



**ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΩΣ**  
**ΤΜΗΜΑ ΟΡΓΑΝΩΣΗΣ & ΔΙΟΙΚΗΣΗΣ ΕΠΙΧΕΙΡΗΣΕΩΝ**  
Διοίκηση Επιχειρήσεων για Στελέχη (Executive MBA)  
Διπλωματική Εργασία

**Presenteeism in Aviation  
&  
Flight Safety**

Καυγάς Αλφρέδος (Α.Μ.: EMBA1222)

Πειραιάς  
Ιούνιος 2015

## **ABSTRACT**

The concept of presenteeism and its effects in an organization, such as productivity loss, is a subject of intense interest especially in recent years, since organizational scholars are getting more familiar with the concept. The purpose of this thesis was to examine, with the aid of Flight Simulator devices, how this phenomenon affects pilots and flight safety. Data were collected from civil and fighter pilots in Germany, Greece and Italy. Results indicated that pilots performance was affected negatively when they act under presenteeism conditions during critical phases of a flight. Limitations and future research are discussed.

## **ACKNOWLEDGEMENTS**

I would like to express my sincerest gratitude to Assistant Professor Filotheos Ntalianis, for his sincerely appreciated assistance and guidance during the course of my research.

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## INTRODUCTION

Flight safety and performance are concepts surrounded by theory, investigation and prevention of flight failures through the proper management that includes regulation, education, and training (International Civil Aviation Organization, 2014). When investigators examine the chain of events that lead to a flight incident or accident, human factor is usually one of the main contributors that affect flight safety, approximately in a rate of 70-80% (Reason, 1990). Additionally, the highly advanced technology of today's cockpit leads to complacency of the pilots (Wiefmann & Shappell, 2003). As a result it would be worth studying any possible factor that could affect pilots' performance and consequently the safely execution of a flight.

The phenomenon of presenteeism is a behavior acted by people who attend work while they are ill or not in a fully productive situation (Johns, 2010). Through many researches (Johns, 2010; Goetzel et al., 2004 and others) it is shown that this behavior ends with cumulative consequences which finally affect productivity levels.

The purpose of this study is to integrate the concepts of flight safety and presenteeism and test if and/or how these two variables are related. Specifically, this thesis aims to explore whether the presenteeism behavior in pilots affects their performance during flight. The assumption of this study is that presenteeism influences pilots' performance, therefore, the study can be seen as an attempt to further investigate the existing theory. Particularly, I examine the effect during critical phases of the flight (Federal Aviation Administration, 2014), such as the take off and

the landing, so us to determine if this performance effect disturbs any part of the accident chain.

In the first chapter the flight safety concept literature is reviewed, focusing mainly on the Human Factor and the Human Factor Analysis and Classification System (HFACS) Model. In the second chapter, an investigation on presenteeism phenomenon literature is being conducted; history, definitions, hidden causes, and theories related to productivity loss are also presented. The third chapter consists of the hypotheses of our research and the fourth describes the methodology of this study. In the fifth chapter the results are presented coupled with a discussion of the limitations and recommendations for future research that are presented in the sixth chapter.

# **FLIGHT SAFETY IN AVIATION – HUMAN FACTOR ANALYSIS AND CLASSIFICATION SYSTEM (HFACS) MODEL**

## **Introduction**

Aviation safety is a concept composed on the one hand by the theory, the investigation, and the categorization of flight failures, and on the other by the prevention of such failures through the proper management that includes regulation, education, and training. It can also be applied in the context of campaigns that inform the involved people as to the safety of flight procedures (International Civil Aviation Organization, 2014).

The concept of the aviation Flight Safety was born with the appearance of the first known accident in the humanity; the Greek legend of Icarus. Although this accident refers to the mythology, we can easily recognize the same necessity, thousand of years later, for maintaining safe flights in the modern history of aviation (Gibbs-Smith, 1970).

Taking a quick look of the flight activities in our days we could recognize a range of aviation operations that have to do with the safe and on time transferring of passengers, the air transportation of patients, fire fighting missions, search and rescue operations and extend up to the territorial integrity defence. In all cases in order to achieve this, it is required an investment in high trained manpower as well as in costly technological sources (Squier & Owen, 1908). Therefore it is given more emphasis to the investigation in depth, by the flight safety agencies, of anything that could not

function properly during any aviation activity, so not to punish but to improve human resources, facilities and procedures to prevent any eventual repetition of an accident (Woods, 2010).

Aviation organizations in order to complete their mission imply the exposure of personnel, which consists its largest multiplier, to risks that require adequate and safe working conditions. The way to achieve the minimization of accidents, a safe work environment and the good and effective functioning of the organizations, is to establish regulations of flight safety which have as a purpose the effective achievement of its objectives (Stolzer, 2010).

The Flight Safety Program is a program for all the personnel involved with aviation activities (cabin and ground crew) creating a safe behavior and education as well as investigating and analyzing matters, concerning aviation safety. The aim of this Program is to prevent accidental loss of aviation resources such as humans or aviation equipment, while accomplishing the mission at an acceptable level of risk (Federal Aviation Administration, 2000).

It is based on the following five fundamental principles: the prevention of occurrences, the mutual information of all Flight Safety critical safety occurrences, the acknowledgement of personnel's errors and omissions and last but not least the creation of Flight Safety culture, which lies on a non-punitive culture so that everyone would be able to report any hazards or safety concerns as they become aware of them, without fear of sanction or embarrassment (Federal Aviation Administration, 2000).

In order to achieve a smoother introduction in this thesis, it is consider appropriate to investigate in the first chapter the topic of flight safety and especially to

understand the reason why aviation organizations consider it as an indispensable factor for their operations. With the detailed explanation of certain terms, we will try to help the reader to acquire an overall understanding of the subject. After introducing the flight safety concept we will emphasize on the human factor that is the factor that contributes and affects mostly flight safety (Federal Aviation Administration, 2010). Subsequently, there would be a reference on the Swiss-cheese model so to focus on human factor and especially the phenomenon of presenteeism and its relation with flight safety. The presenteeism behavior, as it will be illustrated bellow, can cause part of the human error and the risk contribution. For that reason, an optimal response of the phenomenon of presenteeism and consequently of the possible human error can lead to more effective safety management systems. At the end of this chapter we will continue with the explanation of the Human Factor Analysis and Classification System (HFACS), which is the system most of the aviation organizations use in order to find out if and how human factor could affect flight safety.

## **Background**

Interest in Aviation Safety stems from the need of the organizations related to flights to reduce risk, the rate of accidents and mainly the cost (Wood, 1991). As mentioned at the beginning of this unit, this issue has always preoccupied all those who supervise the aviation procedures. Thus, from the first steps of the modern aviation history in the near 1910's, a categorization of the flight failures was held and the prevention of such failures was initiated through education, regulations and training (Gibbs-Smith, 1970). Subsequently, USA in the 1920's passed the first laws in order to regulate the ever growing civil aviation. Gradually, as the experience was getting increased as well as the air traffic and the fatal crashes were augmented, both

commercial airlines and the Air Forces, generated the need to discover a more inexpensive and bloodless ways to develop the aviation evolution and correct previous mistakes. The Air Forces have addressed this issue by creating Safety Centers, where they can evaluate corrective actions succeed and apply safety and risk management education in order to create new safety disciplines (USAF Historical Research Agency, 2009).

During the years, several Civil Safety Aviation Organizations and Foundations have been created according to ICAO's and FAA's rules. At the same time United States Air Force (USAF), as pioneer of all worlds Air Forces has implemented studies and experience in order to improve aviation safety by creating the most prestigious department of Air Force Safety Centre. Nevertheless, the intersection point for most of the World's Air Forces, such as the Hellenic ones, were made around the time of the II World War where Aviation played a significant role for the outcome of the war (Gibbs-Smith, 1970). Taking into consideration the obtained experience and the consequences of War, everyone thought better for the best reconstruction of the most effective weapon that was Air Force. In that time we can also see the first serious steps of the Hellenic Air Force to develop a more organized Flight Safety Program in order to gather important information about previous mistakes. However, as aviation technology continues to evolve there are created new points that require attention. The increasingly automated systems, on the one hand reduce the possibility of potential occurrences, but from the other increase the human workload, interfering with one of the main causes of accidents that is human factor (Reason, 1990).

## **Human Factor**

In many professions human error has been documented as a primary contributor to a large proportion of accidents (Woods, 2010). Aviation industry, such as Air Forces and Airlines, without any exception, attaches to this fact the highest percentage of the accidents (approximately 70-80% of the accidents) (Federal Aviation Administration, 2014). It is worth noting that in the last 40 years, the rapid technological developments have eliminated the accidents caused by mechanical failures (Woods, 2010). Forthwith, those accidents related to human factor, not only are not decreased, but even worse tend to a further increase, since humans are ultimately responsible for ensuring the success and safety of the mission (Reason, 1990). Pilots have to keep being knowledgeable, flexible, dedicated, and efficient while exercising good judgment. Meanwhile, industries continue to make major investments in training, equipment, and systems that have long-term implications. Because technology continues to evolve faster than the ability to predict how humans will interact with it, the industry can no longer depend as much on experience and intuition to guide decisions related to human performance (Woods, 2010).

Developing methods and tools to help operators manage in a most effective way human error, there has been much progress in safety throughout the history of aviation, such as improving the standardization of the procedures needed during flight by developing the pilot's checklist in 1937 and standardizing the cooperation among the crew by using the Crew Resource Management (CRM), a technique that makes use of the experience and knowledge of the complete flight crew to avoid dependence on just the captain (Reason, 1990).

As human factors we could consider the way human abilities, limitations, and other characteristics can be integrated with machines, systems, tasks, jobs, and environments so as to produce safe, comfortable, and effective human use. In aviation, human factors as an area, is dedicated to better understanding how humans can most efficiently and at the same time in a safely way interact with technology and the environment factors. Factors that influence the human element could be fatigue, sleep deprivation, circadian rhythm disturbance, and stress or health problems. These factors can be affected by environmental irregularities or constraints such as humidity, temperature, noise, light, working hours and load (Flight Safety Foundation, 2001).

On the other side, a human error involves an act or omissions of an action, carried out by the operator of a system, from the manufacturer, from the technicians, from the supervisors, perhaps even by the instructors of all those (Flight Safety Foundation, 2001). Accident analyses have shown that obviously technology continues to evolve faster than the ability to predict how humans will interact with it. Although the human element is the most adaptable component of the aviation system, human factors are capable of causing huge disasters. At the same time the industry can no longer depend as much on experience and intuition to guide decisions related to human performance (Abkowitz, 2008).

According to the above, it is concluded that human error is the result of two interactive factors: human itself and the working system which create the exact conditions under which the man will work. The main causes, responsible for the creation of human error, according to several researches (Woods, 2010) could be considered the below:

- Inexperience



- fatigue and lack of sleep
- the health status and emotional strain
- time pressure
- Financial or other familiar and personal problems.

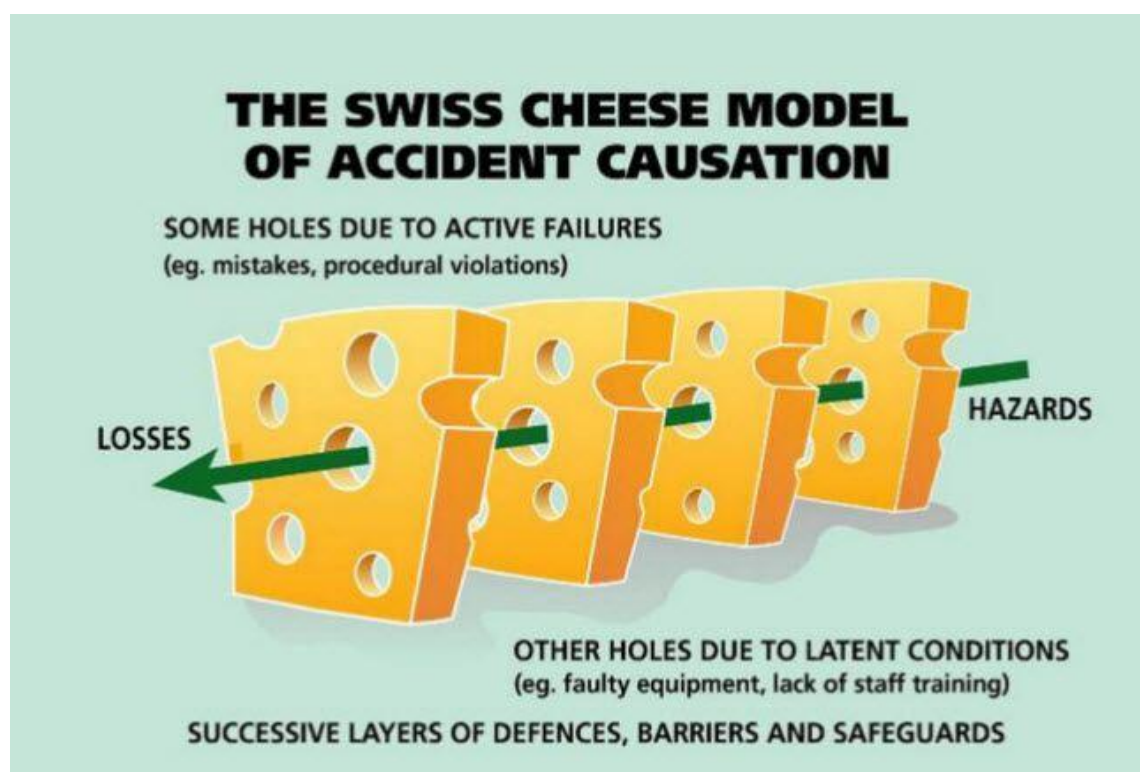
So the main concern of the investigation teams and the Flight Safety Centers is the analysis of all the preceding actions of an accident, up to the time of its completion (Flight Safety Foundation, 2001). For the representation of events that lead to an accident involving the human factor, there have been created many different systems, one of which is that of James Reason, known as ‘Swiss Cheese’ (Reason, 1990). This model can show in a simply way, how a combination of mistakes, hazards and bad management can lead to losses and accidents. As regards the present research, the ‘Swiss Cheese’ model can help us understand how a human error deriving from the phenomenon of presenteeism, can contribute to create the preconditions of an imminent incident.

### **Swiss Cheese Model**

The Swiss cheese model of accident causation or else named as ‘cumulative act effect’ is a model that is used in cases of Risk Analysis and Risk Management in fields such as aviation, engineering and health care. It was introduced by the professor of psychology James T. Reason from Manchester University (Reason, 1990).

This model (figure 1) describes an approach to the analysis of the accident. In this approach the human error is referred to as a symptom of a larger problem within an organization and not as the main cause of the accident. Inside the firm there are

some 'barriers', represented as slices of cheese, which act as deterrents to creating adverse conditions. To maximize the efficiency it is necessary to be fastened with a lot of barrier levels. What is discussed in this model is that the human error has two approaches; one is the person side and the other is the systems side. The first one has to do with the errors of individuals, while the second focuses on environmental factors under which humans build defenses to avoid mistakes or their consequences (Reason, 1990).



**Figure 1. The Swiss cheese model of accident causation** (Reason, 1990).

The person approach focuses on the unsafe acts or errors and procedural violations, which are caused because of inattention, carelessness or poor motivation. The system approach claims that human's nature is making mistakes and errors are to be expected, even from the best employees in an ideal society. This includes continuous traps in the workplace. So what needs to be done is to remove all possible

difficulties that may cause an eventual accident. So since it is difficult to change the human condition, we have to change the conditions under which humans work (Reason, 1990).

Defenses, barriers, and prevention play a key role in the system approach. High technology systems have many defensive layers: some are engineered (auto-pilot system), others rely on people (pilot, navigator, marshaller etc), and yet others depend on procedures. Their function is to protect the total procedure from any hazardous situation. Usually they do this without any problems, but weaknesses do always exist (Reason, 1990).

In an ideal world each defensive layer would be untouchable. In reality, however, they are more like slices of Swiss cheese, having many holes. The presence of holes in any “slice” does not cause a bad incident. Usually, this can happen only when the holes in many layers momentarily are aligned so to allow an opportunity of an accident, as it is shown in the figure, causing serious problems (Reason, 2000).

Reason (1990) argued that most of the organizations have established four levels of barriers, which are naturally in series, which means that if the top level is affected, this will consequently affect the lower levels. Within each level there are created holes which records errors that occurs due to the human factor. These errors can be either active, meaning that are located precisely before the accident and affect directly the accident, or hidden conditions that may be eliminated temporarily or as a result they do not affect in a direct way. Active failures and hidden conditions are the main reasons that can cause the holes in the defenses to become apparent. Of course both of these factors are involved in all these unfavorable events (Reason, 1995).

Active failures are the erroneous acts made by people who are in direct contact with a system. For instance, a series of mistakes and procedural violations can be created when a pilot may use the wrong switch for the pressurization system of an aircraft and as a result the aircraft may fail to pressurize the cabin and lead the cabin crew to hypoxia symptoms (Fogarty, Johnson & Stepanek, 2008). This is what occurred in the case of Helios Airways Flight 522 crash on 2005 (AAIASB, 2006)

Hidden conditions are the inevitable mistakes within the system. They are caused because of wrong decisions or erroneous top level management (Reason, 1990). For example an airline manned a flight to an airport with bad meteorological conditions with two inexperienced pilots, who fly to this airport for the first time. Being able to cope with those hidden conditions result to prevention acts rather than managing a high risk situation. Another example (in order to link also the presenteeism phenomenon in hidden conditions) could be the acceptance or the ignorance of an airline supervisor to let a pilot to fly while having a stuffy nose, which could cause him or her further health problems and consequently affect flight safety (Davis, Johnson & Stepanek, 2008).

Metaphorically speaking active failures are like mosquitoes. They can be swatted one by one, but they still keep coming. The best remedies are to create more effective defenses and to drain the swamps in which they breed. The swamps, in this case, are the ever present latent conditions (Reason, 1990). Airlines and Air Forces, for instance, as high reliability organizations are a good example of the system approach. These organizations are ready to prevent any hazardous situation that can affect the integrity or the safety in most of the levels of the organization. This kind of organizations do not waist much time to occasional problems, but through the safety

culture that they create to their employees, they enhance the resilience into the systems and the procedures (Stolzer, 2010).

In order to understand better the concept of this model we should initially clarify what really are these holes and how can we systematically identify them. How is people's behavior related with this model? Is a hole of the Swiss cheese or is a factor that could create a hole in a slice of cheese? The answers of these questions will be given after the analysis of the Human Factor Analysis and Classification System (HFACS model).

### **Human Factor Analysis Classification System (HFACS)**

The Human Factors Analysis and Classification System ( HFACS ) was developed by Dr. Douglas Wiegmann and Dr. Scott Shappell (2003) at US Navy. The beginning of '90's was one of the most difficult for US Navy, since it was suffering of an extremely increased number of aviation accidents. Drs. Wiegmann and Shappell were chosen, to investigate the reason this types of accidents continue to exist and to find a way to diminish their frequency (Wiegmann & Shappell, 2003).

Having studied extensively Reason's theory (1995), Wiegmann and Shappell developed the model of Human Factors Analysis and Classification System. This new system uses the four layers or barriers that are referred at Swiss-cheese Reason's model to describe the stages of an accident. Moreover, at those stages have been developed categories for the causes of accidents in order to identify and categorize the active failures and the hidden conditions in the interior of an Organization. Having in

mind this certain philosophy, started to analyze the US Navy accidents. The results of their research were impressive.

The extremely high rate of accidents at Navy was due to violations of safety rules. By using the HFACS model, the Navy was able to perform a thorough analysis of the most aviation accidents happened during '90's. The research revealed that those violations were not isolated cases but repeated incidents linked to the specific mission of Navy.

In fact, violations of safety rules were a factor that contributed to the increased number of aviation accidents, but what need to be investigated is the reason this happened. The analysis based on HFACS showed that violations at Navy were a result of some failures at key points of the safety system. Initially, this sector of the US Armed Forces adopted a culture where everyone was pressed to complete a job at all costs, whatever the cost, at a specific time. In that way, there were times that supervisor tolerated violations of safety rules in order to accelerate or complete a particular procedure. On the other hand, those who committed the violations did not have any consequences. Also the lack of supervision to the new or inexperienced staff, especially at high risk missions was a factor for the tolerated violations. Several practices were introduced, emphasizing at professionalism in order to reduce routine errors, such as better supervision. The result was a noticeable decrease of violations (HFACS Analysis of Military and Civilian Aviation Accidents, 2004).

However, the reduction of accidents caused by human error that were related with the violation of safety rules was half truth. The HFACS model gives the opportunity to researchers to identify and reduce also different kind of mistakes. Through the same research was detected that accidents related to ability errors were in

a sudden increase. As ability errors, it is meant those errors that are not related to theoretical knowledge of the staff, such as manipulating an aircraft in close formation. Obviously, recent reductions at the Armed Forces financing, forced pilots to practice more at the simulator rather than a real environment of flight, which is more expensive. So since pilots were practicing more and more tactic fight maneuvers at the simulator, started to loose their ability to manipulate the aircraft at basic maneuvers (Wiefmann & Shappell, 2003).

After several attempts to reduce this problem, the navy finally emphasized the basic principles of the aircraft control. The result was a dramatic reduction of the accidents related to ability errors. Another cause of accidents was the incorrect decisions, which were due to lack of standardization or wrong judgment. In the cockpit, such mistakes are identified mostly in decision making, poor execution of normal procedures or downgraded situation awareness during flight. Soon were detected the roots of the problems and the US navy reduced accidents related to wrong decisions (Federal Aviation Administration, 2010).

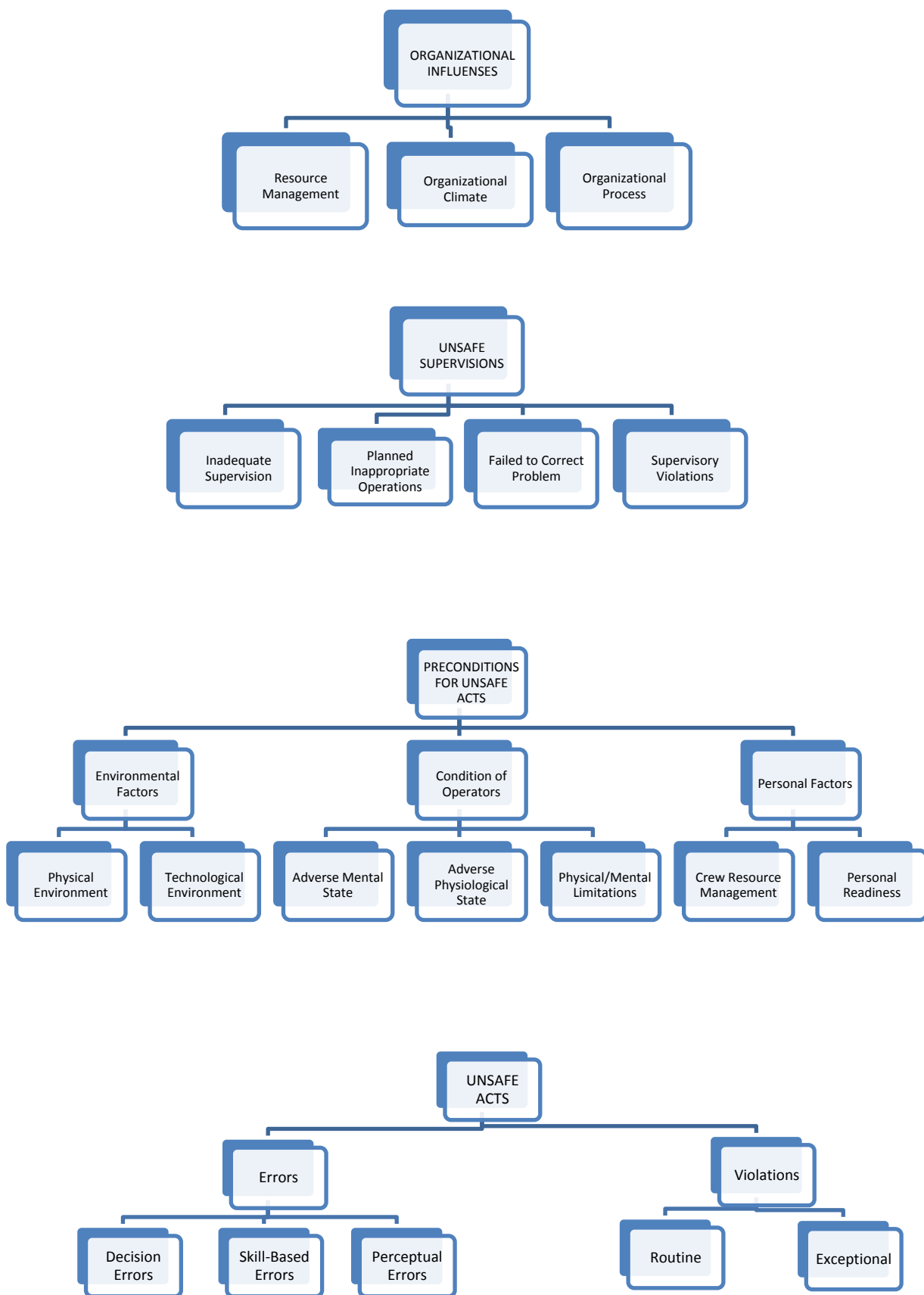
Through the use of HFACS for the investigation of aviation accidents, Wiegmann and Shappell were able to identify sectors that need improvement and to confront certain problems. The above procedure is applicable by an enormous number of different Organizations with similar success. The HFACS model uses the same levels that are represented at Reason's model. Those are:

- organizational influences,
- unsafe supervision,
- preconditions for unsafe acts and
- unsafe acts

In every level of HFACS exist errors that can let an unfavorable situation to be created, when these errors interact with each other. So, in order to prevent a forthcoming accident, it is required to correct every time at least one levels error so to break the chain of this interaction. By using HFACS as a guide, the accident investigation teams are able to find systematically the active and hidden factors that could lead to an accident. It is worth to mention that HFACS objective is not to blame but to understand the main reasons that can cause an accident (Wiefmann & Shappell, 2003).

In that point we should clarify how it is possible to find those errors before they occur. The answer can be found in the analysis and research of an earlier similar accident. Finding the result could seem easy, however, without a well built and scientifically valid model, it could be difficult to compare two accidents. For instance, the incorrect loading of baggage in a cargo airplane because of a wrong estimation of the center of gravity of another type of aircraft. Using the HFACS model, those two kinds of accidents could be compared not only psychologically, but also by the hidden conditions of an organization that lead to this accident. For that reason, dividing an accident into individual pieces (as it is shown in the HFACS framework, figure 2), can help us detect and understand easier the causes of a mistake. An organization is able to provide points where precarious situations could happen according to its background. In that way it is possible to focus in some certain points and at the same time prevent any similar future accidents or even an accident from a wider group of related accidents (Wiefmann & Shappell, 2003).





**Figure 2 The HFACS framework (adopted from Wiegmann & Shappell, 2003)**

## **Focusing on individual aspects of HFACS**

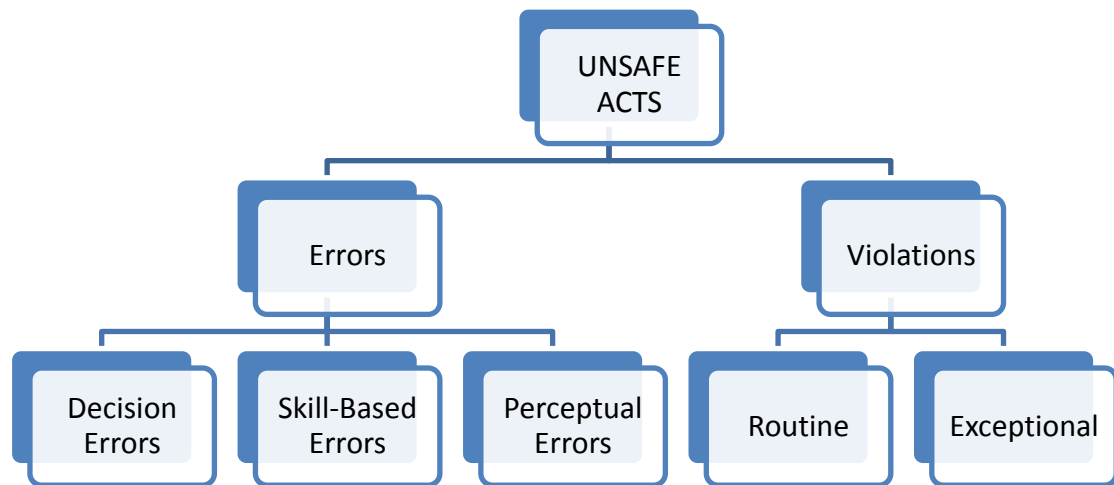
The term human factors, is studying humans at their working environment, their relation with equipment procedures and their communication with the social environment. In Air Force, this term includes also aviation medicine, physiology and psychology and deals with issues such as Crew Coordination Management (CRM), communication skills and abilities, decision making, etc. This system uses the classification of the levels of the active and latent failure of human errors (Wiefmann & Shappell, 2003).

The levels of failure that human error contributes are the following:

1. unsafe acts
2. preconditions for unsafe acts
3. supervision
4. organizational influences

### ***Unsafe Acts***

Unsafe acts are factors that are closely related to an accident and are characterized as possible errors or failed actions that finally lead to a dangerous situation. Unsafe acts in the HFACS system are depicted as errors or violations. For instance unsafe acts can be a wrong decision, routine mistakes caused because of the increased experience and overestimation like taxiing with higher airspeed or using not standardized radio terminology (Wiefmann & Shappell, 2003).



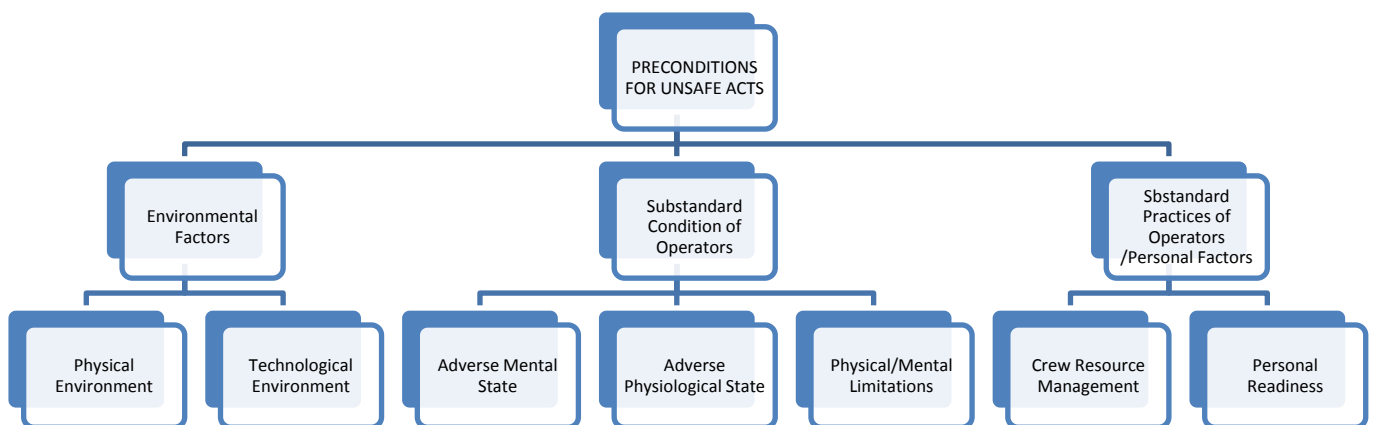
**Figure 3. Unsafe Acts (adopted from Wiegmann & Shappell, 2003)**

Errors are mental or physical activities of the staff that do not reach the desired standards due to lack of skills and perception as well as due to wrong decision and decision making. The errors are not intentional acts and are divided to: i) skill-based errors: errors performed during the execution of standardized procedures which are almost unconscious and related to memory distraction, such as forgetting a switch to the wrong position during the interior inspection of the cockpit, ii) decision errors: those that concern conscious acts that are progressed as scheduled, but finally are considered or as inappropriate or inadequate for the existing conditions, for example insisting to follow the planned route even though the weather does not permit it and a deviation is required to avoid the adverse weather conditions and iii) perceptual errors: mistaken acts that lead to dangerous situations when situational awareness is not corresponding to reality, like for example the wrong reaction of a pilot when acts under any kind of illusion (Wiefmann & Shappell, 2003).

Violations are referred to violation of rules and regulations that leads to a dangerous situation. In contrast to errors, violations are in purpose conscious choices and constitute rarely the cause of accidents. Are divided to routine (usual) violations, that it is consider mandatory to recognize them in order to prevent similar accidents and to exceptional (unusual) violations that because are not predictable, is difficult to deal with (Wiefmann & Shappell, 2003).

***Preconditions for unsafe acts***

Preconditions for unsafe acts are factors that create conditions where errors or dangerous situations can be developed, such as bad weather conditions, fatigue, personal problems, preparation and other. They include the substandard conditions of operators, substandard practices of operations and environmental factors (Wiefmann & Shappell, 2003).



**Figure 4. Preconditions for unsafe acts (adopted from Wiegmann & Shappell, 2003)**

In substandard conditions of operators are included mental or psychological disorders of a person that affect his habits or his acts and lead him finally to a wrong or hazardous situation. It is divided in three subcategories: i) the adverse mental states which are conditions like channelized attention, complacency, distraction, mental fatigue, loss of situational awareness, misplaced motivation and task saturation, the adverse physiologic states which are conditions related to medical fitness such as impaired physiological state, medical illness, physiological incapacitation and physical fatigue, and the physical/mental limitations which are situations where mission conditions surpass human ability, as for example insufficient reaction time, visual limitation (especially during night flights), incompatible intelligence/attitude and incompatible physical capability (Wiefmann & Shappell, 2003).

Substandard practices of operator are referred to personnel/staff management issues or personal readiness, which lead to the commission of unsafe acts. Here we have two subcategories: i) Crew Resource Management: it has been proved that lack of good communication skills and crew coordination have been factors of many accidents. This term is not referred only at the cooperation between the cabin crew, but also between aircraft and air traffic control, maintenance control and other support personnel and ii) Personal Readiness that is a factor when are not respected the regulations or when individuals fail to prepare mentally and physically for a flight. Examples of that could be violation of the crew rest requirements or even worse not keeping the proper time restrictions as regards alcohol consumption (Wiefmann & Shappell, 2003).

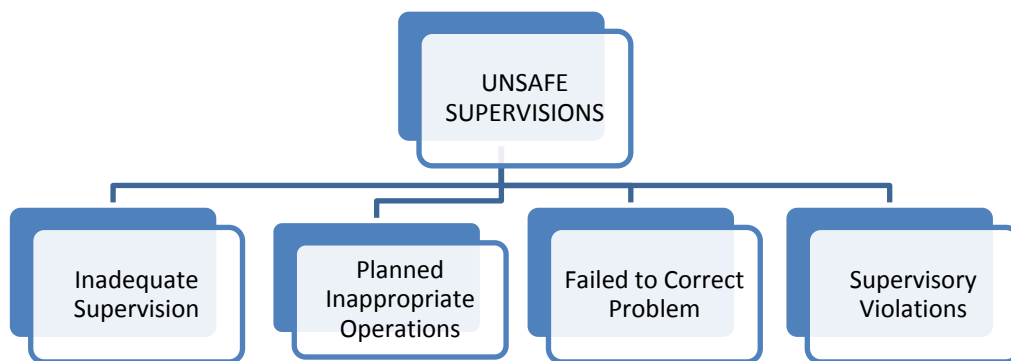
Environmental factors refer to the natural and technological environment in which is working the crew. As examples of natural environment are considered the weather conditions, visibility, high temperatures and other, whereas as technological

factors related to new aircraft systems and radars, their ease of use and other (Wiefmann & Shappell, 2003).

From the above we can also notice that risk management is part of HFACS model, a tool used to control, detect and prevent conditions of creating an accident.

### *Unsafe Supervision*

Unsafe supervision has to do mainly at the level of directors, chief and commanders. There have been identified four categories, as it is shown in figure 5:



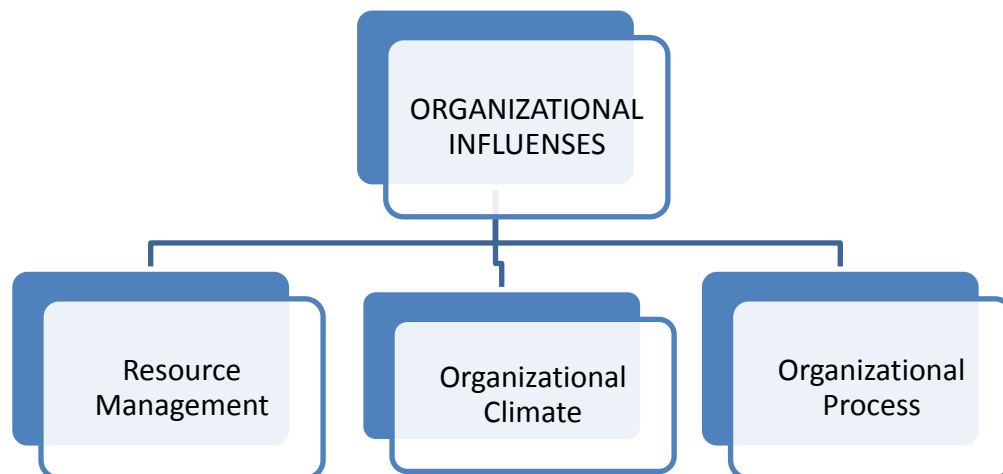
**Figure 5. Unsafe supervision (adopted from Wiegmann & Shappell, 2003)**

i) Inadequate supervision, which is failure to provide guidance, training, oversight, track qualifications or performance, ii) planned inappropriate operations, such as failure to provide correct data, adequate brief time, improper manning, provide inadequate opportunity for crew rest or missions that are not in accordance with rules and regulations, iii) failure to correct a known problem, like identify an at-risk aviator initiate a corrective action, report unsafe tendencies and other, iv) supervisory violations, which could exist when is authorized unnecessary hazard and

unqualified crew for flight, or there is failure to enforce rules and regulations (Wiefmann & Shappell, 2003).

### ***Organizational influences***

Those influences refer to the communication, acts and fallible decisions between upper-level management and supervisors and the staff. They are divided in three subcategories as it is shown in figure 6:



**Figure 6. Organizational influences (adopted from Wiegmann & Shappell, 2003)**

i) the resource management, that has to do also with Human Resources (staffing and manning issues, selection, training), monetary and budget resources (excessive cost cutting, search of funding) and equipment facility resources (design and equipment technology), ii)the organizational climate that is affected mostly by its structure (chain-of-command, communication), its policies (promotion, drugs and

alcohol) and its culture (norms and rules, values and beliefs and organizational justice) and iii) the operational process, that refers to the daily operations (incentive, time pressure, schedules), procedures (standards, instructions) and the oversight (safety and risk management) (Wiefmann & Shappell, 2003).

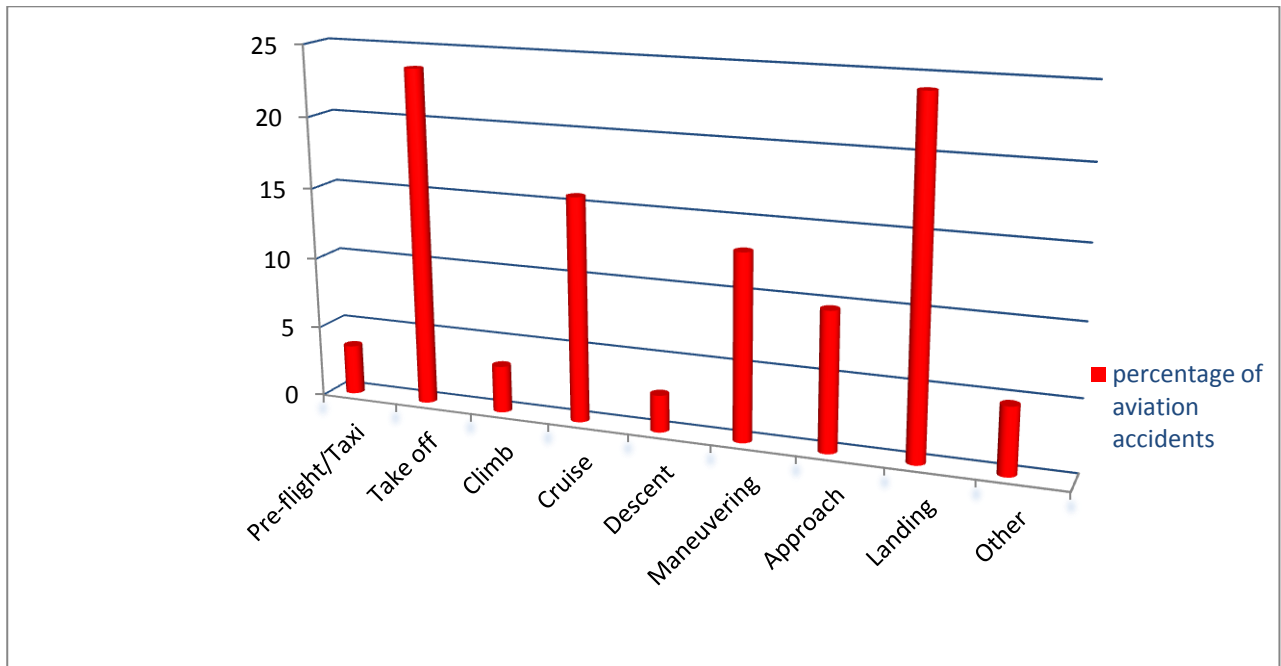
## **Performance Ratio**

According to expert investigation conclusions, the human factor is considered and statistically proven as the factor that contributes approximately in a rate of 70-80% in aviation incidents and accidents (Reason, 1990). A human factor is the term used to describe the interaction of individuals with each other, with facilities and equipment, and with management systems (World Health Organization, 2015). Surely the human error is not new as a factor in aviation accidents. However, many experts believe that the highly advanced technology of today's cockpit leads to complacency of the pilots (Wiefmann & Shappell, 2003).

As we mentioned in the HFACS model, a stage related with the human factor is 'unsafe acts', which is also divided into two categories: errors and violations. In this thesis, we will not focus in the violations (causes and consequences) but we will point mostly the errors caused by a pilot, during the critical phases of a flight, according to bibliography and the results of the investigations (Federal Aviation Administration, 2014). In the following figure (figure 7) we can easily recognize the percentage of aviation accidents as they relate to the different phases of flight. We can notice that the greatest percentage of the accidents take place during the Take off and Landing



procedures, which are a minor percentage of the total flight. As a result those two constitute the most critical phases of a flight (Federal Aviation Administration, 2014).



**Figure 7. The percentage of aviation accidents as they relate to the different phases of flight** (adapted from Pilots Handbook of Aeronautical Knowledge, Federal Aviation Administration, 2014).

For that reason we will examine mainly the performance of pilots during the three phases that is encountered the highest percentage of aviation accidents; during the Take off procedure, during the Cruise maneuver and finally during the Landing procedure. Take off is the procedure when the aircraft goes from the ground to flying in the air (Aviation Glossary, 2011). Cruise is the phase of the flight after the Take off and Climb phases and before the Descent for landing phase where the aircraft maneuvers and follows the planned route. Important in this phase is the positive and

smooth aircraft control pilots should have, taking into consideration the effective flight conditions and the use of all aircraft levers and switches in an ease mode, without any difficulty or faults, according to their experience (Aviation Glossary, 2011). Landing is considered the maneuver where a flying aircraft returns to the ground (Aviation Glossary, 2011).

In the following chapter we will introduce the term of presenteeism, a phenomenon that has been a matter of controversy and discussions on whether and how it affects the productivity of several businesses, as it has been proved in several occasions that is one of the factors that causes productivity loss on workers (Johns, 2010). The focus of this thesis is to examine how presenteeism affects pilots' performance, especially in critical phases of the flight, so us to determine if this performance effect disturbs any part of the accident chain.

## **PRESENTEEISM**

Presenteeism is defined as the act of attending work while sick and is considered by some scientists as the opposite of absenteeism (Johns, 2010). This behavior, as well as the possible causes in the productivity levels, has become a subject of research and discussions in the recent years. Presenteeism is a phenomenon, where employees, although are sick or not in an excellent condition, they stay at work. As it can be understand, presenteeism is, if not an important problem for organizations, a factor that they should consider in order to reduce productivity losses, due to employees who turn up to work even they should not. The main objective of this chapter is to introduce presenteeism, so that we could have a wider idea of how this act can affect flight safety.

### **Definition**

The first time that the term presentee was mentioned is, according to the Oxford English Dictionary Online, in the book ‘The American Claimant’ of Mark Twain in 1892. Since then presenteeism has appeared in various business related periodicals, according to Johns (2010) such as *Everybody’s Business* (1931) or *Contemporary Unionism* (1948). However, in all of the uses of this term, it is mentioned to describe or the opposite of absenteeism or to indicate excellent attendance.

It is very common to see in many articles correlating presenteeism with absenteeism. Absenteeism though is the tendency not to show up at programmed work. Also there are cases where it is believed that the factors that affect positively or negatively the act of being absent could also lead inversely the rates that presenteeism appears. This could be true for some cases, but it is not the case, as there have been found high rates of presentees in professions and industries where those of absenteeism was high as well. (Aronsson, Gustafsson & Dallner, 2000). As far as the definition of presenteeism is concerned, there have been given several approaches throughout the years. Below (Table 1), are summarized some of them.

- 
- i. Attending work, as opposed to being absent (Smith, 1970)
  - ii. Exhibiting excellent attendance (Canfield & Soash, 1955; Stolz, 1993)
  - iii. Working elevated hours, thus putting in “face time,” even when unfit (Simpson, 1998; Worrall et al., 2000)
  - iv. Being reluctant to work part time rather than full time (Sheridan, 2004)
  - v. Being unhealthy but exhibiting no sickness absenteeism (Kivimaki et al., 2005)
  - vi. Going to work despite feeling unhealthy (Aronsson et al., 2000; Dew et al., 2005)
  - vii. Going to work despite feeling unhealthy or experiencing other events that might normally compel absence (e.g., child care problems) (Evans, 2004; Johansson & Lundberg, 2004)
  - viii. Reduced productivity at work due to health problems (Turpin et al., 2004)
  - ix. Reduced productivity at work due to health problems or other events that distract one from full productivity (e.g., office politics) (Hummer, Sherman, & Quinn, 2002; Whitehouse, 2005)

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**Table 1. Definitions of presenteeism** (adapted from Johns, 2010: 521)

It can be easily seen that although all those definitions describe the fact of being physically present at work, they differentiate more or less from each other, focusing in certain points of the term and with lack of scientific utility. Some of them could be presented as a positive act (definitions i and ii), as being someone obsessive with his job (definitions iii, iv and v), as a fact of stating one's health status (definitions v, vi and vii) or finally as a reason that could provoke less than total productivity (definitions viii and ix).

What I want to investigate, is whether the presenteeism phenomenon in crisis professions, such as pilots, could affect flight safety through lower levels of productivity. For that reason the definition of presenteeism we will incline to, is the one taken by Hummer, Sherman, & Quinn (2002), according to which presenteeism is reduced productivity at work due to health problems or other events that distract one from full productivity.

The definition given above does not ascribe motives that can lead to presenteeism. Thus, it seems that one might show up ill or not totally able to give 100% of his capability, because of moral obligation feelings, love for the job or job insecurity (cf. Johns & Nicholson, 1982). However, the definition we decide to use ascribes consequences of presenteeism.

Moreover, any resulting productivity loss implies productivity in comparison to what one would exhibit without the physical or mental condition; compared to being absent, a presentee might be relatively productive (Johns, 2010: 521). Nevertheless, in aviation this fact is very critical because any reduced level of services, is closely related to the safely execution of flight procedures and consequently with the term of Flight Safety.

## **Presenteeism Literature Review**

Antecedents of presenteeism could be considered two main geographically distinct sources; one is the UK and European scholars in management (e.g., Simpson, 1998; Worrall, Cooper, & Campbell, 2000) and epidemiology or occupational health (e.g., Virtanen, Kivimäki, Elovainio, Vahtera, & Ferrie, 2003) and the second one is mainly American medical scholars and consultants. The first ones are concerned that job insecurity stemming from downsizing and restructuring forces exaggerated levels of attendance that result in stress and illness, while the second ones are concerned with the impact of illness in general or specific medical conditions (e.g., migraine) on work productivity (e.g., Johns, 2010; Koopman et al., 2002).

As we have mentioned above, according to the definitions, presentees are people who are at work but not working at 100% of their full capacity. Thus, the first source of British and Europeans are mostly interested in the correlation between the frequency the act of presenteeism appears and the main reasons that cause it, such as job insecurity or other occupational characteristics. On the other hand, the source of Americans are mostly interested in the consequences this act has in the productivity, avoiding the causes that made all those people show up while not been totally in position to be fully productive (such as being ill).

There is plenty of research related to presenteeism in medicine, pharmaceutical and other medical related sectors (Johns, 2010). These sectors have evaluated mostly terms of two health-focused criteria such as medical efficacy and safety. However, lately there is more emphasis on the economic impact of

presenteeism due to the increasing cost of health care and the technology related to medicine.

A number of studies have researched the issue of productivity loss related to different medical conditions. Some of these studies has utilized representative populations and tested the effect of a specific medical condition. Other studies have taken place in the context of organizational health with a purpose to investigate how different illnesses affect one's productivity. Pharmaceutical interests have been the key funders for these numerous researches which have been conducted the last years and an overview of these studies can be found in Schultz and Edington, 2007 (Johns, 2010).

Lerner and colleagues (2004) based on a mostly female sample which was recruited from health plan physicians' offices investigated the effect of depression on work productivity. This sample indicated higher productivity reduction in comparison with a sample with arthritis and a healthy control. Moreover, the likelihood of changing job with lower income or becoming unemployed was higher for this sample, possibly because of lower work effectiveness (Johns, 2010).

Burton and colleagues (2004) conducted another study at Bank One and with the use of WLQ indicated the specific impact of depression on the WLQ mental/interpersonal dimension and work output. At over \$24 million, the costs of presenteeism surpassed those due to absence by \$3 million (Johns, 2010).

Another study of Allen, Hubbard, and Sullivan (2005) examined the impact of pain on presenteeism in a Fortune 100 company. With a study duration of over 4 weeks, it was indicated that those meeting the pain criterion, effectively lost 3.14 days of work due to presenteeism and 0.84 days due to absenteeism, in relation to 0.29 and 0.06 days for the healthy comparison group (Johns, 2010).

Collins and colleagues (2005) interpret Dow Chemical Company's attempt to estimate the impact of health on presenteeism and absenteeism. The study assessed that among people with a lasting health problem, the time which is lost due to absence during a 4-week period ranged from 0.9 to 5.9 hours. Work deterioration ascribed to presenteeism ranged from 17.8 to 36.4 per cent with an increase depending on the number of chronic conditions stated. The authors also assessed that the average Dow employee's health cost the company \$6721 due to presenteeism versus \$661 due to absenteeism, and \$2278 due to direct health care costs (Johns, 2010).

Goetzel and colleagues (2004) based on the integration of the results of five large independent researches of presenteeism which measured multiple medical situations indicated that the average productivity loss across 10 conditions was 12 per cent. Based on the US hourly average wage rate of \$23.15 (2001), the average daily productivity loss due to health was estimated at \$22. Finally, Goetzel and colleagues (2004) estimated that anywhere from 18 to 61 per cent of employers' total medical costs were attributable to presenteeism, although even the low presenteeism estimate exceeded the cost due to absence (Johns, 2010).



As regards the aviation sector, there is no research related to the effects of presenteeism in aviation. The aviation sectors that can be mostly affected by this behavior are aviation efficacy, flight safety as well as the economic impact of those two. According to Collins and colleagues (2005) the costs of a presentee are the direct cost of any health plan which are the costs of being absent plus the costs due to reduced productivity because of not working at full capacity. In aviation, the costs of a presentee apart from just reduced productivity may perhaps include also the cost of an incident or accident. Invaluable cost can also be related to a loss of an aircraft, flight crew, passengers or even inability to complete operational missions, such as air protection and support for military, aero medical transportation, search and rescue missions, firefighting missions or even confrontation of critical flight conditions, like confrontation of emergency situations (Douglas et al., 1996).

### **Hidden causes of presenteeism**

As we mentioned above, there are cases where the factors that affect the act of being absent stimulate also presentees (Koopmanschap et al., 2005). However, although both behaviors and attitudes can share common stimuli, this is not the case, or they do not affect the same person at the same way. It can be generally considered that presenteeism causes can be divided into three general categories: organizational policies, job design features, and presenteeism cultures (Johns, 2010).

The organizational policies include situations and events which in one way or another are able to affect positively or negatively the tendency to be present at work even we should not. The salary one earns, the attendance control or the policy that

exist in any corporation, concerning medical or sick leaves and payment, is a cause that can incline employees to become presentees or not. It is believed that those who earn higher wages generally show less absenteeism. On the other hand, those who earn fewer wages could also appear more often ill to work, in order to save sick leaves or in order not to lose their daily wage (Johns, 2010).

Downsizing or the economic situation that the firm is in that period, can also be a cause that can affect the rates of presenteeism. For example, a possible reduction in workforce due to crisis or strategic reasons could provoke, logically, fear of job loss, increased workload or any organizational structure changes that increase competition for promotions and permanency. All these situations can make people attend work despite having any health problems and working for a lot of hours while not being very productive (Simpson, 1998). Permanency of employment status could also affect presenteeism. Due to job insecurity, non-permanent employees are more inclined to attend work when sick than will permanent employees, because they are more vulnerable to job cuts. That is the reason why temporary and fixed contract workers show less sickness absence, than their more permanent counterparts (Johns, 2010).

Another feature that affects the rate of attending work while not being in excellent condition to do that, are sometimes the job demands. For instance high-demand jobs would make one be more inclined to attend when not fine, so to maintain high levels of performance. That is why high-demand jobs usually correlate burn out with presenteeism. Also opportunities employees have to reduce their work output, especially individuals, might be inclined to show up or alter work procedures in response to being unwell. The ease of replacement, meaning the extent to which work missed due to absenteeism has to be made up upon return to work, is also an

important factor that can make workers tend to be present at work. The lack of staff that can replace someone for a certain job can also tend to presenteeism. So combination of heavy workload, time pressure and lack of assistance contribute to higher rates of this behavior. Finally, being a member of a project, or a team generally, make one feel obliged to follow the team members take less sick leaves (Johns, 2010).

The culture of an organization plays also a significant role, in a way that makes employees understand the importance of being out when ill, so that company's productivity continues unaffected by external and non-computable factors. Organizations have to pass to their employees or better to create a culture, so to make them act fearless, as regards their job loss, alleviating this kind of behavior (Johns, 2010).

Although the role of personal factors has not been researched in a wide extend, it is to expect that people who have positive work attitudes and justice perceptions may probably exhibit presenteeism as would workaholics, the conscientious and the physiological hardly. On the other hand, absentees are mostly people most probably stressed and those with tendency for adopting a sick role (Reason, 1997).

As it is expected, a couple of days of absence could alleviate the health problem and lead to fully engaged attendance. Contrariwise several days of presenteeism might exacerbate the health event and lead to finally to absenteeism (Cooper, 2010). For instance, think of a pilot who has a stuffy nose and decides to show up to a flight. If he/she takes the decision to stay grounded and take the proper medicine, he/she would recover from his problem in a couple of days so that his/her aviation company would be able to take advantage of him as soon as possible. On the

other hand if he/she takes the decision to become presentee, the problem might deteriorate and result in otitis, due to the changes in compression (Davis et al., 2008). So, in this example the pilot could stay much more than a couple of days, even for weeks until he/she becomes fully operational for flying. Meaning that chronic presenteeism might cause further damages in one's health, provoking a consecutive lowered productivity, increased absenteeism and a possible disability (Boles et al., 2004).

Finally, personality might be an additional factor affecting presenteeism. For instance, most of the people who tend to present to work when are not totally healthy are those with a strong work ethic, with internal health control capability, workaholics and those who exhibit the trait of psychological hardiness (Johns, 2010). An example is, that those who found it difficult to say no to others tend to attend to work when ill (Aronsson et al., 2013). Also, conscientious people that attend to work are able to comprehend that their productivity suffers, while workaholics, refuse productivity loss (Boles et al., 2004). In that point we should wonder if co-workers and superiors are aware of the correlation between a person's medical condition and his productivity. Are they also aware of the costs of presenteeism?

Subsequently will follow an example to understand in what way a presenteeism behavior could affect pilots' performance and therefore flight safety. Let us assume a pilot who suffers from a light cold or flew and believes that he is feeling good to fly, because it's just a cold (acts with a presenteeism behavior). In that point, if organizational filters do not exist to stop this action, it is possible to create a safety risk, such as a ruptured eardrum during flight (Reinhard, 2007). A cold, followed by a stuffy nose prevents pressure equalization, due to the fact that the Eustachian tube is difficult to vacuum and to adjust to changes. So it is required an early descent in order

to prevent hearing loss and discomfort (Lounsbury et al.,2003). Otherwise as he continues he suffers from pain that also could lead to a ruptured eardrum and as a consequence apart from sacrificing flight safety during flight (productivity loss), this action could lead to the pilot be grounded for weeks or months and be absolved from flight duty (increased absenteeism and possibility disability) (Johns, 2010).

Another underestimated risk could be a broken sinus passages that are swollen and could have as consequence poor pressure equalization, distraction and severe pain (Gradwell & Rainford, 2006). Last but not least, could be the risk of disorientation. Low pressure equalization could cause problem to the vestibular system and lead pilot to receive or understand the wrong messages (Reinhard, 2007).

On the other hand, if this pilot takes cold and flu medicine, the risks still remain and even worse, can cause other side effects such as drowsiness, sleepiness, performance loss, poor communication and more (Lounsbury et al., 2003). For that reason we should be aware of risks in order to avoid them, meaning if someone does not feel so good, does not have to fly (Reinhard, 2007).

In the following chapter we will present the hypotheses of our research, in order to examine whether a relationship between flight incidents or accidents, meaning flight safety and the presenteeism exists. In that way we will be able to examine how and to what extend the behavior of a presentee pilot has the tendency to perform worse - productivity loss in correspondence with aviation terms and needs (Federal Aviation Administration, 2010) - and create an unsafe act.

## **HYPOTHESES**

In this chapter the main purpose is to integrate the concepts of flight safety and presenteeism and test if and/or how these two variables are related.

As we have already mentioned aviation safety is a concept surrounded by theory, investigation of flight failures and the prevention of similar failures through the proper management that includes regulation, education, and training. Also worth noting that investigators when examine the chain of events that led to an accident, human factor is usually one of the main causes that affect flight safety (Wiefmann & Shappell, 2003).

On the other hand, presenteeism is a behavior acted by people who attend work while ill or not in a fully productive capability. Through many projects (Allen, Hubbard & Sullivan, 2005; Burton et al., 2004; Goetzl et al., 2004; Johns, 2010; Lerner et al., 2004 and others), it is shown that this behavior ends with cumulative consequences (chronic and episodic health events that can lead to extended absenteeism) which finally affect productivity levels.

Take off is the procedure when the aircraft goes from the ground to flying in the air (Aviation Glossary, 2011). In order to execute safely the maneuver, pilots should execute all the required checks according to the aircraft flight manual, maintain the aircraft in the centre line during the take off roll and bring the aircraft in the appropriate altitude in the appropriate airspeed, taking into consideration the weather conditions (International Civil Aviation Organization, 2010).

Suppose that there is a pilot who is injured and has strain or muscle pain in his hands or legs. This person according to aviation organizations should be absolved from flight duty, until recovering from his condition (Wiefmann & Shappell, 2003). It is worth mentioning that before every flight (either civil or military), there is available a medical support to examine if needed the flight crew (Wood, 1991). So, despite the fact that there is a doctor available in the pre-flight briefing, the pilot decides for any personal reason to hide his physical condition and continue to fly without having any expert's examination (here the pilot acts a presenteeism behavior). Also that day there are prevailing bad weather conditions in the departure airport, such as wind conditions, rain or snow. As a result the runway condition is whether damp or icy and in combination with the wind make the take off maneuver even more difficult. In that case if the pilot is injured, it is possible that will have difficulty in maintaining the proper directional control of the aircraft because of the pain feelings, since all switches need the direct control inputs by the pilots' limbs. So, the highest deviation the aircraft has from the runway centre line, the more difficult it is to react in a hazardous situation such as a blown tire. From the above example we can conclude that performance and the take off procedure are affected negatively by presenteeism.

*Hypothesis 1. Presenteeism negatively affects the Take off procedure.*

Cruise is the phase of the flight after the Take off and Climb phases and before the Descent for landing phase where the aircraft maneuvers and follows the planned route (Aviation Glossary, 2011). In order to execute safely the maneuver, pilots should maintain a positive and smooth aircraft control, taking into consideration the hundreds of decisions that have to be made and actions to be taken, ranging from

weather interpretation, fuel uplift and route of flight selection to the operation of the aircraft and its switches and systems to the navigational aspects of the flight. (Wiefmann & Shappell, 2003). It is worth mentioning that during a flight, aircrafts cross each other with 1000 feet altitude separation (International Civil Aviation Organization, 2010). Thus, the altitude deviation an aircraft has from the authorized altitude is important. Aircrafts nowadays are equipped with heading and attitude computer devices, so to maintain better and smoother aircraft control (Reason, 1995). However, there can be situations, where direct human interventions should be executed (Wiefmann & Shappell, 2003). And that is exactly what we are going to examine; the basic aircraft control a pilot can maintain manually, without the use of any auto pilot mode, when he is ill or not in 100% perfect physical and mental condition, as it is required by the aviation organizations (Wiefmann & Shappell, 2003).

Let's assume for instance a pilot who is flying the aircraft without the use of the auto-pilot computer system in an airway. Although this pilot had some symptoms of headache before the flight, he did not request a medical support, because he underestimated his problem and decided to fly (presenteeism behavior). During flight, the negative effects of his simple headache can exacerbate by the environmental factors of altitude and low humidity found in an aircraft in combination with his circadian cycle or a possible fatigue (Newman, 2007). The result could be a noticeable instability in maintaining the altitude while using aircraft systems, due to his distraction from his pain that from a simple headache can become an aggravated sinusitis.

*Hypothesis 2. Presenteeism negatively affects the Basic aircraft control.*



The landing is the maneuver where a flying aircraft returns to the ground (Aviation Glossary, 2011). In order to execute safely the maneuver, pilots should execute all the required checks according to the aircraft flight manual, direct the aircraft in the runway centre and execute gradual reductions in the descent rate so to the aircraft on the ground, taking into consideration the weather conditions (International Civil Aviation Organization, 2010).

This procedure, as well as the take off procedure, is considered as the most critical phase of a flight, because pilots are subjected to limited reaction time. So anything that could cause any difficulty in maintaining the proper directional control of the aircraft because of pain or any other kind of distraction, could affect negatively the pilots performance during the maneuver. Imagine for instance a pilot with a common light cold who flew despite he should not. As we have already mentioned in chapter 2, this pilot could end up with a severe pain of sinusitis during the instrument approach, which may lead to performance loss. That means that during the final approach the pilot in command will be suffering by pain and distraction while executing the proper checks for Landing. If we also suppose that in the airport prevail windy conditions, the pilot probably will not be able to execute the proper wind conditions, since he would be suffering from pain. That increase risk, since he may have some small or greater deviation from the center line of the runway, during the landing maneuver. If we combine this situation with a blown tire, we can imagine what could be the results, because of the simultaneous deviation from the center line, the pain or distraction of the pilot and the increase in the react time pain can cause him. From the above example we can conclude that the Landing procedure is affected negatively by presenteeism.

*Hypothesis 3. Presenteeism negatively affects the Landing procedure.*

As we have already mentioned whenever performance is affected during critical phases of the flight the aircraft can be in a hazardous situation affecting consequently flight safety (Federal Aviation Administration, 2010).

In order to have a safe flight, pilots should not have any tendency to deviate from the maximum accepted performance deviations (Green, 1996). Let's assume a pilot suffers from a stuffy nose and despite the fact that there is a doctor available in the pre-flight briefing, the pilot decides to fly without having any expert's examination (here the pilot acts again a presenteeism behavior). Also that day, the destination weather conditions are cloudy, something that happens usually during winter. According to medicine and especially aviation medicine bibliography (Davis et al., 2008), as cabin pressure changes during a flight's ascent and descent, we may find ourselves in many feelings, different from those that prevail on ground. The eustachian tube connects our middle ear to our throat. Its primary job is to regulate the airflow into and out of our middle ear to maintain an air pressure equal to that of the air around us, something that may be difficult or even impossible when somebody has a stuffy nose. When a plane begins its ascent or descent, the cabin pressure quickly changes and the Eustachian tube kicks into gear to adjust the pressure inside our ear. If anything gets in the way of the airflow, such as blockage from a stuffy nose, we may feel tremendous pressure or pain. While the condition normally rectifies itself as soon as cabin pressure returns to normal, it is not unusual to experience temporary vertigo, tinnitus or hearing loss that can last for up to six weeks. In severe cases, the eardrum may rupture, causing bleeding and pain (Lounsbury et al., 2003). So if something like that happens, the pilot would suffer, if not by a severe pain, that is the most common symptom, by at least distraction or limited concentration. All these, in combination with the weather conditions or a possible aircraft malfunction can affect

the performance ratio of a pilot and most probably create conditions for the existence of an unsafe act related to flight safety (eg. Vertigo in Instrument Meteorological Conditions). Finally apart from that we saw also that this act of presenteeism can even lead sometimes to increased absenteeism, due to medical reasons like for example hearing loss that can last for up to six weeks (Davis et al., 2008). From the above example we can conclude that flight safety and performance could be affected by presenteeism.

*Hypothesis 4. Presenteeism negatively affects the flight safety.*

In the next chapter the methodology used in this study is described, such as data collection, sample and measures used.

## METHODS

In this chapter, we present the methodology used in this study. The first section contains information about the sample used and next, the presentation of the instruments used to measure the study's variables.

### Sample

Data were collected from several aviation organizations such as the Civil Aviation Authority and the Air Force, located in the areas of Athens, Kalamata and Megara in Greece, Königsburg in Germany and Lecce in Italy. The questionnaires were handed out to civil and fighter pilots of different nationalities (American, British, Cyprian, German, Greek, Italian, Jordanian and Spanish). Participants were asked to voluntarily complete the questionnaire and it was clarified to them that their personal responses would be kept anonymous. We should also point out here that the execution of the investigation did not produce any financial cost for the Civil Aviation Authority or the Air Force budgets.

Average age of the respondents was 34.3 years old, with mean flight experience of 2032.50 flying hours. Most of them, approximately in a rate of 93.1% of the participants were male and of all the respondents, 48.6% were married while the 41.7% of them were single. With respect to education, 68.1% had at least a university degree and 29.2% a post-graduate degree. Finally, according to their flying experience, approximately in a rate of 60% of the participants had a previous experience in fighting aircrafts.

## Measures

We decided to examine all hypotheses in Flight Simulators mainly for safety purposes. The deviations measured, were related and affected by the Aircraft type a pilot is flying, like for example an Airbus, a Boeing, an F16, a fire fighting or a training aircraft. Also, pilots' performance can be affected by the level of their experience (Federal Aviation Administration, 2010), for instance if he is a trainee, a co-pilot, a new pilot or an experienced pilot. So, in order to eliminate these deviation differences, we recorded the pilot's performance in the respective Flight Simulator (F/S), without the use of the auto-pilot computer system, according to common limitations described below in this chapter.

### *Presenteeism tendency to fly*

Presenteeism was measured with a self reported instrument and Doctors' reports. The willingness to fly with an aircraft, despite the fact that the pilot was ill (presenteeism behavior) was measured with the following question: 'If you had the opportunity to fly today, despite the fact that you are absolved from flight duty, would you fly?'. Responses were made on a 5-point response scale from 1 (no, definitely I would not fly) to 5 (definitely yes I would fly). The items for the rest three possible answers were: 'maybe yes I would fly', 'I do not know if I would fly', 'maybe no, I would not fly'.

### *Presenteeism tendency to fly a flight in the Flight Simulator Device*

The willingness to fly with the Flight Simulator Device, despite the fact that the pilot was ill (presenteeism behavior) was measured using the following question

:‘If you had the opportunity to fly a Flight Simulator flight today, despite the fact that you are absolved from flight duty, would you fly?’. It is worth mentioning in that point that all aviation organizations regulations consider simulator flights as a real flight and request the same health prerequisites from a pilot to do it (Flight Safety Foundation, 2001). Responses were made on a 5–point response scale from 1 (no, definitely I would not fly) to 5 (definitely yes I would fly). The items for the rest three possible answers were: ‘maybe yes I would fly’, ‘I do not know if I would fly’, ‘maybe no, I would not fly’.

### ***Performance***

Upon the completion of the questionnaire, participants were asked to participate to the respective Flight Simulator device of the aircraft they are flying. Thus, followed one or in some cases more simulator flights (according to the capability of each participant and the organization he/she pertained to). Those flights were of a small duration and increased difficulty, so us to be able to notice and thereafter to prove that, the reason that makes one being absolved from flight duty can affect pilots’ performance and therefore flight safety. As it is known (Reason, 1990), a flight in the Flight Simulator, ‘simulates’ a real flight, with real flying conditions, but actually it is not exactly the same. For that reason, it was attempted to adjust as possible the real flight conditions (Wood, 1991) and in order to make it more realistic and to a degree more difficult, it was also given to the participants a profile so to solve an emergency situation, meaning a serious, unexpected, often dangerous situation that requires immediate action (Aviation Glossary, 2011).

The performance ratios depend always, as already mentioned, on the aircraft a pilot is flying (eg. Civil or fighting, Boeing or airbus, F-16 or fight firing aircraft) as

well as by the experience of the pilot (experienced or student pilot or co-pilot). For that reason in each observation, the researcher tried to modify a profile with maneuvers and situations that could affect pilot's performance. In order to manage this in a limited available time, we had to adjust, as possible, the difficulty of a mission depending on the problem of each pilot. For instance, a fighter pilot with a problem related to headache or dizziness, was asked to execute a fighting profile that is full of aerobatic maneuvers and alternations among the yaw (vertical), pitch (lateral) and roll (longitudinal) axis (x,y,z). On the other hand, for a pilot who is absolved from flight duty due to problems in his eyes (eg. Conjunctivitis or chalazion inflammation of the eyelid glands), we had to adjust a profile that the use of his eyesight was needed with accuracy, such as a flight inside clouds that requests an intensive cross check control among the aircraft instrument displays. At the same time the pilot had to cope with an emergency situation. From the above examples we tried to show whether the performance and the basic aircraft control would be affected negatively by the presenteeism behavior.

Following the above mentioned technique, we recorded in a 5-point scale the performance of pilots in critical phases of a flight. Each of the 5-point scale does not indicate a respective number but the deviation from the expected standard performance, which depends on each pilot's experience as well as the aircraft he is flying. During the flight in the Flight Simulator device, the observer was pointing down the performance of the participant, in order to use this data for further analysis.

Furthermore, there were collected the performance ratio of the same participants flying the same profile in the immediately preceding or in the immediately following flight in the simulator device, but now in perfect health conditions, meaning without acting in presenteeism conditions. Subsequently, the two

performances were compared by using the dependent t-test analysis for repeated measures, for the performance of each of the three phases that is encountered the highest percentage of aviation accidents as mentioned in chapter 1.

### ***Take off performance***

The data collected in the Flight Simulator device were grouped and set in a 5-point scale. For the Take off maneuver we defined the performance of the participant according to the parameter of the aircraft deviation from the runway center line in feet (Federal Aviation Administration, 2010). So on a 5-point scale from 1 to 5 there were set the following deviations, more to the pilot normal expected performance (Flight Safety Foundation, 2001) as follows: 1 = '5 feet', 2 = '7,5 feet', 3 = '10 feet', 4 = '12,5 feet', 5 = '15 feet'.

### ***Basic aircraft control performance***

The data collected in the Flight Simulator device were grouped and set in a 5-point scale. For the Basic aircraft control we defined the performance of the participant according to the parameter of the aircraft deviation in feet from the planned altitude (Federal Aviation Administration, 2010). So on a 5-point scale from 1 to 5 there were set the following deviations, more to the pilot normal expected performance (Flight Safety Foundation, 2001) as follows: 1 = '<100 feet', 2 = '100-150 feet', 3 = '150-200 feet', 4 = '200-300 feet', 5 = '>300 feet'.

### ***Landing Performance***

The data collected in the Flight Simulator device were grouped and set in a 5-point scale. For the Landing maneuver we defined the performance of the participant according to the parameter of the aircraft deviation from the runway center line in feet



(Federal Aviation Administration, 2010). So on a 5-point scale from 1 to 5 there were set the following deviations, more to the pilot normal expected performance (Flight Safety Foundation, 2001) as follows: 1 = '10 feet', 2 = '15 feet', 3 = '20 feet', 4 = '25 feet', 5 = '30 feet'.

### ***Symptoms***

Additionally was investigated whether participants felt or not any symptom during their flight in the simulator device, because of being ill. The existence of the symptom was measured using a questionnaire. Responses were made on a 2-point response scale from 1 (yes, I noticed some symptoms) and 2 (no, I did not notice any).

### ***Stress increase***

Participants were asked to report if they felt any anxiety increase compared to a usual flight in the simulator device when not being ill. Responses were made on a 5-point response scale from 1 (absolutely no increase) to 5 (intense increase). The items for the rest three dimensions were: 'no increase', 'imperceptible increase' and 'little increase'.

### ***Distraction***

Participants were asked to report if they felt any distraction in completing their cockpit task compared to a usual flight in the simulator device when not being ill. Responses were made on a 5-point response scale from 1 (absolutely no increase) to 5 (intense increase). The items for the rest three dimensions were: 'no increase', 'imperceptible increase' and 'little increase'.

### ***Deterioration of the disease***

Participants were asked to report if they felt any aggravation of the disease. Responses were made on a 5–point response scale from 1 (absolutely no increase) to 5 (intense increase). The items for the rest three dimensions were: ‘no increase’, ‘imperceptible increase’ and ‘little increase’.

### ***Flight safety effect***

Participants were asked to report if they felt that because of their disease flight safety was threatened. Responses were made on a 4–point response scale from 1 (no) to 4 (intense). The items for the rest two dimensions were: ‘imperceptible’ and ‘little’.

### ***Controls***

To exclude the possibility of alternative explanation, the flying experience in hours was used as a control variable. Flying experience in hours, is commonly used as a control variable, in aviation research (Southern California Safety Institute, 2010).

In the next chapter follows the presentation of the results on the mentioned examined parameters, which will show us if there is and to what extend relation between presenteeism and pilots performance when ill.

## RESULTS

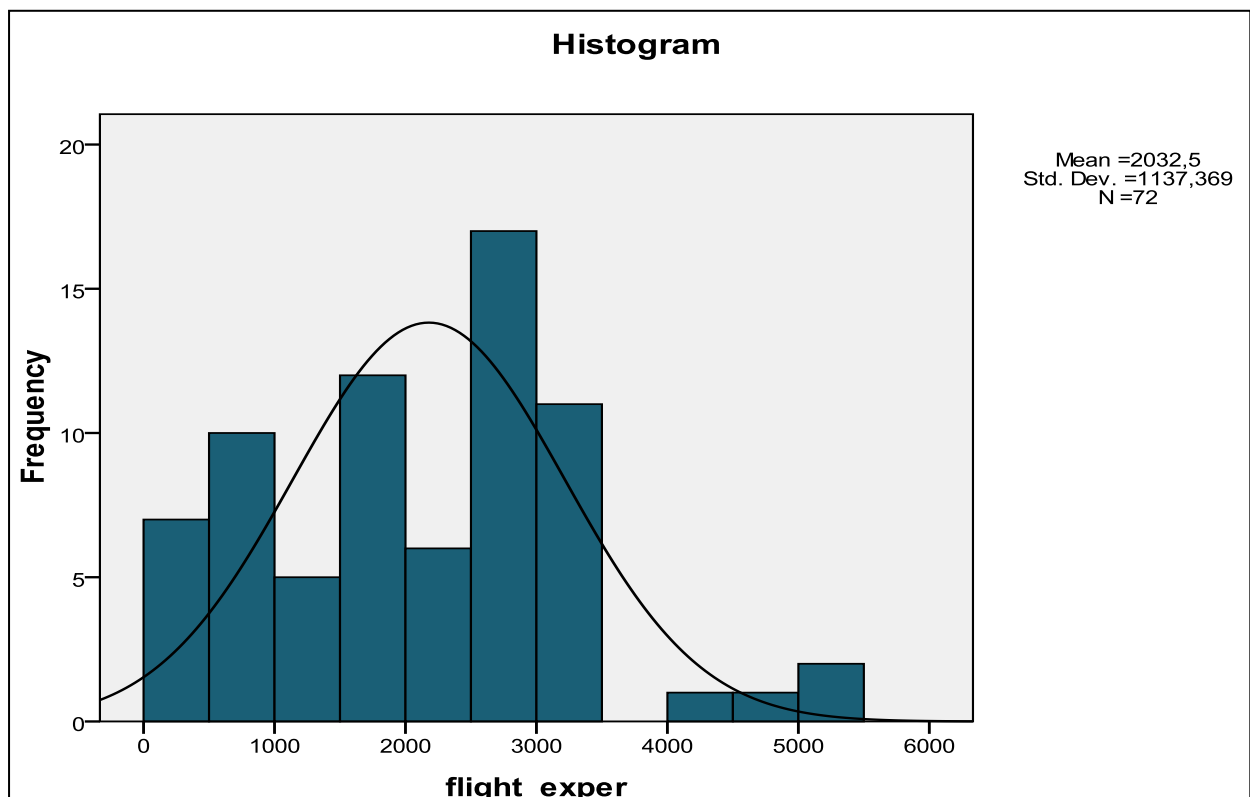
In this chapter were presented the results of our research. The presentation includes graphs and tables so as to become easier by the reader, without the need of any previous statistical expertise, to understand and extract easily the results.

### **Descriptive statistics**

In the following table of descriptive statistics (Table 2) we can see that the mean flying experience of our sample is 2.032,50 hours. The other important measure for our purpose is the skewness and the kurtosis of our sample, both of which have an associated standard error. From the theory (Field, 2009) we know that the values of skewness and kurtosis should be zero in a normal distribution. Thus, the skew value is very close to zero (0,262) that indicates that we have too many low scores in the distribution and kurtosis is a little negative (-0,116) that indicates a flat and light-tailed distribution. Also, because these values are close to zero, mean that our data is normally distributed.

Statistics							
Flight Experience							
N Valid	N Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance
72	0	2032,50	134,040	2000,00	3000	1137,369	1293607,746
Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum	Sum
,262	,283	-,116	,559	4820	180	5000	146340

**Table 2. Statistics – flight experience**



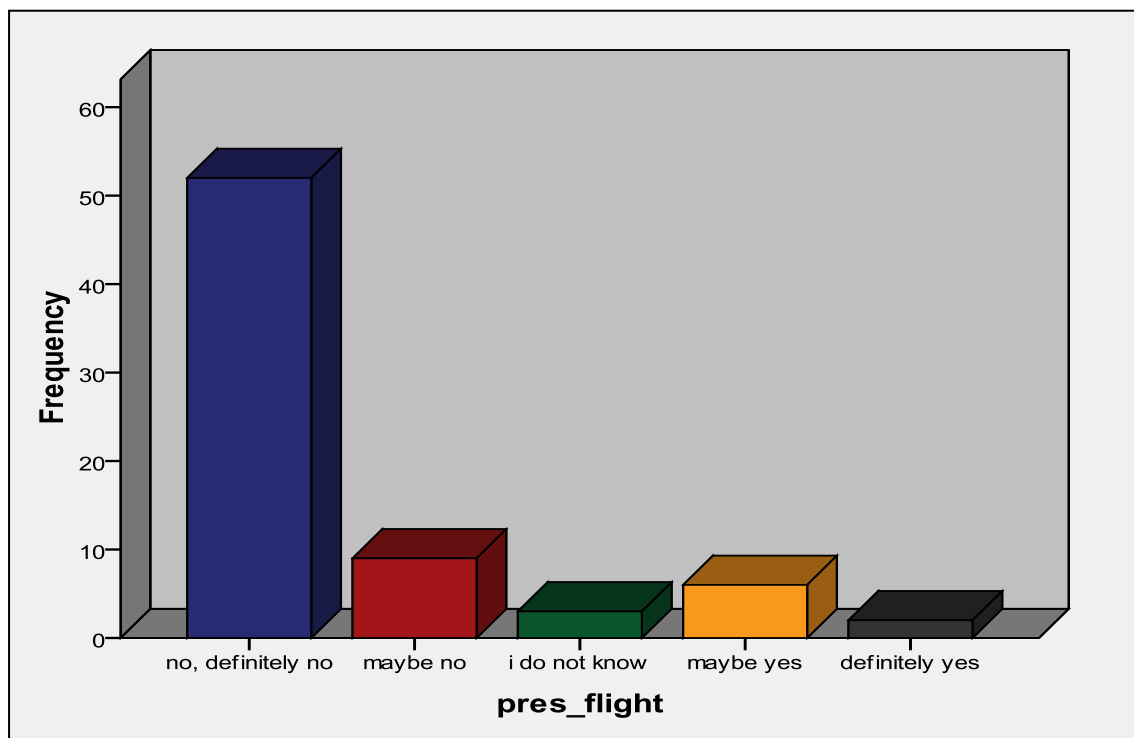
**Figure 8. Histogram-flight experience (hours)**

In order to estimate the tendency to the presenteeism behavior participant pilots answered in the question: ‘if you had the opportunity to fly today, despite the fact that you are absolved from flight duty, would you fly?’ as follows:

		pres_flight			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no, definitely no	52	72,2	72,2	72,2
	maybe no	9	12,5	12,5	84,7
	i do not know	3	4,2	4,2	88,9
	maybe yes	6	8,3	8,3	97,2
	definitely yes	2	2,8	2,8	100,0
	Total	72	100,0	100,0	

**Table 3. Tendency to presenteeism behavior on flying**

From the above data we can see that the 84.7% answered that would not fly, while just the 11,1% answered that would fly.



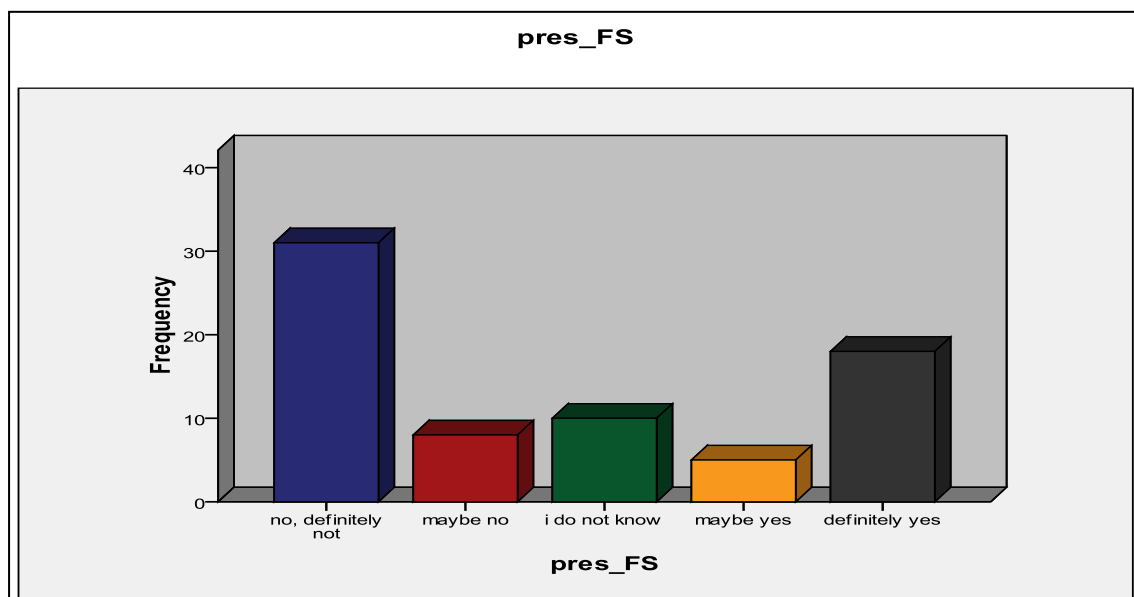
**Figure 9. Histogram of the tendency to presenteeism on flying**

Afterwards we made the same question to the participants for a flight in the Flight Simulator Device ('if you had the opportunity to fly a Flight Simulator flight today, despite the fact that you are absolved from flight duty, would you fly?'), in order to determine if there is any difference in the answers, since a flight in the flight simulator is considered a safer than a real flight environment (Flight Safety Foundation, 2001). Here are the results:

pres\_FS

	Frequency	Percent	Valid Percent	Cumulative Percent
no, definitely not	31	43,1	43,1	43,1
maybe no	8	11,1	11,1	54,2
Valid i do not know	10	13,9	13,9	68,1
maybe yes	5	6,9	6,9	75,0
definitely yes	18	25,0	25,0	100,0
Total	72	100,0	100,0	

**Table 4. Tendency to presenteeism behavior on flying at the Flight Simulator**



**Figure 10. Histogram of the tendency to presenteeism on flying at the Flight Simulator**

We can see that the percentage of those who answered that they would fly is bigger, meaning 31,9% , while 54,2 answered that they would not.

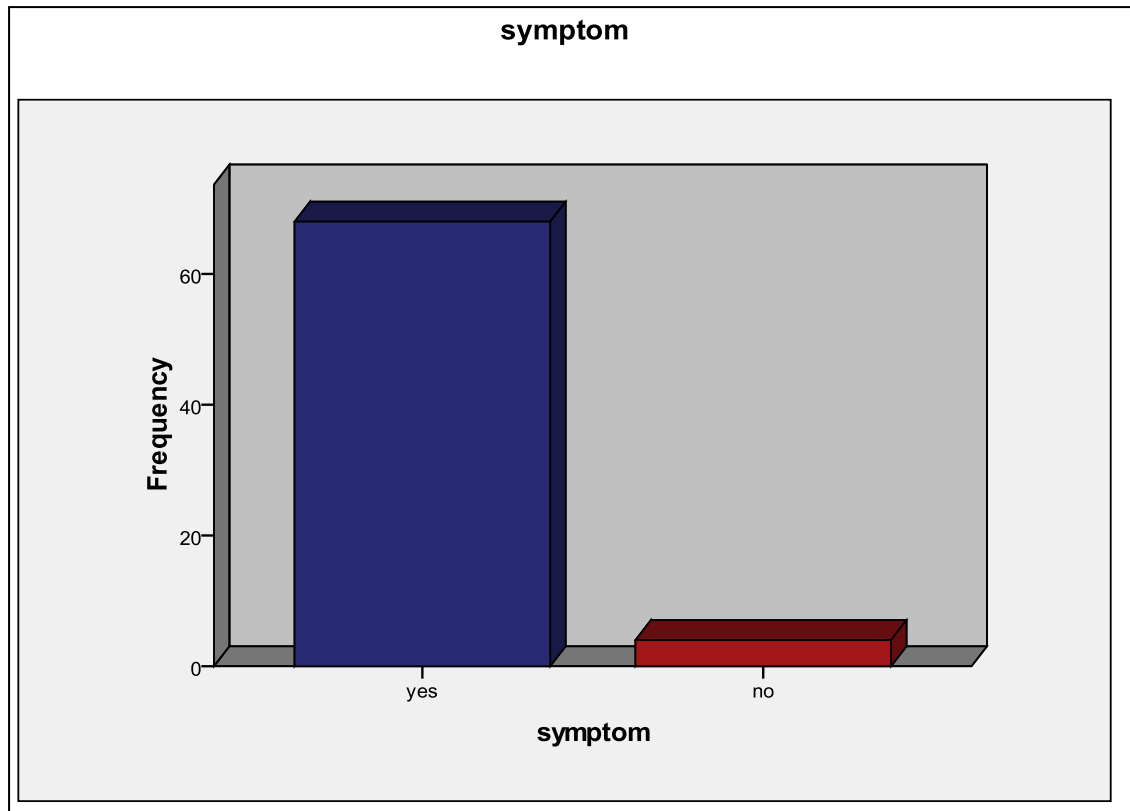
## Symptoms

After the Flight Simulator, apart from recording the results in the performance of each participant, we ask them to report us if they felt any symptom, as well as to report us what kind of symptom was that. It is worth to note the reported results, because can show us the tendency to influence performance. Meaning that in real flying conditions, those symptoms could be a chargeable event of a flight safety incident. In the following Tables and Figures are exposed their reports:

		Symptom			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	68	94,4	94,4	94,4
	no	4	5,6	5,6	100,0
Total		72	100,0	100,0	

**Table 5. Experience of symptoms**

On average, participants experienced a symptom in a rate of 94.4%.



**Figure 11. Histogram of symptoms experience**

And as regards the kind of the symptoms pilots felt, we have:

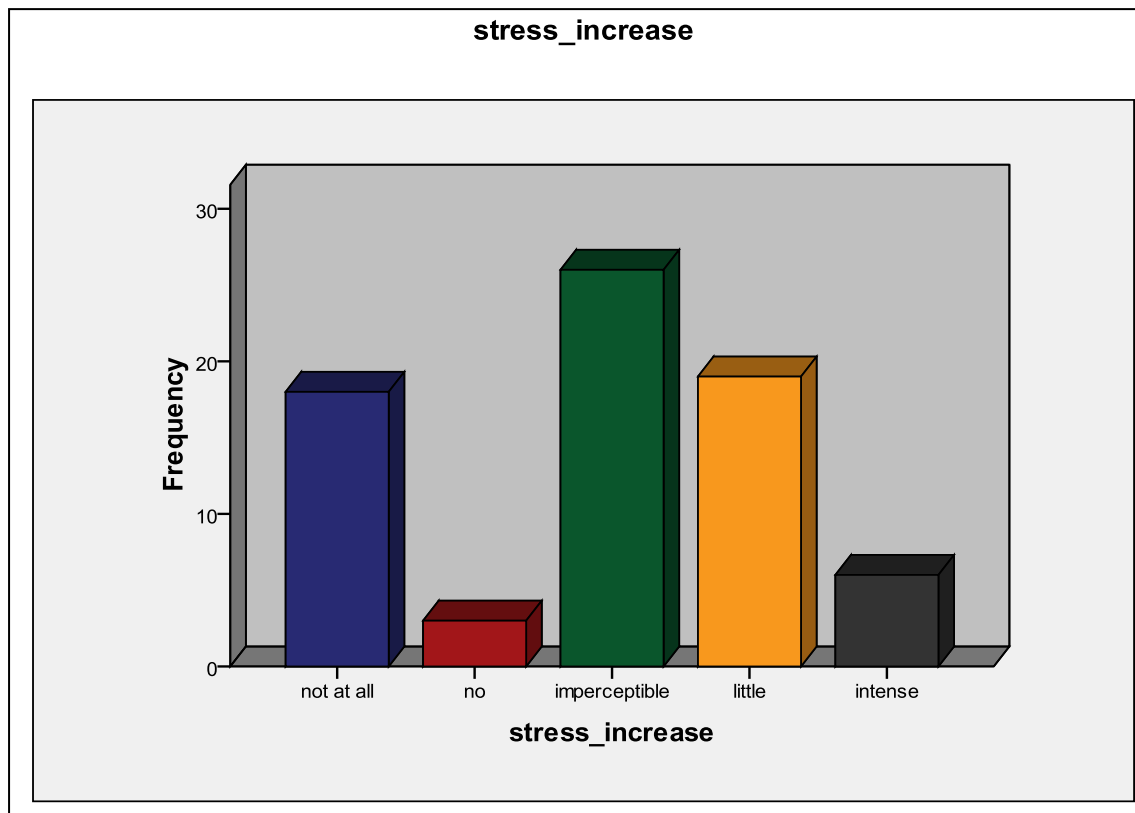
***Stress increase***

According to the pilot's statement, the 70.8% of them felt a more stressful situation due to their physical condition than usual.

		stress_increase			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	not at all	18	25,0	25,0	25,0
	No	3	4,2	4,2	29,2
	imperceptible	26	36,1	36,1	65,3
	Little	19	26,4	26,4	91,7
	intense	6	8,3	8,3	100,0
	Total	72	100,0	100,0	

**Table 6. Sensation of stress increase**





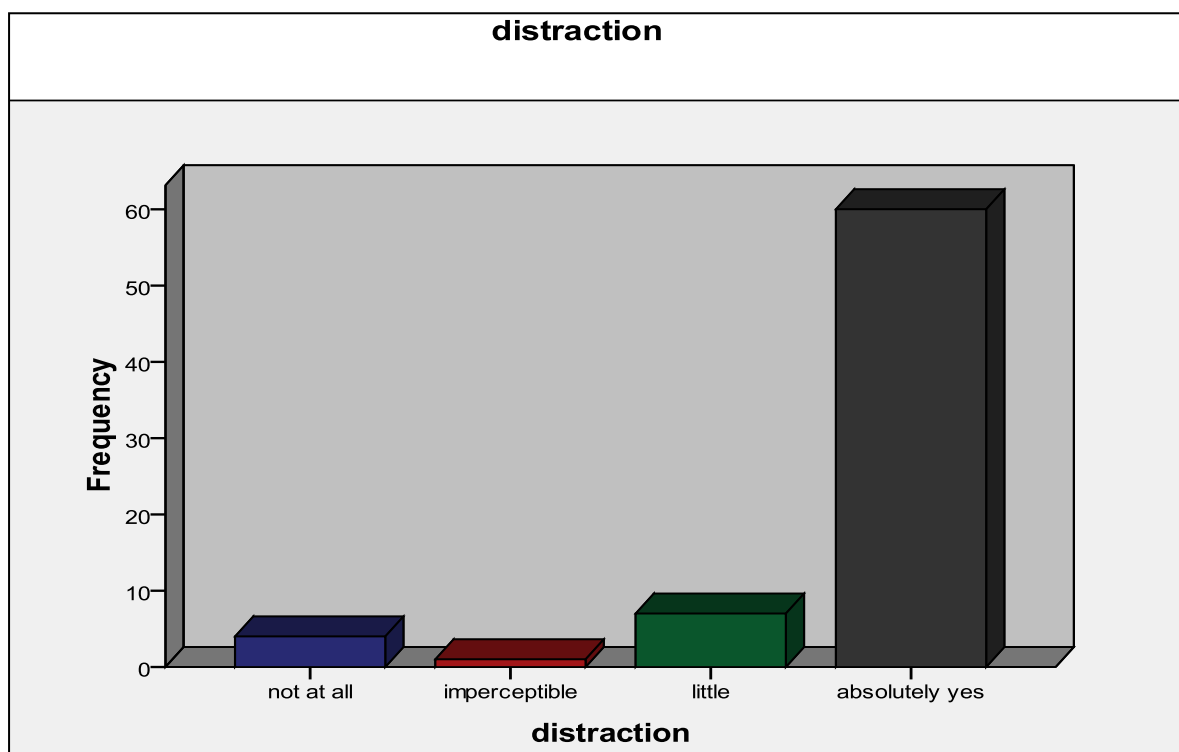
**Figure 12. Histogram of the sensation of stress increase**

### *Distraction*

As regards the distraction of the pilot from his task, we can see that even on the ground flying with the Flight simulator device pilots experienced in a percentage of 94,4% at least an imperceptible distraction, while the 83.3% of them experienced an intense distraction so to complete the proper cockpit task, than usual.

Distraction				
	Frequency	Percent	Valid Percent	Cumulative Percent
	not at all	4	5,6	5,6
	imperceptible	1	1,4	6,9
Valid	Little	7	9,7	16,7
	intense	60	83,3	100,0
	Total	72	100,0	

**Table 7. Sensation of distraction**



**Figure 13. Histogram of sensation of distraction**

***Deterioration of the disease***

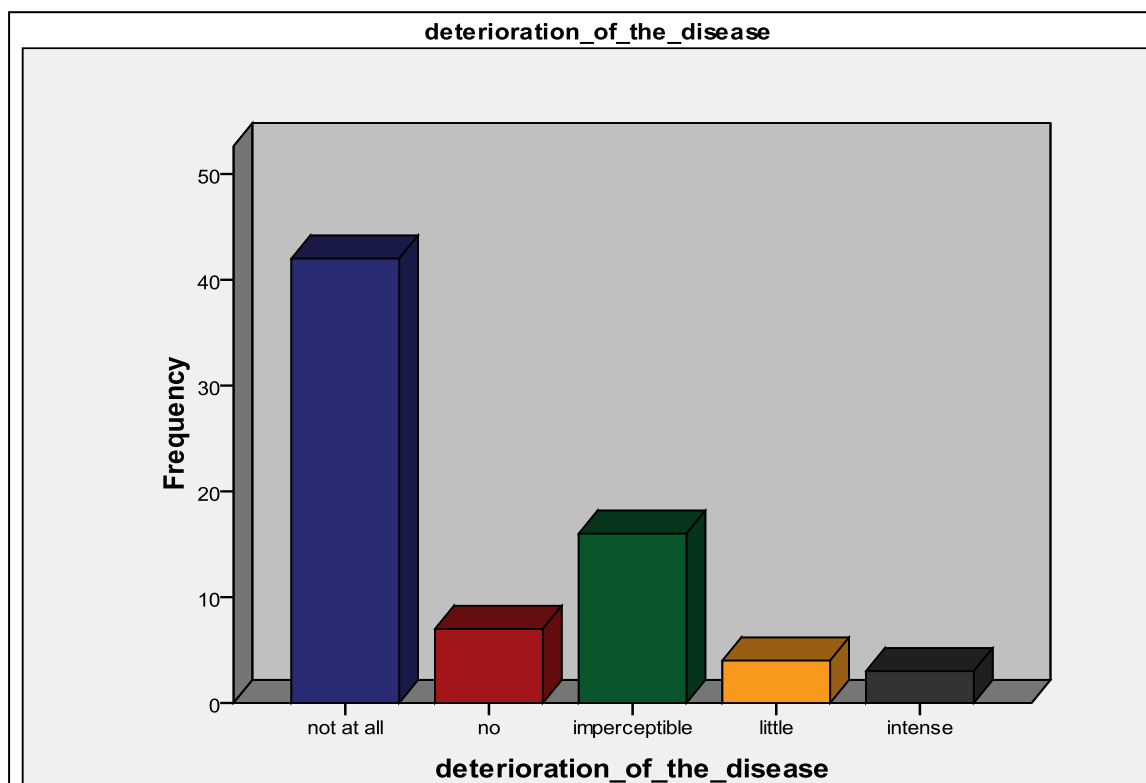
We can see that 68.1% of the pilots did not feel any deterioration of the disease, something expected, since the Flight Simulator device just simulates the real

flight conditions which means that maybe in the real flight conditions this situation could be more aggressive.

aggravation\_deterioration\_of\_the\_disease

	Frequency	Percent	Valid Percent	Cumulative Percent
not at all	42	58,3	58,3	58,3
No	7	9,7	9,7	68,1
imperceptible	16	22,2	22,2	90,3
Little	4	5,6	5,6	95,8
Intense	3	4,2	4,2	100,0
Total	72	100,0	100,0	

**Table 8. Sensation of deterioration of the respective disease**



**Figure 14. Histogram of the sensation of disease deterioration**

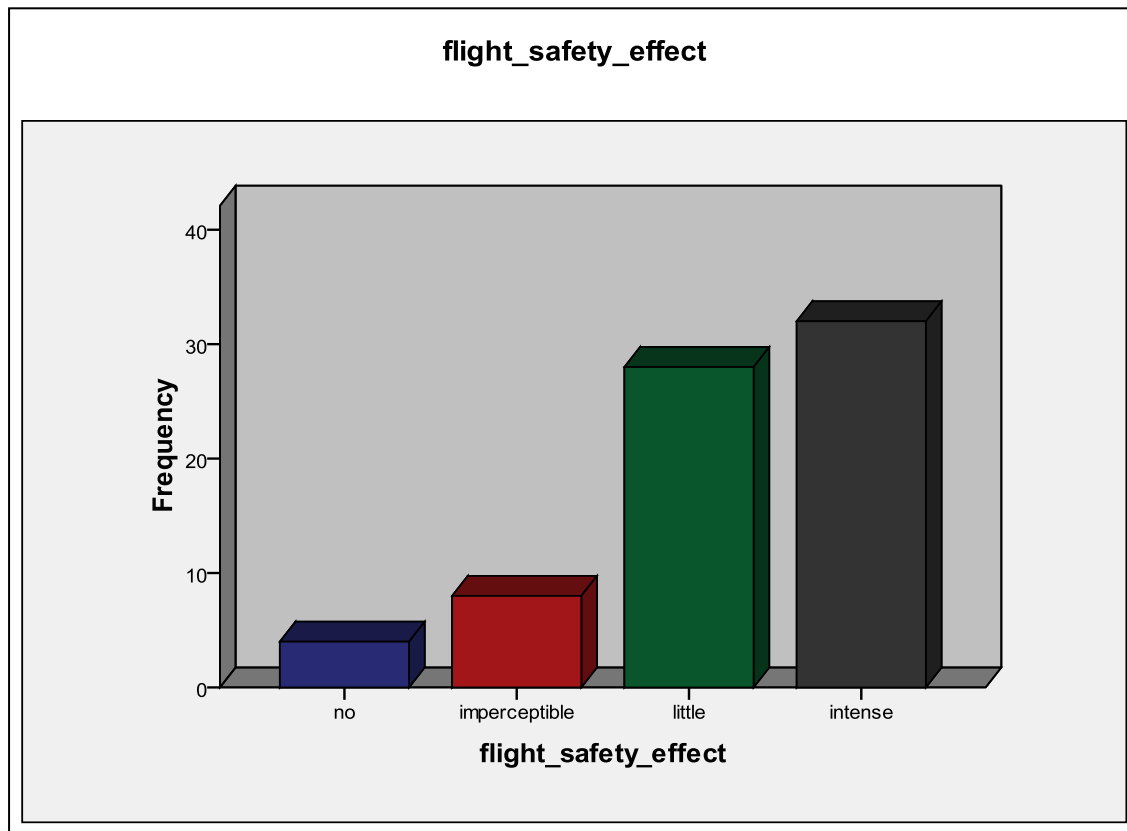
***Flight safety effect***

Finally we ask pilots to report if they felt that flight safety could be affected because of their performance while flying when they fly although they should not because are defined as non flying pilots. Here are the results:

flight_safety_effect				
	Frequency	Percent	Valid Percent	Cumulative Percent
No	4	5,6	5,6	5,6
imperceptible	8	11,1	11,1	16,7
Valid Little	28	38,9	38,9	55,6
Intense	32	44,4	44,4	100,0
Total	72	100,0	100,0	

**Table 9. Sensation of flight safety effect**

Only 5.6% of them stated that probably the flight safety was not affected by their physical condition, while 94.4% of them stated that it was.



**Figure 15. Histogram of the Sensation of flight safety effect**

## Dependent T test

After the flight in the Flight Simulator we recorded the results of the interested items and we compared them with the performance of the same sample in their previous or next flight, when they were totally healthy. Here follow the results:

### *Take off performance*

On average, participants experienced significantly greater deviations during the take off maneuver when flew with presenteeism characteristics - not in a 100% physical or mental condition – (M = 1.33 , SE = 0.69 ) than in a totally healthy condition (M = 1.06 , SE = 0.27),  $t(71) = 5.226$  ,  $p < .05$  ,  $r = 0.52$  (Field, 2009) .

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pres._TO_proc	1,33	72	,581	,069
	Norm_TO_proc	1,06	72	,231	,027

**Table 10. Take Off Procedure Paired Samples Statistics**

		N	Correlation	Sig.
Pair 1	Pres._TO_proc & Norm_TO_proc	72	,700	,000

**Table 11. Take Off Procedure Paired Samples Correlations**

Paired Samples Test

	Paired Differences					T	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 Pres._TO_proc - Norm_TO_proc	,278	,451	,053	,172	,384	5,226	71	,000

**Table 12. Take Off Procedure Paired Samples Test**

Specifically we can define for the Take off procedure that although in a Normal situation only 5.6% of the pilots had more than 5 feet deviation from the center line, in presenteeism conditions this percentage amounts to 27.8% (Tables 8 & 9).

Pres.\_TO\_proc

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 5 feet	52	72,2	72,2	72,2
7.5 feet	16	22,2	22,2	94,4
10 feet	4	5,6	5,6	100,0
Total	72	100,0	100,0	

**Table 13. Take Off Procedure Deviations under presenteeism conditions**

Norm\_TO\_proc

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 5 feet	68	94,4	94,4	94,4
7.5 feet	4	5,6	5,6	100,0
Total	72	100,0	100,0	

**Table 14. Take Off Procedure Deviations under normal conditions**

As a result Hypothesis 1 ‘*Presenteeism affects negatively the Take off procedure*’ is supported.

***Basic aircraft control performance***

On average, participants experienced significantly greater deviations while maintaining the proper Aircraft control when flew with presenteeism characteristics - not in a 100% physical or mental condition - (M = 2.11 , SE = .116 ) than in a totally healthy condition (M = 1.21 , SE = .056),  $t(71) = 10.427$  ,  $p < .05$  ,  $r = 0.77$  .

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pres._Ac_control	2,11	72	,987	,116
	Norm_Ac_control	1,21	72	,473	,056

**Table 15. Basic aircraft control Procedure Paired Samples Statistics**

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pres._Ac_control & Norm_Ac_control	72	,704	,000

**Table 16. Basic aircraft control Procedure Paired Samples Correlations**

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 Pres._Ac_control - Norm_Ac_control	,903	,735	,087	,730	1,075	10,427	71	,000

**Table 17. Basic aircraft control Procedure Paired Samples Tests**

Specifically we can define for the Basic Aircraft control that although in a Normal situation only 18.1% of the pilots had more than 100 feet deviation from the planned altitude, in presenteeism conditions this percentage amounts to 72.2% (Tables 13 & 14).

Pres.\_Ac\_control

	Frequency	Percent	Valid Percent	Cumulative Percent
< 100 feet	20	27,8	27,8	27,8
100-150 feet	33	45,8	45,8	73,6
150-200 feet	12	16,7	16,7	90,3
200-300 feet	5	6,9	6,9	97,2
> 300 feet	2	2,8	2,8	100,0
Total	72	100,0	100,0	

**Table 18. Basic aircraft control Procedure Deviations under presenteeism conditions**



Norm_Ac_control				
	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	< 100 feet	59	81,9	81,9
	100-150 feet	11	15,3	97,2
	150-200 feet	2	2,8	100,0
	Total	72	100,0	100,0

**Table 19. Basic aircraft control Procedure Deviations under normal conditions**

As a result Hypothesis 2 ‘*Presenteeism affects negatively the Basic aircraft control*’ is supported.

### ***Landing performance***

On average, participants experienced significantly greater deviations during the landing maneuver when flew with presenteeism characteristics - not in a 100% physical or mental condition – (M = 1.44 , SE = 0.74 ) than in a totally healthy condition (M = 1.28 , SE = 0.60),  $t(71) = 2.665$  ,  $p < .05$  ,  $r = 0.3$  .

### Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean	
Pair 1					
	Pres._ldg_proc	1,44	72	,625	,074
	Norm_ldg_proc	1,28	72	,510	,060

**Table 20. Landing Procedure Paired Samples Statistics**

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pres._ldg_proc & Norm_ldg_proc	72	,579	,000

**Table 21. Landing Procedure Paired Samples Correlations**

Paired Samples Test

		Paired Differences				T	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	Pres._ldg_proc - Norm_ldg_proc	,167	,531	,063	,042	,291	2,665	71	,010

**Table 22. Landing Procedure Paired Samples Test**

Specifically we can define for the Landing procedure that although in a Normal situation only 25% of the pilots had more than 10 feet deviation from the center line, in presenteeism conditions this percentage amounts to 37.5% (Tables 18 & 19).

Pres.\_ldg\_proc

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 10 feet	45	62,5	62,5	62,5
15 feet	22	30,6	30,6	93,1
20 feet	5	6,9	6,9	100,0
Total	72	100,0	100,0	

**Table 23. Landing Procedure deviations under presenteeism conditions**

Norm\_ldg\_proc

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 10 feet	54	75,0	75,0	75,0
15 feet	16	22,2	22,2	97,2
20 feet	2	2,8	2,8	100,0
Total	72	100,0	100,0	

**Table 24. Landing Procedure deviations under normal conditions**

As a result Hypothesis 3 ‘*Presenteeism affects negatively the Landing procedure*’ is supported.

From the above results we show that the performance of critical phases of the flight, such as the Take off and the Landing procedures, as well as the Basic aircraft control, were affected negatively when pilots were acting under presenteeism conditions. In addition, we presented the symptoms pilots felt during their flight in the Flight Simulator. Obviously, anything that impairs a pilot's ability to make decisions or execute the associated tasks, especially during those critical phases of the flight, will increase the potential for a negative influence of the performance, affecting flight safety and leading an aircraft to a hazardous situation (Newman, 2007).

As a result Hypothesis 4 ‘*Presenteeism affects negatively the flight safety*’ is supported.

## DISCUSSION

This thesis examined how presenteeism affects the pilots' performance and in what extent this can affect flight safety, supporting Hypotheses 1, 2, 3 and 4. Overall, the findings of this study showed that taking the decision a pilot to fly, although he should be absolved from flight duty, plays a significant role in the safe execution of a flight.

As Newman argued (2007), incapacitation of a pilot represents a serious potential threat to flight safety. This incapacitation may be subtle or sudden, partial or complete. It may be due to the effects of a pre-existing medical condition manifesting themselves in flight, or the development of an acute medical condition, or some physiological event that renders an otherwise fit and well pilot temporarily unable to fly or safely operate the aircraft. Whatever the cause, such an event compromises the safety of the flight and puts the crew and passengers at risk.

Researchers (Goetzel et al.; 2004, Johns, 1999; Murphy & Cleveland, 1995; Lerner et al., 2001) have found that although many employers do not realize it, presenteeism may be far more expensive for companies than other health-related costs (Hemp, 2004). In the aviation sector especially, those costs are measured with incidents or accidents. But what we could do in order to reduce this behavior? The first step, clearly, is making our managers and our selves aware of the problem. Educating employees is also crucial. Educating means prevent and prevent means protect. It is also helpful to teach employees how to better manage and to avoid their illnesses according to the aeromedical standards that are set by the International Civil Aviation Organization (ICAO). In general we can see that everything is a matter of

management. Better management of employee health can lead to improved productivity (Pauly, Sloan, Sullivan, 2015).

The research limitations, is one of the problems we had to face during our research. As regards the methodological limitations, the sample size and the lack of a large number of available data was limited by the fact that it was difficult to find pilots that were absolved from flight duty and at the same time that they agreed to attend in our research. Furthermore, the lack of prior research studies on the effect of presenteeism phenomenon in the aviation sector, made it difficult for us to make readers lay a foundation for understanding the research problem. However, as we will mention bellow, this limitation can serve as an important opportunity to describe the need for further research. Additional, the methodology used to collect data, had to be adapted to common characteristics and deviations for both civil and fighter pilots. For that reason we had to converge only to three common critical phases of a flight, in order to keep anonymous the origination of the pilots. The followed method could be a help for future research for gathering important data. On the other hand, during the research were presented also limitations such as the limited or even sometimes denied access, the researcher had to aviation organizations, personnel and documents due to confidential information. Furthermore, the access in the Flight Simulator devices with the help of authorized personnel had to be completed during days and times that those devices were not used for operational training and at the same time without producing any financial cost for these organizations. In order to overcome these limitations in a future research, it would be useful to be done a joint research by civil and air force organizations, so to limit research time and access difficulties.

Future research could examine the impact of the presenteeism phenomenon also in other critical phases of a flight. The influence of flight safety according to the

percentage of aviation accidents (Federal Aviation Administration, 2004), relies also to other phases of flight, apart from the Take off, Landing and cruise. Moreover, research could also look at closer, how this phenomenon could affect flight safety through other specialties related to flight procedures such as ground personnel (aircraft Engineers, Air Traffic Controllers and other) or even cabin crew (flight attendants, doctors and other). Finally one could also examine how motivation and the flight safety concept education interact with presenteeism.

The findings of this research are instrumental for introducing the concept of presenteeism and its effects on flight safety to aviation organizations. In particular, it is shown with numbers and real deviations how pilot's performance can be affected during critical phases of flight. Aviation organizations, in order to limit today's challenges need to include the concept and the possible impact of presenteeism in their management, so to create a competitive business advantage. The notion that the presenteeism behavior affects negatively pilots performance and thus flight safety was shown by this thesis. Therefore, safety valves should be enhanced in order to preserve aeromedical aviation standards and consequently flight safety.

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