Knowledge risk management in aviation

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Abstract. *Aviation is one of the most important domains nowadays from the perspective of the economy and security of a nation. When we talk about aviation, we can say that it is divided into two categories, civil aviation and military aviation. Though they share the same base characteristics, an aircraft departing from an airport and safely landing on another airport, they are parted by a lot of aspects. One of the common things that they share is the risk involved every time an aircraft is prepared for departing and the actual flight, until the safe landing at the designated airport. The two involve different risks that I will approach during the current article. When we narrow the discussion to risk, we can tell for sure that the risk involved in the Romanian Air Force is higher due to the specifics of the mission. The importance of knowledge in aviation is an aspect that involves all of our attention because we have to take into consideration both tacit and explicit knowledge. Knowledge risk management represents a gap in the aviation domain. Except for the explicit knowledge that is necessary to be assimilated in order to be able to play a part in aviation, tacit knowledge is an important part of this activity domain.*

Keywords: knowledge, knowledge risk, risk management, aviation

Introduction

We live in the century of speed, and we can all agree over the socio-economic over the importance of the aviation industry. Due to aviation distance is a relative aspect. From my experience in the Romanian Air Force, I can tell you for sure that the first milestone of aviation is that "Safety is paramount". Due to the fact that I studying emotional intelligence for my paper license in the Air Force Academy and after graduation, I started working in the Air Force, I came to the conclusion that the system is a stiff organization and it made me realize that in the Romanian Army, particularly in the Air Force the domain of knowledge risk management represents a gap. An important part of management is missing from the educational culture of the Air Force. When talking about aviation, we have to take into consideration that the domain is divided into two types, civil aviation and military aviation, and both involve a certain degree of risk. Along the time, a lot has changed in the world of planes. Starting with the basis, the first hot air balloon flight that the Montgolfier brothers did on 14th of December 1782, then the first full-size gliders of the Wrights brothers in 1890, followed by their first powered flight in 17th of December 1903, then with Henri Coanda's discovery, the jet engine and finally ending up with the landing on the moon, the single thing that perpetuated over time and adapted to the flight is risk. Since the first takeoff risk was present in a basic form and as flight evolved, it evolved.

Though the risk is managed using technology and procedures, the main cause of air incidents is mainly the same and hovers around human factors. Though an accident can have its origin in a faulty part, human error or an act of God as it happened in the case of Flight 1549 operated by US Airways, when during departure the plane hit a flock of geese and both engines stopped, one single event in the history of flight changed the face of aviation risk forever. On 11th of September 2001, four passengers airliners were hijacked by 19 al-Qaeda terrorists. United Airline Flight 11 and Flight 175 crashed into the North and South towers of the World Trade Center complex in Manhattan, while Flight 77 crashed into Pentagon and Flight 93 crashed into a field near Shanksville after the passengers attempted to overtake the hijackers. This was the event

that changed the rules in of risk management both in civilian aviation and in the Air Force. The 9/11 event represents an interest in this research because it brings in discussion the situation form Flight 93 were the knowledge of a few passengers determined them to try and thwarted the hijackers. On the one hand, the rules of civil flights tightened, starting from the airport security; on the other hand, the Air Force was faced with a new situation, one in which an airplane it is being used as a suicide plane. This is called "renegade concept" as it is defined by Center of Excellence Defense Against Terrorism, Ankara, Turkey (2007, p.135) "The threat today is from a so-called "renegade aircraft" – either a large commercial aircraft hijacked by a suicide bomber or a small aircraft on which the bomber has loaded a bomb and is flying toward a target." It doesn't matter if we are talking about civilian aviation or military aviation, the most vital part is the period of time that the personnel that encountered the risk has to act in order to prevent disaster or mitigate the effect of it. The purpose of this research is to identify the importance of knowledge risk management in aviation. Strong knowledge risk management can help decision-makers to take the right course of action in a short period of time.

Literature review

Risk management in aviation

Safety is the first thought that comes in our mind we think about flying. International Civil Aviation Organization (ICAO) is the authority that manages the administration and governance of the Convention on International Civil Aviation. They stated that "aviation safety is at the core of ICAO's fundamental Objectives. The organization is constantly striving, in close collaboration with the entire air transport community, to further improve aviation successful safety performances while maintaining a high level of capacity and efficiency. "Especially under the current circumstances where the demand of air transport is growing continuously, crowding the airports and putting more and more pressure on the parts of the system. In the literature risk was defined by Peter Massingham, former Director of the Center for Knowledge Management in his article "Knowledge risk management: A framework" (Journal of Knowledge Management, 2010) from The Stanford Encyclopedia of Philosophy (2007) "a risk is an unwanted event with a negative consequence". In commercial aviation, if we would put risk on a scale, it would have two peaks. The first involves the takeoff and the second the landing. From the safety perspective, the amount of risk involved during takeoff (referred to as "departure") and landing stages exceeds the risk of something happening then when cruising at high altitude. This is caused by the number of procedures that the cockpit crew has to undertake in order to get the plane at the speed, altitude and heading passed by the air traffic controller. According to Ian Savage, a professor in the department of economics at Northwestern University who made a comparison of the fatality risks in United States Transportation, the most secure is the aviation. Because landing implies that the aircraft departed in safe conditions, he counted the number of safe landings and in accordance with the number of accidents and found that commercial aviation is the most secure transport is the airplane. At the opposite pole are the bad weather and the technical problems consisting in part mechanical failure that rarely occur due to the strict maintenance schedule of the aircraft. As shown above, the levels of risk in commercial aviation tend to be linear. When departing and landing, the continuous line of risk grows to a peak, and then it returns to its normal state. But what happens when we talk about Air Force? Is the level of risk the same or it depends on the type of mission that one aircraft has to do?

Though the geopolitical position of Romania, between east and west, placed us in many military conflicts along with history, still the integrity and sovereignty of the national air space are ensured by the Romanian Air Force. An organism that has the mission "to defend the national air space with air-air and ground-air technique, backup friendly forces and national authorities". When a military aircraft departs, the flight can be either GAT (General Air Traffic) when the airplane is under civil ATC (Air Traffic Control) control, doing simple flight from an airport to another respecting the ICAO general safety regulation, or OAT (Operational Air Traffic) when it is under military ATC and it is performing a support, combat, patrol or training mission. Sadly the theme of risk management it not addressed in a proper way, it is ignored or done formally. The linear thinking of the persons in charge, simple ignorance, or the lack of knowledge can be the cause of this. Countries that participated more actively in combat like the United States of America have a culture for risk management. Besides the general safety regulation imposed by ICAO when flying GAT, they implemented risk management for the OAT Flights. By default, when a military aircraft executes a mission, the chances of something unexpected to happen in comparison with civil aviation is much higher. In the US Air Force risk management is defined as a "decision-making process to evaluate possible courses of action systematically, identify risks and benefits, and determine the best course of action for any given situation" (AFI90-802. 2019). When performing any type of mission, the first presumption is that risk is inherent in any situation, on and off-duty, and can be mitigated if it is understood.

Risk is inherent in all activities and especially in aviation, and it is involved in two situations, in the planning of the mission (deliberate) and in real-time. The deliberate one offers comfort on thinking over time the hazards and how to avoid them or mitigate their effects. The real-time risk management is the one that implies calm, sharp thinking, the capacity of evaluation, power of acting. What amplifies the risk, even more, is the period of time between the moment that an unexpected event occurred and the end of it. Time is divided in two types: physical and psychological, where the "physical time is uniform and straight, one minute is equal with another minute in any experimental context. Psychological time is uneven and nonlinear, minutes being longer or shorter depending physical length of the moment" (Bratianu, 2015, p. 79). By understanding this, we realize that depending on their knowledge, a pilot traveling at a certain speed, when he will encounter a risk involving a situation, will feel as if he has time to take action, so this makes time the most important variable in a hazard situation. If he does not use the five steps of risk management process, failure is inevitable.

"Hazard can be defined as any real or potential condition that can cause mission degradation, injury, illness, death to personnel or damage to or loss of equipment or property" (AFI 90-802). In the US AF five steps are used to apply real-time risk management to approach hazard situations and consist of: Identify hazards, assess hazards, develop controls and make decisions, implement controls, supervise and evaluate. Identifying the hazard is the first step undertake for a risk implying situation. The key aspects include a list hazards and a list of causes. Assess the hazard is the second step, and its key aspect is: assess hazard exposure, hazard severity, probability. Develop controls and make decisions is step three and suggest that proper action can mitigate the component of risk (Probability, Severity, and Exposure). Step four is the core of risk management because it includes: Making implementation clear, establish accountability, provide support. The final step is to supervise and evaluate the situation.

Knowledge in aviation

As in any domain, knowledge plays an important part when it comes to aviation. Knowledge is a difficult thing to quantify or explain. Bratianu presents knowledge as "a complex combination between conscious and unconscious, between rational and irrational, between the direct experience of life and knowledge, and respectively the experience mediated in the learning process." (Bratianu, 2015, p 28) and along with the literature divides knowledge in two, *explicit knowledge* that is a byproduct of our willingness to learn and evolve, being rational, and *tacit knowledge* that originates from our direct interaction with the world and sediments in our unconscious, being non-rational. The best part of explicit knowledge is that it can be expressed and explained. In aviation, the volume of explicit knowledge is huge. To be a pilot in commercial aviation, you have to pass the medical exams first and then to be sure you have good knowledge of mathematics and physics to be able to understand the principle of flight. Besides that, there is a lot of information regarding meteorology, aerodynamics, airplane characteristics, and so on that need to be learned by one if he wants to be a commercial pilot. In the tacit knowledge world, the things tend to be complicated. Scientists grouped the tacit knowledge in spiritual and emotional knowledge. Emotions have two basic biological functions. The first function is to create a specific reaction to the new stimulus or contextual situation in which the organism might be at a certain moment. The second function is to biologically prepare the organism to execute the first function (Bratianu, 2015). We understand the emotions are at the base of the survival-oriented attitude. As in the case of Flight 93 from the 9/11 events where the passengers roused against the terrorist in an attempt to overcome them and take control of the aircraft. When they realized what was going to happen with them they decided to take their chance. The spiritual and emotional knowledge they experienced made them act because in the end, the mind is the playground of the feelings. "Emotions are complex, largely automated programs of actions concocted by evolution. These actions are complemented by a cognitive program that includes certain ideas and modes of cognition, but the world of emotions is largely one of the actions carried out in our bodies, from facial expressions and postures to changes in viscera and internal milieu" Damasio (2012, p. 116). The emotional knowledge, along with the spiritual knowledge, drove them to act. When a thing is not as it should be, our instinct or feeling from the unconscious will identify this it will send a signal to our conscience, and as soon as it realizes the difference, it will generate an action. The spiritual knowledge is often mistaken with religion because people tend to associate spirituality with faith. Dalai Lama (1999, p.22) defines the difference between religion and spirituality: "Religion I take to be concerned with faith in the claims of one faith tradition or another, an aspect of which is the acceptance of some form of heaven or nirvana. Connected with this are religious teaching or dogma, ritual prayers, and so on. Spirituality I take to be concerned with the qualities of the human spirit - such-as love and compassion, patience, tolerance, forgiveness, contentment, a sense of responsibility, a sense of harmony – which bring happiness to both self and others". There is no better way of explaining spiritual knowledge than being a "direct result of the process of thinking about existence, and searching for meaning and purpose in our lives, a process based on deeply held personal values. Bratianu, C (2017). Emotional and spiritual knowledge. In Handrazic, M & Bassi, A. (Eds). Knowledge and project management: A Shared approach to improve performance, pp. 66-69. Springer, Heidelberg. The spiritual knowledge implies the one should have a nonlinear thinking about his role in society and the reason of his existence. In the book *Spiritual Capital*, Zohar and Marshall (2004, p. 17) reveals that "We need a sense of meaning and driving purpose in our lives. Without it we become ill or we die." This is

obvious if we look at the career-focused personnel from the army. After serving for 30 years or more and the main activity in their lives being the army, when someone retires, they lose their meaning of life because there is a major change in their life. Going from a stable program and a known purpose remaining home and not having an occupation is a major challenge. A person that managed to develop his or her spiritual intelligence will adapt to the new situation and will find a new objective to reach. The spiritual knowledge tends to be the core of the defense system. Serving your country and be willing to sacrifice yourself for it implies a big dose of spiritual knowledge. This type of knowledge is grown in the mind and soul of a soldier. He will be trained to withstand any psychological pressure for the good being of others.

In aviation the cognitive knowledge is a must, and it is clearly determined and evaluated. But what about emotional or spiritual knowledge? One of the most relevant cases is the one Flight 1549 from La Guardia, New York bound for Charlotte, North Carolina with 150 passengers on board. The captain of the aircraft was Chesley "Sully" Sullenberger, a pilot at the age of 57, who accumulated 19,663 flight hours. An ex-military pilot that flew The flight was a regular one, the air traffic controller cleared for takeoff the aircraft with the initial indication that after takeoff, turn right and continue climbing until 5,000 feet. While climbing, at the altitude of almost 3,000 feet the jet hit a flock of Canadian geese, causing both engine to shut down and lose power. Every pilot in the situation when he loses all engines, in the time of the glide he will look for a flat place to land, like a large field, or in extreme a river. In the case of Flight 1459, after the impact, the pilots radioed the situation to the ATC and though he was advised to land at La Guardia or on another airport, somehow he knew that was not an option and decided to land the plane on the icy Hudson River. The landing was a success and all the passengers and flight crew survived. In the investigation done after the incident, the conditions were replayed in simulator and other pilots were confronted with the same situation. None of the experienced pilots that tried to stretch the glide of the aircraft did not managed to land the plane on the airport. When a pilot such as Chesley Sullenberger having almost 20,000 flight hours, the cognitive knowledge is so well sedimented that he knew exactly what to do from the procedure point of view to land the plane in a safe condition on the river. It is remarkable to see how his knowledge worked together. He analyzed the situation with calm and decided. The decision process involves both tacit and explicit knowledge in order to obtain the best result. "Every one of us learned a series of things through our direct experience or we developed a series of abilities which help us make better decisions and be more efficient in what we do. This knowledge, which we generated in our own knowledge universe, but which we did not structure in a way that we could communicate them represents tacit knowledge (Bratianu, 2015, p. 29). This was, in the end, the silent voice that whispered in the captain's head that if he is going to try and glide the plane back to the airport, he was going to crash.

Knowledge risk management in aviation

Knowledge risk management is a part of management formed by uniting the other two parts of it, risk management and knowledge management. This part of management is worthy to be observed and studied in aviation because this segment of the industry does not afford mistakes. Though it is a very secure way of transport, accidents still happen and the main course of it is, as Oster, Strong and Zorn (1992) reveal, natural pilot errors represent the majority of aviation crashes, and the main cause of this is the lack of knowledge or poor judgment by the cockpit crew. This means that the lack of necessary knowledge has the same effect as the situation where the amount of

knowledge and the quality of them is good but the persons is not capable of using all of them at the same time and in the right amount, in order, to make the right decision. Risk management consists of two situations, as mentioned previously, deliberate and real-time. While commercial aviation is confronted mainly with the real-time risks, military aviation does deliberate risk management to mitigate the probability of encountering hazards. As I mentioned earlier the amount of risk involved in commercial aviation tends to uplift only at some stages in the process of flying. The Air Force on the other side, enhance risk as part of the mission. Neither the commercial or military aviation pilots afford a lack of knowledge or poor judgment when performing their job. Risk management it is very well documented and implemented in the US Air Force. For a better understanding of how knowledge risk management is done in aviation, two constructs should be taken in consideration: individual characteristics, knowledge characteristics. The risk involved by individual characteristics is tied to ineffective recruitment and ineffective training, where ineffective recruitment consists of the organizations ability to select qualified personnel, because not all of the candidates are suitable for the mission and ineffective training is represented by the period of time in which the selected candidates are trained for the mission. In the Air Force knowledge characteristics do not necessarily focuses on explicit knowledge and accumulating them, rather than how to pass the tacit knowledge form one to another. The tacit knowledge represents the know-how of the process because it is based on personal experience. "Tacit-tacit transfer is a transfer process of knowledge between two persons or between one person and a group of persons, which are all at the same time in the same situational context" (Bratianu C, 2015, p. 37), some things can not be explained, they have to be shown. A helicopter pilot could read and talk with his or her instructor plentyof hours of how a reversal is done, in the end he or she will only have an idea about it. The difference will be made when the instructor will perform the reversal with the instructed person by his side.

When dealing with a hazard involving a situation speaking the same language is essential. By speaking the same language, I am referring that all of the persons included know the procedures and how to act in order to avoid the risk or to mitigate the effect of it. RTRM (real-time risk management) in aviation has a short form of the five steps RM and it is the ABCD Model. This is a mnemonic for all personnel to make it easy to remember. The ABCD Model stands for Asses the situation, Balance Controls, Communicate, Decide and Debrief. This model "stablishes a standard structure for individuals, teams, and/or crew to learn and effectively apply new or complex behaviors, skills, values and understanding to a situation by providing a common language and structure for a measured response when an individual, crew or team is executing a routine task or when they are under duress form a more complex situation." (AFPAM90-803).

Conclusions

Knowledge risk management in aviation is a subject that was not approached enough. This paper consists a base for the research due to the importance of the subject. In the aviation domain there is no place for mistakes. As described above, time is essential when risk situation are present in a daily training flight, mission or even simple flight as in the commercial ones. By working in the aviation environment I was able to identify the gap that knowledge risk management represents in the aviation system. Not only that the risk management evaluation is done at la low level, but the personnel involved in the procedure of flight is not properly trained or evaluated from the knowledge perspective. If we are studying commercial or military aviation the conclusion is that the importance of knowledge in aviation is the same as safety. If we refer to cognitive knowledge,

they are the same in both cases. The difference between commercial and military aviation starts to reveal when we put into discussion the emotional and spiritual knowledge. As shown in the case of Flight 1549 the emotional knowledge accumulated by the captain during his career helped him save the lives of all the passengers and flight crew. By evaluating and developing the emotional intelligence of the flight crews, we can help them improve the ways to confront the risk when is the case. Not always the hazards can be avoided, but at least the effects of it can be mitigated. Because decision making is based mainly on rational thinking by using cognition, the emotional tends to be left aside. By according the necessary attention to emotion and spiritual knowledge, we can at least get a glimpse on what is inside the wordless knowledge of the persons that are involved directly in the flight activity. Identifying the persons that have a developed knowledge risk, especially emotional and spiritual and helping them pass the knowledge to their fellows is the key to knowledge risk management.

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