CONSIDERATION ABOUT AERONAUTICAL MAINTENANCE AND SAFETY MANAGEMENT SYSTEM

Dragoş POPA, Traian TOMESCU

CONSIDERAŢII DESPRE MENTENANŢA ÎN DOMENIUL AERONAUTIC ŞI SISTEMUL DE MANAGEMENT AL SIGURANŢEI

The present paper regards elements about safety management system and maintenance in civil and military aeronautical field. All organisations must correlate the minimum risk with higher performance in their specific activity.

Cuvinte cheie: de întreţinere, de gestionare a riscurilor, de siguranţă, costuri

Keywords: maintenance, risk management, safety, costs

Improving global flight safety is the top priority and on this account, all aeronautical organization with helicopters is fully involved in the work of IHST (International Helicopter Safety Team) who aims at reducing the helicopter accident rate worldwide by 80 % by the year 2016. One of IHST's main recommendations to the operators is to introduce a SMS. The methods described below come as a supplement to the "SMS Toolkit" and to the documentation on this subject, issued by the Aviation Authorities. We like to make you aware of the importance of hazard identification and risk management which are the core of any safety risk management system and present you a methodology for dealing with this subject:

- Draw up a list of generic and specific hazards encountered during your daily activity.
- Identify and qualify potential repercussions of these hazards on your activity.
- Define corrective and protective measures in order to prevent such hazards and eliminate or mitigate their consequences.

1. Scope

This methodology, can generically be used for to Commercial Air Transportation aerial work, aerial emergency missions, training or general aviation flights, and generally for every activity associated with operations in flight or on the ground.

2. Glossary

ASR: Air Safety Report; CAA: Civil Aviation Authority; CFIT: Controlled Flight Into Terrain; EASA: European Aviation Safety Agency; ICAO: International Civil Aviation Organization; EI: Undesirable Event; EU: Ultimate Event (accident); IHST: International Helicopter Safety Team; SSP: State Safety Program.

3. Definitions

Safety: Situation in which the risks of personal injury or material damage are limited to an acceptable level and are maintained at this level or a lower level due to the continued hazard identification and risk management process [1](Doc 9859).

Safety culture: The following definition was proposed by Dr. James Reason in 1997 to define Safety culture: Safety culture comprises “fairness”, interchange of information, and learning from events which occurred in the past. A “fair”culture is a culture that establishes an atmosphere of trust in which personnel is encouraged (or even rewarded) to provide information essential to safety, and where the limit between an acceptable and unacceptable behavior is clearly set.

Air accident [1] Appendix 13: event related to aircraft operation, which occurs between the time a person boards the aircraft with the intention of performing a flight and the moment when all the persons having boarded the aircraft with this intention, have disembarked, and during which:

a) A person is fatally or seriously injured because the person is:

- in the aircraft, or

- in direct contact with any part of the aircraft, including parts which have become detached, or

- directly exposed to engine jet wash, unless the injuries are due to natural causes, injuries caused by the person himself or by other persons, or injuries sustained by a stowaway hidden outside the passenger and flight crew access areas, or

b) The aircraft sustains damage or a structural failure:

- altering its structural strength, its performance or flight characteristics, and

- normally requiring a substantial repair or the replacement of the damaged component, except for an engine failure or engine fault if the damage is limited to the engine, the engine cowlings or engine accessories, or damage limited to the propellers, the wing tips, the antennas, the tires, the brakes, the fairings or to small notches or perforation of the skin, or

c) The aircraft has disappeared or is completely inaccessible:

Incident: an incident is defined in this document as an event, other than an accident associated with aircraft preparation or operation, which would or could affect the safety of aerial operations. An Undesirable Event is considered as an in flight incident which may be caused by technical, organizational or operational occurrences.

Undesirable Event: also called forerunner event, an Undesirable Event identifies any deviation from what is expected and may cause personal injury or material damage. This event can be defined as a loss of control of the situation, i.e., any event which may give rise to an accidental sequence if no efficient recovery action is taken. Consequently, the Undesirable Event behaves like a signal whose systemic analysis makes it possible to improve the risk prevention mechanisms of the organization.

Hazard. A condition or object potentially causing injuries, damage to equipment or the structure, loss of material or reducing the ability to perform the assigned functions [1](Doc 9859).

Safety risk management. The “Safety risk management“ indication was defined to transmit the idea that this risk management was not directly associated with the management of financial, statutory, legal, economic and other risks, but that it was mainly limited to Safety risks [1](Doc 9859).

Safety risks. They are defined by assessment, expressed in terms of probability and severity of the consequences of a hazard, by

taking into account the most unfavorable hypothesis. A risk level is generally defined through alphanumeric convention to assess its criticality [1](Doc 9859):

- Probability: possibility of occurrence of an event (engine power loss: 10-5 per Flying Hour).

- Severity (or seriousness): consequence of the occurrence of this event (aircraft damage, slight injuries etc.).

- Criticality: measurement of the combination of the two factors: C = P x S.

4. Analysis & operational risk management process

The analysis & operational risk management process is applied to detect, analyze and determine the steps to be taken in order to reduce the risk level:

- during aircraft preparation or in flight,

- during maintenance operations or maintenance instructions,

- for any new activity, modifications to procedures or work organization, etc. to be introduced in the normal functioning of a company and which may have an effect on the flight safety. How to implement this process of hazard identification and risk management? To do this, we suggest that you answer the following questions:

a) What could happen in my activity (hazard identification)?

b) How could it happen (identification of causes)?

c) Which would be the consequences?

d) How to proceed to prevent or limit the probability that it occurs (risk mitigation)?

e) How to proceed to eliminate it or failing this, to limit its consequences (protection)?

f) How to introduce these risk limitation measures (implementation)?

5. What could happen in my activity (hazard identification)

There a several kinds of hazards, for example:

- Natural hazards (earthquakes, volcanic phenomena etc.).

- Environmental hazards (cyclones, snow or sand storms etc.).

-Technological hazards (related to the aircraft design, their maintenance, their operation etc.).

- Organizational hazards (related to the company operating manner).

- Statutory hazards.
- Human hazards (related to training, competence, job culture etc.).
- Physiological hazards (epidemic diseases etc.).

There are two types of sources of identification of hazards:

- Internal sources: they cover, for instance, incident report analyses, voluntary event reports of the organization, flight data analyses of Flight Data Monitoring programs, reports of safety-audits, follow-ups of safety indicators, statements of employees etc.
- External sources: they cover the exchange of information with other companies, the subscription to an incident/accident data bank, the study of reports of national and international organizations, the analysis of manufacturer recommendations, the study of accident reports of the different Air Accident Investigation Boards, specialized publication etc.

Using these information sources, it is recommended to draw up a list of Undesirable Events which may impact the activity. A meeting composed of one representative from each expert field shall be held to implement the process of identification of hazards and risk management. We recommend that you proceed per risk factor family as indicated in the ICAO SMS Manual 9859 (Ch 4 §4-4): Design; Organization; Communication; Working environment; Regulations; Human Performance; Procedures and operational practices; Existing means of defence to counter these hazards.

6. Identification of causes

Every operator should select the method the most suitable to the size and activity of his company. In the SMS 9859 manual, the ICAO proposes the use of the "Bow Tie"-method. The identification of causes focuses on the upstream part of the Feared Event. It is the return to the root causes of the potential accident.

7. Which would be the consequences?

Which would be the consequences for:

· the persons on board the aircraft and tasked with preparing the aircraft or third parties near the scene of the accident (injuries, fatality)?
· the aircraft, the working tool? Will it be necessary to rent another aircraft? Another tool? Find another place for the operations (case of fire in a hangar)?

· the environment (destruction of goods, pollution, fires etc.)?
· the company image (loss of credibility, withdrawal of customers, media impact, legal proceedings etc.)?

8. How to proceed to prevent or limit the probability that it occurs (risk mitigation)

The risk analysis is the first element of the risk management process. It covers the detection and assessment of risks. After a hazard has been detected, any related risks and their level must be determined. We suggest the risk matrix presented by Mr Tony Cramp, SHELL Aircraft International's Air Senior Advisor, during the CHC Safety & Quality Summit in 2010.

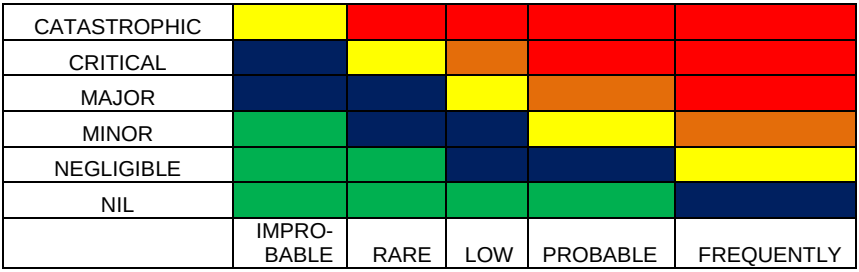

Fig.1 Risk matrix

Color code: ACCEPTABLE MEDIUM SERIOUS UNACCEPTABLE

Key to probabilities and associated codes in the matrix:

IMPROBABLE: almost unthinkable that the event occurs; it has never occurred in the history of the aviation industry;

RARE: very unlikely to occur, but has already occurred in the aviation history;

LOW: unlikely to occur, but has already occurred, in the company, at least once

PROBABLE: has already occurred in the company (Frq < 3x year)

FREQUENT: has already occurred in the company (Frq > 3x year)

Key to severity indices and associated codes in the matrix:

SEVERITY Personnel Environment Material Image

NIL No injury No effect No damage No impact

NEGLIGIBLE Superficial injuries Negligible effects Damage < 10 k€ Light impact

MINOR Slight injuries Little impact Damage < 50 k€ Limited impact

MAJOR Serious injuries Noteworthy local effects Damage < 250 k€
Considerable impact

CRITICAL Fatality Effects difficult to repair Damage < 1 M€ National impact

CATASTROPHIC Multiple fatalities Massive effects (pollution, destruction etc.) Damage > 1 M€ International impact

This first step consists in qualitatively determining the potential causes of the unwanted incident, its specific features, the operational, material and environmental factors, etc. which may have an effect on this event, as well as the targets likely to be affected by this event. Then you must assess the probability of the occurrence of the hazard.

Acceptable or Medium risk level: Lowest risk level likely to be reasonably reached and under which the remaining part of risk can be controlled appropriately. No measure is required to mitigate the risk.

This risk level is not fixed on a long-term basis. It depends on the complexity of the operation to be performed (environment, availability of existing documentation, personnel qualification, duration of the mission etc.), on the existing objective data enabling a qualitative analysis of the risks, on the resources specific to the organization to conduct this risk analysis etc.

Serious risk level: Risk level at which the organization accepts to move in order to benefit from some advantages
for its activity and on the condition that the risk is mitigated as much as possible.

Unacceptable and Unacceptable+ risk level: Means that the activity cannot be continued as is and that it cannot be resumed unless the risk is brought back to the “Acceptable” or “Medium” level or at least to the “Serious” level.

Concerns risks considered as "SERIOUS" to "UNACCEPTABLE+" during the assessment process and requiring measures to bring the risks back to a "MEDIUM" level at least. It is at this stage that a corrective measure plan is defined.
There are two risk reduction strategies:

- prevention, by taking any actions to reduce the frequency of occurrence of an incident/accident (probability),

- protection, by eliminating/reducing the severity of the consequences of an incident/accident if it were to occur.

9. Implementation of protective measures

All solutions are possible, but they all involve costs. It is mandatory to conduct a cost analysis prior to taking any steps. The cost of protective measures should not exceed the cost of the consequences of a risk and for that can use the decision matrix below as a decision-making aid.

Tabel1 Cost/Benefit analysis matrix

	BENEFIT			
COST		High	Medium	Low
	Low	1	2	3
	Medium	2	3	4
	High	3	4	5

1 to 2: The preventive and protective measures can be adopted as are.

3: If possible, reduce the cost of the implementation of the preventive and protective measures.

Higher than 3: Review the risk analysis to find new solutions.

10. Conclusions

The analysis and management of the operational risk, associated with an organization minimizing the risk of errors, are components essential to flight safety.

BIBLIOGRAPHIE

[1] * * * ICAO - International Civil Aviation Organization, SMS Manual.
[2] * * * Safety Management System, 2011.
[3] * * * Information Note 22510 EADS.

Ph.D.Eng.Euring. Dragoş POPA
member of AGIR Board, President SETEC-AGIR, independent technical expert, electrical and board systems engineer
tudodei@yahoo.com
Eng. Traian TOMESCU
aircraft and board systems engineer, independent technical expert,
member of AGIR Board, president of AGIR- Braşov
ttomescu@clicknet.ro