A CASE STUDY TO COMPARE THE ADVANTAGES AND LIMITS OF TWO ACCIDENT ANALYSIS METHODS

Anthony Vacher, Léonore Bourgeon, Anne-Emmanuelle Priot

Institut de recherche biomédicale des armées [French Armed Forces Biomedical Research Institute],
Département Action et cognition en situation opérationnelle [Cognitive Science Department], Brétigny sur Orge, France
Contact: anthony.vacher@irba.fr

INTRODUCTION

❖ **Accident investigation**
- Important source of information to guide safety management priorities despite its reactive view on safety and the multiple pitfalls on the pathway to understand accident causation

❖ **Accident causation in complex sociotechnical systems**
- A strong consensus in the literature to explain accident by the combination of multiple human and systemic factors
- A need to shift from traditional sequential and epidemiological models of accident causation (focusing on component failures) to systemic models (focusing on interaction between components and performance of the system as a whole) HOLLNAGEL, 2004
- Despite the fact that systemic models appear more appropriate for modern complex sociotechnical systems, their use is lower than previous models SALMON AND AL., 2011

STATE AIRCRAFT ACCIDENT INVESTIGATION

❖ **2003: Creation of the *Bureau Enquêtes Accidents Défense-Air* [French State Aircraft Accident Investigation Board (SAIB)]**
- Around 30 staff members, including 10 technical investigators

❖ **Review of the first 10-years of SAIB's activities (2003- 2012)**
- Between 1 to 3.5 accidents per 100 000 flight hours each year
- 194 investigations: 117 accidents, 77 serious incidents
- Investigations mainly for: French Air Force (47%), Army (19%) and Navy (12%) => proportional to aerial activity
- According to SAIB: 80% of all identified causes are related to "Human and organizational Factors" and more than half being "Unsafe Acts" of front-line operators

❖ **Human and Organizational Factors Investigations**
- SAIB safety investigators, SAIB's ergonomist (since 09/2014)
- Armed Forces Biomedical Research Institute (on request of SAIB)

❖ **2013: Introduction, by the management of SAIB, of a French translation of the HFACS taxonomy** (WIEGMANN & SHAPPELL, 2003) **to standardize practices between safety investigators**

OBJECTIVE

To compare the advantages, the limits and the quality of information gathered by two accident analysis methods
- *Human Factors Analysis and Classification System* (HFACS), derived from the Reason's Swiss Cheese model (1990) => epidemiological accident causation model
- *AcciMap method* derived from Rasmussen's risk management framework RASMUSSEN, 1997 => systemic accident causation model

METHODS

Qualitative study. Analysis of data available in one final safety accident investigation report from the SAIB, including cockpit voice recorder transcription, flight data recorder data, interview with air crew members, information on organizational context

EVENT SUMMARY

July 17, 2013 – Sahara Desert – Operational mission. During a dust landing with night vision goggles, the crew of an helicopter (2 pilots, 1 flight engineer) looses visual references and helicopter's control. 3 injured persons.

References
Hollnagel, E. (2004). *Barriers and Accident Prevention*. Aldershot, UK: Ashgate Published Limited.
SAIB Bureau enquête accident defense-air *[French State Aircraft Accident Investigation Board] (2015)*. Rapport final d'enquête de sécurité *[Final safety report on accident T-2013-010-A]*. Accessed June 15, 2015; at defense/ministere/organisation/organisation-du-ministere-de-la-defense/organismes-dependant-du-ministrehttp://www.defense.gouv.fr/portail-/les-bureaux-enquetes-accidents-defense.
Rasmussen, J. (1997) Risk management in a dynamic society: a modelling problem. *Safety Science*, 27:2/3, 183-213.
Salmon, P.M., Stanton, N.A., Lenné, M., Jenkins, D.P., Rafferty, L., Walker. (2011). *Human Factors Methods and Accident Analysis. Practical Guidance and Case Study Applications*. Farnham, UK: Ashgate Published Limited.
Wiegmann, D.A. and Shappell, S.A. (2003) *A human Error Approach to Aviation Accident Analysis. The Human Factors Analysis and Classification System*. Burlington, VT: Ashgate Published Limited.
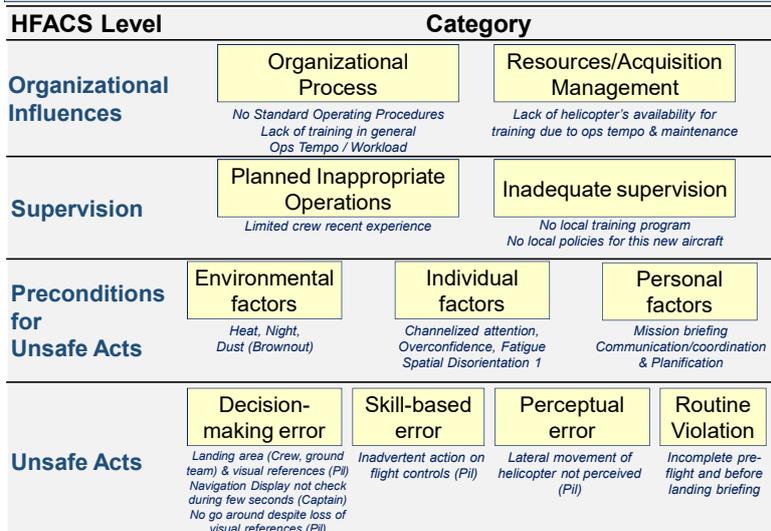
RESULTS

HFACS Level	Category			
Organizational Influences	Organizational Process *No Standard Operating Procedures Lack of training in general Ops Tempo / Workload*		Resources/Acquisition Management *Lack of helicopter's availability for training due to ops tempo & maintenance*	
Supervision	Planned Inappropriate Operations *Limited crew recent experience*		Inadequate supervision *No local training program No local policies for this new aircraft*	
Preconditions for Unsafe Acts	Environmental factors *Heat, Night, Dust (Brownout)*	Individual factors *Channelized attention, Overconfidence, Fatigue Spatial Disorientation 1*		Personal factors *Mission briefing Communication/coordination & Planification*
Unsafe Acts	Decision-making error *Landing area (Crew, ground team) & visual references (Pil) Navigation Display not check during few seconds (Captain) No go around despite loss of visual references (Pil)*	Skill-based error *Inadvertent action on flight controls (Pil)*	Perceptual error *Lateral movement of helicopter not perceived (Pil)*	Routine Violation *Incomplete pre-flight and before landing briefing*

Figure 1. **HFACS taxonomy** describing active and latent failures leading to helicopter accident. *Notes.* Cpt: Captain, Pil: Pilot
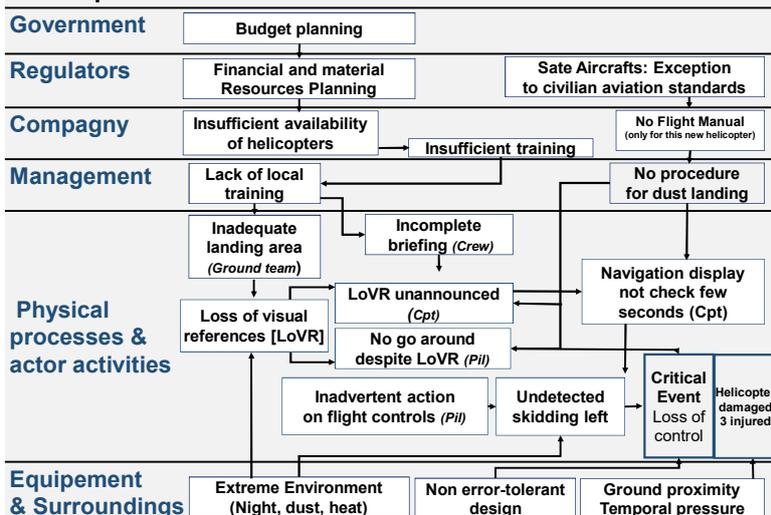
Figure 2. **AcciMap diagram** describing conditions and developments leading to helicopter's loss of control. *Notes. Cpt: Captain, Pil: Pilot.*

DISCUSSION/PERSPECTIVES

		ADVANTAGES	LIMITS
H F A C S		- A relatively comprehensive and user-friendly taxonomy - Useful for sharing information (used by numerous AIB)	- Limit the scope of investigation to the predefined taxonomy and organization level - Focus mainly on the "fallible" human component *(all organization's level)* - Current event explained by past causal factors - No validated French translation
A C C I M A P		- Accident: emergent phenomenon - Focus equally on equipment & surroundings than human activities	- No predefined taxonomy to support analysts in classifying causal factors (few guidance) - Graphical diagram large and rapidly complex

❖ Two complementary accident analysis methods
❖ Assessment of a French version of HFACS (validity, reliability)
❖ Applying AcciMap methods during investigations