PRISM SOLUTIONS

RESEARCH BRIEF

Research Request:

Controlled Flight Into Terrain (CFIT) Accidents–

Organizational Factors

Research Response:

Introduction

Aviation operations gain safety margin from increased knowledge and awareness of the factors involved in preventing CFIT. In a great many CFIT accidents, systemic factors made the flight crew the final link in the accident chain of events. Thus, in order to significantly reduce CFIT accidents, existing aviation systems that facilitate error must also be improved. Management must ensure that a viable and effective CFIT accident prevention program is in place within its organization.

Organizational Factors

There are many factors that lead to CFIT accidents. Accidents and incidents do not normally happen because of one decision, or one error. They rarely happen because the flight crew knowingly disregarded a good safety practice. Accidents and incidents happen insidiously. Flight crews fall into traps—some of their own making and some that are systemic. We all accept that the flight crew has the final responsibility for preventing a CFIT accident, but if many of the factors normally associated with these accidents were eliminated, or at least mitigated, the potential for flight crew errors would be lessened.

In any critical review of CFIT incidents or accidents, it becomes evident that there exist many interrelated factors that contribute to the causes of CFIT accidents. All of these factors are derived from some level of decision making. It is accepted that the flight crew is the last line of defense in preventing a CFIT accident, and that they make operational decisions that are critical to a safe flight. But what about the insidious factors?

The overarching responsibility for aviation safety within a company is at the top level of management. There must be a commitment at this level to reducing CFIT accidents. This is where the safety culture is established, and this is where many of the contributing factors to a CFIT accident must be eliminated. Decision Makers are those people in organizations who make or influence policy matters. Many contributing factors associated with CFIT accidents are embedded in policies and decisions made by these Decision Makers. In fact, many recommendations or strategies can only be successful if they are supported and implemented by the Decision Makers.

The reality is that humans make errors and always will, and, therefore, there will always be some level of risk associated with the aviation industry. The goal at the Decision Makers level must be management of this risk. Each level of authority has the capacity to implement recommended CFIT avoidance strategies and achieve worthwhile results independently of other levels. When all levels do so in coordination with one another, the maximum effect can be achieved.

Reducing CFIT accidents requires recognition that such accidents are system induced; that is, that they are generated by shortcomings in the aviation system, including deficiencies in the organizations that constitute that system. Such understanding will preclude the piecemeal approaches based on design, training, or regulations which have plagued past safety initiatives. Looking into the organizational context permits one to evaluate whether organizational objectives and goals are consistent or conflicting with the design of the organization, and whether operational personnel have been provided with the necessary means to achieve safety goals.

Management creates the safety culture that affects everyone within the organization. Although not a distinct component of the model employed as an analytical tool, corporate culture deserves special mention, since it has been recognized as one of the most important and effective barriers against hazards and safety breakdowns in high technology systems. Management must put safety into perspective, and must make rational decisions about where safety can help meet the objectives of the organization. From an organizational perspective, safety is a method of conserving all forms of resources, including controlling costs. Safety allows the organization to pursue its production objectives without harm to human life or damage to equipment. Safety helps management achieve objectives with the least risk.

Historically safety initiatives have originated at the institutional levels closest to the accident, i.e., operators. This has improved performance, and it has resulted in enhanced aviation safety; however, the industry has reached the point of diminishing returns from this approach. A greater expenditure of resources at the operational end of the system will not result in proportionate safety benefits

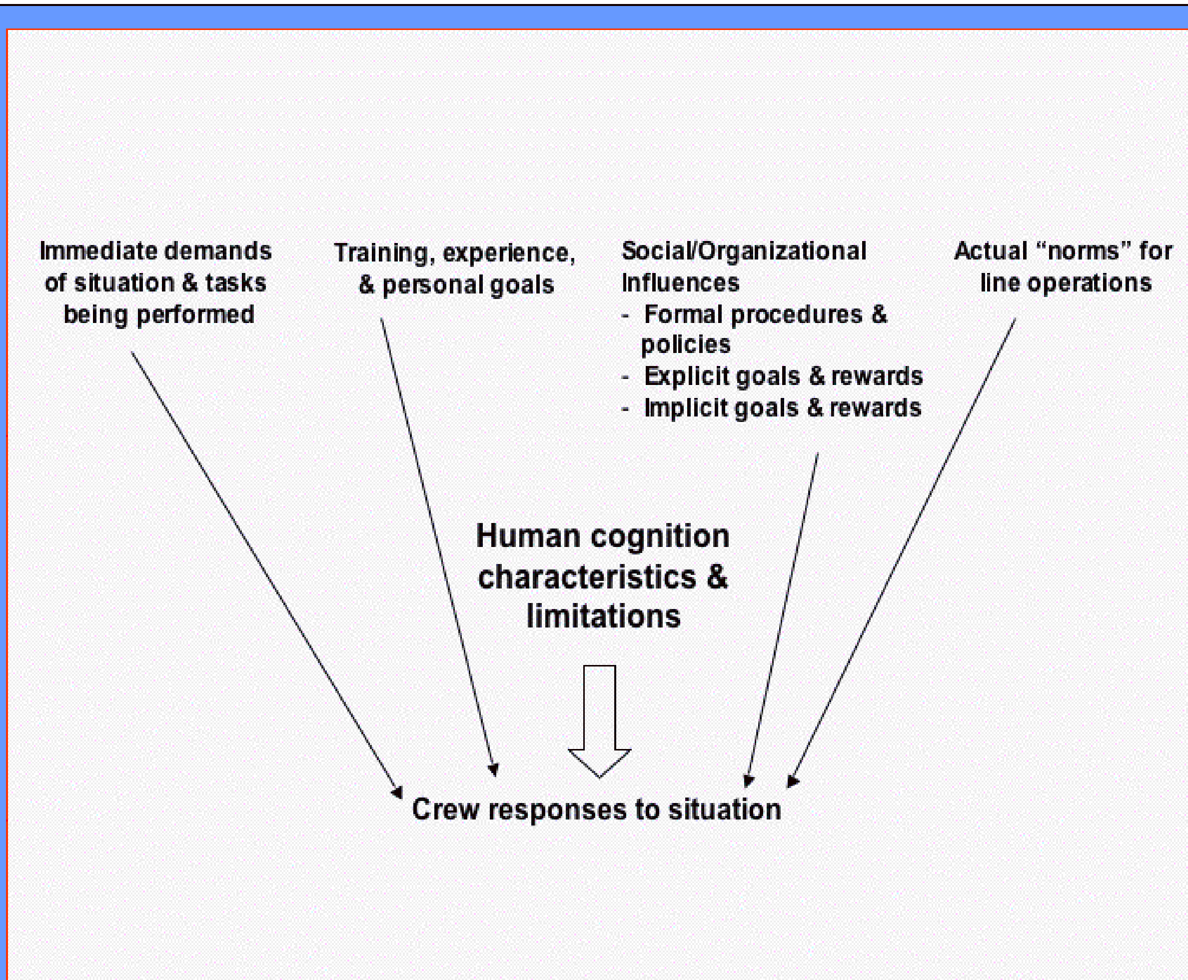
Specific Strategies

Decision Makers are responsible for the broad scope of the operation, and they set the tone for the everyday routine. They must listen to those people who accomplish the day-to-day tasks, take appropriate action based on data obtained from operational performance monitoring systems, and be able to adjust the overall scope to meet the operational challenges. All who are involved must work as a team to prevent CFIT. This includes the flight and cabin crew, the mechanics, and the leading managers.

The majority of CFIT incidents/accidents are known to occur in IMC and at night, when the pilot flying the approach also lands the aircraft. Proper management of flight crew workload at night and during IMC requires that precise and unambiguous procedures be established. It is recommended that operators consider adopting a monitored approach procedure during approaches and missed approaches conducted in these conditions. In this case, the First Officer will fly approaches and missed approaches. The Captain will monitor approach progress and subsequently land the aircraft after obtaining sufficient visual reference.

Decision Makers should support effective Crew Resource Management (CRM) and ensure that it is the normal way that flight crews operate within their organization. This is essential for safe and orderly operation of flights.

Influencing Conditions Stimulate Errors



These are the factors that influence the efficiency and reliability of human performance in a particular work context. The following tables present a breakdown of local working conditions and list the principal factors.

Table 3. Situational and task factors

Error factors	Common factors	Violation factors
Change of routine	Time shortage	Violations condoned
Negative transfer	Inadequate tools and equipment	Compliances goes unrewarded
Poor signal-noise ratio	Poor procedures and instructions (ambiguous or inapplicable)	Procedures protect system not person
Poor human-system interface	Poor tasking	Little or no autonomy
Poor feedback from system	Inadequate training	Macho culture
Designer-user mismatch	Hazards not identified	Perceived licence to bend rules
Educational mismatch	Undermanning	Adversarial industrial climate (them and us)
Hostile environment	Inadequate checking	Low pay
Domestic problems	Poor access to job	Low status
Poor communications	Poor housekeeping	Unfair sanctions
Poor mix of hands-on work and written instructions (i.e., too much reliance on knowledge in the head)	Bad supervisor/worker ratio	Blame culture
Poor shift patterns and overtime working	Bad working conditions	Poor supervisory example
	Inadequate mix of experience and inexperienced workers	Tasks affording easy shortcuts

Table 4. Personal factors

Error factors	Common factors	Violation factors
Attentional capture	Insufficient ability	Age and gender
Preoccupation	Inadequate skill	High risk target
Distraction	Skill overcomes danger	Behavioural beliefs
Memory failures	Unfamiliarity with task	(gains outweigh risks)
Encoding interference	Age-related factors	Subjective norms
Storage loss	Poor judgement	condoning violations
Retrieval failure	Illusion of control	Perceived behavioural
Prospective memory	Lease effort (cognitive	control
Strong motor programs	economics)	Personality
Frequency bias	Overconfidence	Non-compliant
Similarity bias	Performance anxiety	Unstable extravert
Perceptual set	(deadline pressures)	Low morale
False sensations	Arousal state	Bad mood
False perceptions	Monotony & boredom	Job dissatisfaction
Confirmation bias	Emotional stress	Attitudes to system
Situational unawareness		Management
Incomplete knowledge		Supervisors
Inaccurate knowledge		Discipline
Inference & reasoning		Misperception of hazards
Stress & fatigue		Low self-esteem
Disturbed sleep patterns		Learned helplessness
Error proneness		

2) Inadvertent Slips/Oversights in Practiced Tasks under Challenging Conditions

- Probability of commonplace errors goes up with workload, time pressure, fatigue and stress
- Snowball effects: events/decisions/actions increase workload, time pressure, and stress downstream, increasing chance of more problems and errors

Stress

- Hard to evaluate extent, but stress is normal physiological/behavioral response to threat
- Acute stress hampers performance
  - Narrows attention (“tunneling”)
  - Reduces working memory capacity
- Combination of surprise, stress, time pressure, and concurrent task demands can be lethal setup

Conclusion

There is no single solution to avoiding CFIT accidents and incidents. All the factors are interrelated, with their level of importance changing with the scenario. This brief has focused on some the organizational factors, but be aware, there are many traps with constant presence!

The answer to CFIT occurrences lies in looking at them from a systems perspective, and act upon the latent failures which have slipped into the system, ready to combine with operational personnel active failures, further compounded by adverse environmental conditions, can combine to produce an accident. Examples of these latent failures include poor strategic planning of operations, absence of clear channels of communication between management and operational personnel (a widely lamented but seldom acted upon typical system failure).

System failures, such as incompatible goals, poor communication, inadequate control, training and maintenance deficiencies, poor operating procedures, poor planning and other organizational deficiencies are indentified as modern accident causations responsible for disasters in high technology systems. Periodic checking of these system "health condition" markers and continuously actioning upon them remain the single most important keys to reduce CFIT occurrences.

Sources: Flight Safety Foundation CFIT Task Force Final Report;

The Limits of Expertise: The Misunderstood Role of Pilot Error in Airline Accidents
By Key Dismukes and Loukia Loukopoulos

Accident Examples

FINAL REPORT

HCL 49/01 Accident
Aircraft Type: Dassault Falcon 20
Engine(s): 2 CF 700-2D2
Crew: 2- fatal injuries
Place: 4.5 nm SW of Narsarsuaq (BGBW)

Aircraft Registration: D-CBNA
Type of Flight: Charter, IFR
Passengers: 1- fatal injuries
Date and Time: 05.08.2001 0443 UTC

On the final approach to runway 07 at Narsarsuaq (BGBW), the aircraft impacted mountainous terrain 4.5 nm SW of the aerodrome. The flight crew and the passenger were fatally injured. The aircraft was destroyed. The accident occurred in dark night and under visual meteorological conditions (VMC).

The flight, during which the accident occurred, was part of a non-scheduled international cargo flight from Gdansk (EPGD) to Louisville (KSDF). The flight crew had previously on August 4, 2001, on another charter flight, flown the aircraft from Hanover (EDDV) to Palma de Mallorca (LEPA) and then to EPGD in order to bring the aircraft in position for the cargo flight.

1.17 Organisational and management information

1.17.1 The Management of the Operator.

1.17.1.1 The Operator was a one-man owned company. The Commander was the owner of the company. In the JAR-OPS 1 organisation, the Commander acted as the Accountable Manager and as the nominated post holder of Flight Operations. The First Officer acted as the nominated post holder of the Maintenance System, the Crew Training and the Ground Operations. The passenger was employed as First Officer.
1.17.1.2 At the time of the accident, the Operator had a total number of 7 employees, of which two were employed as freelance pilots, one as Quality Manager and one as Administrator.

2.3.4 In combination with fatigue, another contributing element to the accident might have been stress, since the flight was chartered to deliver the cargo in KSDF at 0900 hrs on August 5, 2001. When leaving EPGD, the flight was more than two hours late. The handling agent in BIKF stated that the Commander seemed stressed.

Accident Examples

NTSB Identification: **DCA89MA026**.
The docket is stored on NTSB microfiche number **37878.**
Nonscheduled 14 CFR
Accident occurred Sunday, February 19, 1989 in CORONA, CA
Probable Cause Approval Date: 06/01/1990
Aircraft: CESSNA 402B, registration: N69383
Injuries: 10 Fatal.

THE PLT WAS OPERATING AN ON-DEMAND AIR TAXI PASSENGER FLT TO SANTA ANA, CA. THE ACDT OCCURRED DRG DESCENT, WHEN THE ACFT COLLIDED WITH A MTN AT 2060 FT MSL. THE PLT HAD RCVD A PREFLT WX BRIEFING IN WHICH HE WAS ADVISED OF LOW CEILINGS AND REDUCED VIS IN THE LOS ANGELES BASIN, SURROUNDING MTNS OBSCURED BY CLOUDS, AND THAT VFR FLT TO SANTA ANA WAS NOT RECOMMENDED. HE DEPARTED VFR. WHILE EN ROUTE, THE PLT WAS ADVISED THAT SANTA ANA WAS REPORTING 1400 FT OVCST WITH 5 MILES VIS. A VIDEOTAPE RECORDED BY A PASSENGER SHOWED MTN PEAKS PROTRUDING THROUGH A SOLID CLOUD LAYER AND SHOWED THE ACFT DESCENDING INTO THE CLOUDS. WITNESSES DESCRIBED A LOW CLOUD CEILING NR THE CRASH SITE AND CLOUD TOPS AT 5000 FT. EXAMINATION OF THE WRECKAGE REVEALED EVIDENCE OF POWERED FLT AND NO EVIDENCE OF PREIMPACT CONTROL OR ENGINE MALFUNCTION. RECORDS INDICATED THAT THE PLT HAD ENCOUNTERED IMC ON ONLY 1 FLT IN THE PREVIOUS 9 MOS. HE WAS DIR OF OPNS FOR THE OPERATOR.

The National Transportation Safety Board determines the probable cause(s) of this accident as follows:
THE PILOT'S FAILURE TO PROPERLY PREFLIGHT AND PLAN FOR FLIGHT AND HIS INTENTIONAL FLIGHT INTO IMC CONDITIONS. FACTORS CONTRIBUTING TO THE ACCIDENT WERE THE LOW CEILING CONDITIONS IN CONJUNCTION WITH THE MOUNTAINOUS TERRAIN.

Accident Examples

EXECUTIVE SUMMARY

On October 24, 2004, about 1235 eastern daylight time, a Beech King Air 200, N501RH, operated by Hendrick Motorsports, Inc., crashed into mountainous terrain in Stuart, Virginia, during a missed approach to Martinsville/Blue Ridge Airport (MTV), Martinsville, Virginia. The flight was transporting Hendrick Motorsports employees and others to an automobile race in Martinsville, Virginia. The two flight crewmembers and eight passengers were killed, and the airplane was destroyed by impact forces and postcrash fire. The flight was operating under the provisions of 14 Code of Federal Regulations (CFR) Part 91 on an instrument flight rules (IFR) flight plan. Instrument meteorological conditions (IMC) prevailed at the time of the accident.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of this accident was the flight crew's failure to properly execute the published instrument approach procedure, including the published missed approach procedure, which resulted in controlled flight into terrain. Contributing to the cause of the accident was the flight crew's failure to use all available navigational aids to confirm and monitor the airplane's position during the approach.

Postaccident Actions

After the accident, Hendrick Motorsports made immediate, short-term, and long-term changes to the company’s organization, practices, and equipment. Some of these changes had already been planned or were in progress at the time of the accident and were further enhanced as a result of the company’s participation in the investigation.

Hendrick Motorsports installed an EGPWS on each aircraft. The EGPWS provides pilots with a pictorial view of terrain (displayed on the radar screen, the multifunction display, or the GPS screen) in addition to aural warnings (as provided by the EGPWS). The company also installed a traffic alert collision avoidance system in each aircraft. Further, the company installed new Garmin GPS 400 units (with EGPWS) in Beech

1900 airplanes. In addition, the company moved the terrain depiction on the Gulfstream II from the global navigation system screen, which is mounted on the center console, to the radar screen on the front instrument panel, which is directly in the pilot's view.

Hendrick Motorsports created three new positions: aviation director, safety program manager, and full-time dispatcher. (The company previously had a part-time dispatcher.) The company's chief pilot was selected as aviation director and was responsible for the oversight of the entire aviation department. (The most senior company pilot was then promoted to chief pilot.) The responsibilities of safety program manager were added to the duties of a newly hired pilot who had a background in safety for a major airline. Along with the staffing changes, Hendrick Motorsports established a safety committee that comprised staff members from the company's operations, flight, and maintenance departments and hired an independent safety consulting firm to review the flight department's operations.