# Understanding Resilience in Flight Operations

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In this paper I will describe a method to gain a better understanding of the operational activities that resulted in a safe flight. Success rather than failures can provide the insight how flight crew under pressure, with resource limitations and multiple conflicting goals contribute to the ultra-safe aviation system.

## Introduction

Resilience, as the capability to absorb disturbances that threaten a safe flight, is not yet part of current Safety Management System (SMS) methods. Most of today's SMS's focus is put on hazard identification, mitigation and the failures that occurred. When a focus on resilience is included in SMS practices it gives a better understanding of how safety threats are handled in flight operations. It should be recognised that, due to the complexity of flight operations, hazard identification and risk mitigation will always fall short of the almost infinite ways in which factors can combine in the actual execution of a flight. Operational risk mitigation and the handling of disturbances is an essential quality of the flight crew. Although often only the pilots are mentioned I regard the flight as a complete system with many actors of which we seek to understand the resilient capacity.

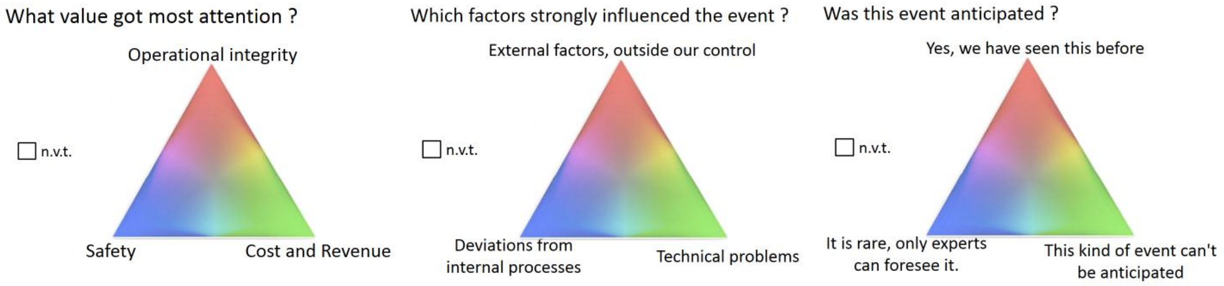
## Method

The Flight Operations Resilience Experience Collector (FOREC) is inspired by the SenseMaker method developed by Dave Snowden a Knowledge Management expert. SenseMaker is based on complexity theory which claims that it is not a priori possible to know all the issues in a complex system. Therefore open questions are needed to collect relevant data as opposed to closed questions (as used in current ASR) which assume the issues are known. The method provides pilots a way to share their operational experiences and their view on the shared event. Standard Air Safety Reports (ASR) that are currently filled out by the pilots when a safety event has occurred have only boxes to tick and a field for a narrative. The pilots view on the event is not systematically collected. The ASRs are categorised by which context is lost and used for trends in SMS reports. FOREC data remains contextual and is treated differently.

For this experiment the FOREC will be an extension of the ASR. The narrative of the ASR is also used for FOREC. The narrative describing the operational experience provides qualitative data and the pilots view expressed via the triangles and scales provides quantitative data. The quantitative data is used to find patterns in the data. The qualitative data is used to support understanding of the patterns found.

The pilot is challenged by an opening question to share his experience in a short narrative and with some tag words. The answer to the opening questions serves as the event description for the ASR. The triangles or triads (patent pending Snowden) have a topic at each corner. The interpretation of this corner text provides a reference for the opinion of the pilot about the event. The corner points or signifiers provide some closure on the opinion the pilot can express about his experience. The signifiers in FOREC will be operationalizations of resilience engineering concepts such as the work of Hollnagel and Woods and the Viable System Model (Beer) control functions. The signifiers will be expressed in a language that the pilots are familiar with (Meriam). This is how the pilots can frame their view on the event in a resilience engineering (RE) language.

Triads (patent Snowden): A pilot can put his mark in the triangle. The distance to each corner is a qualitative measure used to search for patterns.




The performance of the flight is dependent on the capacities of the system and the conditions in which it operates. I use the Common Performance Conditions (CPC) (Hollnagel 1998) to describe relevant aspects of the system and its environment. Some CPC examples are: availability of procedures, available time, conflicting goals, human machine interface etc. In FOREC scales (dyads) are available for the pilots to qualify the CPCs as judged during the experience they want to share. Many of the CPCs are under the direct influence of  airlines management; Via the quality of the CPCs the airline management executes its safety management. Some of the 11 CPC to qualify the conditions of the reported event.

| **CPC** | **Description / Qualification** |
|---|---|
| Working conditions | The conditions under which the work takes place, such as ambient lighting, glare on screens, noise from alarms, interruptions from the task etc. |
| *Descriptors* | *Advantageous/ Compatible /Incompatible* |
| Adequacy of MMI and operational support | The quality of the MMI and/or specific operational support provided for operators. The MMI includes control panels, workstations, and operational support provided by specifically designed decision aids |
| *Descriptors* | *Supportive/ Adequate/ Tolerable /Inappropriate* |
| Availability of procedures/plans | The availability of prepared guidance for the work to be carried out, including operating/ emergency procedures, routines & familiar responses |
| *Descriptors* | *Appropriate/ Acceptable/ Inappropriate* |

## Expected Results

The FOREC experiment will run in April and May. Based on comparable SenseMaker projects I expect that FOREC will provide airline management with new insights on flight safety performance. Success stories will now be systematically shared. The FOREC data will contain more contextual data than the ASRs and that will result in richer discussions about issues when a pattern is discovered. The quality rating of the CPC is new information for the airline management.

Since the quantitative data in the reports can be processed without the need of intervention (classification and trending) airline management gets more (near) real time information.

FOREC data can provide feedback for pilot training. Effective activities and strategies derived from the FOREC reports can be further enhanced by pilot training.

FOREC data can be shared among pilots so they can learn for each other experiences. These data can be specified per aircraft type, airport or flight region. This improves the pilots Threat and Error Management (TEM), a method for operational risk management.

I expect to have at least preliminary results of the experiment during the REA symposium.

## Discussion

Resilience is a new concept in airlines flight safety offices. At present SMS legislation is putting pressure on the offices. Running too far ahead of current issues might reduce acceptance of yet another safety management method although I have received positive reactions from a safety manager and several operational managers in an airline.

The effort pilots need to make to share an experience is critical for their willingness to share. The paper method can only be used for an experiment not when the method is implemented. Still the paper method will show the benefit of the method and the usefulness of the data.

### Managing Trade-offs

The triads will have signifiers that capture the trade-offs the pilots made during the event. A triad will address the goal that was sacrificed (e.g. passenger comfort, cost or network integrity) for safety. Another triad will address the value that was most impacted by the event e.g. safety, cost, schedule.

### Significance and take home message

The significance of the method is that RE concepts are specifically addressed and operationalized in a language understandable for operational people in actual operational settings. FOREC can serve as an example for other operational domains to show that a relative simple method (based on complexity theory) can provide a better understanding of the resilience in their respective operational field.

## Conclusion

FOREC is a practical method to collect very cost effective a new kind of data that has the potential to further enhance the resilience of flight operations.

### *References:*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