data and expertise of the JHSAT members present.

The following are the "Why" Question categories:

- Organization's policies, procedures, and practices
- Aircraft design, equipment availability, or manufacturer's operational guidance
- Technical knowledge, skills, abilities, and/or experience
- Environmental or situational factors
- Coordination/communication factors
- Situational awareness of the individuals
- Regulatory guidance or oversight
- Air Traffic System and or services
- Airport facilities and environment
- Interaction between the individuals involved and the equipment or systems

A series of questions should be asked to trigger the identification of any contributory latent factors or root causes. These questions are examples to assist in identifying factors that affect the event/accident and/or the individuals involved. These individuals could include flight crew, regulatory personnel, maintenance personnel, ground support personnel, air traffic personnel, flight crews of other aircraft, other support personnel, manufacturer personnel, etc.

1. Did the **organization's policies, procedures, and practices** impact the event/accident or the individuals involved in the event/accident (e.g. on-time dispatch, financial concerns, management pressure, company practices not aligned with written procedures, flight planning, quality control, etc.)

2. Did the **aircraft design, equipment availability, or manufacturers' operational guidance** impact the event/accident or the individuals involved in the event/accident (e.g. layout, Minimum Equipment Listing (MEL), mode awareness, control feedback, lighting, etc.)?

3. Did the **technical knowledge, skills, abilities, and/or experience (or lack thereof)** impact the event/accident or the individuals involved in the event/accident (e.g. system knowledge, piloting skills, new to the aircraft, new controllers, new to the procedure, etc.)?

4. Did **environmental or situational factors** impact the event/accident or the individuals involved in the event/accident (e.g. physical health, fatigue, time constraints, workload, traffic density, inter-personal conflict, complacency, peer pressure, weather, wildlife, etc.)?

5. Did **coordination/communication factors influence the performance of the individuals** involved in the event/accident (e.g. crew coordination, delegation of work, challenges by other crewmembers or ATC, cabin/flight deck coordination, inter- and intra-organizational communications, etc.)?

6. Did the **situation awareness of the individuals** impact the event/accident (e.g. availability, assimilation, and integration of information, mode awareness, positional awareness, etc.)

7. Did the **regulatory guidance or oversight (or lack thereof)** influence the event/accident or the individuals involved in the event/accident (e.g. regulatory requirements, training requirements, compliance and enforcement policies, quality control, certification procedures, etc.)?

8. Did the **air traffic system and/or services** impact the event/accident or the individuals involved in the event/accident (e.g. security, language compatibility, equipment inadequacies, quality control, infrastructure, etc.)?

9. Did the **airport facilities and environment** impact the event/accident or the individuals in the event/accident (e.g. Crash, fire, and rescue; LZ condition; signing and marking; wildlife control; obstructions; terrain; NOTAMs; fueling facilities; deicing facilities; etc.)?

10. Did **interaction between the individuals involved and the equipment or system** impact the event/accident (e.g. appropriate mode selection, choice of equipment to be used, weight and balance, adequacy/appropriateness of procedures for system use, proper application of procedures and training, level of automation chosen, etc.)?

Occurrence Category

Identify the type of occurrence that precipitated the accident. See **Appendix F** for list of occurrences. This occurrence categorization establishes the event most closely preceding the accident. The sub occurrence is a secondary event in the immediate events of the accident, often filled with the autorotation secondary category of forced or practice.

File number	Timeline	Event/Conditions: What Happened	Analysis /Why/Contributing factors	Occurrence Cat	Sub-Occurrence Cat
CHI0XCA999	3:00	Model xxx, training flight started for student CFI add-on rating. Conducted 3 practice auto to airport		AUTO - Autorotation	P - Practice
RF	3:20	Practiced 2 settling-with-power autos with recoveries. Diverted to private grass field 500' x 1300' to do full touchdown autos. Landing to long side but not to the middle.	Poor planning toward first field full-touchdown auto into a grass field over perimeter trees with a steady head wind.	AUTO - Autorotation	P - Practice

Figure 6 Occurrence

9. Assign Standard Problem Statements:

The team should use the list of Standard Problem Statements provided in Appendix C and add to that list as new problems are identified. The Standard Problem Statements have enough detail to lead to meaningful interventions, but are general enough to be relevant to more than just the accident being studied. A standard problem list allows identification of similar problems across accidents. This helps foster common, highly influential solutions. Care should be taken to ensure that only uniquely different problem statements are added to the list and absolutely essential.

If an Standard Problem Statement is not identified to fit, generate a new one in the same format as the existing ones. This should include the source of the problem/contributing factor or who/what did it (flight crew, ATC, equipment, operator, FAA, etc.), what they did or didn't do, and why they did or didn't do it. Assign a number to the new Standard Problem Statement and use that number for any additional occurrences of that problem in other accident analyses. If the JHSAT is working in sub-teams, ensure the new SPS is provided to the other sub-teams. This will preclude the necessity to develop a single standard problem list later. Also, review previous accident analysis to ensure accurate application of the new SPS is accomplished. Periodically designees from each subteam will meet to reconcile and consolidate similar Standard Problem Statements. Consolidated Standard Problem Statements will be given new permanent numbers and will be substituted back into the event sequences. The team may consider having an independent review of the problem statements.

Note: As stated previously it is strongly recommended that the teams use existing SPS lists to ensure accurate roll up of the data at an international perspective.

Figure 7 is an example of the spreadsheet with Standard Problem Statements added.

Occurrence Cat	Sub-Occurrence Cat	SPS Level 1	SPS Level 2	SPS Level 3	SPS Code
AUTO - Autorotation	P - Practice	Ground Duties	Preflight Briefings	Inadequate flightcrew briefing	104020
AUTO - Autorotation	P - Practice	Pilot Judgment & Actions	Flight Profile	Pilot's flight profile unsafe – Approach	503050
AUTO - Autorotation	P - Practice	Pilot Judgment & Actions	Human Factors - Pilot's Decision	Pilot decision making	501030

Figure 7 SPS Spreadsheet

10. Identify Intervention Recommendations

Interventions are strategies designed to prevent or mitigate a given problem or contributing factor. Interventions should be suggested after the team or subteam has developed the event sequence, the draft problem statements, any contributing factors and has identified and evaluated the Standard Problem Statements. One or more interventions may be identified for each problem statement and/or contributing

factor. The interventions should be aimed at reducing or eliminating the effects of the contributing factors and their associated problems.

Interventions should be worded as general requirements rather than as specific hardware solutions. They should define what needs to be provided, and should reference available technology. Look for interventions that solve more than one problem/contributing factor. Interventions should be structured so that they have the following components, stated as briefly as practicable:

Why: Identify the main purpose of the intervention.

Examples: "To prevent misinterpretation of fault messages," "To ensure proper completion of checklists, "

Who: Identify the group(s) that will implement the intervention.

Examples: "Pilots", "Regulatory authorities"

What: Identify the action to be taken and the measurable/observable outcome

Examples: "Should modify training requirements to include...," "Should develop regulatory material which specifies..."

When: Identify time-criticality (when needed)

Examples: "Immediately require...," "phased implementation...," "as part of recurrent training....."

Any intervention that cannot be directly tied to an event in the accident sequence should not be used. Care should be taken to use the same terminology for similar interventions during the development of the intervention strategies. The U.S. JHSAT developed an intervention list in its first year of accident analyses and modified the list to standardize language, to consolidate interventions that were stated in different words but with similar intent, and to ensure consistent usage. An updated list of Intervention Recommendations and numbering is included in Appendix D. The team should use the list of standard Interventions Recommendations (IRs) provided and only add to that list as additional accidents are reviewed and a legitimate need for new IR is recognized. If new IRs is generated use the standard format, assign a number, and use that number for additional occurrences. Pass the new IRs to sub-teams if they are being used. Look for diverse approaches for addressing the problem.

SPS Level 1	SPS Level 2	Standard Problem Statement	SPS Code	Intervention Level 1	Intervention Level 2	Intervention Statement	IR Code	Comments (optional)
Ground Duties	Preflight Briefings	Inadequate flightcrew briefing	104020	Training/Instructional	CFI Training	Improve preflight planning / briefings	T3010	
Pilot Judgment & Actions	Flight Profile	Pilot's flight profile unsafe – Approach	503050	Training/Instructional	Safety Training	Training emphasis for maintaining awareness of cues critical to safe flight	T6019	Landing spot selection and allow for headwind wind should be key factors in first time auto to tree-lined short field
Pilot Judgment & Actions	Human Factors - Pilot's Decision	Pilot decision making	501030	Training/Instructional	CFI Training	CFI judgment and decision making training to follow student more closely	T3030	

Figure 8 Intervention Recommendation

A comments field maybe useful for those items that may not be completely obvious in the SPS or IR statements. Comments may also be entered for those that need to be flagged for further investigation or research.

11. Scoring

To assist the JHSIT, industry and regulatory agencies in determining the most advantageous courses of action to take, it was initially thought that scoring the identified standard problems and subsequent interventions might be of value. The process for this evaluation involved the following rating elements, Validity, Importance, Ability and Usage. However, during subsequent analysis, this process was discontinued as it was labor intensive and did not add value to the process. It was agreed that frequency of occurrence of Standard Problem Statements (SPS) and Intervention Recommendations (IR) was far more important to reduce the accident rate than a ranking of interventions based on qualitative measures.

12. Interpreting the results and forming safety recommendations

The higher frequency of common SPSs and Interventions should be the major focus in developing implementation efforts. The JHSAT reports should provide the

necessary information and recommendations that JHSIT will need to prioritize its implementation efforts.

Several methods of prioritizing the recommendations have been used. Simple counts of the highest number of total recommendations may be presented in lists. Cross comparisons of the higher level SPS versus the Intervention Recommendations may be presented in a table. Second level SPS versus IR statements tables serve to provide more focus to specific recommendations.

13. Peer Review

Prior to presenting the results and analysis to the IHST Executive leadership team for its approval, the Chair(s) may have a peer review of the report. This technical review is not intended to serve as a process assessment of the JHSAT process. The Chair(s) should select an individual, or group of individuals, to review the report, and determine the extent of that review.

14. Report Results

Upon completion of the JHSAT analysis, the results should be documented in a formal report and presented to the IHST Excom for approval. The report should state that it is intended primarily for use by the IHST JHSIT. It cannot be used as a stand-alone document, as it will not contain an assessment of the feasibility of implementation of the recommendations. This "JHSAT Results and Analysis" report does not need to include extensive documentation of every process step. However, as a minimum, it should include:

1. Data set used
2. Demographics
3. Analysis Results including frequencies of;
   Problem statements (SPS)
   Intervention Recommendations (IR)
   Type of Occurrences
4. Conclusions and Recommendations

15. Additional Observations and Comments

1. The U.S. JHSAT team successfully developed and documented a process that allows both industry and government the ability to analyze various accidents from available public data (e.g., published studies, analyses, accident reports, etc).

2. The team demonstrated that government and industry can work together on

aviation safety issues.

3. As a result of this study, the U.S. Joint Safety Analysis Team (US JHSAT) recommends that the International Helicopter Safety Team (IHST) charter additional regional teams to review other regional datasets and recommend intervention strategies developed using the process outlined in this report.

4. Regional JHSAT teams should start with the problem and intervention statement lists found in the Appendixes of this handbook, however, they may be modified to adapt the teams analytical work to the need of the region.

5. Members assigned to the JHSAT teams must commit themselves to be present at all team meetings and to remain a part of the team until its work is complete.

6. During the final part of each JHSAT analysis process, each accident should be re-examined to capture any mitigating actions that may have minimized damage or fatalities.

7. Select the dataset as early as possible. When appropriate use the data and information that is available from the team members' organizations.

Appendixes

Appendix A Acronyms

AC	Aircraft
AC	Advisory Circular
AD	Airworthiness Directive
ADM	Aeronautical Decision Making
AFCS	Avionics Flight Control System
AFM	Airplane Flight Manual
AGL	Above Ground Level
ATC	Air Traffic Control
Auto	Autorotation
CAST	Commercial Aviation Safety Team
CFI	Certified Flight Instructor
CFIT	Controlled Flight into Terrain
CIR	Cockpit Information Recorder
CRM	Crew Resource Management
CVidR	Cockpit Video Recording
CVR	Cockpit Voice Recorder
DA	Density Altitude
DGPS	Differential Global Positioning System
EASA	European Aviation Safety Agency
EGPWS	Enhanced Ground Proximity Warning System
ELT	Emergency Location Transmitter
EPIRB	Emergency Position Indication Radio Beacon
EVS	Electronic or Enhanced Vision Systems
Excom	Executive Committee (IHST)
FAA	Federal Aviation Administration
FDR	Flight Data Recorder
FLIR	Forward Looking Infrared
FOQA	Flight Operations Quality Assurance
FSF	Flight Safety Foundation
GOM	Gulf of Mexico
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
GW	Gross Weight
HOGE	Hover out of ground effect
HOMP	Helicopter Operational Monitoring Program
HUMS	Health and Usage Management System
HTAWS	Helicopter Terrain Avoidance Warning System
HVR	Hover
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IHST	International Helicopter Safety Team
IMC	Instrument Meteorological Conditions
IP	Instructing Pilot
IR	Intervention Recommendation
JAA	Joint Aviation Authorities
JHSAT	Joint Helicopter Safety Analysis Team
JHSIT	Joint Helicopter Safety Implementation Team
LTE	Loss of Tail Rotor Effectiveness
LZ	Landing Zone

Appendix A Acronyms

MEL	Minimum Equipment List
M&M	Make and Model
MR	Main Rotor
Mx	Maintenance
NASA	National Aeronautics and Space Administration
NAVAID	Navigation Aid
NOTAM	Notice to Airmen
NR	Main Rotor RPM
NTSB	National Transportation Safety Board
NVG	Night Vision Goggles
OGE	Out of Ground Effect
OH	Overhaul
PAH	Production Approval Holder
PAX	Passengers
PIC	Pilot in Command
PINC	Procedural Intentional Non Compliance
QA	Quality Assurance
QFE	Field Level – Altimeter Setting
QNH	Mean Sea Level – Altimeter Setting
RAA	Regional Airline Association
RIN	Retirement Index Number
RR	Rolls-Royce
SAT	Safety Analysis Team
SNV	Synthetic Night Vision
SOP	Standard Operating Procedure
SPS	Standard Problem Statement
SVS	Synthetic Vision Systems
TAWS	Terrain Awareness Warning System
TBO	Time Between Overhauls
TQ	Torque
TR	Tail Rotor
TSN	Time Since New
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
WX	Weather

Appendix B Definitions

Accident	An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage.
Contributing Factors	Identify factors both in the crew's environment and personal factors that help explain why an inappropriate response or latent failure occurred.
Data Driven	Decisions, results and recommendations that are supported by, rooted in, and traceable to data (accident/incident reports, FOQA or flight data monitoring data, prior studies, etc.) Expert opinions that are logical, structured and traceable to data will also be used.
Events	Describe, relative to a time mark, the actions taken or omitted by the crew, the conversations of the crew and between the crew and ATC, and the airplane maneuvers prior to the accident.
Feasibility	Current potential for implementation of the intervention strategies on a widespread basis.
Implementation	How to incorporate a given intervention strategy.
Intervention Recommendation	Proposed activity intended to prevent or mitigate a given safety-significant problem (SPS) associated with the cause of an accident.
Standard Problem Statements	(SPS) Describe what went wrong, define a deficiency, or describe a potential reason some action occurred or did not occur. They represent inappropriate crew responses, latent failures in organizational management and/or regulatory agency oversight. They may also reflect active failures by maintenance personnel or ATC controllers. Equipment failures are also identified as problems.

Appendix C Standard Problem Statements

SPS Group Number	SPS Sub Group Number	SPS Number	SPS (Standard Problem Statement)
Ground Duties			
100	Mission/Flight Planning		
100	10	101010	Inadequate consideration of aircraft operational limits
100	10	101012	Inadequate consideration of density altitude
100	10	101014	Inadequate consideration of aircraft power margins
100	10	101020	Inadequate consideration of aircraft performance
100	10	101030	Inadequate consideration of weather/wind
100	10	101040	Pilot experience leads to inadequate planning regarding weather/wind
100	10	101050	Mission requirements/contingencies planning inadequate
100	10	101060	Pilot did not adequately consider and plan for alternate
100	10	101070	Incorrect fuel planning/calculations
100	10	101080	Weather – Accurate weather information not available to Flight Crews and dispatchers.
100	10	101090	Inadequate consideration of obstacles
100	10	101100	Use of out of date or inadequate operational data
100	10	101099	Mission/Flight Planning – Other
100	Weight and Balance		
100	20	102010	Incorrect weight and balance calculations
100	20	102020	Incorrect aircraft loading, out of CG/weight limits
100	20	102030	Company procedures not followed
100	20	102099	Weight and Balance – Other
100	Aircraft Preflight		
100	30	103010	Published Aircraft Preflight procedure inadequate
100	30	103020	Performance of Aircraft Preflight procedures inadequate
100	30	103030	Doors/cowlings not properly secured
100	30	103040	Diverted attention, distracted during preflight
100	30	103050	Tie downs not removed
100	30	103099	Aircraft Preflight – Other
100	Preflight Briefings		
100	40	104010	Passenger safety briefing inadequate
100	40	104020	Inadequate flightcrew briefing
100	40	104099	Preflight Briefings – Other
100	Post flight Duties		
100	50	105010	Inlet covers not installed
100	50	105099	Post flight Duties - Other
Safety Management			
200	Management		
200	10	201010	Non-aviation dispatcher/communication center
200	10	201020	Management policies/oversight inadequate
200	10	201030	Failure of company to realize the unintended consequences of new flight operations policies
200	10	201040	Failure to enforce company SOPs
200	10	201050	Management disregard of crew aeromedical factors
200	10	201060	Management disregard of human performance factors i.e. Duty/flight time, fatigue
200	10	201070	Management disregard of known safety risk
200	10	201080	Customer/company pressure
200	10	201090	Crew hiring criteria
200	10	201100	Lack of local supervision of remote operations
200	10	201110	Lack of supervision of remote maintenance
200	10	201115	Management of combined fixed wing and rotary ground operations
200	10	201120	Public-Use operating below civil regulatory standards
200	10	201125	Inadequate provision of operational information

200	10	201099	Management - Other
200	Safety Program		
200	20	202010	Safety program inadequate
200	20	202020	Lack of a formal system for threat-free reporting of safety-related incidents within the company/industry.
200	20	202030	Risk Management inadequate
200	20	202040	Insufficient employee performance monitoring
200	20	202050	Inadequate lessee risk awareness
200	20	202060	Customer risk awareness (See Matt re: A06)
200	20	202099	Safety Program - Other
200	Equipment (Safety Management)		
200	30	203010	Helicopter inadequately equipped for mission
200	30	203020	Personal Protection Equipment inadequate or not provided
200	30	203099	Equipment – Other
200	Pilot		
200	40	204010	Disregard of known safety risk
200	40	204020	Pilot-In-Command self induced pressure
200	40	204099	Pilot – Other
200	Scheduling/Dispatch		
200	50	205010	Crew assignment
200	50	205020	Crew – crew matching
200	50	205030	Crew – mission assignment
200	50	205040	Lack of monitoring of flight ops data
200	50	205099	Scheduling/Dispatch – Other
200	Training Program Management		
200	60	206010	Training vehicle too unforgiving for use
200	60	206020	Training inadequate for inadvertent IMC
200	60	206030	CFI preparation and planning
200	60	206040	Inadequate flightcrew training due to cultural/economic
200	60	206050	Inadequate CRM training
200	60	206060	Inadequate crew-mission training
200	70	206065	Inadequate crew-mission equipment training
200	60	206099	Training Program Management – Other
200	Flight Procedure Training		
200	70	207010	Emergency training inadequate
200	70	207020	Inadequate avoidance, recognition and recovery training: Vortex ring state (“settling with power”)
200	70	207022	Inadequate avoidance, recognition and recovery training: Loss of Tail Rotor Effectiveness (LTE)
200	70	207024	Inadequate avoidance, recognition and recovery training: Dynamic Rollover
200	70	207026	Inadequate avoidance, recognition and recovery training: Ground Resonance
200	70	207030	Inadequate systems failure training
200	70	207040	Autorotation Training Inadequate
200	70	207050	Special operations training inadequate
200	70	207099	Flight Procedure Training – Other
200	Transition Training		
200	80	208010	Pilot transition training
200	80	208020	Transition to aircraft make/model
200	80	208030	Transition from one engine type to another
200	80	208040	Transition from one geographic area to another
200	80	208050	Transition between fixed wing and rotary
200	80	208060	Transition to new crew role
200	80	208070	Transition to new mission (e.g. EMS to External Loads)
200	80	208099	Transition Training – Other
200	Pilot Experience		
200	90	209010	Pilot inexperienced

200	90	209020	Pilot inexperienced with geographical area
200	90	209025	Pilot inexperienced with mission
200	90	209030	Pilot lacking experience in make/model
200	90	209040	Student Pilot
200	90	209050	Inadequate pilot knowledge
200	90	209099	Pilot Experience – Other
200	Ground Personnel Training		
200	100	210010	Inadequate Ground Crew training
200	100	210020	Inadequate Landing Zone personnel training
200	100	210099	Ground Training – Other
200	Survival training		
200	110	211010	Egress training land
200	110	211020	Egress training water (dunker)
200	110	211099	Survival training – Other
Maintenance			
300	Maintenance Procedures/Management		
300	10	301010	Failure of QA or supervisory oversight
300	10	301020	Inadequate documentation of aircraft records
300	10	301030	Mechanic insufficient training/experience
300	10	301040	Aircraft released in unairworthy condition
300	10	301050	Pre Functional Check Flight maintenance settings lead to hazardous conditions
300	10	301060	No post maintenance Functional Check Flight
300	10	301070	Lack of Functional Check Flight procedures
300	10	301099	Maintenance Procedures/Management – Other
300	Performance of MX Duties		
300	20	302010	Maintenance did not detect impending failure
300	20	302020	Failure to perform proper maintenance procedure
300	20	302025	Improper installation of equipment
300	20	302030	Failure of personnel to coordinate
300	20	302040	Maintainer interrupted
300	20	302050	Intentional non-compliance
300	20	302060	Maintenance induced Foreign Object Damage
300	20	302070	** DO NOT USE** Loss/degradation of flight control system due to inadequate maintenance
300	20	302080	** DO NOT USE** Loss/degradation of Tail Rotor drive system due to inadequate maintenance
300	20	302099	Performance of MX Duties – Other
300	Maintenance Tools		
300	30	303010	Lack of airborne equipment to detect impending part failure
300	30	303020	Lack of ground equipment to detect impending part failure
300	30	303099	Maintenance Tools (related to maintenance)- Other
300	Quality of Parts		
300	40	304010	Unapproved parts (e.g. Bogus or surplus) used
300	40	304020	Tracking/cert military/surplus parts
300	40	304030	Fuel Contamination
300	40	304035	Other Fluid Contamination
300	40	304040	Manufacturing non-conformance
300	40	304050	Overhauled/Repaired part non-conformance
300	40	304060	Previous damage to part or system
300	40	304099	Quality of Parts – Other
Infrastructure			
400	Oversight/Regulation (Infrastructure)		
400	50	405010	**DO NOT USE** (see 1305040) Fixed-wing to rotary wing transition training requirements
400	50	405020	Inadequate oversight/regulations
400	50	405030	Inadequate tower/wire markings

400	50	405099	Infrastructure Oversight/Regulation – Other
400	Equipment (Infrastructure)		
400	60	406010	Lack of compatible air/ground communication equipment
400	60	406020	IFR system incompatible with helicopter missions
400	60	406030	Weather information for departure/enroute/destination inadequate or not available
400	60	406040	Improper modification of weather/navigational aids
400	60	406050	Lack of navigation/approach aids
400	60	406060	Failure of non-aircraft based navigation/approach aids
400	60	406070	Aerodrome/landing site related factor
400	60	406075	Dirty landing site/Foreign objects at landing site
400	60	406099	Infrastructure Equipment – Other
Pilot Judgment & Actions			
500	Human Factors - Pilot's Decision		
500	10	501010	Poor resource management
500	10	501020	Disregarded cues that should have led to termination of current course of action or maneuver
500	10	501030	Pilot decision making
500	10	501040	Willful disregard of aircraft limitations
500	10	501050	Willful disregard for rules and SOPs
500	10	501060	Used unauthorized equipment
500	10	501070	Failed to follow procedures
500	10	501080	Disregard for rules and SOPs
500	10	501090	Pilot disabled warning system
500	10	501100	Pilot misjudged own limitations/capabilities
500	10	501099	Human Factors – Pilot's Decision – Other
500	11	501110	Not in possession of valid airman/medical certificate
500	Human Factors - Pilot/Aircraft Interface		
500	20	502010	Sense of urgency led to risk taking
500	20	502020	Diverted attention, distraction
500	20	502030	Perceptual judgment errors
500	20	502040	Visual Illusions
500	20	502050	Crew Disregard of crew aeromedical factors
500	20	502060	Crew Disregard of human performance factors i.e. duty/flight time, fatigue
500	20	502099	Human Factors – Pilot/Aircraft Interface – Other
500	Flight Profile		
500	30	503010	Pilot's flight profile unsafe for conditions
500	30	503020	Pilot's flight profile unsafe – Altitude
500	30	503030	Pilot's flight profile unsafe – Airspeed
500	30	503040	Pilot's flight profile unsafe – Unsuitable terrain
500	30	503050	Pilot's flight profile unsafe – Approach
500	30	503060	Pilot's flight profile unsafe – Takeoff
500	30	503070	Pilot's flight profile unsafe – Rotor RPM
500	30	503080	Pilot's flight profile unsafe – Power margins
500	30	503099	Flight Profile – Other
500	Landing Procedures		
500	40	504010	Selection of inappropriate landing site
500	40	504020	Landing site reconnaissance
500	40	504030	Misperception of stability and motion cues in hover
500	40	504040	Autorotation – Forced
500	40	504050	Autorotation – Practice
500	40	504060	Improper termination of precautionary landing
500	40	504099	Landing Procedures – Other
500	Crew Resource Management		
500	50	505010	Inadequate and untimely PiC action to correct 2nd pilot action
500	50	505015	Inadequate and/or untimely intervention by other crew member

500	50	505020	Inadequate and untimely CFI action to correct student action
500	50	505099	Crew Resource Management – Other
500	Procedure Implementation		
500	60	506010	Pilot improper action due to misdiagnosis
500	60	506020	Pilot control/handling deficiencies
500	60	506030	Inadequate response to Loss of tail rotor effectiveness
500	60	506040	Inappropriate Energy/power management
500	60	506050	Improper recognition and response to dynamic rollover
500	60	506060	Lack of In-flight fuel quantity monitoring
500	60	506070	Critical controls selected inadvertently/inappropriately
500	60	506099	Procedure Implementation – Other
Communications			
600	Controlling Agencies		
600	10	601010	Coordination with Ground/Landing Zone personnel
600	10	601020	Coordination with ATC
600	10	601099	Controlling Agencies – Other
600	Other Crew Members		
600	20	602010	Coordination with other pilots
600	20	602020	Coordination with other crew members
600	20	602030	Handoff of helicopter from one pilot to another pilot on ground
600	20	602040	Lack of positive transfer of control
600	20	602099	Other crew members – Other
600	Inadequate Procedures		
600	30	603010	Hot expedited loading process inadequate
600	30	603020	Inadequate flight following/operational company communications
600	30	603030	Inadequate coordination with tactical operations control
600	30	603099	Inadequate Procedures – Other
Pilot situation awareness			
700	Visibility/Weather		
700	10	701005	Flight into IMC
700	10	701007	Flight into Icing conditions
700	10	701010	Reduced visibility-darkness, night
700	10	701020	Reduced visibility--fog, rain, snow, smoke
700	10	701030	Reduced visibility--whiteout, brownout
700	10	701040	Reduced visibility--sun/glare
700	10	701050	Local and enroute weather
700	10	701099	Visibility/Weather - Other
700	External Environment Awareness		
700	20	702010	Aircraft position and hazards
700	20	702015	Failure to detect and/or avoid conflicting traffic
700	20	702020	Altitude
700	20	702030	Aircraft state
700	20	702040	Lack of knowledge of aircraft's aerodynamic state (envelope)
700	20	702050	Pilot unaware aircraft restrained by the ground or ground obstruction/obstacle
700	20	702060	Failed to recognize cues to terminate current course of action or maneuver
700	20	702070	Low flight near wires
700	20	702080	Use of Enhanced Vision Systems in inappropriate environmental conditions
700	20	702090	Use of thermal imaging in inappropriate environmental conditions
700	20	702099	External Environment Awareness – Other
700	Internal Aircraft Awareness		
700	30	703010	Unaware of low fuel status leading to fuel starvation/exhaustion
700	30	703099	Internal Aircraft Awareness – Other
700	Crew Impairment		
700	40	704010	Pilot/crew impaired

Appendix C Standard Problem Statements

Part/system failure			
800	Aircraft		
800	10	801010	Airframe component failure
800	10	801015	**Moved to 803020 **Failure of aircraft component due to lighting strike
800	10	801017	**Do not use** See 304040 Failure of aircraft component due to Manufacturing defect
800	10	801018	Failure of aircraft component/system due to Improper Design
800	10	801020	Main Rotor Drive system component failure
800	10	801030	Main Rotor Blade failure
800	10	801035	Main rotor hub failure
800	10	801040	Tail Rotor Drive system component failure
800	10	801050	Tail Rotor Blade Failure
800	10	801055	Tail rotor hub failure
800	10	801060	Tail Rotor Gearbox failure
800	10	801065	Intermediate gearbox failure
800	10	801070	Transmission system component failure
800	10	801080	Main Gearbox failure
800	10	801090	Flight control system failure (mechanical systems)
800	10	801095	Main rotor control failure
800	10	801097	Tail rotor control failure
800	10	801100	**DO NOT USE** See 3040xx Components used did not conform to type design
800	10	801110	Avionics system component failure (incl AFCS)
800	10	801120	Electrical system component failure
800	10	801130	Hydraulic system component failure
800	10	801140	Hydraulic fluid loss
800	10	801150	Fuel System Failure
800	10	801160	Landing Gear/Skids
800	10	801170	Fuel Quantity System Failure
800	10	801180	Failure of data recording equipment
800	10	801099	Aircraft - Other
800	Powerplant		
800	20	802010	Engine Component failure
800	20	802015	Failure of powerplant due to Improper Design
800	20	802020	Engine Oil Starvation
800	20	802025	Engine Fuel Starvation
800	20	802099	Powerplant – Other
800	Operational		
800	30	803010	Part/system failure due to Operational FOD (not maintenance related)
800	30	803020	Failure of aircraft component due to lighting strike
800	30	803030	Failure of part/system due to Bird strike
800	30	803099	Operational Part/System Failure - Other
800	Mission Specific Equipment		
800	40	804010	Mission specific equipment - civil
800	40	804020	Mission specific equipment - military
800	40	804099	Mission specific equipment - Other
Mission Risk			
900	Terrain/Obstacles		
900	10	901010	Mission involves flying near hazards, obstacles, wires
900	10	901020	Mission involves selection of remote landing sites
900	10	901030	Mission involves flight over unsuitable emergency landing terrain
900	10	901035	**Do not use** See 904020 Mission involves operations at high density altitudes
900	10	901037	**Do not Use** See 101014 Mission involves operations with limited power margins
900	10	901040	**Do not Use** See 504020 Lack of operating site reconnaissance
900	10	901099	Terrain/Obstacles - Other

900	Pilot Intensive		
900	20	902010	Mission involved flying in inclement weather conditions
900	20	902020	Mission involves flight in high traffic areas
900	20	902030	Mission requirements place pressure on crew to fly
900	20	902040	Mission requires low/slow flight
900	20	902050	**Do not use** See 904020 Mission involves operations at high density altitudes
900	20	902060	Mission involves operations with limited power margins
900	20	902070	Mission involves operations to moving decks
900	20	902080	Mission involves repetitive/high frequency tasks
900	20	902099	Pilot Intensive - Other
900	Aircraft Intensive		
900	30	903010	Mission involves repeated heavy lift
900	30	903099	Aircraft Intensive – Other
900	Environment		
900	40	904010	Mission involves operations in high turbulence and/or temperature fluctuations
900	40	904020	Mission involves operations at high density altitudes
900	40	904030	**Do not use** See 902070 Mission involves operations to moving decks
900	40	904040	Mission involves operations at night or darkness
900	40	904099	Environment – Other
900	Crew Intensive (e.g. winching, HEMS, load lifting etc.)		
900	50	905010	Mission introduced crew member hazard
900	50	905020	Mission involves high level crew interaction - e.g. winching, short haul
900	50	905099	Crew Intensive – Other
Post-crash survival			
1000	Safety Equipment		
1000	10	1001010	Safety equipment not installed
1000	10	1001020	Safety equipment installed by OEM removed/disabled
1000	10	1001030	Safety equipment failed/malfunctioned
1000	10	1001033	** Do Not Use** See 1001030 Safety equipment malfunctioned
1000	10	1001035	** Do Not Use** See 1001030 Safety equipment failed to deploy
1000	10	1001037	Safety equipment not deployed/operated by crew
1000	10	1001040	Passenger/crew survival gear not used (e.g. Includes helmets/restraints, etc.)
1000	10	1001045	Personal Safety Equipment not provided
1000	10	1001099	Safety Equipment – Other
1000	Crashworthiness		
1000	20	1002005	**Do not Use** Vehicle did not withstand impact
1000	20	1002010	Vehicle sank and/or capsized
1000	20	1002015	Emergency egress difficulties (Change from EASA wording)
1000	20	1002020	Post-crash fire
1000	20	1002030	**Do not Use** Lack of standard for water impact (i.e. not ditching)
1000	20	1002099	Crashworthiness – Other
1000	Delayed rescue		
1000	30	1003010	ELT inoperative/damaged by impact
1000	30	1003020	Inaccessible accident site
1000	30	1003030	Bad Weather
1000	30	1003040	No flight following - slow to locate site
1000	30	1003050	Night-Darkness
1000	30	1003060	Inadequate communications between survivor(s) and rescue
1000	30	1003099	Delayed rescue – Other
Data issues			
1100	Inadequate information in report		
1100	10	1101010	Information missing/incomplete in report

1100	10	1101020	Information unavailable to investigators
1100	10	1101025	Incomplete data from recorder
1100	10	1101030	Inadequate human factors information
1100	10	1101040	Inadequate control of accident scene
1100	10	1101050	Use and availability of info for flight path unknown
1100	10	1101060	Inadequate Investigation
1100	10	1101099	**Do Not Use** See 1101010 Inadequate information in report – Other
Personnel - Non Crew			
1200	Ground personnel		
1200	10	1201010	Failure to disconnect all ground/aircraft connections
1200	10	1201020	Fuel servicing
1200	10	1201030	Marshalling
1200	10	1201040	Aircraft Internal/External Loading
1200	10	1201099	Ground personnel – Other
1200	Passengers		
1200	20	1202010	Passenger failed to follow instructions
1200	20	1202099	Passengers - Other
Regulatory			
1300	Accident Prevention		
1300	10	1301010	Failure to require data recording capability sufficient to understand accident sequence.
1300	10	1301020	Insufficient analysis of previous incidents and lack of available incident information to the operators due to lack of oversight on the part of the regulator(s).
1300	10	1301099	Regulatory Accident Prevention – Other
1300	Safety Culture		
1300	20	1302010	Lack of a formalized system for threat free reporting of safety-related incidents from operators to manufacturers.
1300	20	1302020	Lack of a formalized system for threat-free reporting of safety-related incidents from operators to the Authority
1300	20	1302099	Regulatory Safety Culture – Other
1300	Safety System		
1300	30	1303010	Lack of a reliable process for reviewing/revising safety decisions based on field data collected after certification.
1300	30	1303020	Failed to disseminate pertinent flight safety information.
1300	30	1303030	Inadequate regulatory oversight/regulations for Sightseeing Ops not regulated as Commercial Air Transport
1300	30	1303099	Regulatory Safety System - Other
1300	Oversight and Regulations (Regulatory)		
1300	40	1304010	Inadequate application of government/industry standards and regulations
1300	40	1304020	Inadequate government/industry standards and regulations
1300	40	1304030	**DO NOT USE** (see 1304020) Regulations inadequate to ensure proper flight crew proficiency for the type of operations being conducted.
1300	40	1304040	Inadequate oversight by the Authority
1300	40	1304050	Inadequate Authority control of military surplus aircraft/parts
1300	40	1304060	GSA control of military surplus aircraft/parts (U.S. Only)
1300	40	1304099	Regulatory Oversight and Regulations – Other
1300	Operations		
1300	50	1305010	General Aviation vs. Commercial Air Transport pax-carrying operations
1300	50	1305020	Training requirements for Transition from one engine type to another
1300	50	1305030	Transition training requirements - general
1300	50	1305040	**DO NOT USE** (See 1305030) Fixed-wing to rotary wing transition training requirements
1300	50	1305099	Regulatory Operations – Other
Safety Systems and Equipment			
1400	Safety Systems and Equipment (level 2)		

1400	10	1401010	**DO NOT USE** (See new 506070) Cockpit design allowed critical controls to be selected inadvertently/inappropriately
1400	10	1401020	Safety assessments did not adequately identify system failure consequences
1400	10	1401030	Intolerance to wire strike
1400	10	1401040	Lack of annunciation/caution/warning of critical condition (including low rotor RPM)
1400	10	1401050	Engine flameout from snow/ice ingestion
1400	10	1401060	**Do not Use** Lack of warning of incipient flight critical failures
1400	10	1401070	**Moved to 803030** Intolerance to bird strike
1400	10	1401080	**Do not Use** See 80xxxx Intolerance to directional control failure (e.g. tail rotor, fenestron, NOTAR)
1400	10	1401090	**Do not Use** Design of helicopter does not permit recovery from flight into degraded visual environments (e.g. IIMC, low textual environment, insufficient light sources at night)
1400	10	1401100	**Do not Use** Certification requirement Intervention times for time-critical emergencies do not reflect “human performance limitations"
1400	10	1401110	**Do not Use** See Crashworthiness Emergency exits do not permit evacuation within 'breath hold' time
1400	10	1401120	**Do not Use** See 701007 - Inadequate airframe protection from flight in icing conditions
1400	10	1401099	Safety Systems and Equipment – Other
1400	RFM		
1400	20	1402010	Inadequate or missing procedures
1400	20	1402020	Missing or inadequate performance data
1400	20	1402030	Limitations absent from Flight Manual
1400	20	1402040	Required RFM Supplement not present
1400	20	1402099	RFM - Other
1400	Human Machine Interface (HMI)		
1400	30	1403010	System failure indication
1400	30	1403020	**Do not Use** See 1403010 System failure/alert warning inadequate
1400	30	1403099	HMI - Other

Appendix D Intervention Recommendations

Code	Intervention Recommendation	Details
D0000	**Data/Information**	
D1000	**Investigation**	-
D1010	Improve quality and depth of NTSB investigation and reporting	Provide requirements/ procedures to determine root cause;NTSB emphasis on root cause; include MX records
D1020	Provide feedback to the NTSB through Academy re need for root cause analysis and more thorough documentation	
D1030	Require assessment of student training adequacy when student pilots involved in accidents	
D1040	Require std log book format and identification	
D1050	Require further investigation of flight critical parts failures	
D1060	Maintain a tight chain of custody on event evidence	
D1070	Congress to provide adequate field accident investigation resources	
D1099	Investigation - Other	
D2000	**Recorder**	-
D2010	Install cockpit recording devices	
D2020	Install data recording devices	FDR with underwater pinger
D2030	Install platform video recording devices	
D2040	Real time performance monitoring via satellite	
D2099	Recorder - Other	
D3000	**Disseminate safety info**	-
D3010	Establish means to disseminate safety critical info to pilots, i.e., web site	
D3020	Increase awareness of common accident causes	via company risk assessment program; target various levels,company,missionops, pilots;
D3030	Increase awareness of common risks associated with ground support equipment via "traveling" workshops	
D3040	Update Rotorcraft Flying Handbook	
D3050	Develop stand alone risk assessment/management handbook for part 91 community Similar to rotorcraft flying handbook, include decision making	
D3060	National Ag A/C Association (NAAA) develop Best Practices	
D3099	Disseminate safety info - Other	
E0000	**Systems and Equipment**	
E1000	**Cockpit Indication/Warning**	-
E1001	Add external load meter	
E1002	Requirement for recorded load cell	
E1003	Automated cyclic load measuring equipment	
E1004	Automate carb anti-ice function, early warning alert function	Develop automatic carb heat system FAA RE&D report no xyz
E1005	Ground equipment/Tie Down still attached Warning or break away capability	
E1006	Install door/cowl positive latch warning indication	
E1007	Install low rotor warning	
E1008	Low airspeed indicator/warning	
E1009	LTE indication system	
E1010	Fuel System improvements	Low Fuel Indicator/Annuciator, Supply lever "Off" indicator, Alternate method of verifying fuel on board
E1011	Hover drift indicator	
E1012	Modify cockpit design - add switch guard	
E1013	Modify cockpit design - change annunciation system	
E1014	Provide power avail vs power required indicator	
E1015	Recommend functional attitude indicator for night flight	
E1099	Cockpit Indication/Warning - Other	

E2000	**Situational Awareness Enhancers**	
E2010	Install EVS/SVS/NVG	Install EVS and/or NVG
E2020	Install HTAWS equipment	
E2030	Train and equip with HTAWS, radar alt, EVS, SVS	
E2040	Install radar altimeter	
E2050	Install proximity detection system	TR Prox sensor/signaling system
E2060	TR strike protection	
E2070	Install rearward camera/video	
E2080	Short-term auto-hover recovery system	In cockpit dynamic rollover alert system
E2090	Wire detection system for low alt ops	
E2099	Situational Awareness Enhancers - Other	
E3000	**Post Incident Survivability**	
E3010	Install / use shoulder harnesses for all occupants	
E3020	Install WSPS	
E3030	Install engine auto relight kit	
E3040	Crash resistant fuel systems	
E3050	Improve helicopter specific ELT practices/standards	Including developing an integral antenna
E3060	Use EPIRB or personal location device	
E3099	Post Incident Survivability - Other	
E4000	**PAH corrective action**	
E4010	Design approval holder implement corrective action and mitigate field risk	PAH released design change; field action by OEM; ICA improved; ASBs / Ads issued
E4020	Improved OEM manufacturing quality assurance	
E4030	Modify RFM - add warning to emergency procedure	
E4040	Recall affected components once hazard/failure is identified	
E4099	PAH corrective action - Other	
I0000	**Infrastructure**	
I1000	**Communications**	
I1010	Establish radio frequency compatibility standards	for EMS ground/air comm
I1020	Use of direct ground to AC communication	for homebase and LZ ops
I1030	FAA installation of ADS-B in GOM to facilitate IFR operations in adverse Wx and at night	
I1099	Communications - Other	
I2000	**Ground support**	
I2010	LZ training for ground/LZ personnel	
I2020	Improved first responder training	Improve quality of first responder info to pilot
I2030	Operator mark/paint intended touchdown point on platform; and/or provide marshaller to guide platform landings	
I2040	Scheduled Mx check on windsock and fix on first failure noticed	
I2099	Ground support - Other	
I3000	**Pilot history**	
I3010	Develop industry standards for data collection and sharing of pilot history for hiring/screening	
I3020	Expand the Pilot Records Improvement Act to include rotorcraft pilots	
I3030	Aviation Medical Examiner cross check all available medical records before issuing Medical Certificate	
I3099	Post Incident Survivability - Other	
I4000	**Wx info**	
I4010	Better pilot availability/access to Wx information	
I4020	Implement local Wx PIREP system for intra/inter company flights	
I4030	Prevention of improper modification of Wx/nav aids	
I4099	Wx Info - Other	
M0000	**Maintenance**	
M1000	**QA**	
M1010	Better Mx QA oversight to ensure adherence to the ICA/Manual	Including Remote Mx
M1020	Training for Mx supervisor	
M1030	Improve preflight and/or Mx inspections	
M1040	Mx Ops foreign debris/object safety review	

M1045	Follow procedures in Mx/installation manual	
M1050	Procedures to prevent release of Aircraft in unairworthy status	
M1060	Require maintainer certification for TOT system Mx	
M1070	Use only FAA approved airworthy parts with known history	
M1099	QA - Other	
M2000	**FCF**	
M2010	Establish company SOPs for conduct of Mx FCF	
M2020	Conduct Mx FCF risk assessment	
M2030	Clarify Mx FCF requirements for RTS	Comply with requirements for return to service (CFR 91407)
M2099	FCF - Other	
M3000	**Instructions for Continued Airworthiness (ICA)**	
M3010	Follow ICA procedures with confirmation of compliance	including ASBs;following MX safety of flight components;supervisory oversight; TC/STC holder ICA
M3020	Evaluate adequacy of published ICA	evaluate inspection procedures interval
M3030	Automated component life monitoring	
M3040	Adopt civil aircraft Mx standards and applicable ICA's for mil surplus aircraft	
M3099	ICA - Other	
M4000	**Recorder/Monitor**	
M4010	Engine Monitoring System (EMS) - impending failure warning	
M4020	Install part failure detection system (HUMS)	real-time health monitoring
M4030	Install performance trending equipment, HOMP	
M4040	Install HUMS/HOMP	
M4099	Recorder/Monitor - Other	
M5000	**Records Management**	
M5010	Establish Mx records systems, enhance retention requirements	Electronic Records included
M5020	Audit of Mx record keeping and actions taken	
M5030	Establish system to allow for reliable surplus parts tracking/identification	
M5099	Records Management - Other	
N0000	**No Recommendation**	
R0000	**Regulatory**	
R1000	**Oversight**	
R1010	Suspected Un-approved Part (SUP) investigation and enforcement actions	
R1020	Improve Government oversight of critical part Mx records	including PMA approvals
R1030	Establish risk based process for mil surplus part oversight	to include release of airworthiness and record
R1040	Improved government oversight of Public Aircraft operations	
R1050	Require applicants to demonstrate engineering knowledge and capability to meet same design requirements as TC holders	
R1060	Identify gov't agency responsible for mitigating field risk (recall)	
R1070	Improve design/system safety on field approval installation	
R1080	Increased Government oversight of Operations	part 91 Sightseein Ops
R1090	Increased Government oversight of Maintenance	
R1099	Oversight - Other	
R2000	**Regulations/Standards**	
R2001	Accelerate rulemaking and policy on HTAWS, SVS, EVS	
R2002	Adopt new ICAO annex 14 helideck standards	
R2003	Improve BLM/MMS standards and oversight of landing platforms on offshore rigs and production platforms	
R2004	Recommend Public Aircraft comply with civil standards	
R2005	Review FAA practice for approval of restricted to normal category aircraft	
R2006	Review and update regulatory requirements regarding Inadvertent IMC recovery training	
R2007	Enhanced regulation or guidance for external load ops to minimize overloading (update AC133-1a ?)	
R2008	FAA order 8110.56 Restricted Cat Type Cert (2/27/06)	
R2009	Require Public Aircraft to adopt Inter-agency Committee for Aviation Policy	
R2010	Review and update responsibility of POIs to identify and help operators mitigate hazards	

R2011	Update AC 150/5345-27D, Spec for Wind cones, to preclude improper modifications	
R2012	Review and update part 135 ops HBATs/regulations that cover requirements for training	
R2099	Regulations/Standards - Other	
R3000	**Disciplinary action**	-
R3010	Recommend enforcement action - certificate suspension/revocation	
R3020	FAA remedial action	
R3030	Disciplinary action targeted at the individual actually performing the Mx	
R3099	Disciplinary action - Other	
R4000	**Aircraft Registry**	-
R4010	Easily accessed database of aircraft serial number, history, use, etc	
R4099	Aircraft Registry - Other	
S0000	**Safety Management**	
S1000	**Flight ops management**	-
S1010	Formalized ops oversight program	improve flight ops oversight program; provide departmental oversight of flight ops program
S1020	Establish/assert operational control/oversight by operator	Supervisory intervention
S1030	Improved supervisory and operational oversight	local and remote ops
S1040	Establish mission specific SOP and flight ops oversight program	
S1050	Expand cold Wx operations procedures to include precautions to prevent engine inlet snow/ice accumulation	
S1060	Increased company briefing requirements regarding local area obstructions to include on-board charts	
S1070	Procedural intentional non-compliance (PINC) training	
S1099	Flight ops management - Other	
S2000	**New Employees**	-
S2010	Improve company ability to assess risks of low time pilot assignment	
S2020	Improve company ability to assess risks of new employees	
S2030	Practice Require demonstrated proficiency before solo operation to remote platforms	
S2040	Preliminary screening in simulator	
S2099	New Employees - Other	
S3000	**SOP - Ops Mgt**	-
S3001	Develop pilot decision aid regarding Wx and alternate routing while in-flight	
S3002	Ensure company SOPs establish Wx ops minimums	Develop SOPs for Wx launch/abort criteria
S3003	Establish company SOPs disallow flying in adverse Wx at night except under IFR	
S3004	Establish SOP / procedure for continuing from interrupted checklist event	
S3005	Establish HOMP monitoring program	HOMP to identify takeoff and landing anomalies; install HUMS/HOMP; to verify employee flight performance
S3006	Establish more comprehensive communication for group movement of aircraft	
S3007	Establish more comprehensive preflight planning SOP for group movement of aircraft	
S3008	Establish policy to reduce risk of VFR into adverse Wx	
S3009	Establish pre-approved designated LZ	
S3010	Establish preflight maneuver briefings	
S3011	Establish procedures to evaluate risk reduction benefits merits of installing optional equipment	
S3012	Establish refueling SOP that provides for proper refueling and fuel quantity measurement (of all fuel tanks)	Improve refueling SOP
S3013	Establish risk assessment program that addresses the potential for VFR into adverse Wx and night flight ops	
S3014	Establish risk assessment program to address adverse Wx flight ops	Implement SMS risk assessment for Wx decision making
S3015	Establish SOP / procedure for remote ops pilots to ensure all preps complete before commencing startup for takeoff	
S3016	Establish SOP for selection of off airport or remote LZ	
S3017	Establish standardized training for platform ops/SOPs	
S3018	Hot/expedited loading SOP briefings and conditional situation checklists	

S3019	Implement a company flight following system to include updated Wx, location, risk eval	
S3020	Implement pilot/dispatch clrnc procedures with rq'd items	
S3021	Obtain standard Wx briefing	
S3022	Operator require pilot emphasis on proper checklist procedures	
S3023	Require proficiency check for low time helicopter pilots	
S3024	Revise company checklist to be consistent with OEM checklist	
S3025	SOP requirement for landing site recon before landing at any remote site	
S3026	Standardized operational briefings and conditional situation checklists	
S3027	Strengthen SOPs relative to gear loose in aircraft cabin	
S3028	WX training to emphasize mission abort in deteriorating WX conditions	
S3099	SOP - Ops Mgt - Other	
S4000	**SOP - Ops Pilot**	
S4010	SOP directed preflight planning procedures	
S4020	Use published preflight planning procedures	
S4030	Insure adequate consideration is given to Wx during preflight planning	
S4035	Formal Preflight Briefing Guide for flight procedures	including transfer of aircraft control, passenger briefings, planned maneuvers
S4040	Conduct site reconnaissance at safe altitude	
S4050	Conduct a ground survey for an unimproved field site prior to being used for autorotation training	
S4060	Training and recognition on suitable landing site selection	
S4070	Decision making training for operations in wind	around buildings/obstacles
S4080	Increase nearby hazard awareness	
S4090	Clean glare free windscreen fundamental checklist item for Ag ops	
S4099	SOP - Ops Pilot - Other	
S5000	**SOP - MX**	
S5010	Terminate FCF test when acceptable parameters exceeded	
S5020	Adopt civil aircraft Mx standards and applicable ICA's for Public Aircraft	
S5030	Follow requirements laid out in the flight manual - install both particle separator and deflector	
S5099	SOP - MX - Other	
S6000	**SOP - Mission Specific**	
S6010	Establish operator SOP to ensure functional preflight of mission equipment	
S6015	Establish SOP for Night Vision Google operations	
S6020	Improved power/performance margin planning for specific mission	
S6099	SOP - Mission Specific - Other	
S7000	**SOP - Compliance**	
S7010	Enforce company SOP	
S7020	Establish oversight to ensure compliance with published procedures in AFM	
S7030	Operator require pilot emphasis on proper preflight check procedures	Require emphasis on proper preflight check procedures; Preflight evaluation/walk around looking for hazard awareness
S7040	Follow SOPs for departing into wind	
S7099	SOP - Compliance - Other	
S8000	**Risk Assessment/Management**	
S8005	Establish/Improve Company Risk Management Program	including Wx risk management tool/policies
S8010	Use Operational Risk Management Program (Preflight)	Wx, Route Selection, LZ Operations, Crew Currency
S8020	Use Operational Risk Management Program ()	Wx, Route Selection, LZ Operations
S8030	Establish/Improve Maintenance Risk Management Program	Culture of non-compliance
S8040	Mission Specific Risk Management Program	EMS, Sight-Seeing, Ag Ops, Remote Site platforms
S8050	Personal Risk Management Program *(IMSAFE)*	IMSAFE Checklist
S8060	Enforce Compliance with Risk Management Program	
S8099	Risk Assessment/Management - Other	
S9000	**Safety Culture**	
S9010	Establish risk assessment program to eliminate culture of non-compliance	
S9020	Proactive correction of known safety risks	Proactive correction of known safety defects

S9030	Periodic Safety Audit of heliport	
S9099	Safety culture - Other	
T0000	**Training/Instructional**	
T1000	**Basic Training**	-
T1010	Enhanced Aircraft Systems Training	including warning systems
T1020	Enhanced Aircraft Performance & Limitations Training	
T1030	Enhanced Mission Planning Training	Fuel planning, Route Selection, Wx
T1035	Aircraft Preflight Procedures	
T1040	Ground Hazard Awareness/Proximity Training	
T1050	In-flight Power/Energy Management Training	
T1060	Simulator Training - Basic Maneuvers	
T1099	Basic Training - Other	
T2000	**Advanced Maneuver Training**	-
T2010	Autorotation Training Program	
T2020	LTE Training Program	
T2030	Inadvertent IMC Training	
T2040	Dynamic Rollover Training	
T2050	Emergency Procedures Training	Loss of System, Recognition and Recovery Training
T2060	Simulator Training - Advanced Maneuvers	Dynamic rollover, Emergency Procedures Training, Ground resonance, quickstop maneuvers, targeting approach procedures and practice in pinnacle approaches, unimproved landing areas, and elevated platforms
T2099	Advanced Maneuver Training - Other	
T3000	**CFI Training**	-
T3010	Improve preflight planning / briefings	
T3020	Training and Refresher training on advanced handling techniques / cues / procedures for CFIs	low RPM, airspeed issues, simulated emergencies
T3030	CFI judgment and decision making training to follow student more closely	
T3040	CFI training to take charge despite age or total exp differences	
T3050	CFI utilization of Risk Management techniques	
T3060	Change training program to improve safety margin	solo release procedure, Increase hover height
T3070	Increase CFI training on cues for low RPM, airspeed issues	
T3080	Require CFI endorsement for advanced maneuvers by students	operation from platforms
T3099	CFI Training - Other	
T4000	**M/M transition**	-
T4001	Application of risk assessment model, currency requirement	
T4002	Classroom and in type sim training	
T4003	Ensure use of adequate transition training program	
T4004	Establish new equipment training program	
T4005	Model specific sim training for low time in type pilots	
T4006	Model specific transition training	
T4007	Require systems familiarization, increased requirements for M/M transition training	
T4010	Specialized training for pilots migrating from fixed to rotor wing aircraft	
T4011	Systems familiarization, increased requirements for transition training from turbine to piston	
T4012	Type familiarization pilot training	
T4013	Use pilot handbook/guide for mission planning, risk assessment Handbook could be aircraft/engine class specific (single/piston, etc)	
T4060	Simulator training - M/M specific	Simulator training - M/M specific and classroom instruction; in M/M before actual flight Instruction
T4099	M/M transition - Other	
T5000	**Mission specific**	-
T5001	Company- Ensure new pilot training includes Back to Basics elements and a mandatory review of the Rotorcraft Flying Handbook	
T5002	Company new employee ops training	Company- Require mission- and locality-specific training for new pilots

T5003	Enhanced training in type of maneuvers being performed in this operation	
T5004	External load / LZ training	
T5005	Insure adequate training on aircraft operations in snow	Including required Equipment
T5007	Mission specific training focused on wind, night, low, slow, at or near maximum gross weight and orbiting	
T5008	Operational training for known hazards in event area	
T5009	Proficiency training night aerial application and landings	
T5010	Push "mission specific" best practice info into existing company training programs for elevated helipads	
T5011	Push "mission specific" best practice into existing company training program	
T5012	Push "nearby object awareness" best practice info into existing company and customer training programs	
T5013	Require proper training and proficiency before allowing pilots taking off and landing on trailers/dolly. Add to Basic Helicopter Handbook	
T5014	Standard approach training for rooftop helipads	
T5015	Training in long line SOPs	Training in dealing with long line equipment malfunctions
T5016	Training in mountain flying	
T5017	Training in recovery from settling with power situations and the hazards of landing and or maneuvering in tailwinds and mountainous terrain	
T5060	Simulator Training - Mission Specific Training	
T5099	Mission Specific - Other	
T6000	**Safety Training**	-
T6001	ADM training	
T6002	AMRM training and utilization(AC00-64)	
T6005	CRM training	Including Assertiveness and Utilization training
T6006	Develop a "Rotorwings" program similar to the "Wings" program	
T6007	Flight training on common operational pilot errors	
T6008	Increase student training on cues for low RPM airspeed issue	
T6009	Mission specific risk assessment training	
T6010	Mission specific risk assessment training - Ag Ops	Specialized risk assessment training/materials for Ag Ops
T6011	Mission specific risk assessment training - EMS dispatch/comm center personnel	
T6012	Mission specific risk assessment training - external load	
T6013	Mission specific risk management training	additional training in emergency procedures
T6014	Plt judgment training risk assessment	Risk assessment training
T6015	Precautionary landing decision making training	
T6016	Recurrence training	
T6017	Risk assessment/management training	with emphasis on Wx decision making
T6018	SMS specialized EMS ADM training	
T6019	Training emphasis for maintaining awareness of cues critical to safe flight	
T6020	Training emphasis on techniques for maintaining visual alertness	
T6021	Training emphasis on techniques for maintaining visual contact	
T6022	Training for awareness of flight time/waypoint progress	
T6023	Training on optimum aircraft operating regimes during an emergency situation	
T6099	Safety Training - Other	

Appendix E Occurrences Table

Occurrence Categories	Code	Secondary	Code
ADRM - Airport	ADRM	Heliport/Airport	H
ADRM - Airport	ADRM	Platform	P
ADRM - Airport	ADRM	Fixed Helipad	F
ADRM - Airport	ADRM	Mobile Helipad	M
LZ - Landing Zone	LZ	Prepared	P
LZ - Landing Zone	LZ	Unprepared	U
RAMP	RAMP		
AMAN - Abrupt Manuever	AMAN		
AUTO - Autorotation	AUTO	Emergency	E
AUTO - Autorotation	AUTO	Practice	P
FUEL	FUEL	Exhaustion	Ex
FUEL	FUEL	Starvation	ST
FUEL	FUEL	Contamination	C
FUEL	FUEL	Carb Ice	Carb
EXTL - External Load	EXTL		
SCF - System Component Failure	SCF	Engine	E
SCF - System Component Failure	SCF	Helicopter	H
SCF - System Component Failure	SCF	Mission Equipment	M
SCF - System Component Failure	SCF	Unconfirmed/Perceived	U
ARC - Abnormal Runway Contact	ARC		
CFIT - Controlled Flight into Terrain	CFIT		
DITCH - Ditching	DITCH		
FIRE	FIRE	Non Impact	NI
FIRE	FIRE	Post Impact	P
LOC - Loss of Control	LOC	Dynamic Rollover	DR
LOC - Loss of Control	LOC	Emergency Procedures	EP
LOC - Loss of Control	LOC	Exceeding Operating Limits	OL
LOC - Loss of Control	LOC	Interference with Controls	INT
LOC - Loss of Control	LOC	Loss of T/R Authority	LTE
LOC - Loss of Control	LOC	Performance Management	PM
LOC - Loss of Control	LOC	Tie-downs/hoses	TD
LOC - Loss of Control	LOC	Settling w/ power	SP
LOC - Loss of Control	LOC	Ground Resonance	GR
LOC - Loss of Control	LOC	Unknown	UNK
STRIKE	STRIKE	Object Strike	OBJ
STRIKE	STRIKE	Takeoff or Landing	HTOL
STRIKE	STRIKE	Low Altitude Mission	LALT/M
VIS - Visibility	VIS	White-out/Brown-out	W/B
VIS - Visibility	VIS	Windscreen	WS
VIS - Visibility	VIS	Sun/Glare	SG
VIS - Visibility	VIS	Fog/Glare	FG

Appendix E Occurrences Table

VIS - Visibility	VIS	Flat Light	FL
VIS - Visibility	VIS	Glassy Water	GW
VIS - Visibility	VIS	Night/Darkness	NI
VIS - Visibility	VIS	Inadvertant IMC	IIMC
ICE - Icing	ICE		
WSTRW - Windshear/Thunderstorm	WSTRW	Windshear	WS
WSTRW - Windshear/Thunderstorm	WSTRW	Thunderstrom	TS
UNK - Unknown/Other	UNK	Regulatory	REG
UNK - Unknown/Other	UNK	Other	OTH
UNK - Unknown/Other	UNK	Unknown	UNK
DATA	DATA		

Appendix F Lessons Learned

Many lessons were learned from which future teams could benefit. The following serve as a reference:

1. Accident Investigation Authority reports were considered the standard for information presented because of their general acceptance by the safety community. Some reports contain little usable information or depth of investigation. Reports with little factual data may be used with caution.

2. Identify the team members early, ensure all necessary disciplines are included, and maintain continuity of membership. If member attrition occurs, revitalize the group with the addition of new members as required to replace lost expertise and skills and to reduce the burden on members who remain with the team.

3. Support is needed from top management to ensure that members have the time available for team participation. Team members also need support to cover regularly assigned duties when participating on a JHSAT.
4. Publish clear and concise objectives and agendas for each team meeting to maximize the use of the team's time.

5. Consider establishing a web site or some other means of managing the data, documents, resource documents for the teams work. As an example, the U.S. JHSAT used 4000 data files for a single year of accident data (NTSB, year 2000).

6. It is very important to complete the event sequence before identifying problems and interventions to avoid confusion.

7. U.S. JHSAT found that Standardized Problem Statements and Interventions made identification of problems and interventions easier and more accurate. Standardization prevented duplication of work, aided the analysis process to determine the most frequent problems and interventions. See the Appendixes for SPS and IR. Key words are necessary to aid in the organization and sorting. Numbers should be assigned to each problem and intervention, and those numbers should be retained, regardless of revisions or deletions, to maintain ties to the accident information. U.S. JHSAT did this after the first year of analysis and found standardized problem statement and intervention recommendation lists extremely useful in subsequent years.

8. Teams should strive for development of interventions that do not rely principally on training. Interventions should address underlying factors such as the hiring, training, establishment of appropriate procedures and standards, and operational oversight.

9. Unique Intervention Recommendations can be used for a specific accident. Common groupings of related IRs can be used for specific mission/segment or at the industry level.

10. When the overall team is split into subteam(s) in order to increase efficiency, steps must be taken to ensure that the subteams' efforts are well coordinated and consistent using the same set of SPS and IR statements.

11. It was very important to maintain the tie between the accident, the specific event, the assigned problem statements, and the interventions.

12. Peripheral issues/interventions identified beyond the scope of study should be captured in the report and be labeled as such. An example would be crash survivability issues.

13. Reports should be concise where possible, yet with enough information to provide needed understanding by the reader.