# RISK OF A HUMAN FACTOR IN AIR TRAFFIC CONTROL: SALVATION BY TECHNOLOGY?

**Tomáš SCHÓBER[*], Blažej LIPPAY[**], Pavel NEČAS[***]**

[*]GCI, Operational Centre, Zvolen, Slovak Republic
[**]National Security Authority, Bratislava, Slovak Republic
[***]Armed Forces Academy of General M. R. Štefánik, Liptovský Mikuláš, Slovak Republic

***Abstract:*** *For air traffic controllers, both civilian and military, time is the biggest adversary when dealing with extraordinary situations in the air. Every human needs an adequate amount of time for analysis, decision-making, and passing crucial information to other working stations. The major characteristic of the entire decision-making process is a lack of time, which may results into human errors and mistakes leading to accidents, or even to catastrophes. This article elaborates on human factor, and it underlines the importance, and even an absolute necessity, of utilization of software applications as a support of military air traffic controllers' (MATC) decision-making (and appropriate authorities) accountable for taking important decisions.*

***Keywords:*** *function, error, threat, emergency, decision-making process, emergency situation application*

## 1. HUMAN FACTOR

While the number of aviation accidents attributable solely to mechanical failure has decreased markedly over the past decades, those attributable at least in part to human error have declined at a much slower rate. Given such findings, it would appear that interventions aimed at reducing the occurrence or consequences of human error have not been as effective as those directed at mechanical failures. Clearly, more emphasis must be placed on the genesis of human error as it relates to accident causation.

Human error is a causal or contributing factor in the majority of aviation occurences. All personnel commit errors, although there is no doubt they did not plan to have an accident. Errors must be accepted as a normal component of any system where humans and technology interact. They are a natural bi-product of virtually all human endeavours. Errors may occur at the planning stage or during the execution of the plan.

Errors lead to mistakes – either the person follows an inappropriate procedure for dealing with a routine problem or builds a plan for an inapproriate course of action to cope with a new situation. Even when the planned action is appropriate, errors may occur in the execution of the plan. On the understanding that errors are normal in human behaviour, the total elimination of human error would be an unrealistic goal. The challenge then is not merely to prevent errors but to learn to safely manage the inevitable errors.

## 2. THE NEED FOR DECISION SUPPORT TOOLS

The performance of the human element cannot be specified as precisely. We should also take into account the fact that incidents rarely, if ever have a single cause. They usually occur as part of a sequence of events in a complex situational context.

Even if not altogether avoidable, human errors are manageable through the application of improved technology, relevant training and appropriate regulations and procedures.

Air defence decision making process has severe (possibly catastrophic) consequences for errors.

It is a complex task accomplished by a team of highly skilled personnel. It requires mental integration of data from many sources. Control and Reporting Centre (CRC) is responsible for all aircraft in their surveillance area and must maintain awareness of available resources, monitor audio and verbal messages and prepare situation reports. Although almost all of the control centres have a high tech equipment, critical data are still manually recorded on a desk, whiteboard or notepad. In this environment, it can be difficult for Air defence crew members to notice or identify key pieces of information that may enable them to better understand the tactical situation. CRC personnel in real-world are working under conditions which comprise dynamic, fluid situation; time pressure; high-risk multiple decision makers; shifting and competing goals; action feedback loops and situations with uncertain and incomplete data.

## 3. SOFTWARE APPLICATION FOR CRC DECISION-MAKING SUPPORT

Emergency Situation Application (ESA) is a software application for CRC crews, which simplifies, improves, and speeds up decision-making processes when dealing with extraordinary situations. This application may be used at all levels and it contributes to taking necessary measures against a threat, which cannot be accounted in advance. The goal is to provide on the screen all the necessary information for a proper decision-making processes in a graphic format in order to diminish a possibility of a mistake. ESA combines outputs from various sources, as well as various algorithms, which calculations are based on specific demands of a user. This application offers a possibility to pay an attention to the most important objectives and threats, it warns on missing data, yet it continually provides relevant information and data, which must be kept in mind, and thus it diminishes a possibility of forgetting or underestimating certain information. Among the major ESA functions belong a projection of basic and enhanced predictions; history; objects of a special/extraordinary/ importance; complete information on all accessible airports from various sources and projection devices; and MATC algorithms and tools.

Support applications of all kind are used in civilian air traffic control widely.

However, in military sector the opposite is true despite the fact that they are absolutely necessary. Decision–making support applications must be flexible, simple for use, with dissemination of information in a real time. Every MATC working station/position/ should have an access to some kind of decision-making support application with its own setting.

## 4. EMERGENCY SITUATION APPLICATION

Information and projection system used in air traffic control should, apart from standard functionalities, projections, and setting options, also offer ESA. This would greatly help to crews when dealing with extraordinary and dangerous situations. The basic element of this application (as in case of every extraordinary situation in the airspace) is a correct target declaration. A working station responsible for identification of an aircraft (in our case Track Production Section) is the only, which can actively access into identification assigning process and, in case of necessity, it can modify it. Declaration of a given target (threat) is automatically disseminated in a real time to all working stations involved in dealing with extraordinary situations. In everyday life, sometimes happens that a pilot, of a specific aircraft, during its flight resets on his transponder his actual alpha code based on a type of a situation to hijack, commloss or emergency. Not every situation, however, which may potentially lead into extraordinary situation, requires change of alpha code.

On the other hand, there are also certain circumstances when an aircrew does not even realize a threat (due to technical problems for example), or an aircrew has no time to react to it adequately (hijack for example).

In accordance with civilian legislation of a given nations the Track Production Section, based on specifics criteria, declares a target such as an airspace violator, suspected, probable, and confirmed renegade. Exact identification is crucial from a legal point of view in order to decide an amount and scope of use of force or weapons system against an airplane that is being intercepted.

Besides this, it is important (despite the fact that this is not a function of an ESA) for a projection system to generate, evaluate, and project fast change, a deviation in altitude, course and speed of all targets automatically.

Signalization of a sudden change (deviation) is projected only on the bases of comparison last 3 values due to potential errors in data processing of a target.

**4.1 Prediction function.** *"Prediction Function"* enables setting of a prediction line for an individual track. It is possible to choose from „none" options, when a prediction line does not appear in, „1min", „2min", „3min", „4min", „5min" or „10min". The length of a prediction line in specific cases corresponds to a distance flown in a given time while keeping actual flight parameters.

**4.2 History function.** By clicking on a *„History Function"*, a sub-window appears with 5 items in 5 pos., 10 pos., 20 pos., full history, or cancel history. The user has an option to set a size of history according to his/her needs. In terms of graphics, this function appears as white (insignificant) dots exactly copying flown path of a given track. It depends on a crew itself, and a type of its activity, whether it selects a closest history, which is the most clear, or it chooses a full history, which shows a full history of a given track since its take off, or a point where it appeared on the screen for a first time. Moreover, in case of cursor movement on a specific history point, a small window appears with information on time (and basic parameters of a flight such as altitude and speed), in which an aircraft was located at the given position.

By eventual click on a given place a window remains active. It can be closed by double-click on the right button of a mouse. This is practical for gaining (in real time) and verification (objective documentation) of data such as time and place of reaching the supersonic speed, or a contact point of Quick Reaction Alert Interceptor (QRA-I) with target.

**4.3 High value objects function.** *"High Value Objects (HVO) Function"* consists of two items: „active", and „inactive". When selecting active HVO, objects formerly predefined into the system by a technical crew appears as small significant red circles. In order to have a better clarity, after selecting „active" item, small circles without any signs appear. Only after cursor move on a given point, a window opens with a name of an object, its exact coordinates, and elevation of its highest point. However, in case that a followed target has been reclassified as a confirmed renegade of the airspace, all HVO will appear automatically in an active regime regardless of previous user settings.

**4.4 Airports function**. *"Airports Function"* consists of items „all", „suitable", and „none". When selecting item „all", all the airports located at Slovak territory, along with their code names (including small aero clubs airports), are highlighted by a neutral color appear on the screen. At the same time, we will get a full list of these airports in text form in the information window. By clicking on a specific airport, a window with detailed information opens up. This may consists of data such as a scope of provided air traffic services of a given airport, phone contacts, frequencies of tower and approach control, and actual meteorological information and technical limitations at a given airport.

Item "suitable" marks on the screen in green color all the airports usable for landing of a selected aircraft. This will happen in both, graphic and text mode. In case of a situation that in the Flight Plan (FPL) of a given target is mentioned a specific type of an aircraft, all airports suitable for landing of this aircraft will be highlighted on the screen. If there is no mentioned a type of an aircraft in FPL, all aircraft located at Slovak territory will appear.

The Algorithm pays attention not only to fixed information such as the lengths of a runway (RWY), surface type and carrying capacity, but also on changing information which influences usability of given airports such as actual meteorological information, obstacles on a RWY, or other technical limitations. The algorithm constantly recounts data from a database for minimal conditions during which an airplane is able to land, and compares them with actual values provided by a given airport.

**4.5 Lock display function.** When clicking on *"Lock Display Function"*, a screen centers itself in such way that a given track is constantly locked in the centre of the screen, while a map background moves in accordance with a speed and real vector of target flight. Due to this, a user gains an optimal situational awareness. Such display mode minimizes a possibility of overlooking important inputs in all directions. This Function can be cancelled by clicking on „unlock", when the screen, or better to say, its map background, remains in a positions manually selected by a crew.

**4.6 Additional info function.** By selecting "*Additional Info function"*, a user will gain further accessible information related to the aircraft itself – for example from Aeronautical Fixed Telecommunication Network (AFTN), such as type of flight, or dangerous cargo on board that requires special dealing with the airplane. This function also offers a possibility to add further data according to specific needs of a user/crew of a given working station.

**4.7 Intercept trajectory function.** Fast visual identification of a target by the QRA-I and identification of a character of his activity (problem or malfunction) is an important condition for a successful solution to a given situation. Here, a complex algorithm proposes and draws an optimal trajectory for the fastest reaching of a point for launching a turn for target identification. The trajectory and radius of a curve is counted based on a value of actual speed and altitude of a target in accordance with real abilities and characteristics of a fighter aircraft.

**4.8 Position function.** *"Position Function"* provides so-called "one click" recording of an aircraft with all its attributes. There is of course an option to add the text to a given position, which is marked as small x. By this, we can write down important positions (GPS, GEOREF) of aircrafts such as for example point of reaching the supersonic speed, intercept point, crash point, and loss of contact.

## 5. CONCLUSION

Successful solution of a crisis/ extraordinary situation depends on successful handling of the first minutes. Therefore, mistakes that occur at the beginning of a decision-making process are extremely difficult to eliminate and, moreover, they may lead to fatal consequences. A human is the last, the most important, yet the weakest element in a decision-making process. According to all accessible and relevant information a human must take a final decision. Consequently, he/she must bear a responsibility for it. CRC decision-making process takes place often under extreme conditions, which includes high tempo, multitasking, and importance of a short-term memory. This is the main reason why applications such as ESA are becoming useful assistance tool in air traffic control. Its aim is to assist crews in taking decisions by minimizing their need to keep most of information in their mind.

By this, it enables ATC crews to concentrate their attention to the highest priority targets and to provide high level of situational awareness in stress situations. ESA is able to facilitate situation for CRC to recognize a threat, and to take appropriate measures, as well as to ease strategic decision-making processes by national authorities.

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