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Ministère de l'Ecologie,
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et de l'Energie

BEA
Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile


**Investigations and Safety Management Systems**

# "Touchdown too long, SMS comes up short"

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*After joining the French Air Force in 1973 as an engineer and pilot,* ***Philippe Mauviot*** *flew fighter aircraft, including 1,000 hours on the MIRAGE III, then the TRANSALL C160 tactical transport and later did 2,000 hours on PUMA helicopters. He became a helicopter test pilot and also commanded various air units and participated in military operations in foreign countries. He was awarded the Aeronautical Medal, the "Légion d'Honneur" and the "l'Ordre Nationale du Mérite". He is an officer graduate of the Staff Technical College. After a 30-year military career and more than 5,000 flying hours, he left the French Air Force with the rank of Colonel. Philippe joined the BEA Investigation Department in 2002 and has participated in and managed national and international investigations in both general aviation and public transport.*

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## 1. INTRODUCTION

On the night of 16 October 2012, the crew of a Bombardier CRJ-700 was flying between Paris Orly and Lorient Lann Bihoué, their fifth and last flight of the day. They landed at about 1,100 m past the threshold of runway 25 and did not manage to stop the aeroplane overrunning the runway. At the time of the landing, a crosswind of about 15 kt was blowing in gusts and a heavy squall was sweeping across the aerodrome. The visibility was reduced to between 2,000 and 3,000 metres and the runway was described as being wet with puddles of water. The crew of the previous flight had reported difficulties during their landing because of aquaplaning.

The initial findings brought to light active errors by the flight crew:

- excessive speed on short final,
- a long landing,
- under-estimation of the meteorological conditions,
- under-estimation of the runway contamination.

These errors were amplified by a non-sterile cockpit.

These initial findings raised two questions whose answers constituted real levers to improve safety:

1. How could such an accident happen to a competent and correctly trained crew, given that other crews could be confronted with the same difficulties?
2. How can the aviation system be improved so as to better detect a crew's failings in public transport?

Following an approach based on identifying systemic failures, the Safety Investigation then turned to organizational factors. These provided plenty of possible answers and led to an analysis of the SMS of the various actors in this complex event.

The aim of this article is to show in what ways the SMS helped refine the investigators' questioning, which is illustrated by three examples, and how investigations and SMS can provide each other with feedback**.**

## 2. INVESTIGATIONS AND SMS

The method applied by the BEA was consistent with its usual practices. Some working groups (Operations, Systems/Performance and Aircraft) were set up and mandated to cover all aspects of the investigation. The Operations group was responsible for the examination and analysis of the organizational and systemic factors. It was this perspective that led the group to study the SMS of the airline, the ATC service provider (PSNA) and the aerodrome operator.

The first challenge for the investigation team was to understand how the SMS of each operator worked. The declared aim of an SMS is, through a generalized proactive approach within the organization, to identify the risks and establish risk prevention measures. The temptation could thus be great, in the context of an investigation, to conclude that the SMS failed. This would be falling into the trap of an easy retrospective bias without, however, helping the organisations involved to progress in their mastery of safety.

**2.1 - The airline's SMS:**

The airline had determined a list of risks to which it was exposed in its daily operations and had grouped them together on a map. Following this approach they identified the runway excursion as an « ultimate event». The long landing was designated as an « undesirable event». The operator then identified the safety barriers to prevent the occurrence of a long landing.

This list of barriers constituted a guide for the Safety Investigation. It allowed us to ask ourselves precise questions on the operator's organisational aspects:

- Was the list of identified barriers complete?
- Were these barriers really in place?
- How did the operator ensure the effectiveness of these barriers?

The answers to these questions can be tricky to find, but they make it possible to identify and understand the organisation's latent failings.

| Barrier | Fact |
|---|---|
| The flight crew carried out the standard approach procedures. | Flight analysis showed the existence of many long landings. |
| The flight crew configured the aeroplane for the landing. | The airline's operations manual included a non-compliant configuration in the aeroplane's flight manual. |
| The flight crew applied flare techniques. | The flare techniques were not described in a uniform manner in the airline's documentation. |

Table: Example of facts established based on the airline's risk map.

**2.2 – Another operator, another world:**

Use of Lorient Lann Bihoué aerodrome is mixed: military and civil. The PSNA is military. The European regulation does not require certification in such cases. France nevertheless decided to certify all of the PSNA's involved in commercial aviation operations. These have an SMS like that required by the European regulation.

In the context of this accident, the PSNA was thus certified, but no SMS dedicated to airport activity and its associated risks was in place.

Consideration of SMS in the investigation was then oriented towards simple fact-gathering in relation to the benefits of an SMS:

- establishing good practices as defined by the DGAC[1] in relation to airport operations, by the military operator,
- the military operator taking into account ASR's concerning infrastructure,
- reduction in the time required to correct any problems identified.

Investigative actions linked to SMS remained traditional. The investigation's approach (organisational and systemic) remained the same for the BEA but a privileged correspondent was identified: the SMS manager. In fact the discussions with the various operators were facilitated by the existence of SMS and by sharing the common objective that is risk management.

## 3. TOUCHDOWN TOO LONG, SMS COMES UP SHORT

The examples that follow illustrate the use that was made of SMS during the investigation. They show the difficulty of measuring the overall impact of SMS in improving safety today.

### 3.1 - Long landing: Overall measurement V specific risk

The airline had launched a study on long landings (beyond 600 m past the threshold) within its operations. Based on the first results, a significant number had been identified. The factors that could contribute to these long landings were many and led to defining an overall policy to fight against these long landings:

- zero tolerance for landings outside of the area specified in the operations manual, during training and check activities,

- distribution of information to pilots on long landings and their consequences (not completed at the time the accident)

This overall policy nevertheless came up against technical and operational difficulties. Specifically, the flight simulator did not make it possible for the operator to check the landing area during training and checks.

In addition an overall measurement of landings did not make it possible for the specific features of each aerodrome to be taken into account. Thus, in the overall statistic (Figure 1), long landings with CRJ700's at Lorient runway 25 only represented a rate of 6%.

[1] Direction Générale de l'Aviation Civile (French civil aviation authority)

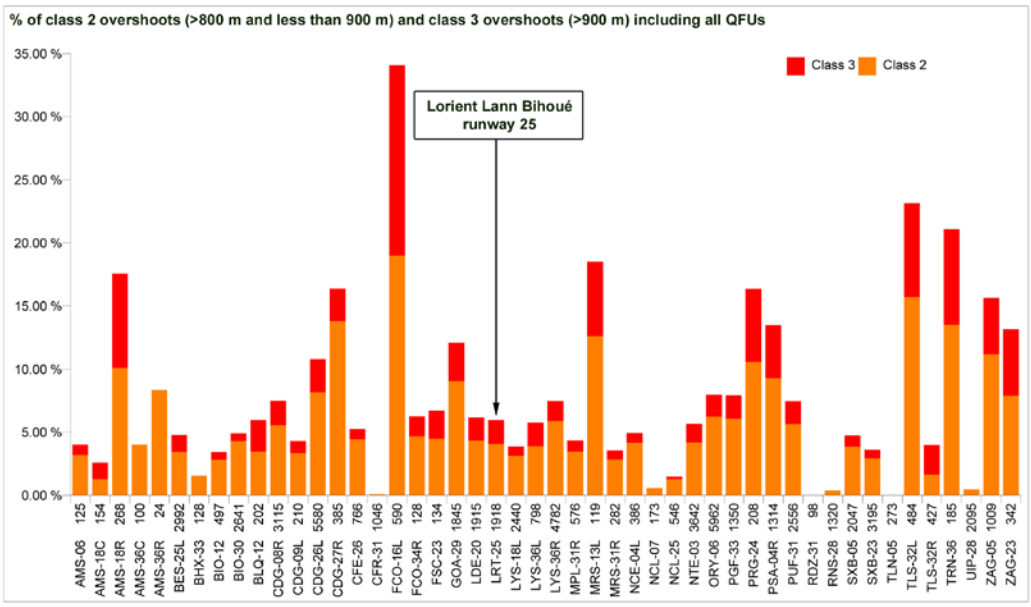


Figure 1

A targeted analysis of the shortest aerodromes (Figure 2) would have made it possible to identify the higher exposure to the risk of runway excursions for runway 25 at Lorient. Further, 12 landings beyond 1,000 metres on this runway appeared in this analysis.

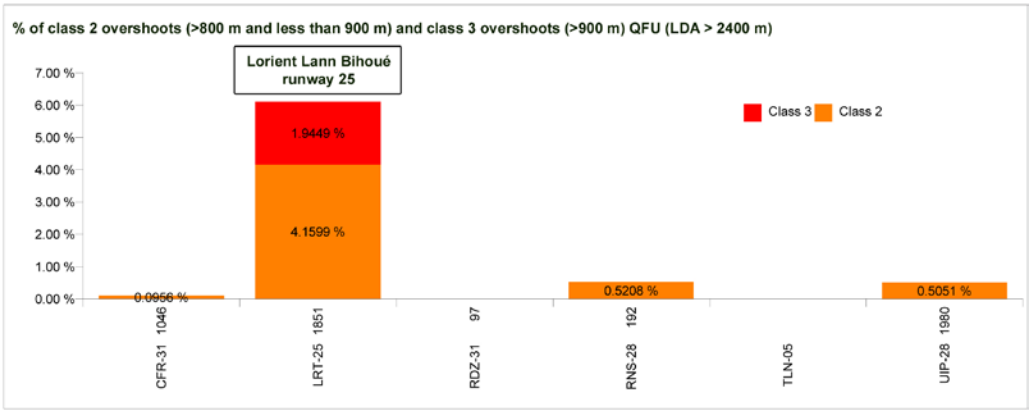


Figure 2

Despite the relevant identification of the risk and of the means implemented, an overall analysis can be inadequate, and overall measures can be ill-adapted to handle a specific case.

### 3.2 - SGS-RF: regulatory requirements V safety performance

The airline had developed specific risk management system linked to crew fatigue (SGS-RF) over several years. This system reached the requirements of the oversight authority for reduced rest management[2] practiced by the

[2] Rest time equal to or less than 10 hours.

airline. The SGS-RF thus contained provisions relating to fatigue in general, such as for example:

- recommendations to benefit from restorative sleep,
- consideration of the importance of feedback,
- management of the controlled sleep during flight.

These provisions did not however specifically address the risk of fatigue that could occur while undertaking daily five-leg rotations, though they are recognised by the airline as being the most demanding.

Thus, fatigue, which was identified by the BEA as a contributing factor in the accident, had not been taken into account by the airline and did not thus enable risks to be diminished in a specific context (five legs). This example thus showed once again the difficulty of implementing risk management operationally, even though it was studied and analysed precisely.

### 3.3 - State of the runway: SMS, a boost to safety

As previously explained, the military aerodrome operator was not certified. More than two years before the accident, following two runway excursions by military aircraft, large areas of water retention had been identified where runways 07/25 and 02/20 crossed.

As of the date of the accident, the treatment of these water retention areas by grooving the runway had been approved but the work had not yet been undertaken.

Water retention areas on the runway at Lorient Lann Bihoué

In addition, the French civil aviation authorities had notified the military aerodrome operator of many deviations relating to the runway markings. A corrective action plan had been issued by this operator to remedy these deviations around one year after the notification.

The investigation showed that the characteristics of runway 25 had contributed to the accident.

In the absence of any SMS, the aerodrome operator did not formalize any risk analysis that might have led to faster corrective measures, or to a restriction of operations.

The investigation found that this type of aerodrome operator, with no SMS, could not guarantee the same level of safety as a certified civil aerodrome.

## 4. RECOMMENDATIONS: SMS, an effective new relay

The report published following the investigation includes many recommendations. Beyond the simple demand for regulatory compliance for some recommendations, the BEA considered that, for those that were directly linked to the operators' safety performance, it would be more effective to relay them through the SMS.

### 4.1 - Management of threats and errors

The specific features of aerodromes served by this airline were not systematically known to the crews, nor were they consultable. Although this is in compliance with the regulations, this situation had an operational impact that the investigation recognized in the causes of the runway excursion. That is why the BEA recommended, through oversight actions by the authority, that aircraft operators identify the threats specific to their operations in order to integrate them in their SMS.

This verification by the authority took place in February 2014 for the airline.

### 4.2 - Management of fatigue risk

Fatigue, in particular that associated with the crew's five flights on the day of the accident, was identified as a contributing factor to the accident. The airline had developed an SGS-RF to best manage fatigue risk in general. This SGS-RF did not however specifically address the issue of five-leg flights and thus did not plan specific measures. Their set-up was the subject of a recommendation. The regulatory changes linked to SMS and SGS-RF also led the BEA to recommend an evolution in SMS as such, and not of the SGS-RF.

### 4.3 - Certification of mixed aerodromes

The safety performance of the whole of the aviation system has been made more robust thanks to the adoption of a common tool, SMS. Its absence in a structure can weaken the whole and does not thus offer the same level of safety.

The BEA therefore recommended that the French authorities extend to military aerodromes receiving commercial civil traffic, the certification and SMS requirements applicable to civil aerodromes with equivalent traffic.

### 4.4 – Lessons from the symposiums and the European Action Plan (EAPPRE[3])

The lessons learned and recommended practices, issued at the time of the DGAC symposium on 25 November 2010, were not subject to real development in the context of SMS, recently put in place at that time.

During the investigation, ECAST[4] published recommendations to fight against runway excursions (EAPPRE) that answered many of the problems identified during the investigation.

Although not obligatory and/or regulatory, it is significant that operators evaluate the relevance of these lessons and integrate them into their operations. The BEA therefore considered that this voluntary approach in the whole of the aviation system should be solidified through the SMS.

That was why the BEA recommended, through the authorities' oversight actions, that SMS take into account recommendations from this work.

## 5. CONCLUSION

The investigation into this accident showed the legitimacy of SMS and its interest for the identification of risks. The examples studied brought to light all of the benefits of the SMS concept, but also all the difficulties encountered in realizing it in reality. More than ever before, the proven concepts of feedback, continuous improvement and the further development of flight analysis will contribute to the rise in significance of SMS, and thus to a better level of safety.

From a methodological perspective, SMS and Safety Investigations operate hand in hand and symbiotically. Identification of risks makes it possible to track the work of the investigation, making it more diligent and effective. In return, the Safety Investigation can lean on the SMS to carry out its recommendations and thus contribute to their maturity. For the investigation authorities this represents a new and alternative vector for improving safety compared to classic, and indeed fastidious, regulatory changes.

As an investigation organisation, the conditions of its use need to be refined to optimize our investigations and avoid falling into the trap of exposing failures in the SMS through retrospective bias. Must investigators be SMS specialists? Must all investigation groups be assigned, in addition to their standard investigation tasks, that of analysing SMS? Do investigation

[3] European Action Plan for the Prevention of Runway Excursions
[4] European Commercial Aviation Safety Team

organisations have to participate in supporting operators in their implementation of SMS, in particular to help them to identify and classify risks? Like operators and oversight authorities, investigation authorities will have to hone and test their methods.

A whole new era in perspective!