Analysis of the Anthropotechnical System Pilot (Crew) – Helicopter Surroundings

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Abstract — **This publication presents the analysis of the antropotechnical system pilot (crew) – helicopters- surroundings. The decision model has influence on the safety system in aviation operations. Function of this system is support for selecting essential information. What the more it enables to lead analyses of important flight data of helicopters, which subsequently allows of the crew on quick and efficient planning of tasks. Model of decision is a very good indicator of the crew's performance and should be used like that by pilots and crew members for operation of helicopters.**

Keywords-- human factors, information in safety system, maintenance, safe system of aircraft.

I. INTRODUCTION

System pilot (crew) - helicopter – surroundings aspect, as an influence of the structure and elements increasing the viability of the crew on her decision-making processes determine the environment at changeable interactive factors.
The system includes stimuli a crew is guided by which, receiving danger signals, and then is making proper action in the cabin of the helicopter. In decision-making processes it is very important to understanding (awareness) of possessing a skill of correct action of the crew. If working of a danger signal isn't actually interpreted and the lack is of explicit having an influence on the analytical system in the critical time, then a plane crash can appear. That being so this perspective system should contain the following elements [8]:

- stimulus psychological,
- cognitive action (habits, behaviours, reactions and the like),
- correct answers of the pilot (crews) and of air traffic controllers.

Cooperating of human factors with mechanical interactions is aimed at it. Psychological changes (stimuli pilot - crew) must in the same way influence using the helicopter as the ground equipment (e.g. control system of the flight). The crew is one of components which can be supported by the system modelling, analysing and forecasting the technical state of the helicopter.

The man is given senses (the eyesight, the hearing, the smell and the touch) letting receive signals coming from the panel of deck devices and from the environment being outside the cabin of the helicopter.

Therefore crew, being driven by his senses, must take the right decision, choosing out of many possibilities. This model recognizes the specificity of cognitive functions of the memory of the brain of the crew for the realization of requirements in the airspace.

II. THE DECISION MODEL OF THE PILOT (CREW)

System crew - the helicopter is essential for identifying initiated problems while performing the flight which should already be taken into account in the aircraft design.
In this system it is necessary:

- to get appropriate, changeable signals back from surroundings of the source of damage (right diagnostic system),
- to get back effective signals of damaging electromechanical elements for the attention of the crew including their individual predispositions,
- to take into account memory of the pilot (crews) to different kinds of systems,
- to get applicable criteria of the possibility of the crew back from for purchasing habits, of behaviours and the reaction in decision-making processes.

The changeability of the presented system, as the probability of the formation of different signals (the noise, the smoke, the inadmissible pressure or the temperature of the oil and the like) depending on different symptoms (leakiness of the installation, upsetting the arrangement and the like) influences the effectiveness of the crew (actually making a decision) while performing the flight. The system is also expressing the aspect concerning the modelling for the purposes of forecasting the technological future backed up with the simulation software. This system in the design process can also take into account the influence of the

Survivability of the helicopter on the decision-making time of the crew by examining recognised intentions, behaviours and the reaction of crew members.

One should take into account correlation between the development of the technique and human factors in the model manufacturing system of the helicopter which is being initiated through restrictive, straight procedural test loop taking experience into account in practice, e.g.: earlier life cycle and of operating the aircraft (the pilotage and repairs).

The following elements form the model of the manufacturing system of the helicopter [8]:

- designe and production decision,
- producing the helicopter,
- quality of controlling, test, storing and delivering,
- of the invoice and payments,
- financing,
- development of air examinations,
- the air market research.

The production decision is correlating the system with ordering the model TQM (Total Quality Management) which is taking into account abilities and the development of employees of the enterprise, of cooperation with the supplier and the research on a production process of sub-assemblies and elements of the helicopter [7].

It is held through the qualitative test of the control, certification, of storing and delivering, where can appear negative phenomenon of the temporal delay. Helicopter (prototype) before the made decision on the production must also be checked diagnostic on they appeared of damage while using him. Moreover the production decision is not only being created by orders of the company management board, but also through the air market research what influences achieving success in the production and the sale of the helicopter.

The financial aspect in the manufacturing system of the helicopter is pointed with:

- payments in decision-making processes concerning the production of the helicopter,
- financing the development of air examinations.

The model also considers the development of air examinations, as the crucial element for the forming of the air market. It is ensuring the forecast of the technical development and new procedures and purposes for increasing the effectiveness of producing the helicopter. Moreover the good level of checking the stage of manufacture of the helicopter is significant qualitatively with test in the destination of getting and sending the essential reliable information to the improvement in implementation activities etc [3].

The proposed model of the manufacturing system of the helicopter is only one of tools supporting the design process. In the air design taking factors spreading through the relation into account is a criterion of success man-helicopter, being used for modelling, analysing, interaction (loop of decision-making processes of the crew) with taking the quality management system into account in order to get the effectiveness and the safety of the flight.

Decision-making processes of the crew affect surviving the helicopter and the health and the life of the aircraft crew and passengers during the performance of tasks in air.

A performance is a being of decision-making processes of the crew right analyses of existing requirements and performing the activity connected with correct using the aircraft. Taking the safety of performing flights into consideration, it is possible to apply the simplified decision model of the pilot drawn up by John Boyd's OODA Loop which by modifying is taking genetic factors into account, cultural and earlier past experiences (fig. 1).

In the offered decision model of the crew all occurring thought processes were taken into account and motor concerning put requirements, analysis of aims, made decision; action is occurring in the logical sequence of events, making a loop. The decision-making loop is showing affecting factors for making a snap decision and then performing determined activities in order to perform a deliberate task in-flight. Put requirements for crew acquaintances concern norms, principles and procedures and behaviours and reactions which are adapted to stochastic (of varying conditions of surrounding including had individual personality trademarks. In the decision-making terminus analysis of aims is the first element for making a decision which directly considers existing requirements (e.g. damaging the helicopter, changing weather conditions etc.).

Analysis of aims is taking into account the validity check and the sense of reasoning of delivered information by the crew during for performing the flight. On correct interpretations of presented information influences:

1. Genetic legacy associated with biological conditioning, where the personality trademark being characterized is definite through:
    a. Temperament in the form:

- of the demand for the stimulation as the tendency of reacting to new impetuses (appearing of particular situations in flight - air events);
- of avoiding negative reinforcements as the tendency of stopping action (temporary paralysis in the pilotage) in response to negative stimuli (riot of damaging the helicopter) in-flight;
- of making conditional from receiving a prize, as the tendency to sustaining behaviours (level of the air education) in response to the positive reinforcement (individual rewarding with a prize);
- of the perseverance of habits, the reaction and habits, as the ability for independent supporting ability air.

2. Character taking properties purchased in the course of the personal development into account:

- ability to self-direct, consisting on the self-control, the self-regulation and accommodating itself to requirements arising while appearing of diverse air events;

- ability for the cooperation as the ability of the identification of both approval of behaviours of the pilot and the composition of the crew or other outside persons;
- ability to the automatic transcendence as feeling that they are a part of the universe through spiritual feelings.

3. Cultural conditioning including bringing up in the home, school environment and at the work.
4. Experience purchased in the course of performing flights through preventive trainings in simulators.
5. Intellectual development in the process getting and consulting the knowledge along with constant improving its abilities.

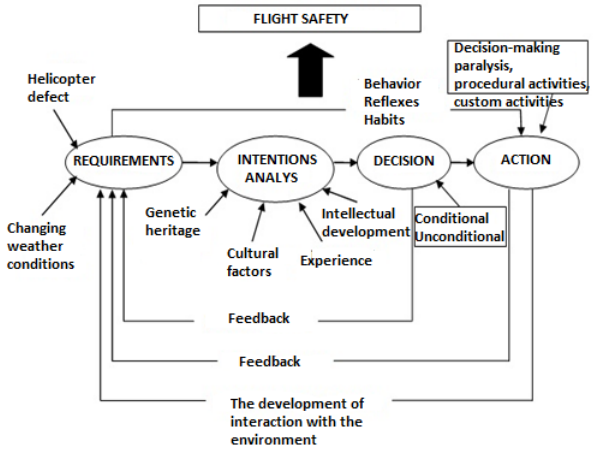


Fig. 1. Pilot (crew) decision model

Source: own study based on John Boyd decision - OODA Loop

6. Cultural conditioning including bringing up in the home, school environment and at the work.
7. Experience purchased in the course of performing flights through preventive trainings in simulators.
8. Intellectual development in the process getting and consulting the knowledge along with constant improving its abilities [2].

The decision of the crew which can be conditional or unconditional consists on ultimate deciding performing specific activities in order to meet requirements in safe continuing the flight of helicopter.

Moreover process of making a decision along with procedural or custom action of the crew are conjugated with reflexive information in the form of interaction what has on the destination of controlling performed pilot activities. A decision-making paralysis can also appear in action of the crew, eh let meet requirements arising during performing the flight.

The model in the form of the decision-making loop contains trademarks behaviours crews taking into account genetic predispositions to the achievement like the highest level of the pilotage for her while using the helicopter. Moreover the decision-making loop is connected with the process of prediction, sensing, selecting and analysing the relevant information what allows on fast and effective action during appearance of damage. With being of it there is correlation of the human factor with the resistance to damaging (with life-span) of helicopter what material meaning has in the design process, because for them larger rate of the vitality, all the longer time of the availability for making a decision by the crew.

In the process of the decision making a failure to consider is a threat to the crew at the stage of designing and using the helicopter of [4]:

- the different requirements concerning the configuration of the cabin and a passenger compartment;
- interface typical of with other systems on the stage of performing the flight;
- selection typical (completing) crews;
- the professional action plan in particular situations in flight;

III. INFLUENCE OF THE DECISION OF THE PILOT (CREWS) TO THE SURVIVABILITY OF HELICOPTERS

In the course of performing an air task the pilot is playing important and responsible role. Both the pilot and the helicopter are creating the indissoluble arrangement which is essential from the point of view of safety of flights.

The helicopter has its dynamics and operating limitations which they cause, that don't constitute the pleasant workplace for the pilot [1]

Therefore the pilot should be marked by a great flexibility, a responsibility and self-control, in order to correctly flight with helicopter. The functioning of the remote control doesn't consist only in the dynamic coordination of controls of the helicopter, but he is also bearing responsibility for the work of all installed aboard systems.

Prompt finding appropriate devices is setting the pilot operation- navigational and correct interpreting their readings and information coming from surrounding for taking the right decision.

The performing an air task requires by the pilot constant changing of information through senses, of her selection and processing.

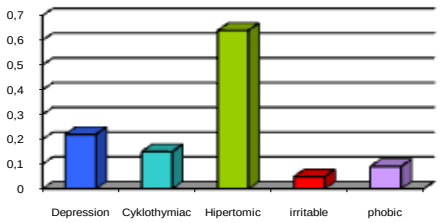
Also taking control of air habits and decision-making skills are important in given environmental conditions, that is appearing apart from the cabin of the helicopter from which the pilot is obtaining all the information about the performed flight.

Pilot which isn't expecting disruptions and isn't on not immune, can make a leading mistake even to a plane crash.

Also threats caused by the sudden address are having an influence on decision-making processes of the pilot damage to the helicopter or the influence of changeable, difficult weather conditions in-flight.
Disruptions arising can cause change of the process of perceiving, remarks, abandons, thinking as well as reduce the endurance and the stress resistance on account of the deficit of the needed time for making a decision by the pilot in the course of the dangerous flight.
One should also remember that abilities of the human brain are limited; the pilot isn't able to take note of a few signals simultaneously and in the same time to develop of decisions concerning a few activities [2].
He results, so from it, that in the relation of the arrangement pilot - a helicopter is unfortunately a man a weak point is determining.
The technological development of helicopters causes increasing their vitality, i.e. for the resistance to paralysing, and hence a time for making a decision by the pilot in-flight is increasing.
Combining the Survivability of the helicopter into decision-making processes of the pilot is creating the system of information between the immunity to paralysis and the value of the flexible time for analysis delivered what in the prevailing conditions a success of the performed air task can guarantee.
The received (feat back) information on from air measuring instruments in the stress situation, under pressure of deficit of the time; it isn't simple, and the division of the attention much is hampered, because contrary to appearances it isn't facilitating the maneuver at all. Therefore the determined Survivability of the helicopter definitely affects decision-making processes of the pilot.
Furthermore effecting competent selection of leads by the pilot is backed up with structural members, increasing the permanence of the helicopter (e.g. lapped control systems, navigation, drive and the like) [6].
The process of selection of information consists in the concentration simultaneously on many stimuli coming from surroundings. The mechanism of selection to the awareness only allows limited number of information. One should emphasize that he isn't omitting remaining data, but is registering them with individual kinds of the memory (among others: short-lived, long-term) on account of changes which can only to become known.
It influences the speed of correct making by the pilot of procedures indeed during the incoming information about paralysing the helicopter.
In the deficit of the time for decision-making processes of the pilot a measure of the unreliability of the helicopter influences in the aspect of his vitality.
Analysis of decision-making processes of the pilot they in the function are making the battle vitality through parameters:

- flexible time,
- time of the life-span, determining effects of paralysing or damaging the helicopter during the flight.

Making competent selection of important information by the crew is being backed up with structural members increasing the Survivability of the helicopter (e.g. lapped control systems, navigation, drive and the like).
Therefore in the deficit of the time for decision-making processes of the crew a measure of the unreliability of the helicopter influences in the aspect of his vitality.
To include in the evaluation of the flexible time temperament associated with special predispositions to acting in conditions of the stress at persons about the high creativity is included.
Exploiting the scale TEMPS-A, they conducted research in the group of pilots (along with the crew) which are making important decisions for the safety of the flight and the life of other people, in the ability of emotional advising in stress situations. 30 pilot were included in an examined group along with crew members in the century from 19 up to 57 years (average of the age 33.2 +10,8 of years). The number of logged hours by the aircraft crew on helicopters took out from 1500-11000 (on average 8500 +300 of hours). Conclusions of the questionnaire TEMPS-A with regard to the probability of their riot in the examined group of people is presenting evaluations of features of the temperament graph 1.



Graph 1.Conclusions of the questionnaire TEMPS-A in the examined group of 30 pilots

As it turned out along with other members of the crew she was a dominating positive characteristic of examined pilots' hypertonic, that is the openness, the good mood, a sense of humor and the resistance to tiring out.
Nevertheless in an age bracket of 30-37 years, about the substantial amount of logged hours, which criterion the crew constitutes significant influence on experiencing them, took risky decisions more.
It is to consider the motion which is involved in the design process of structures and equipping the helicopter, he is also relevant information for the training program which he is supposed to take into account the age and the level of training the aircraft crew.
To sum up, the parameter as the flexible time taking into account individual personality features of the crew and their level of the education, affecting decision-making processes,

with time which is reflecting structural ownerships of the helicopter and character of the flight, is correlating vitalities maneuvers situations and of kind of the disturbance of damaging paralysis in the moment during performing the flight.

IV. CONCLUSION

The publication proposes a new approach to the analysis and evaluation of anthropotechnical security system pilot (crew) - helicopter - the environment in order to minimize the probability of an aircraft accident. Due to the vastness of the topic object of the study has been limited to selected areas of technical sciences related to the survivability and psychotechnical circumstances in decision-making by the pilot (crew) helicopter in dangerous situations.
Moreover, given the complexity of the anthropotechnical system and variety of factors affecting the resistance of helicopters during air missions, selected only the necessary areas of technical sciences, together with the management of the organization.

Therefore, one can draw the following conclusions:

1. Contemporary development of technical sciences allows you to create a systemic approach , in which the life of the aircraft include derivative of the decision-making processes in the anthropotechnical system man - machine - environment.
2. Properly designed level of resistance to damage the helicopter provides adequate disposable time (t_D) to take a correct decision by the pilot (crew) during flight by day and night.
3. The questionnaire TEMPS -A (Temperament Evaluation of Memphis , Pisa, Paris and San Diego - Autoquestionnaire version) allows you to evaluate individual personality traits airmen, which should be taken into account in the design process of the helicopter .
4. The project management airlines and aviation training programs should take into account not only the criteria for the design of the helicopter (eg, ergonomic cabin, rescue system) , but also the personality traits of the crew.
5. Taking account of the life of the helicopter and biomechanical properties of the remote control (the crew) in the ambient data can help you in the proper anthropotechnical system design. This also allows for the analysis and assessment in predicting the cause-and- effect relationship , mutual conditions and the impact of the damage caused during the action of the helicopter pilot (crew) in the conditions of lack of time .

To recapitulate , applied a new approach will broaden knowledge on issues viability of the anthropotechnical system pilot (crew) - helicopter - environment, and thus may be a contribution to the theory of safety engineering systems used in the design process.

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