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EMERGENCY MANAGEMENT SYSTEM OF THE AVIATION, PRINCIPLES OF PROTECTION OF THE PASSENGERS

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Annotation. An aviation emergency response plan provides specific steps for a company to take after an aircraft accident has occurred to protect your business. Insurance companies often look favorably upon ERPs because it shows prior preparation in the case of an incident or accident. A lot of research in Air Traffic Control (ATC) has focused on human errors in decision making whilst little attention has been paid to the cognitive strategies employed by controllers in managing abnormal situations and This study looks into cognitive strategies in taskwork that enable controllers to become resilient decision-makers. Two field studies were carried out where novice and experienced controllers were observed in simulator training in emergency and unusual scenarios. This article reveals such concepts as: An emergency situation, types of emergencies, ways to prevent them, decisions needed to be taken by management in such a difficult situation.

Keywords: emergency; control system; management in civil aviation; abnormal situations; aviation safety; Air Transportation Safety.

An emergency situation is one in which the safety of the aircraft or of persons on board or on the ground is endangered for any reason.

An abnormal situation is one in which it is no longer possiible to continue the flight using normal procedures but the safety of the aircraft or persons on board or on the ground is not in danger.

Emergency or abnormal situations may develop as a result of one or more factors within or outside an aircraft, for example:

- Fire on board the aircraft;
- Aircraft component failure or malfunction (e.g. engine failure, landing gear malfunction or loss of pressurisation);
- Shortage of fuel (or other essential consumable substance);
- Flight crew uncertain of position;
- Worsening weather;
- Pilot incapacitation (e.g. as a result of illness);
- Aircraft damage (e.g. as a result of collision, bird strike or extreme weather;

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- Illegal activity (e.g. bomb-threat, wilful damage or hi-jacking).

An emergency or abnormal situation may result in it being impossible to continue the flight to destination as planned, resulting in one or more of the following outcomes:

- Loss of altitude;
- Diversion to a nearby aerodrome;
- Forced landing.

Constant increases in the volume of air traffic impose demands on front-line ATC practitioners in terms of managing intensive tempos of operations and coping with multiple goals. Emergencies and abnormal situations are common place in ATC, challenging the stability of the system and driving it towards the boundaries of safe operation. Controllers have to intervene to contain any disturbances in the work environment and their performance has become one of the most significant elements of ATC compensation mechanisms. The joint human and technical system is stretched to accommodate new increases in the volume of traffic which often competes for resources required for managing safety.

Undeniably, improvements in technology to manage new intensive tempos of operations may further stretch the cognitive capacity of air traffic practitioners.

The ATC system is a prime example of the application of the law of stretched systems (Woods and Hollnagel, 2006). In this sense, emergencies and abnormal situations are a fertile ground for stories of resilience which can stipulate human factors research; hence, a need arises to examine the decision-making of controllers in abnormal situations.

Managing emergencies & abnormal situations in air traffic control

Controllers work in a complex and dynamic environment which requires continuous processing of critical and uninterrupted flows of information generated by an interleaved net of Communication, Navigation and Surveillance (CNS) systems. The ATC is a complex safety critical system with the following work characteristics:

1. Rapidly Escalating Situations: The transition from normal to abnormal situations can be rapid – e.g., an aircraft experiencing a decompression can initiate a rapid descend of 6,000ft per minute affecting the safety of other aircraft, without any prior notice.

2. Severe Time Pressure: Available time for decision-making and coordination is severely constrained – e.g., in a loss of separation scenario, the conflict geometry must be detected and resolved within a few seconds.

3. Severe Error Consequences: Errors can lead to disasters when compensating mechanisms (e.g. automation safety nets) are not be present or act in destabilizing ways.

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4. Complex, Multi-Component Decisions: Controllers may have several degrees of freedom (e.g., change the flight level, the speed and the route of aircraft) but their decisions may be in conflict with other goals.

5. Conflicting/Shifting Goals: The goals of Safe, Orderly and Expeditious flow as imposed by the International Civil Aviation Authority (ICAO, 2001) are conflicting and consequences may cascade from system design down to the tactical level of day-to-day operations. For example, an orderly flow of air traffic may be a safe flow but not an expeditious one. In this operational context decision-making is an intensive, stressful and cognitively complex activity.

During their professional careers, controllers are expected to manage successfully a wide range of emergencies and abnormal situations from air misses (e.g., loss of nominal separation between two aircraft) to complex emergencies where information uncertainty prevails (e.g., the Helios 522 accident) or system wide problems occur suddenly (e.g., the terrorist attacks on the 9/11). Emergencies may represent simple textbook cases or may occur suddenly, following unfamiliar escalation patterns.

Although flight crews are usually credited with the main cognitive burden of managing an emergency, it is also widely accepted that the handling of emergencies is affected by the communication and coordination with the air traffic controllers (Burian et al., 2005). Euronontrol acknowledged the significance of handling emergencies and conducted a research project involving controllers and airline pilots. The outcome was a standard model for handling unusual occurrences - ASSIST (Acknowledge – Separate – Silence – Inform – Support - Time) – which was incorporated in training manuals for controllers (EATMP, 1999; 2004).

ASSIST was not intended to replace local emergency procedures but rather to act as a generic mnemonic model that could accommodate local procedures.

It is quite similar to several aeronautical decision models and provides a mnemonic function for available local procedures, or a tool for structured decision making in unfamiliar situations.

It is apparent that emergencies present controllers with many challenging issues. Threats and concerns must be detected promptly because time is limited and original plans must be modified as the situation evolves over time and new threats may appear. There is a need for monitoring information continuously in order to fill in gaps, correct explanations and clarify assumptions. This calls for strategies in anticipating how the situation will evolve in future and when to engage extra members in the operation. These cognitive strategies in taskwork are important sources of resilience that provide a good basis for debriefing controllers after critical events, developing training programs, and comparing alternative automation designs.

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The main aim of this paper was to produce a taxonomy of taskwork strategies in air traffic control and support their measurement on the basis of observations of behaviours in the simulator or the operating context.

The approach was based on ergonomic research methods widely adopted in aviation (Seamster et al., 1993; Flin et al., 2003), the military (Cohen et al., 1996) and process control (Kontogiannis, 1996; Woods and Hollnagel, 2006). The study is divided into the following phases: (i) a literature review to develop a taxonomy of taskwork strategies, (ii) a validation of the taxonomy in the context of a study of novice and expert controllers, and (iii) a comparison of strategies employed by novice and experts.

On the one hand, the RPD model looks into the processes of recognition and rapid decision making required in dynamic work whilst the R/M model expands on strategies for managing uncertain and unfamiliar situations. On the other hand, COSMO focuses on aspects of anticipation and contingency planning whilst the anomaly response model explores the interaction of cognitive processes such as recognition, (re-) planning and diagnosis. Specific models of performance in air traffic control (Reynolds et al., 2002; Oprins et al., 2006) and cognitive analysis of ATC tasks (i.e., Seamster et al., 1993; Kallus et al., 1999) have also been used to tailor the generic models of decision making into the requirements of the operational context of ATC emergencies and abnormal situations. The model was termed T2EAM (Taskwork & Teamwork strategies in Emergency Air Traffic Management) and was based on a core set of five cognitive strategies: anticipation, recognition, uncertainty management, planning and workload management.

To establish a suitable structure for the taxonomy of taskwork skills, we adopted the format of the European behavioural marker system for rating pilot’s non-technical skills – NOTECHS (Flin et al., 2003). This has a tri-level hierarchical structure of skill categories (e.g., recognition), elements (e.g., noticing distinguishing cues) and behavioural markers (e.g., identifying military aircraft as a threat). Performance can be rated at both the category and element levels depending on the purpose of assessment and the amount of feedback detail required. The behavioural markers are intended to help external raters to recognise the types of behaviour associated with the performance of each element.

Table 1 summarizes the five categories of cognitive strategies and their elements for dyadic teams in air traffic control.

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Table 1 : Cognitive strategies (taskwork categories and elements) of T^2EAM

Taskwork categories	*Elements*
Recognition	Noticing cues and recognizing states
	Projecting & estimating states
Uncertainty management	Critiquing models of the situation
	Critiquing goals and responses
Anticipation	Acknowledging threats
	Exploiting less busy periods to plan
Planning	Standard planning
	Contingency planning
Workload management	Prioritizing tasks
	Managing interruptions and distractions

Behavioural markers were also developed in the form of 'exemplar behaviours' to increase the reliability of taskwork assessments (Table 2).

Table 2. 'Exemplar behaviors' for managing uncertainty

• Builds a comprehensible model of the situation by collecting all relevant information from the onset of emergency rather than collecting data in a peace-meal fashion. • Critiques model of situation (even though it looks familiar), verifies assumptions and does not disregard new evidence that is inconsistent with existing model.
• Asks flight crews to offer additional information to verify assumptions. • Requests route and altitude information for military traffic in the sector when intentions of aircraft have not been specified. Critiquing goals and responses • Builds a model of response but critiques priorities to account for new evidence. • Makes a quick test of time to decide whether further critiquing of responses is feasible. • Makes a decision on whether to take immediate action or continue investigating the nature of an observed altitude or route deviation.
• Decides how long to persist in establishing two-way communications with suspect ground radio communications or switch to secondary frequencies or backups.

A runway incursion happens where two or more vehicles are either on the same runway or approaching the same runway which can result in a conflicting situation. This can also be defined as "An event at an airfield involving the incorrect presence or a vehicle, aircraft or person on the protected area of the surface designated for the landing and taking off of an aircraft".

- The following general observations were seen to be the most common consequences;

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- Mistaken entry of an aircraft or vehicle onto the runway protected area without ATC clearance;
- Misidentified presence of a vacating aircraft or vehicle onto the runway protected area;
- Wrong runway crossing by an aircraft or vehicle without or against ATC instructions;
- Landing without ATC clearance;
- Take-off without ATC clearance;

Other main factors that can increase the possibility of incursions occurring include the following:

- Low visibility may increase the chance of a pilot becoming disorientated and unsure of their position whilst manoeuvring along taxiways. These conditions are also likely to restrict ATC‟s ability to identify and follow the aircraft visually.

- The design of the taxiway infrastructure which requires aircraft to cross an active runway to travel between its take-off or landing runway and the parking position, brings additional risk of an incident potentially occurring.

- Line ups for a series of aircraft departures from the same runway but from different entry positions could lead to an increased risk for runway incursion occurrences.

- Late changes to departure times and clearances may lead to a temporary lack of concentration in the pilots attentiveness.

-Use of Non-Standard Terminology can lead to confusion and misunderstanding between the pilots and controllers.

-Simultaneous use of more than one Language for communications between ATC and vehicles crews.

The FAA estimates that there are approximately three runway incursions that happen every day at towered airports in the United States. The main cause for these incursions can be categorised as:

Incorrect entry of an aircraft or vehicle onto the runway protected area without or contrary to ATC clearance ,Incorrect presence of a vacating aircraft or vehicle onto the runway protected area.

The 4 categories of runway incursions:

- **Category A** is a serious incident in which a collision was narrowly avoided.
- **Category B** is an incident in which separation decreases and there is a significant potential for collision, which may result in a time critical corrective/evasive response to avoid a collision.
- **Category C** is an incident characterised by ample time and/or distance to avoid a collision.

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- **Category D** is an incident that meets the definition of runway incursion such as incorrect presence of a single vehicle/person/aircraft on the protected area of a surface designated for the landing and takeoff of aircraft but with no immediate safety consequences.

Air travel is one of the safest modes of transportation in the world, with millions of passengers flying every day without incident. This is due to the rigorous safety standards and regulations that govern the aviation industry, as well as the training and experience of pilots, air traffic controllers, and other aviation professionals.

The aviation industry is committed to maintaining high levels of safety, and there are multiple layers of safety measures in place to ensure that flights are as safe as possible. These measures include:

1. Compliance with Regulations: Aviation is one of the most regulated industries in the world, with strict rules and regulations that govern every aspect of flight operations. These regulations cover everything from the design and manufacture of aircraft to the training and certification of pilots and air traffic controllers.

2. Pre-Flight Checks: Before every flight, pilots and ground crew perform a series of checks to ensure that the aircraft is in optimal condition for flight. These checks include inspecting the exterior and interior of the aircraft, checking the fuel levels, and reviewing the flight plan.

3. Pilot Training: Pilots undergo extensive training to obtain their licenses, and they must continue to receive regular training and certification throughout their careers. This training includes simulation exercises that simulate emergency situations, so pilots are prepared to handle any unexpected events that may occur during a flight.

4. Air Traffic Control: Air traffic controllers play a critical role in ensuring the safety of air travel. They monitor the movements of aircraft, provide pilots with instructions, and alert them to any potential hazards or conflicts. Air traffic controllers undergo rigorous training and certification to ensure that they are capable of handling the complexities of air traffic control.

Despite these safety measures, accidents can still occur. When they do, the aviation industry works diligently to investigate the cause of the accident and implement measures to prevent similar incidents from happening in the future. The industry also uses data and analysis to identify trends and areas for improvement, so safety standards can continue to evolve and improve over time.

Emergency management compulsory part of the aviation safety. This method of air traffic control methods is used in various countries (USA, China, Japan, Spain), as well as in the Uzbekistan, but when managing in an emergency, it is used arbitrarily, according to the place and nature of accidents in an emergency.

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