

THE ALASKA AIRLINES FLIGHT 261 ACCIDENT: A SYSTEMIC ANALYSIS OF FUNCTIONAL RESONANCE

Rogier Weltjer
Linköping University, IDA/CSELAB
Linköping, Sweden

Erik Hollnagel
École des Mines de Paris - Pôle Cindynique
Sophia-Antipolis, France

On January 31, 2000, Alaska Airlines flight 261, an MD-83, crashed into the Pacific Ocean; after airplane pitch control was lost as a result of the in-flight failure of the horizontal stabilizer trim system jackscrew assembly's screw nut threads (NTSB, 2003). Accident investigation revealed a wide range of human, technical, and organizational factors contributing to this tragic event, providing a case where popular linear models and methods have difficulty addressing the full complexity of the processes leading up to the accident. This paper treats each of the steps of analysis according to the Functional Resonance Accident Model (FRAM; Hollnagel, 2004), a systemic non-linear modeling method, and discusses how functional resonance occurred through the variability in functions performed by joint human, technical, and organizational systems. It thereby aims to facilitate a better understanding of how functional variability in design, certification, limited and inadequate maintenance, negligent safety culture, economic factors, and human performance together can resonate and contribute to accidents. In this way it aims to contribute to accident prevention and the engineering of more resilient complex dynamic systems.

Introduction

On the 31st of January, 2000, Alaska Airlines flight 261, an MD-83, crashed into the Pacific killing all 88 persons on board. Accident investigation (NTSB, 2003) revealed a wide range of human, technical, and organizational factors contributing to this tragic event.

Analyzing and attempting to understand accidents is an essential part of the safety management and accident prevention process. Accident models play an important role in this process, since they (implicitly or explicitly) affect what investigators look for, which contributing factors are found, and which recommendations are issued. In other words, the quality of the accident model used determines to a large extent how good we will be at preventing the next accident. As scholars have recently argued, event-chain models of accident causation, and the view on safety as a hunt for human error, do not suffice to be able to model and understand the complex nature of contemporary accidents, and more 'systemic' models of accidents and safety are necessary (Amalberti, 2001; Dekker, 2004; Hollnagel, 2004; Leveson, 2004; Rochlin, 1999; Woods & Cook, 2002). Systemic models treat safety as an emergent property of systems as a whole, and try to find systemic vulnerabilities rather than flawed components of a system.

One specific systemic accident model is the Functional Resonance Accident Model (FRAM; Hollnagel, 2004). FRAM decomposes socio-technical

systems by the functions they perform rather than by their structure, and aims to capture the dynamics of such systems by modeling non-linear dependencies and variability with which functions are performed. FRAM postulates that both normal performance (success) and failure are emergent phenomena that cannot be attributed to specific system components. Performance variability is natural in socio-technical systems, enabling people to cope with complexity and uncertainty. Thus, every function has a normal weak variability. In FRAM, functional resonance is the detectable signal (an undesirable event) that emerges from the unintended interaction of the weak variability of many signals.

Purpose

After describing the accident in more detail, FRAM is presented and used in an attempt to understand and model aspects of the Alaska Airlines Flight 261 accident. FRAM is applied in this paper to the facts and findings that the NTSB (2003) reported after their investigation and analysis. This paper thereby serves the following purposes: (1) to describe, model and thereby understand why the factors contributing to the accident as identified by the NTSB could manifest themselves as they did, (2) to assess the usefulness of the Functional Resonance Accident Model for accident analysis and thereby to sketch how it may be used for accident prevention.

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