Chapter 1
AF 447 as a Paradigmatic Accident:
The Role of Automation on a Modern Airplane

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ABSTRACT

In this chapter, the author presents a human factors problem for automation: why, when, and how automation has been introduced in the aviation domain; what problems arise from different ways of operating; and the possible countermeasures to limit faulty interaction between humans and machines. This chapter is divided into parts: definition of automation, its advantages in ensuring safety in complex systems such as aviation; reasons for the introduction of on-board automation, with a quick glance at the history of accidents in aviation and the related safety paradigms; ergonomics: displays, tools, human-machine interaction emphasizing the cognitive demands in high tempo and complex flight situations; illustration of the AF 447 case, a crash happened in 2009, which causes are linked to faulty human-machine interaction.

INTRODUCTION

Human error is considered the first cause of accident. Actually, as many safety scholars affirm, the human error is only an epiphenomenon. The real cause of accident is what induces the human error, such as human performances and limitations, poor teamwork, organizational pressures on crews to obtain unreasonable performances, faulty human-machine interaction and lately some psychological upset, where the pilots posed an intentional threat to the safety of flight.

Although humans could be considered somehow a threat to safety, they are also the main resource to cope with unexpected events, unruly technology, changing environment and uncodified system failures. System designers often conceive the human being as a superman or a robot. Actually, we have psychological limitations (constant or transient), physical constraints (due to ageing, fatigue, etc.), big

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differences among individuals, vices and emotions. All these elements are powerful sources of variability. This brings pros and cons. Variability is often considered something negative, because aviation is based on standard procedures. On the other hand, variability provides the needed flexibility to make the entire system resilient. Resilient systems are characterized by flexibility and robustness. Automation provides the latter characteristic. It is important to point out that we cannot achieve one alone, be it flexibility or robustness. Both are needed. The problem is how making this two necessary elements work together. The aim of this chapter is to show why, when and how automation has been introduced in the aviation domain, what problems arise from different ways of operating, and the possible countermeasures to limit faulty interaction between humans and machines. This chapter is divided into four main parts:

1. Definition of automation, its advantages in ensuring safety in complex systems such as aviation;
2. Reasons for the introduction of on-board automation, with a quick glance at the history of accidents in aviation and the related safety paradigms;
3. **Ergonomics:** Displays, tools, human-machine interaction emphasizing the cognitive demands in high tempo and complex flight situations;
4. Illustration of the AF 447 case, a crash happened in 2009, which causes are linked to faulty human-machine interaction.

WHAT IS AUTOMATION

According to a shared definition of automation, it may be defined in the following way: “Automation is the use of control systems and information technologies to reduce the need for human work in the production of goods and services”. Another plausible definition, well-suited the aviation domain, could be: “The technique of controlling an apparatus, a process or a system by means of electronic and/or mechanical devices that replaces the human organism in the sensing, decision-making and deliberate output” (Webster, 1981). The Oxford English Dictionary (1989) defines automation as:

1. Automatic control of the manufacture of a product through a number of successive stages;
2. The application of automatic control to any branch of industry or science;
3. By extension, the use of electronic or mechanical devices to replace human labour.

According to Parasumaran and Sheridan, “Automation can be applied to four classes of functions:

1. Information acquisition;
2. Information analysis;
3. Decision and action selection;
4. Action implementation.

Information acquisition is related to the sensing and registration of flight data. These operations are equivalent to the human perception. Let’s imagine a video camera. It helps to replace continuous, boring, monotonous human observation with reliable, objective and detailed data on the environment. Automation may handle easily and reliably these functions, as it is more efficient than humans in detecting. At the same time automation offers the possibility of positioning and orienting the sensory receptors,