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HUMAN ERROR – COCKPIT VULNERABILITIES

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Abstract: *The present paper aims to underline the importance of the crew in the aeronautical activity. Apart from personal talent, the aptitudes of each member of the crew and, not at least, the level of knowledge of the flying crew, the knowledge and training for the purpose of communicating, tasks distribution, decision making and hierarchy within the aircrew represent some key elements for success regarding flight safety.*

Key words: *flight safety*, *Crew Resources Management, leader, communication, flight deck, training.*

1. INTRODUCTION

"To learn out of experience is reasonable, yet, to the same lesson twice is unacceptable!" [2].

There are hardly any human activities that do not imply certain risks. We can only distinguish between hazardous activities and activities that are less risky.

We can say that the main objectives of safety in the field of aeronautics is to reduce to minimum losses of resources, especially human resources, which are difficult to replace if one takes into account the investment of time and training involved.

In order to accomplish this objective it is necessary for the management to focus on several directions [1]:

- identification and elimination of hazard conditions that may generate difficulties;
- establishment of a framework for limiting risks to as lower a level as possible;
- awareness raising, training and checking of the crew in the light of obeying operational safety measures;
- reports drawing with regard to latent hazard situations identified;
- effectiveness improvement of safety management system based on periodical activity analyses at all hierarchical levels.

2. NECESSITY OF ADHERING TO CRM CONCEPT

Starting from the main resource of any organization, the HUMAN being, researches done for increasing service safety (in each particular area of human activity) concentrated on reducing human errors with secondary effects on productivity, effectiveness and especially on the human resources lives and health. The first step in identification and reduction of latent deficiencies in the chain of hazards causality was achieved in the field of aviation.

Thus, two years after the air disaster of 1977 that occurred in Tenerife, when two Boeing 747 aircraft crashed on the runway, causing the death of 582 people aboard, the National Aeronautics and Space Administration (NASA) organized a workshop on the topic of "Resources Management on the Flight Deck". As a result of debates, human error or the pilot's error was no longer considered the main cause of air crashes. Thus, the conclusion was that flights safety does not rely only on the pilots' possibilities, skillfulness or capacity of flying their aircraft or on the good functioning of the technique, but also on existent interpersonal relationships within the crew, relationships that may alter the reaction capacity or the attention of any crew member holding responsibilities in the flight deck. Consequently, NASA introduced the CRM term (Cockpit Resource Management), a concept based on warning crews against deficiencies in information management, decision making and communication among the air crew members and of leadership from the flight deck.

The term and also concept of CRM was intensely spread world wide and it was developed so that it was implemented in each and every sector of human activities, not only related to aviation organization, although initially it was met with reticence. Once the CRM had developed, it was replaced by Crew Resource Management or Company Resource Management, in accordance with various necessities.

The foundation for the development of the actual CRM concept was represented by unbeatable realities of the human nature:

- the human being is subjected to error;
- the human being is unique, people have various personalities, specific cultures, each individual holding special talents and aptitudes.

3. WHAT IS CRM?

CRM stands for the correct use of all existent resources (crew, aircraft, flight controls, information) for the purpose of obtaining maximum performance regarding the operational effectiveness [4].

- It is a training method meant to optimize human performance in adequate interrelating through the reduction of human factor error reduction and through the use of all available resources, in the process of problem solving;
- A system that takes into account defining elements such as:

1. The manner in which safety is affected by the behavior and attitude of a crew's members;
2. The crew is an indivisible whole, an individual;
3. The training is performed more practically than theoretically;
4. A clear description of each member's responsibilities;
5. The preservation of the subordination relation and equally, the formation of an effective crew;
6. The possibility for the members of the crew to re-analyze and improve their performance.

One of the settings for the crew resources management is represented by Threat and Error Management - TEM, a concept that implies the recognition and avoidance of errors that are part of the operational activity. The mere observation of errors, without identifying the factors contributing to the error, makes it hard to understand what is to happen. Threats and the manner in which the crew are aware of them and manage them were included as observations so that to allow for the description of a specific event and of the entire instance that may lead from the phase of threat to catastrophe.

The three concepts of TEM are as follows [5]: *threats, errors and the undesired aircraft state (unwanted position of the aircraft).*

The term *threat* refers to external conditions that endanger the flight safety during the aircraft operation. Threats may be defined in terms of events and errors that:

- Occur without being initiated by the crew;
- Increase the piloting and the flight complexity;
- Require increased attention on behalf of the crew for maintaining the safety condition of the flight.

One threat that was not identified and annulled in due time is correlated with the crew error (piloting error). In other words, a threat that is incorrectly managed represents an *error*. Accordingly, *error* is defined as being an action or the crew's lack of action that:

- Leads to a deviation from the course of intentions or expectations of the crew;
- Decreases the flight safety due its surpassing safety measures;
- Increases the probability of an unwanted event to occur.

The undesired (difficult to control) position of the aircraft may be defined as the aircraft trim for which altitude, speed or configuration:
- Emerge from the crew's piloting errors (inadequate actions or lack of action);
- Endanger obviously safety measures.

4. WHY CRM?

Examples or theories regarding the importance of CRM are numerous. But why is the training for CRM necessary, or, why does the crew have to act as a unitary whole? Further, we will focus on a case study related to crew teamwork during flight; we will attempt to highlight threats, errors as well the undesired position of the aircraft at a certain moment, the crew ineffectiveness due to external pressures and vulnerabilities that may lead to catastrophe.

4.1. Case Study. It was a dull day, with low temperature and fog. It happened somewhere in the Russian Federation airspace. The sky was overcast with Stratus clouds, the flight level was around 3800 meters, and the ground was not visible. On approach, at approximately 1000 meters away from the threshold the aircraft hits some tree tops than crashes against the ground. As a result of the impact, all people aboard died.

For landing, the crew established radio contact with the "Severny" military aerodrome by means of the ATC call sign "Korsaj". It was a military passenger transport aircraft, of Russian production, but which did not belong to the Russian Federation. Aboard it there were 8 crew members and some other 88 passengers, each of whom occupied high positions in state and in the military. The flight was international, of the VIP type, considered to be "A" class.

As a result of the radio contact with the "Korsaj" ATC, communication was in Russian, not in English, so as international standards required. The crew's level of knowledge of Russian was not known. Nevertheless, it was proved by the CVR (Cockpit Voice Recorder) that the PIC's (Pilot in Command) level of knowledge of phraseology in Russian was SATISFACTORY.

The beginning of the series of events that were about to lead to catastrophe is represented by the first pieces of information given by the Korsaj ATC, regarding meteorological conditions: *fog, visibility 400 meters, improper landing conditions.* The crew gives the read back and acknowledges the received information. The same information regarding visibility conditions are given out in an evident emotional manner by the pilot of a different aircraft, of the same nationality, who had landed previously on Severny aerodrome, suggestion that he *might* attempt to land.

In this moment, the only wise decision of the military passenger transport aircraft would have been to divert its route to an alternate aerodrome. However, the PIC requested from the ATC approval of approaching in the intention of an *attempt* to land.

The aircraft crew intercepted the slide path. The approach in these conditions was a classical one (2 NDB – Non Directional Beacon and radar approach) due to the lack of ground advanced operating system (ILS – Instrument Landing System). ATC announced the crew that the minimum descent altitude - MDA using this procedure was 100 meters (should the crew not have visual contact with the ground upon reaching the altitude of 100 meters, either in terms of runway markings or

beacons, the crew has to initiate missed approach). Along the slide path:
- PIC descended below 100 meters without interacting with the crew;
- the navigator was reading the altitude using a radio altimeter and not a barometric altimeter;
- one of the altitude gauges was set on standard pressure (1013 hPa), which led to the display of three different values of the altitude;
- the crew did not react at any of the ”TERRAIN AHEAD” cautions, nor against the ”PULL UP” warning;
- PIC ignored the CP indications of missed approach at an altitude of 65 meters on the radio altimeter;
- the vertical descent speed was very high (8m/s represents almost the double of recommended speed);
- the cruise speed was 300 Km/h instead of 265 km/h.

The last minute decision to initiate a missed approach at an altitude of approximately 10 meters high (on the radio altimeter) represented an instinctive, rapid and uncontrolled thought that probably appeared at the moment when the PIC noticed the height based on ground markings.

4.2. Crew errors. Following the quick analysis of the sequence of events, here are some of the errors made by the crew at the moment of clear evidence of threats:
- The crew did not make the decision of using a different aerodrome, despite the unfavorable meteorological conditions and without taking into account the pilots flying experience;
- The interception of the slide path at a higher altitude, which led to the increase of speed and the maintaining of the vertical speed at a rate much higher than the recommended one and even below the MDH (Minimum Descending Height) of 100 meters;
- PIC did not execute the missed approach at the altitude of 100 meters high;
- Neither of the pilots initiated final descent when they heard the TWAS (Terrain Awareness and Warning System) warnings;
- The ineffective use of the CRM under heavy weatherl conditions;
- The inexistence of any cautions on behalf of the previously landed crews against cancelling their landing intention, although some relationships between pilots were informal, fact that was revealed by the names they used to call one another.

All these factors, each taken separately, may have negative effects for the activity and behavior of the PIC. When combined, these factors may result in an air catastrophe.

5. CONCLUSIONS & ACKNOWLEDGMENT

The decision made by the PIC to attempt an approach is based on the psychical pressure put on him (and on his crew) to come to approach by all means. This pressure is put mainly by the attendance aboard of the state President and by the presence aboard the flight deck of the Chief of Air Force Staff, who did not react in any way at the sight of unfavorable meteorological conditions from the final phase of approach. Mentioned should be made that, two years before this incident of the aircraft under scrutiny, the PIC of the aircraft had been the copilot – CP – of another VIP transport flight in which, due to security reasons, the PIC of that flight made the decision of landing on a different aerodrome. The steps taken against him affected his profession negatively [3]. Throughout the last twenty five minutes of the flight the PIC was highly charged emotionally, which was reflected by a conflict of interests: *should he land at all costs* or *should he choose a second aerodrome?!*

The lack of leadership abilities of the PIC, as well as evidence with regard to crew’s responsibilities, finally resulted in a tragic air crash. The fact that upon MDH, the PIC did not inform about his excessive descent speed, the crew’s behavior lacking decision making and communication effectiveness, as well as the erroneous reading of the altimeter, by the navigator, represented grievous consequences of the absence of CRM training.

The case study under debate was based on data collection and official investigation resulting from the air catastrophe of the 19 of April 2010, from Smolensk, the Russian Federation, in which the Tu-154 aircraft belonging to the Polish Air Force was involved, killing all passengers aboard, among whom the president of the State.

The current paper is intended to be one in search for evidence of existent vulnerabilities on the flight deck, during flight, and not a

conclusion for the events that led to the tragic event occurrence.

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