ROMANIAN AIR FORCE AVIATION OCCURRENCES

Oliver CIUICĂ[*], Carmen ŞTEFAN[**], Serjiu OBREJA[*], Nicolae CREŢU[***]

[*]"Henri Coanda"Air Force Academy, Brasov, Romania (oliverciuica@yahoo.com, sergiuobreja@gmail.com)
[**]Romanian Aviation Academy, Bucharest, Romania (carmen.garnita@gmail.com)
[***]Romanian Air Force HQ, Bucharest, Romania (ncretu@roaf.ro)

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Abstract: *The history of modern aviation in Romania had its beginning in the period when the jet planes entered our logistics. It is well known that after World War II many of the aviators involved in war operations were grounded by the new political regime. In this way, the Romanian Air Force lost a lot of well trained personnel and it had to face challenges regarding new generations of airmen. After 1950, when the decision of Stalin was to strengthen the Eastern Europe air power by offering a new generation of aircraft, Romania started to train new young personnel, pilots, engineers, technicians and air traffic controllers under the Russians' supervision. The fast training process was meant to make Romanian Air Force to be ready for war in three years. Because of the intense practice and the number of new types of planes, the aviation events had multiple forms and causes. Looking back in history until nowadays it is essential for us to learn from mistakes and to set some lessons learned being aware of the most important resource, the human resource.*

Keywords: *history, flight safety, aviation occurrences, cause-chain, factors, errors.*

1. INTRODUCTION

Aviation occurrences, incidents or accidents, include a variety of unwanted events in which aircraft and crew are involved. They may be air collisions, ground collisions or collision with the ground, air or ground explosions (fire), in-flight canopy depressurization or opening and, not the least, careless exploitation of the technique, resulting in involuntary accidents, sometimes with tragic ending. Learning from others mistakes is essential for all organization. That is why, the conclusions of aviation occurrences must be disseminated in the real form to the entire personnel. Our research is meant to be a draft material to all airmen and to all those who are linked to aviation activities.

2. HISTORY TYPES OF ACCIDENTS

Surveying the air occurrences of the period 1950-2014 [1, 6], we can mention some of the most important ones:

a. Air collisions

-1952, Craiova airdrome. Four MiG 15 aircraft took off in formation of twos, at an interval of 20 seconds after each other, for later on to fly together on the circle circuit. During their coming closer, the leader of the first formation hit the leader of the second formation upon a too steep turn.

-As a result of this maneuver, the aircraft became uncontrollable and because of the low altitude they were flying, the ejection could not be executed in due time; the two planes crashed to the ground and the two pilots lost their lives.

These are, in fact, the first recorded victims of the jet aviation in our country, and also the first air collision between two flying apparatuses.

- 1993, Deveselu airdrome. Two fighter aircraft MiG 21 were involved in an air collision while executing two different missions. One of them, two seats, was executing a classical flight to approach, while the other, single seat, was executing its takeoff maneuvers for a flight on route. At the altitude of 3100 m, the two aircraft crashed into each other; consequently, the two seater crew died and the single seat aircraft pilot performed the ejection.

This case is unique in the history of aviation, being the first and the only one to occur between different flight missions (different from the previous one, of the flight in formation).

- 2004, Câmpia Turzii airdrome. An intercept training mission by the quick reaction alert formation, made up of MiG 21 LanceR aircraft, of the aircraft that flew unauthorized over the Romanian airspace, the target aircraft being another MiG 21 LanceR. During the escort flight of the target aircraft, the two aircraft collided, the pilots managing to save themselves by ejection.

This represented the tenth and last air collision in the history of our national military aviation.

b. Ground collisions

- 1953, Craiova airdrome. During a night flight, an aircraft, type MiG 15, while taxiing on the runway, got seriously damaged by a truck at high speed and having its headlights turned off. As a result of this incident, the aircraft was removed from use.

- 1992, Boboc airdrome. During a day flight an aircraft, type L 29, while taxiing toward the runway holding point hit with its right wing and fuselage the startup machine of the airdrome. As a result, the aircraft was removed from the operational use and it was exhibited on base.

c. Collisions into terrain

- 1952, Deveselu airdrome. During a training flight mission on route, under instrument meteorological conditions, in formation of two, two aircraft, type MiG 15 hit the ground attempting a forced landing on unknown terrain/ outside the runway, due to a sudden worsening of visibility, disorientation and fuel consumption aboard, one of them colliding into a river bank and the other into a hill top.

- 1972, Ianca airdrome. During a training flight for learning the low height maneuvers, an aircraft, type L 29 crashed, the two pilots (the instructor and a trainee of the aviation school) lost their lives. Witnesses declared afterward that the instructor had deviated from the mission's profile, executing a low pass over a lake and not managing to establish the real height.

- 2006, Otopeni airdrome. During a training flight on route, at low altitude, the crew of a helicopter, type IAR 330 Puma, flew over a lake, at very low altitude. The sun shine and the lack of any possibility of determining the height following landscape contour led to the helicopter collision into the body of water. As a result of this catastrophe, the three members of the crew lost their lives.

The reminding of the two cases of interdicted very low passes is not at all randomly. This is one of the very frequent causes for collision into terrain.

- 1997, Giarmata (Timişoara) airdrome. In order to perform the flight trainings preliminary to the Aviation Day (June, 17), during the meteorological flight in the proximity of the airdrome, the crew of a fighter/ training aircraft L 39 executed a skew flip at a too low altitude, the recovery not being possible the aircraft hit the ground, causing the death of the two members of the crew.

This event is the only aviation catastrophe of this type and the only loss of a General that the Military Aviation experienced.

The cases presented previously represent classical situations of CFIT - Controlled Flight into Terrain, occurrences that are quite frequent and typical for both national and international environments.

-2010, Tuzla airdrome. During a training flight for parachute dropping, upon takingoff, an An 2 aircraft lost lift and hit the ground, falling from an approximate height of 50-60 meters. The catastrophe left two survivors (one of the pilots and a paratrooper), the other 12 occupants of the aircraft being deceased after the crash. Following this air tragedy the An 2 aircraft was withdrawn from exploitation, but it remained stored on Boboc airdrome.

- 2012, Boboc airdrome. During flight training for acclimatization and observation of the aircraft controls under various flight regimes, a helicopter, type IAR 316 B Alouette hit the ground from a height of under 50 m. The crew made up of the instructor pilot, the student-pilot (student of the Air Force Academy, in his first year) and two board technics lost their lives following the crash.

Again, this is one of the unique cases in history resulting in the death of the youngest military trainee pilot, the student aged 19.

The last two cases invoked are different from the first two, because on the descending trajectory of aircraft to approach the pilots lost control of their aircraft (Loss of Control In - flight – LOC-I).

c. Explosion (fire) in the air or on the ground

- 1972, Borcea airdrome. During the takeoff for a night training flight under visual meteorological conditions, the pilot of an aircraft, type MiG 21, was force to perform the ejection maneuver after the aircraft explosion and break in the air, at an altitude of approximately 800 m.

- 1997, Craiova airdrome. A mixed technical crew was assuring the arming and preparation of an aircraft, type IAR 93, which was to execute a real firing testing flight. During the preliminary steps of the aircraft's arming there was an explosion that led to 16 fatalities, including technical and flight engineering staff.

d. Cockpit depressurization or canopy opening en route

- 1953, Craiova airdrome. During a training flight with an aircraft, type MiG 15 two seats, the canopy opened from its lock mechanisms and, under the air flow hit the head of front occupant, leaving him dead. The aircraft was landed by the instructor, the occupant of the rear seat.

- 2007, Câmpia Turzii airdrome. On a post-mintenance flight of a MiG 21 LanceR, during the climb toward the indicated area, at the altitude of 6500 m, the pilot noticed the broken glass canopy. He interrupted his mission immediately, announced the air traffic controller and came to approach, under safety conditions.

e. Careless exploitation of the technique

- 1986, Craiova airdrome. The accident occurred during the flight mission, toward the end of a solo flight, when the pilot was ready to exit the cockpit. He opened the canopy, released himself from the seat safety belts and involuntarily pressed the ejection. Consequently, the system came in operation, the ejection took place and the seat and pilot were ejected at 32 m away from the plane. Because of the injuries, the pilot died.

- 1994, Mihail Kogălniceanu airdrome. During the arming process of the MiG 29 aircraft with unguided reactive projectiles, at one moment, one of the projectiles was armed and exploded. The result was the death of the load officer and the serious injury of another.

3. FACTORS THAT INFLUENCE THE AVIATION OCCURRENCES

Rarely does an accident or catastrophe hold just a unique cause. In most of the cases, we may speak of a primary cause, to which one or more secondary ones are added. For example, a critical situation, initially produced due to a technical defect, may become worse because of the pilot's wrong action. Or, an initial error, the generating factor for a critical situation, may be followed by new errors which can deteriorate the situation even worse, [2].

The Romanian Explanatory Dictionary defines the 'cause' as "a phenomenon or a set of phenomena which precede something and, under definite conditions, determine the appearance of another phenomenon, named effect, to which it serves as a starting point". In "Instructions regarding the manner of technical investigation of aviation occurrences involving military aircraft", causes are defined as the "actions, omissions, events, conditions or any combination of these diverse elements that produced or could have produced an air occurrence", [3].

The causes of aviation occurrences are included within three major groups, as follows:

- human factors;
- technical factors;
- environmental factors.

By environmental factors one should understand atmospheric conditions in their totality (reduced visibility, ceiling, turbulence, strong wind, icing, precipitations, thunderstorms, storms, fog, bird activity etc.). However, we should not ignore the artificial environment, either, because it has direct effects on the human factor.

In the specialized literature, [7, 8], there is also mentioned a fourth group, named "operational factors" or "organizational factors", a group that may be integrated in that of the human factors, since it refers to the organization of activities and deficiencies that may appear throughout their process. Taken individually, each of these causes, in most of the times, do not hold extreme relevance, but when combined, they may generate a long range of events, apparently without any relationship between one another, still which result in an accident.

In the attempt of clarifying the air occurrences in the military aviation throughout time, there were taken into account (only) the three factors (human, technical, environmental) and their derivatives.

Thus, the investigation commissions release their conclusions mentioning as the main factors the following, [1]:

- human error;
- technical flaw;
- indiscipline;
- material wearout;
- piloting error;
- bird strikes;
- meteo conditions;
- unknown causes;
- Other causes.

From the studied analyses, there resulted that out of 296 catastrophes and accidents these were attributed to the following factors (Figure 1):

- Human factor/ HF 152;
- Technical factor/ TF 87;
- Environmental factor/ EF 32;
- Undetermined/unknown causes/ UNK 25.

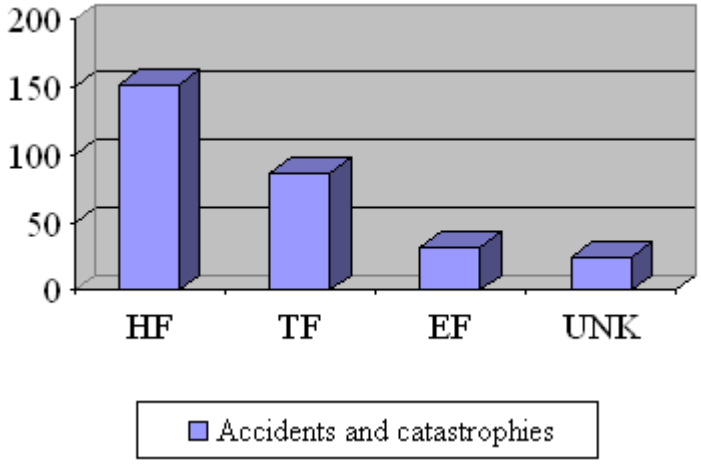

FIG. 1 – Accidents determining factors

As it is noticeable from the block chart above, the main reasons of the air occurrences and implicitly of the human and material resource losses are those of technical and human nature. We will further detail on the aircraft components subjected to material wearouts/failures as well as on the human factor's contributions to the occurrence of accidents, so as they resulted from the conclusions released by the investigation commissions.

From the analysis of the technical factors contributing to the serious aviation events, there turns out that the main systems of aircraft such as the power installation (engine) or material wearout/failure led to the occurrence of most of the serious aviation events. Irrespective of the pilots' level of training or professional experience, the appearance of one of the enumerated system defects places the crew in the impossibility of maneuvering the aircraft and implicitly it requires the choice of the optimal solution. If the time at the crew's disposal is reduced, or if the rescuing option by leaving the cockpit is excluded based on aircraft construction reasons, then disaster is almost imminent.

Referring to the human factor, the most present cause in aviation occurrences (and in other domains) worldwide, it is also the basis for the greatest human losses among pilots. Why? The answer is simple: the crew is taken by surprise and does not have the time to react (low pass flight, aerobatics at low altitude) or, wishing to repair their mistake (voluntary or involuntary, based on perceptions) the crew tries its best to save the aircraft, hoping for a happy ending, thus managing to "hide" itself from the punitive repercussions of the system.

As a result of the serious occurrences, the number of lost or removed from exploitation aircraft as well as the situation of the flying personnel are in Table 1.

Out of 304 lost aircraft throughout this period of time, starting with 1950, their types and numbers were the following:

Table 1 – Aircraft losses and flying personnel fatalities

Aircraft type	Exploited	Destroyed	Crew fatalities	Aircraft type	Exploited	Destroyed	Crew fatalities
IAK 23	62	15	3	IAR 330	106	28	35
MiG15/ S 102	470	84	58	IAR 93	86	11	2
MiG 17	24	5	3	IAR 99	28	8	3
MiG 19	27	11	7	Il 28/H5	28	8	11
MiG 21	350	86	46	Mi8/17	41	5	9
MiG 23	46	7	1	IAR 823	58	4	8
MiG 29	21	4	3	IAK 18	20	2	2
L 29	52	7	5	IAK 52	24	2	1
L 39	32	1	2	An 2	26	1	4
IAR 316B	127	15	16				

Although an impressive number of aircraft were lost, the fact that there were survivors to share from their experience and sensations lived from the very incipient stage of the events up to the safe landing, by means of parachute or as a result of a forced landing, makes the number of the avoided events to be never found out. It is certain that among pilots there are many 'talks'. This sharing of occurrences, sometimes slightly nuanced, leads to a decrease in the number of air events, but it does not make them disappear for good.

By far, the top three aviation events include three types: aircraft MiG 15 and MiG 21, and helicopter IAR 330. The multitude of missions that are possible to execute in the tactical field under all meteorological conditions made the three types of aircraft to be purchased and used intensely for the flying personnel's training and carrying out of combat orders. In the incipient phases of starting using those types of aircraft, their use for training missions was applied under normal meteorological conditions, especially during the daylight. Out of easy to understand reasons, not all the flying personnel designated to be trained on these types of aircraft got to the performance of using the technique at its maximum capacity. Thus, a selection of crews, based on their skills, performance, and, not the least, intellectual capacity was performed. The more efficient the technique is, the more the crews' capacity of data synthesis and analysis must be and implicitly the time for decision making in a coordinated and adequate manner is shorter.

Taking into account the previous specifications, many of the pilots had to, out of their own initiative (or forced by the military system), admit their limits and to select another inferior category of aircraft, or even specializations that did not include flight activities. We not at all wrong to affirm that some of those pilots displaying reduced capacities of exploiting and using aircraft were 'excluded' by them.

Our viewpoint with regard to the personnel that managed to face difficult situations, while putting their experienced facts and events into the lessons learned chapter of their professional lives, is that they are ready to exploit their given aircraft. Even though they made mistakes that led to a series of events, their capacity and expertise made them not degenerate and succeed in managing difficult moments in a unique manner, many times reducing resources loss.

For comparison purposes, the number of destroyed aircraft, of losses and survivals of the flying personnel, is represented on decades, in Table 2.

Table 2 – Situation of lost aircraft and flying personnel involved on decades

Destroyed aircraft	1950-1959	1960-1969	1970-1979	1980-1989	1990-1999	2000-2014	Total
Without ejection system	-	-	6	18	15	7	**46**
With ejection system	75	39	43	34	48	22	**261**
Total aircraft	**75**	**39**	**49**	**52**	**63**	**29**	**307**
Fatalities	46	22	39	49	33	33	**222**
Ejections	8	10	18	15	20	7	**78**
Survivals	27	9	6	22	23	6	**93**
Total rescues	**35**	**19**	**24**	**37**	**43**	**13**	**171**

4. CHARACTERIZATION OF THE AVIATION ACTIVITY BETWEEN 1950 AND 2014

By analyzing the percentages of collected and analyzed data, we found the following facts:

- Out of 1628 aircraft, 19 different types, to which we refer, there were 304 aircraft lost, representing 18.6% of the total;
- Out of the total number of helicopters equipping the Romanian Air Force (207), there were 48 lost, representing 17.5%.
- The number of airplanes taken out of use, 256, represents a percentage of 19% of the total of 1354 items.
- A number of 219 people that lost their lives (pilots, technical crew, navigators, shooters and radiotelegraphists) were part of the 298 serious accidents (6 helicopters were lost on the ground, as a result of fire in one of the hangars, in Sibiu).
- Out of these 298 accidents, a number of 171 flying personnel was rescued, 73 of whom managing to save their lives by ejection procedures.

Note: out of the 78 successful ejections, a number of 3 pilots executed two ejections, only 2 of whom are still alive today.

Starting from the number of fatalities from the period 1950-1959, 46, we notice that the number of life losses decreases suddenly, by almost 52%, in the period 1960-1969, up to 22.

The years of 1970 recorded an increase of 77% fatalities, a number of 39 human losses among the flying personnel, compared to the previous decade, the ascendant trend being in place for the ’80s, as well, when 49 people lost their lives, approximately with 30% higher level.

For the next two decades, the value of human resource loss remained the same, counting 33 pilots, which represents a decrease with 33%, as compared to the years of ’70-’79.

By analyzing the existent data with regard to the survival percentages in contrast with the human lives losses, we can reach the following conclusions (Figure 2):

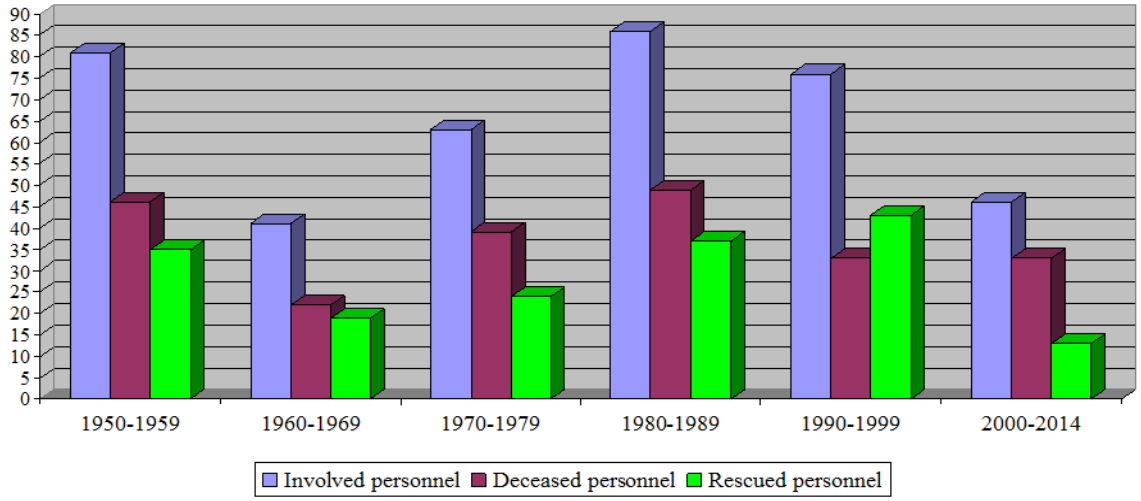

FIG. 2 – Personnel involved in accidents

- Between 1950-1959 – out of 81 aviators involved in flight events, 46 (57%) of them died and 35 (43%) saved their lives;
- Between 1960-1969 – out of 41 aviators involved in flight events, 22 (54%) of them died and 19 (46%) saved their lives;
- Between 1970-1979 – out of 63 aviators involved in flight events, 39 (62%) of them died and 24 (38%) saved their lives;
- Between 1980-1989 – out of 86 aviators involved in flight events, 49 (57%) of them died and 37 (43%) saved their lives;
- Between 1990-1999 – out of 76 aviators involved in flight events, 33 (43%) of them died and 43 (57%) saved their lives;
- Between 2000-2014 – out of 46 aviators involved in flight events, 33 (72%) of them died and 13 (28%) saved their lives.

Comparing the six decades, we can divide them into three distinct periods:

1. Years of ’50-’89, when the ratio of survivals held an average percentage of 42.5% (**under the percentage of fatalities** of 57.5%);

2. Years of ’90-’99, when the values are exactly the opposite. The ratio of survivals held the value of 57% (**above the percentage of fatalities** of 43%);

3. Years of 2000-2014, when, unfortunately, the ration of survivals decreases a lot beneath fatalities – 28% of survival compared to 72% fatalities!!!

The first period falls under the influence of the beginning of use of a great number of types and variants of aviation equipment purchased from the former USSR and other member states of the Warsaw treaty, in large amounts. The lack of flight experience, but also the alert pace in the training of the flying personnel is tightly connected to the numbers shown above.

The little experience acquired on double-seater aircraft, tremendously different from the one that were used for regular training in solo flights, led to discovering the secrets of flying progressively, through repeated attempt, which were many times disastrous, [4, 5].

The period between 1990 and 1999 is one of social relaxation, which its presence felt in all areas of human activity.

The massive growth in the number of flying hours allotted to flying training, the hunger for the continuation of training being evident for each member of the military aeronautical organization, led to an increase in the number of air accidents survivors and all these denote, first of all, an increase in the awareness regarding the importance of the human resource and equally, trust in the capacity of rescuing means found aboard of aircrafts. Moreover, the participation in joint exercise with other NATO member states and other states influenced the approach to training the personnel belonging to the Air Force.

With regard to the period of time before Romania's joining the NATO structures, there was the time for implementing tactics and techniques of forming, training and using the Air Force based on the principle "not many, but best". The massive leaving of the military environment, starting with the year of 1998, by a large number of professionals, conducted to the disappearance of experts in the area of aeronautical activities' planning and execution.

The minimal acquisition of equipment and new technique and budgetary limitations led to abandoning many types of aircraft, considered "inadequate for the training of flying personnel based on the NATO standards", but also to the adopted solution, that of crisis time, of modernization and expansion of the lifetime of a number of aircraft equipping the air fleet, in order to maintain the minimum level of national defense of our air space and to meet the minimum standards required by the alliance. The training of crew is thus tremendously influenced by the level of allocated financial resources for the aviation bases but also by the massive exodus of the personnel with a high level of expertise.

5. CONCLUSIONS

There are known problems, and, more seriously than that, they are sometimes accepted.

Why should we discover them when we can prevent them? The current paper aims to bring up new elements in the traditional field of aviation safety and to eliminate vulnerabilities regarding it.

The diverse causality draws our attention toward an essential fact: at any time, deficiencies in the aeronautical system, which were previously ignored, will be able to generate, through different combinations, a series of more or less visible and serious events. It is relevant in this respect the "iceberg" model (Figure 3), which highlights:

a) a continuum of events, from the simple deficiencies to accidents and catastrophes;

b) the frequency of errors representing the visible part of the iceberg is much smaller than that of 'inoffensive' errors, in first place;

c) the possibility of interrupting the undesirable event's evolution through the detection and recovery in due time of errors at all decision making levels.

The cause-chain of critical events progresses from bottom to top, which means that the chances of early prevention of an air accident decrease as we get closer to the top. The event analysis tries to decrease as much as possible toward the bottom of the pyramid, in order to find a large spectrum of primary causes.

This approach to an air disaster analysis allows the identification of dysfunctions in the air system under analysis and which may drag about other air incidents or accidents.

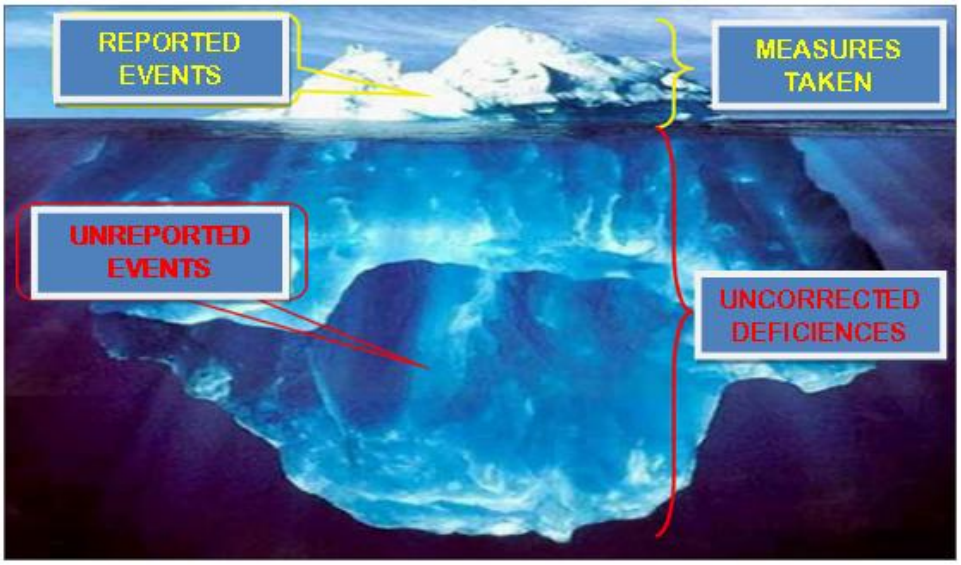

FIG. 3 – Visual exemplification of latent errors

By analyzing this photography let's try to identify, at least, those uncorrected deficiencies, whereas the decision making fora are left with the duty of eliminating as many factors as possible.

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