Southwest Airlines Flight 1248: A Case Study Using the Human Factors Analysis and Classification System Framework

Shaddi Abdala
Embry-Riddle Aeronautical University

Abstract

The Human Factors Analysis and Classification System (HFACS) is a human factors accident analysis framework that facilitates the investigation of active failures by frontline employees as well as organizational factors upstream in the organization. The HFACS addresses human errors and violations and the human factors underpinning them at four levels: unsafe acts of operators; preconditions for unsafe acts; unsafe supervision; and organizational influences. In this study, Southwest Airlines flight 1248 will be analyzed using the HFACS model and could demonstrate the importance of this framework as a tool to facilitate the investigation of the underlying causes of human errors and violations. Moreover, it helps accident investigators develop more effective safety interventions designed to mitigate latent conditions and unsafe acts, greatly improving aviation safety. Findings of this study are expected to suggest that active failures by the flight crew that contributed to the mishap were a consequence of deeper organizational problems, such as an unhealthy safety culture and failure of upper-level management to provide the pilots with consistent training.

The Accident- Southwest Airlines Flight 1248

On December 8, 2005, Southwest Airlines flight 1248, a Boeing 737-7H4, overran runway 31 center (31C) after landing at Chicago Midway International Airport (Figure 1). The aircraft rolled into the road outside of the airport perimeter and struck an automobile, killing a child inside. The aircraft was substantially damaged. The day of the accident, weather conditions were near approach minimums and there were mixed braking action reports (National Transportation Safety Board, 2007).

The Human Factors Analysis and Classification System

The HFACS framework was originally introduced to reduce the number of accidents in the U.S. Navy and Marine Corps caused by human error in 1990 by Dr. Shappell and Dr. Wiegmann (Shappell & Wiegmann, 2007). The HFACS model successfully identifies errors by front line personnel and latent conditions upstream in the organization at the four levels depicted in Figure 2, with their respective subcategories.

In theory, one failure will occur at each level of the model to result in an adverse event. The HFACS model’s use of a four level structure for identifying causal failures, has enabled investigation teams to diagnose the mistakes made in the upper levels of the organization that led to the unsafe acts by frontline employees resulting in an aircraft accident.

Figure 2. The HFACS framework. Adapted from the HFACS model developed by Wiegmann and Shappell (2003).

National Transportation Safety Board Investigation

An accident investigation was conducted by the National Transportation Safety Board (NTSB), the probable cause of the accident was determined to be the pilots’ active failure to deploy the thrust reversers immediately after touchdown, their delay resulted in a runway overrun. Additionally, organizational failures of Southwest Airlines were identified to include:

1) failure to properly introduce and train its pilots on company guidelines regarding procedures related to arrival landing distance calculations;
2) programming and design of the on board performance computer, which did not present inherent assumptions in the program critical to pilot decision-making;
3) implementing new autobrake procedures without a required familiarization period; and
4) lack of procedures to calculate a safety margin in arrival assessment to consider operational uncertainties.

Findings

The focus of this accident study was to identify the failures in a top-down approach at each of the four levels of the HFACS framework that failed to be corrected before the mishap occurred.

Organizational Influences: Southwest Airlines’ failure to provide standardized operational guidance for pilots on the topics of thrust reverser policies, mixed braking action reports, and auto brakes procedures

Unsafe Supervision: Organizational failure to explicitly and routinely introduce the previously mentioned topics in pilot training to allow appropriate time for familiarization of procedures

Preconditions for Unsafe Acts: Poor meteorological conditions including heavy snow, low visibility, and poor runway braking action combined with poor aeronautical decision making by the pilots resulting from lack of standard procedures training

Unsafe Acts: Crew’s failure to immediately apply reverse thrusts upon touchdown, correctly calculate arrival landing distances on the on board performance computer, familiarly operate autobrake system

By applying the HFACS framework to Southwest Airlines flight 1248, latent failures in the upper levels of organizational operation are identified as conditions that prompted unsafe acts by the crewmembers.

Conclusion

The analysis of the accident involving Southwest Airlines flight 1248, using the HFACS framework, clearly demonstrated that latent failures in the upper organizational levels can propagate to operations at lower levels and create conditions for unsafe acts to occur as active failures by crewmembers. The HFACS framework can be progressively applied to appropriately identify latent failures that require attention for successful mitigation and prevention of similar future accidents.

References


Acknowledgments

Dr. Flavio Antonio Coimbra Mendonca, Assistant Professor of Aeronautical Science, ERAU