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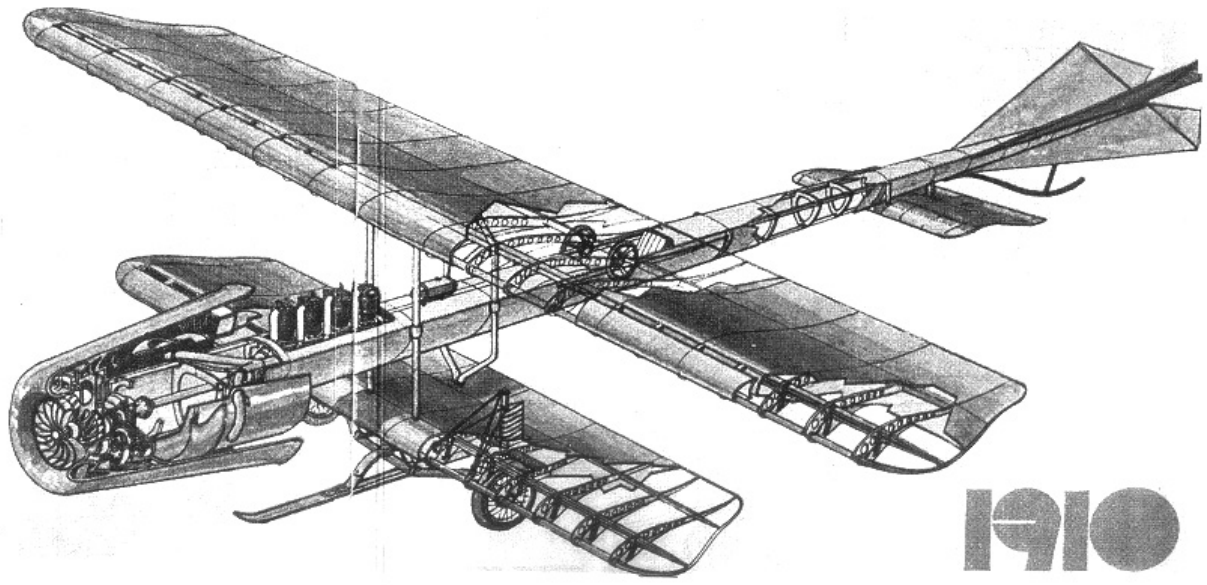

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C O N T E N T S

BOOK REVIEW

COMPUTING NONLINEAR AIRFOIL CHARACTERISTICS OF HELICOPTER ROTOR BLADES

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Abstract: *This paper deals with analytical and numerical study of helicopter rotor blades air loads, a subject which comes under the more general purpose of aerodynamic response (lift and pitching moment) for unsteady effects found on airfoil operating under nominally attached flow conditions away from stall. In this paper are presented some results about the study of air loads of the helicopter rotor blades, the aerodynamic characteristics of the airfoil sections, the physical features and the techniques for modeling the motion of the airfoil in the high angle of attack regime. The unsteady problem was approached on the basis of Theodorsen theory, where the aerodynamic response is considered as a sum of no circulatory and circulatory parts. The numerical calculus and the graphical parts were made in MAPLE software environment.*

Keywords: *unsteady aerodynamics, helicopter aerodynamics, rotor blade air loads*

1. INTRODUCTION

The aerodynamic behavior of airfoils in the high AoA regime is important for predicting the adverse effects produced in the reverse flow regime on the rotor. In the reverse flow region, the direction of the relative flow vector changes from the trailing edge toward the leading edge of the airfoil. While the fundamental process of the blade wake and tip vortex formation is similar to that found with a fixed wing, one difference with helicopter tip vortices is that they are curved and so they experience a self-induced effect. Another complication with helicopter rotors is that the wakes and tip vortices from other blades can lie close to each other and to the plane of blade rotation and so they have large induced effects on the blade lift distribution. Some authors have examined the higher harmonics of the rotor loading in forward flight and have concluded that the effects of the tip vortices are generally more important than the shed wake.

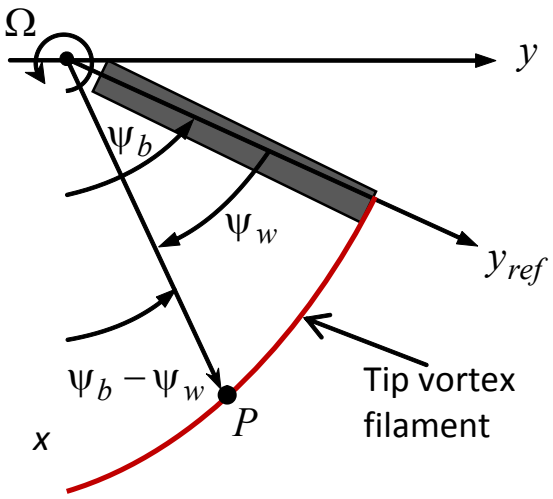

Fig. 1 Tip vortex trajectory

If the wake is assumed to be undistorted in the tip path plane and no wake contraction occurs in the radial direction (fig. 1), then the tip vortex trajectories are described by the equations

$$\begin{cases} x = R\cos(\psi_b - \psi_w) + R\,\mu\,\psi_w \\ y = R\sin(\psi_b - \psi_w) \end{cases} \quad (1)$$

where ψ_b is the position of the blade when the vortex was formed and ψ_w is the position of the vortex element relative to the blade.

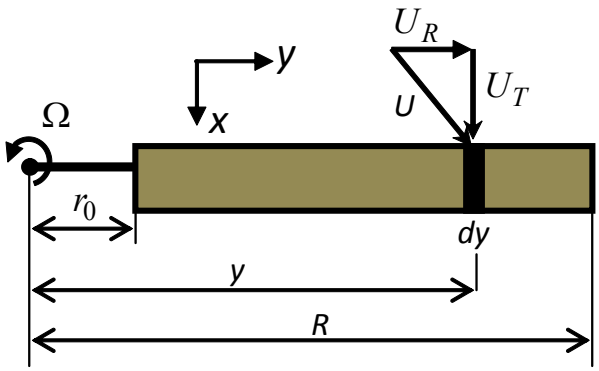

Fig. 2 Helicopter rotor blade

The angular or rotational speed of the rotor is denoted by Ω, the rotor radius by R, the advanced ratio $\mu = V_\infty \cos\alpha / \Omega R$ and $r = y / R$ where y is the axis along the rotor blade and α is the angle between the helicopter forward velocity V_∞ and the plane of the rotor. The subscript symbols T and R denote the tangential and radial velocity (fig. 2).

These interactions of blades and tip vortices (called blade-vortex-interactions, BVIs) can occur at many different locations over the rotor disk and also with different orientations.

The most important component of the helicopter is the main rotor for which there is a great deal of activity in developing new and improved mathematical models that predict the flow physics. A high tip speed gives the rotor a high level of stored rotational kinetic energy and reduces the rotor torque required for a given power, but there are two important factors that work against the use of a high tip speed: compressibility effects and noise.

The additional effects of compressibility on the overall rotor profile power requirements, when the tip of the advancing blade approaches and exceeds the drag divergence Mach number were estimated using the blade element theory combined with the airfoil section characteristics. A more detailed analysis of compressibility effects on the rotor must represent the actual nonlinear airfoil characteristics as functions of Mach number through stall at each blade element followed by numerical integration.

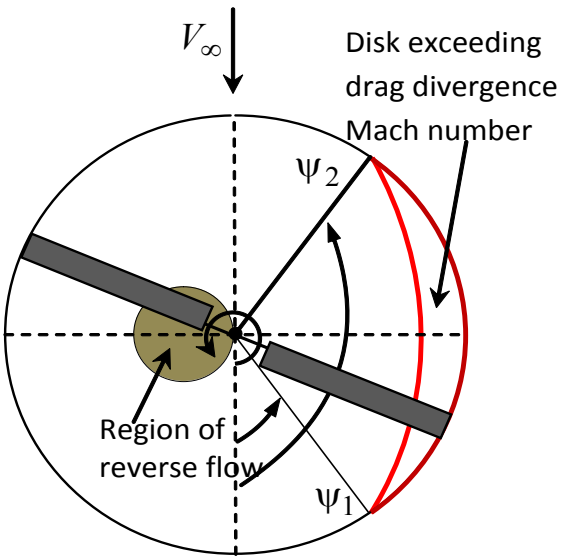

Fig. 3 Helicopter rotor in forward flight

The region of the rotor disk affected by compressibility effects is shown in fig. 3 and is defined on the surface where the incident Mach number of the flow that is normal to the leading edge of the blade exceeds the drag divergence Mach number, M_{dd}. If $M_{\Omega R}$ is the hover tip Mach number, than the region of the disk affected by compressibility effects is defined by

$$M_{r,\psi} = M_{\Omega R}(r + \mu \sin\psi) \geq M_{dd} \tag{2}$$

The azimuth angle for the onset drag divergence, ψ_1, can be obtained by setting $r = 1$, so that

$$\psi_1 = \arcsin\left(\left[\frac{1}{\mu}\left(\frac{M_{dd}}{M_{\Omega R}} - 1\right)\right]\right) \tag{3}$$

and $\psi_2 = 180 - \psi_1$.

The increment in the profile power ΔC_P associated with this region on the disk is

$$\frac{\Delta C_P}{\sigma} = \frac{1}{4\pi}\int_{\psi_1}^{\psi_2}\int_{r_{dd}}^{1}(r + \mu\sin\psi)^3 \Delta C_d \, r \, dr \, d\psi \tag{4}$$

where ΔC_d is the extra drag on the blade section when it exceeds the drag divergence Mach number, M_{dd} and σ is rotor solidity coefficient which represents the ratio of the blades area to the rotor disk area. For the NACA 0012 airfoil, Prouty (1986) suggests that this can be approximated by

$$\Delta C_d(M) = \begin{cases} 12.5(M-0.74)^3 & \text{for } M \geq 0,74 \\ 0 & \text{otherwise} \end{cases}$$

The rotor limits may be determined by two conditions, one condition given by advancing blade compressibility effects and the other one condition given by retreating blade stall. In either case the advancing blade operates at low angle of attack (AoA) but at high subsonic or transonic conditions, whereas the retreating blade operates at low Mach numbers and high lift coefficients.

The helicopter rotor airfoil must assure a high maximum lift coefficient, a high drag divergence Mach number, a good lift-to-drag ratio over a wide range of Mach number and a low pitching moment. At higher angles of attack the advert pressure gradients produced on the upper surface of the airfoil result in a progressive increase in the thickness of the boundary layer and cause some deviation from the linear behavior of lift versus angle of attack. On many airfoils, the onset of flow separation and stall occur gradually with increasing angle of attack, but on some airfoils (those with sharp leading edges) the flow separation may occur suddenly.

2. THE APPARENT MASS TENSOR

The rate of change of the impulse vector, in general, is not in the direction of the acceleration of the body. The external force F_e applied to the body to translate it through the fluid has to be applied in a direction different from that of the acceleration of the body through the fluid. Physical conditions that should be satisfied on given boundaries of the fluid (boundary conditions) depend on the assumptions made with regard to the nature of the fluid, more specifically on the nature of the differential equations that are assumed to govern the motion of the fluid. For a solid-fluid boundary, at each point of the solid-fluid surface, at every instant, the component normal to the surface of the relative velocity between the fluid and the solid must be vanish, $\vec{V} \cdot \vec{n} = 0$, where $\vec{V}$ represents the relative velocity and $\vec{n}$ the normal to the surface (fig. 4).

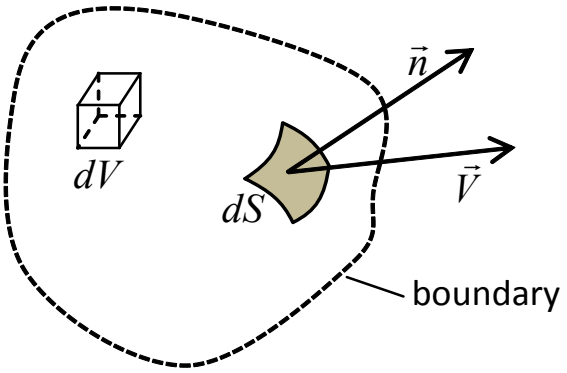

Fig. 4 Solid-fluid surface

If the surface is represented by a scalar function of position and time, $F(\vec{r},t)=0$, then the total time rate of change is zero,

$$\frac{D(F)}{Dt} = \frac{\partial(F)}{\partial t} + \vec{V} \cdot grad(F) = 0 \tag{5}$$

on $F(\vec{r},t)=0$.

The fluid force acting on a rigid body of arbitrary shape translating with a velocity $\vec{U}(t)$ is given by

$$\vec{F} = -\int_S p\,\vec{n}\,d\,S \tag{6}$$

where S denotes the surface of the body and p is the pressure on the surface of the body. In general, the body may be translating, rotating and deforming; consequently, the velocity U is a function of position on the surface and time. If the body is rigid and is in translation motion, then U is a function of time, but uniform over the surface of the body. The mathematical problem is to determine the externally force $\vec{F}_e$ applied to the body to translate it through the fluid.

According to Newton's second law, we have

$$\frac{d}{dt}\left(m\vec{U}\right) = \vec{F}_e + \vec{F} \tag{7}$$

where m is the mass of the body. The above equation may be rewritten as

$$\vec{F}_e = \frac{d}{dt}\left(m\vec{U}\right) - \vec{F} \tag{8}$$

or

$$\vec{F}_e = \frac{d}{dt}\left(m\vec{U} + \vec{I}\right) \tag{9}$$

where $\vec{I}$ is the impulse applied on the fluid and $\vec{F} = -d\vec{I}/dt$.

The fluid force acting on the body is

$$\vec{F} = \frac{\partial}{\partial t}\oint_S \rho\phi\vec{n}\,dS - \rho\vec{U}\times\oint_S \vec{n}\times grad(\phi)\,dS \tag{10}$$

The integral $\vec{I}_C = \oint_S \vec{n}\times grad(\phi)\,dS$ is related to the circulation C around the body (fig. 5) and ϕ is the potential of velocity.

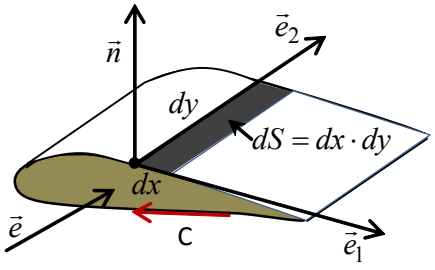

Fig. 5 Rotor blade element

The unit vector $\vec{e}$ is normal to the cutting planes, the unit vector $\vec{e}_1$ is tangent to the curve of intersection between the blade element surface and the cutting plane and the unit vector $\vec{e}_2$ is tangent to the blade element surface.

The component of the vector $\vec{I}_C$ in the direction $\vec{e}$ is

$$\vec{e}\cdot\vec{I}_C = \oint_S \vec{e}\cdot\vec{n}\times\vec{q}\,dS \tag{11}$$

and the vector $\vec{n}\,dS$ corresponding to the surface element $dS = dx\cdot dy$ may be written $\vec{n}\,dS = \overrightarrow{dx}\times\overrightarrow{dy}$, where $\overrightarrow{dx} = dx\vec{e}_1$, and $q = grad(\phi)$.

On the other hand,

$$\vec{n}\,dS\times\vec{q} = \left(\overrightarrow{dx}\times\overrightarrow{dy}\right)\times\vec{q} = \left(\vec{q}\cdot\overrightarrow{dx}\right)\overrightarrow{dy} - \left(\vec{q}\cdot\overrightarrow{dy}\right)\overrightarrow{dx}$$

and

$$\vec{e}\cdot\vec{n}\times\vec{q}\,dS = \vec{e}\left(\vec{q}\cdot\overrightarrow{dx}\right)\overrightarrow{dy} - \vec{e}\left(\vec{q}\cdot\overrightarrow{dy}\right)\overrightarrow{dx} \tag{12}$$

Since the unit vectors $\vec{e}$ and $\vec{e}_1$ are normal it follows that $\vec{e}\cdot\overrightarrow{dx} = 0$ and

$$\vec{e}\cdot\left(\vec{n}\times\vec{q}\right)dS = \left(\vec{q}\cdot\overrightarrow{dx}\right)\left(\vec{e}\cdot\overrightarrow{dy}\right) \tag{13}$$

The scalar product $\vec{e}\cdot\overrightarrow{dy}$ is the normal distance between the cutting planes of the solid body (fig. 5). If we denote $dh = \vec{e}\cdot\overrightarrow{dy}$ it follows

$$\vec{e}\cdot\oint_S \vec{n}\times\vec{q}\,dS = \int_{h_1}^{h_2}\left(\oint_C \vec{q}\cdot\overrightarrow{dx}\right)dh = \int_{h_1}^{h_2}\Gamma_e(h)\,dh \tag{14}$$

Here h is the distance measured along the fixed direction $\vec{e}$ and

$$\Gamma_e(h) = \oint_C \vec{q}\cdot\overrightarrow{dx} \tag{15}$$

is the circulation around the curve of intersection between the body surface and the cutting plane. The limits h_1 and h_2 denote the extremities of the body measured along the direction $\vec{e}$. It follows that for motions without circulation the force on the body is given by

$$\vec{F} = \frac{\partial}{\partial t}\left(\oint_S \rho\phi\vec{n}\,dS\right) \tag{16}$$

where the velocity potential ϕ is the solution of the system

$$\begin{cases}\nabla^2\phi = 0\\ grad\phi\cdot\vec{n} = \dfrac{\partial\phi}{\partial n} = U(t)n \quad on\ S\end{cases} \tag{17}$$

Since the equation and boundary condition for ϕ are linear, the solution could have the form

$$\phi = \phi_1 + \phi_2 + \phi_3 \tag{18}$$

where each of the function ϕ_1, ϕ_2 and ϕ_3 is a solution of the equations

$$\begin{cases}\nabla^2\phi_i = 0\\ grad(\phi_i)\cdot\vec{n} = \dfrac{\partial\phi_i}{\partial n} = u_i n_i \quad on\ S\end{cases} \tag{19}$$

i=1, 2 or 3.

In the Cartesian coordinate system the vectors $\vec{U}$ and $\vec{n}$ have the expressions

$$\begin{aligned}\vec{U} &= u_1\vec{i} + u_2\vec{j} + u_3\vec{k}\\ \vec{n} &= n_1\vec{i} + n_2\vec{j} + n_3\vec{k}\end{aligned} \tag{20}$$

Because time enters through u_i, it is convenient to set $\phi_i = u_i\varphi_i$, so the system (19) takes the form

$$\begin{cases}\nabla^2\varphi_i = 0\\ grad(\varphi_i)\cdot\vec{n} = \dfrac{\partial\varphi_i}{\partial n} = n_i \quad on\ S\end{cases} \tag{21}$$

With these considerations the impulse $\vec{I}$ becomes

$$-\vec{I}=\oint_S \rho\phi\vec{n}\,dS=\oint_S \rho\left(\sum_{k=1}^{3}u_k\varphi_k\right)\vec{n}\,dS=$$
$$=\sum_{k=1}^{3}\left(\oint_S \rho\varphi_k\vec{n}\,dS\right)u_k \tag{22}$$

The components of the impulse $\vec{I}=I_1\vec{i}+I_2\vec{j}+I_3\vec{k}$ are

$$\begin{cases} I_1=\vec{i}\cdot\vec{I}=\sum_{k=1}^{3}\left(-\oint_S \rho\varphi_k n_1\,dS\right)u_k \\ I_2=\vec{j}\cdot\vec{I}=\sum_{k=1}^{3}\left(-\oint_S \rho\varphi_k n_2\,dS\right)u_k \\ I_3=\vec{k}\cdot\vec{I}=\sum_{k=1}^{3}\left(-\oint_S \rho\varphi_k n_3\,dS\right)u_k \end{cases} \tag{23}$$

The surface integral in the above equations may be written as follows

$$\oint_S \rho\varphi_k n_i\,dS=\oint_S \rho\varphi_k\frac{\partial\varphi_i}{\partial n}dS \tag{24}$$

According to Green's theorem, if ψ_1 and ψ_2 are two harmonic functions, then

$$\oint_S \psi_1\frac{\partial\psi_2}{\partial n}dS=\oint_S \psi_2\frac{\partial\psi_1}{\partial n}dS \tag{25}$$

Introducing the symbol m_{ki},

$$m_{ki}=-\oint_S \rho\varphi_k\frac{\partial\varphi_i}{\partial n}dS \tag{26}$$

with $m_{ki}=m_{ik}$, the components of the impulse $\vec{I}$ are therefore given by

$$I_i=\sum_{k=1}^{3}m_{ik}u_k \quad \text{, i=1, 2, 3} \tag{27}$$

and the force applied externally to the body is

$$\vec{F}_e=\frac{d}{dt}m\left(u_1\vec{i}+u_2\vec{j}+u_3\vec{k}\right)+$$
$$+\frac{d}{dt}\left(m_{11}u_1+m_{12}u_2+m_{13}u_3\right)\vec{i}+$$
$$+\frac{d}{dt}\left(m_{11}u_1+m_{12}u_2+m_{13}u_3\right)\vec{j}+$$
$$+\frac{d}{dt}\left(m_{11}u_1+m_{12}u_2+m_{13}u_3\right)\vec{k} \tag{28}$$

or

$$\vec{F}_e=\left[\left(m+m_{11}\right)\frac{du_1}{dt}+m_{12}\frac{du_2}{dt}+m_{13}\frac{du_3}{dt}\right]\vec{i}+$$
$$+\left[m_{21}\frac{du_1}{dt}+\left(m+m_{22}\right)\frac{du_2}{dt}+m_{23}\frac{du_3}{dt}\right]\vec{j}+$$
$$+\left[m_{31}\frac{du_1}{dt}+m_{32}\frac{du_2}{dt}+\left(m+m_{33}\right)\frac{du_3}{dt}\right]\vec{k}$$

The coefficients m_{ik} form a set of nine numbers which may be displayed as an array

$$\begin{pmatrix} m_{11} & m_{12} & m_{13} \\ m_{21} & m_{22} & m_{23} \\ m_{31} & m_{32} & m_{33} \end{pmatrix} \tag{29}$$

which may be referred to as a virtual mass tensor or virtual masses that need to be added to the mass of the body in order to find the force that must be applied to translate it through the fluid. Introducing the symbol δ_{ik} defined by $\delta_{ik}=0$ if $i\neq k$ and $\delta_{ik}=1$ for $i=k$, equation (28) may be rewritten

$$\left(F_e\right)_i=\sum_{k=1}^{3}\left(m\delta_{ik}+m_{ik}\right)\frac{du_k}{dt} \tag{30}$$

For any body there are three perpendicular directions such that $m_{ik}=0$ for $i\neq k$, so with respect to such axes, the equation (30) becomes

$$\left(F_e\right)_i=\left(m+m_{ii}\right)\frac{du_i}{dt} \quad \text{, i=1, 2, 3.} \tag{31}$$

The sum $\left(m+m_{ii}\right)$ represents the apparent mass for translation in the i-direction and the corresponding m_{ii} is the additional apparent mass.

3. RESULTS

The oscillatory motion of the airfoil can be decomposed into contributions associated with angle of attack which is equivalent to a pure plunging motion (fig. 6) and contributions associated with pitching (fig. 7).

A plunge velocity $\dot{h}$ produces a uniform velocity perturbation w, that is normal to the chord, $w(x)=-\dot{h}$ and the pitch-rate term produces a linear variation in normal perturbation velocity.

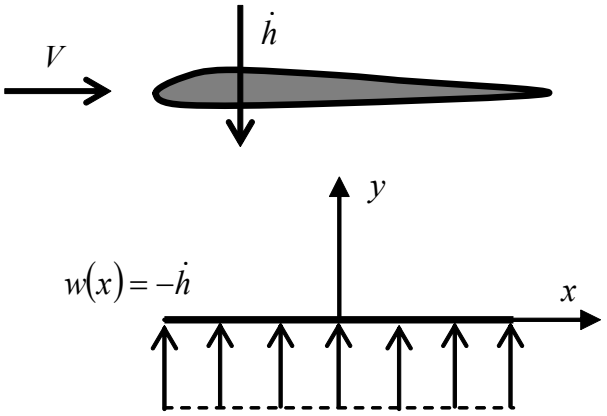

Fig. 6 Plunge velocity

For a pitch rate imposed about an axis at "*a*" semi-chords from the mid-chord, then $w(x) = -\dot{\alpha}(x-a)$ so that the induced chamber is a parabolic arc.

The problem of finding the air loads on an oscillating airfoil was solved by Theodorsen, who gave a solution to the unsteady air loads on a 2-D harmonically oscillated airfoil in inviscid, incompressible flow, with the assumption of small disturbances. Both the airfoil and its shed wake were represented by a vortex sheet with the shed wake extending as a planar surface from the trailing edge downstream to infinity. The assumption of planar wake is justified if the angle of attack disturbances remain relatively small. As with the standard quasi-steady thin airfoil theory, the bound vorticity, γ_b, can sustain a pressure difference and, therefore, a lift force.

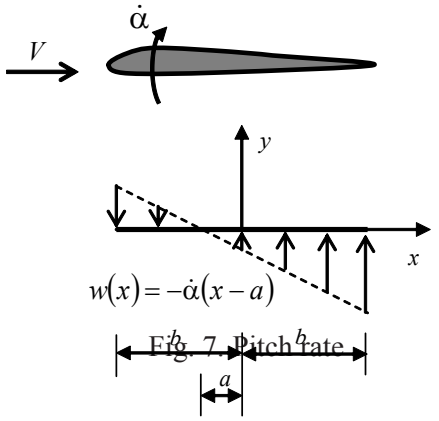

Fig. 7 Pitch rate

The wake vorticity, γ_w, must be force free with zero net pressure jump over the sheet.

According to the Theodorsen's theory, the solution for the loading γ_b on the airfoil surface under harmonic forcing conditions is obtained from integral equation

$$w(x,t) = \frac{1}{2\pi}\int_0^c \frac{\gamma_b(x,t)}{x-x_0}dx + \frac{1}{2\pi}\int_c^\infty \frac{\gamma_w(x,t)}{x-x_0}dx \tag{32}$$

where *w* is the downwash on the airfoil surface.

At the trailing edge, $\gamma_b(c,t) = 0$, and the airfoil circulation $\Gamma(t)$ is given by

$$\Gamma(t) = \int_0^c \gamma_b(x,t)dx \tag{33}$$

So long as the circulation about the airfoil is changing with respect to time, the circulation is continuously shed into the wake and will continuously affect the aerodynamic loads on the airfoil. For a general motion, where an airfoil of chord $c = 2b$ is undergoing a combination of pitching $(\alpha, \dot{\alpha})$ and plunging $(\dot{h})$ motion in a flow of steady velocity *V,* Theodorsen's solutions for the lift coefficient and pitching moment coefficient corresponding to mid-chord, $M_{1/2}$ are

$$\begin{cases} c_l = \pi b\left[\dfrac{\ddot{h}}{V^2} + \dfrac{\dot{\alpha}}{V} - \dfrac{b}{V^2}a\ddot{\alpha}\right] + \\ \quad + 2\pi\left[\dfrac{\dot{h}}{V} + \alpha + \dfrac{b\dot{\alpha}}{V}\left(\dfrac{1}{2}-a\right)\right]C(k) \\ c_{m1/2} = \dfrac{\pi}{2}\left[\dfrac{b}{V^2}\ddot{h} - \dfrac{b^2}{V^2}\left(\dfrac{1}{8}+a^2\right)\ddot{\alpha}\right] + \\ \quad + \pi\left(a+\dfrac{1}{2}\right)\left[\dfrac{\dot{h}}{V} + \alpha + b\left(\dfrac{1}{2}-a\right)\dfrac{\dot{\alpha}}{V}\right]C(k) - \\ \quad - \dfrac{\pi}{2}\left[\left(\dfrac{1}{2}-a\right)\dfrac{b\dot{\alpha}}{V}\right] \end{cases}$$

where *a* is the pitch axis location relative to the mid-chord of the airfoil, measured in terms of semi-chord and $C(k) = F(k) + iG(k)$ is the complex transfer function. It could be appreciated that $C(k)$ function serves to introduce an amplitude reduction and phase lag effect on the circulatory part of the lift response compared to the result obtained under quasi-steady conditions [3].

This effect can be seen if a pure oscillatory variation in angle of attack is considered, that is, $\alpha = \bar{\alpha} e^{i\omega t}$, so the circulatory part of the airfoil lift coefficient is given by

$$c_l = 2\pi\bar{\alpha} C(k) = 2\pi\bar{\alpha}\left[F(k) + iG(k)\right] \tag{34}$$

For $k = 0$, the steady-state lift behavior is obtained, that is, c_l is linearly proportional to α. As k is increased, the lift plots develop into hysteresis loops and these loops rotate such that the amplitude of the lift response (half of the peak-to-peak value) decreases with increasing reduced frequency. These loops are circumvented in a counterclockwise direction such that the lift is lower than the steady value when α is decreasing with time (i.e., there is a phase lag). For infinite reduced frequency the circulatory part of the lift amplitude is half that at $k = 0$ and there is no phase lag angle. The noncirculatory or apparent mass terms arise from the velocity gradient term and account for the pressure forces required to accelerate the fluid in the vicinity of the airfoil.

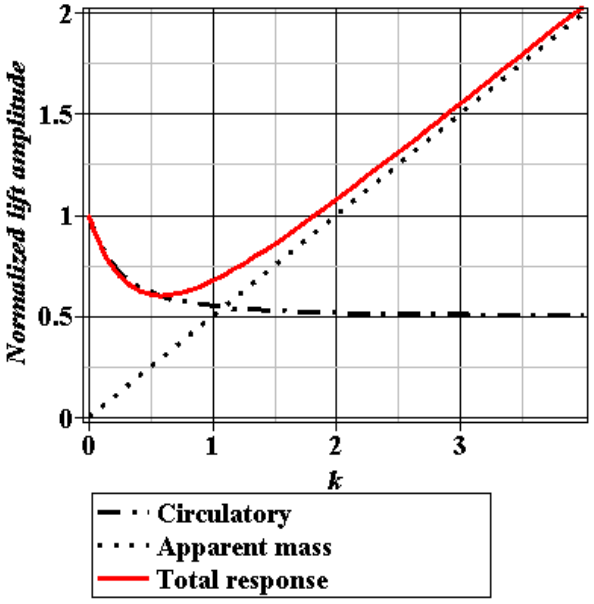

Fig. 8 Normalized lift amplitude

The normalized lift amplitude, $c_l / 2\pi\alpha$ and phase of lift for pure angle of attack oscillations are presented in fig. 8 and fig. 9, where the significance of the apparent mass contribution to both the amplitude and phase can be appreciated.

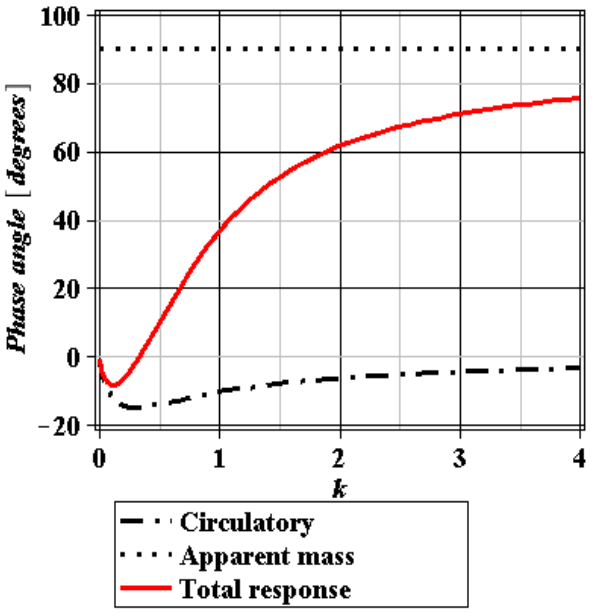

Fig. 9 Phase angle

At lower values of reduced frequency, the circulatory terms dominate the solution. At higher values of reduced frequency, the apparent mass forces dominate.

For harmonic pitch oscillations, additional terms involving pitch rate $\dot{\alpha}$ appear in the equations for the aerodynamic response. The forcing is given by $\alpha = \bar{\alpha} e^{i\omega t}$ and the pitch rate by $\dot{\alpha} = i\omega\bar{\alpha} e^{i\omega t}$. In this case, the lift coefficient is

$$c_l = 2\pi\left[F(1+k) + G(i-k)\right]\bar{\alpha} e^{i\omega t} + \pi k\left(i - \frac{k}{2}\right)\bar{\alpha} e^{i\omega t} \tag{35}$$

The lift amplitude initially decreases with increasing k because of the effects of the shed wake and then, for $k > 0.5$ begins to increase, as the apparent mass forces begin to dominate the air loads.

4. CONCLUSIONS

The airfoil can generate high lift as a result of a vortex that is shed at the leading edge at the instant of stall. The vortex travels back over the top of the airfoil carrying with it a low pressure wave that accounts for the very large lift coefficient.

When a wing's angle of attack is increased rapidly, it can momentarily generate a higher maximum lift coefficient than it could if the angle of attack were increased slowly. This overshoot can be related to the change in angle of attack during the time required for the air to travel one chord length. The dynamic overshoot is attributed to two effects (for the airfoils that stall first at the leading edge): the delay in the separation of the boundary layer and the momentary existence of a vortex shed at the leading edge after the boundary layer does separate. The delay in separation corresponds to the finite time required for the aft edge of the separation bubble to move forward to its bursting position. Airfoils that stall first at the trailing edge also exhibit a dynamic overshoot, but considerably less than those airfoils that have leading edge stall.

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COMMAND AND CONTROL OF THE FLYING WING IN THE MORPHING CONCEPT

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Abstract: *Flying wings in the morphing concept allow a growth to the aerodynamic performance for different flight conditions using 2D and 3D changes in the bearing surface geometry. The command and control architecture presents three operations levels: stability and control, navigation and autonomy. This article presents a solution regarding the equipment used for a UAV type flying wing together with some marks about the test activity of the aerial vector.*

Keywords: *flying wing, morphing, autopilot, command and control, flying test.*

1. INTRODUCTION

UAV systems have become a military and civilian branch which develops continuously in an alert rhythm. The necessities and modern fight trends can be extracted from efficiency, speed and precision. The main purpose for any confrontation is to protect your own men without reducing the combat power and in the same time to increase the fighting skills.

Tailless aircraft are used almost in any category of operational UAV, starting from a small UAV till a UCAV, see figure 1 (Blyenburg, 2011).

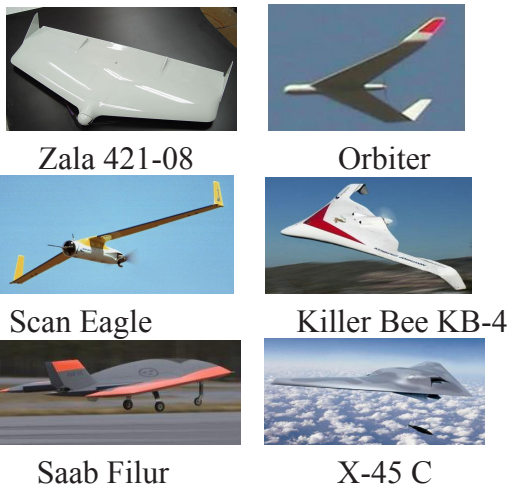


Fig. 1 Flying wing UAV

A conventional flying wing is designed for a specific type of mission and will fly optimal with limits regarding the flight conditions for which was designed and the flight time. Flying wings in the morphing concept allow a growth to the aerodynamic performance for different flight conditions using 2D and 3D changes in the bearing surface geometry (Bowman, Sanders, 2007). The morphing concepts are inspired from biomimetics area, birds change their wing position with the purpose to make specific maneuvers or to adjust the aerodynamic profile so it can adapt to the flight conditions, (Mc Gowan, Cox, Lazos,2003), see figure 2.

a. loitering, b. strike

Fig. 2 Morphing

The 3D evolutions of the flying wing in morphing concept have been possible due to process information obtained from nature with the help of sensors and the execution through servo actuators, these two being a part of the command and control architecture.

2. THEORETICAL REFERENCES

2.1 Command and control architecture. They are three hierarchical levels that could be identified in autopilot modern system:

Level 1. Control and stability. At this level the system ensures only dynamic stability of the aircraft. The module contains three accelerometers on three axes, these calculating the angles between the afferent axes and the gravitational force vector and for the yaw angle the system contains a magnetic compass. The system also contains a speedometer and altimeter (barometric, sonar, laser) to record static and dynamic pressure.

Level 2. Navigation. At this level the autopilot can perform take-off/landing maneuvers, a flight on an established trajectory without any human intervention and in consequence in contains a GPS module. The UAV which are equipped at this level must have additional equipment at the ground base to program the missions (GCS – ground control system).

Level 3. Autonomy. Without any doubt it is the most complex level containing the interpretation functions that recognizes objects, risk, the capacity to take a decision in a mission and to reach the objective with minimal risks, aircraft identification in the flight zone, information exchange between UAV, detecting damage and future modification to save the aircraft (see figure 3).

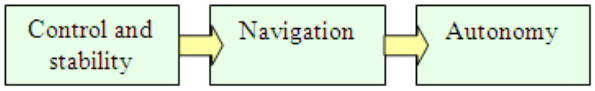


Fig. 3 Autopilot levels

2.2 The autopilot control theory. To obtain the desired maneuvers from the aircraft the autopilot system uses directly and indirectly control curls for the execution elements.

Lateral control (figure 4) can be obtained by changing the lateral inclination angle and flight direction angle. This could be realized through two direct curls and one indirect curl: aileron control depending on the flight rotation around the longitudinal axe *(V_x)*; aileron control depending on the lateral inclination angle (φ); aileron control depending on the flight direction represents the indirect curl.

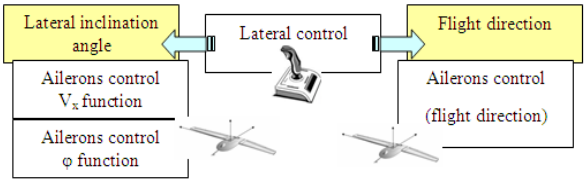


Fig. 4 The lateral control

The longitudinal control (figure 5) target is the pitch angle, speed and altitude. It is realized through three direct curls and two indirect ones. The direct curls control the depth and the motor rotation and the indirect curls command the direct curls. The direct curls are: the depth controller depending on rotation speed around the lateral axe *(V_y)*; the depth controller depending on the pitch angle; speed control (*n*) depending on the flight. The indirect curls are: the depth controller depending on the altitude; depth controller depending on the flight speed (Deliu, 2001).

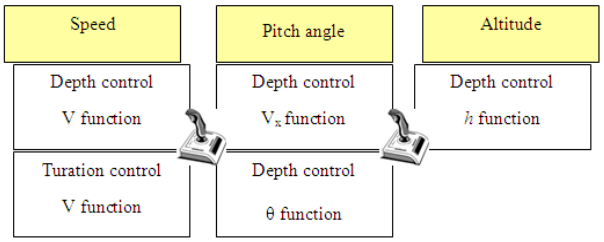


Fig. 5 The longitudinal control

Control calculation in turn attitude. To determine the conditions to execute a coordinated turn we use the state equation: First element (figure 6) is the UAV, the control regroup is done after ψ, ψ and δ command. The third element realizes serial connections, passive and active and ***N*** is the static characteristics of the execution element.

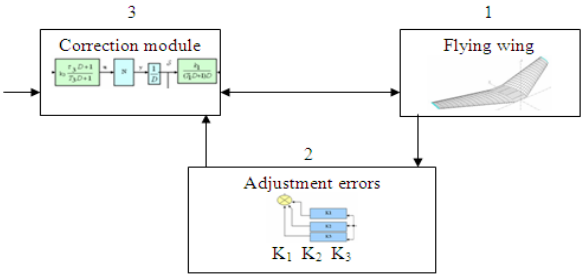


Fig. 6 Control in the turn

We have the following operators: the considered structure realizes the control after their state variables which imply characteristics and superior dynamic performances (Voicu, 2002). In this minimal architecture the state vector has the following components:

$x1 \cong r = c1\psi + c2\psi + c3\psi$

$x2 = \overset{\circ}{x1} - c3T1y$ (1)

$x_3 = \overset{\circ}{x_2} + T_1 r-(k_1c_2+c_3)y$

We have the following operators:

$$H1(D) = \frac{k_1}{(T_1+1)D^2}, \quad (2)$$

$$H_2(D) = c_1 + \left(c_2 + \frac{c_3}{k_1}\right)D + \frac{c_3T_1}{k_1}D^2, \quad (3)$$

$$H_2(D) = k_3 \frac{\tau_3 D+1}{T_3 D+1}, \ \tau_3 \neq T_3. \quad (4)$$

The state equations of the system

$$\overset{\circ}{x} = Ax+by+ep+fv, \ y = g(u) \quad (5)$$

$$u = c^Tx + dy + h^Tp + d^{(3)}v$$

What does the control realizes after 3 state variables with elements:

$$A = \begin{bmatrix} -\frac{1}{T_1} & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 \\ -\frac{k_3\tau_3}{T_3^2}(k_3-1) & 0 & 0 & \frac{-1}{T_3} \end{bmatrix}, \quad (6)$$

$$b = \begin{bmatrix} c_3 \\ \frac{k_1c_2+c_3}{T_1} \\ \frac{c_1k_1}{T_1} \\ 0 \end{bmatrix}, \quad c = \begin{bmatrix} -\frac{k_3\tau_3}{T_3} \\ 0 \\ 0 \\ 1 \end{bmatrix}, \quad (7)$$

$$d = 0, \quad f = \begin{bmatrix} 0 \\ 0 \\ 0 \\ \frac{k_3\tau_3}{T_3} \end{bmatrix},$$

$$d^{(3)} = \frac{k_3\tau_3}{T_3}, \quad p = 0. \quad (8)$$

For linear systems, the correction parallel-opposite through c_2 and c_3 from the second element resembles the series correction from the third level in the following form:

$$H_{3e} = k_{3e}\frac{b_2D^2+b_1D+b_0}{a_2D^2+a_1D+a_0} \quad (9)$$

If the non-linearity **N** is replaced with a linear element that has no unitary path memory the equivalent operator has the following expression:

$$H_{3e}(D) = \frac{(T_1D+1)D}{T_1D^2+(1+c_3T_1)D+k_1c_2} \quad (10)$$

3. THE COMMAND AND CONTROL CONCEPT

The proposed concept envisages the realization of a simple aerial vector, modular and scalable that would be amenable to the low cost concept in the conditions imposed by the international aeronautic normative. The concept is based on a series of aerodynamic analysis which propose an implementation for the stabilization module on the main command chains (Prisacariu, Cîrciu, Boşcoianu, 2012).

This would be used for: gaining information about the aeromechanic behavior structures in laboratories and real flight conditions; obtaining information about the tactical situation in the interest zones; optimization and management of aerodynamic, mechanic components and a functional aerial vector. The result of the optimization and management process would be the improvement of maneuverability of the chosen configuration while maintaining the project designed characteristics.

3.1. Flying wing module

Upgrading the project fazes and manufactures from figure 6 we imposed a flying wing module in diagram conditions from figure 7. The wing is manufactured out of expanded polystyrene reinforced with tubular strut of duralumin.

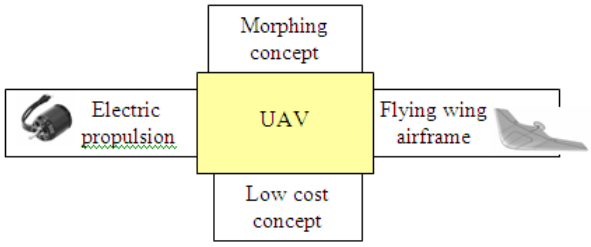


Fig. 6 Design conditions

The morphing command is based on the torsion of the bearing surface through the scale,

the torsion moment being transmitted from the servomotor at the extreme nervure with the help of duralumin rods that get through the tubular strut of the wing.

The torsion angles are: $\tau_r = \tau_l = \pm 15^0$. The flying wing (from figure 7) is designed with the help of the aerodynamic analysis software in 2D/3D named XFLR5 v.6.07 (***, 2011).

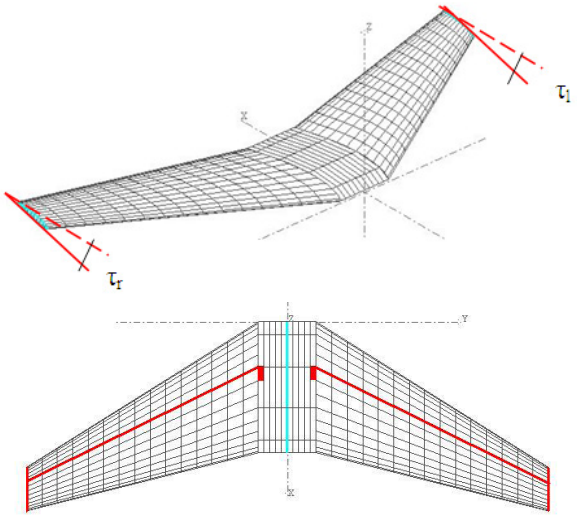


Fig. 7 Torque command

3.2. The command and control system

The command and control system contains necessary propulsion elements, control of the command surfaces and connections between the pilot and the airship (figure 8).

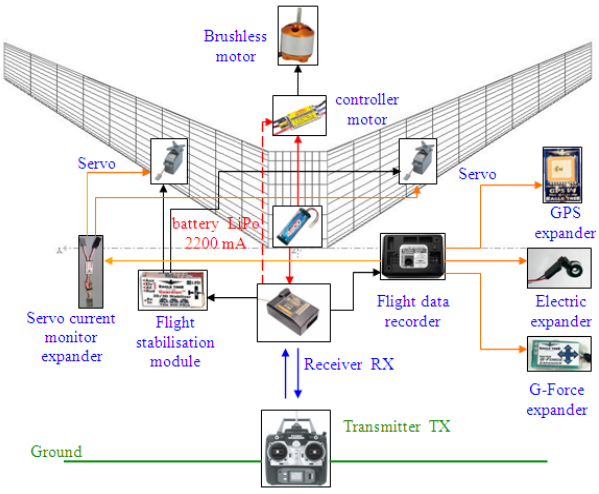
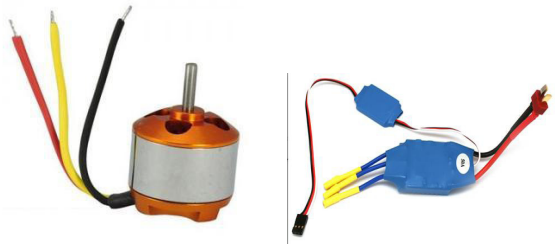


Fig.8 Command and control system

The propulsion is realized with the help of a brushless out runner motor controlled by an electronic speed variable of 50 A, (see figure 9).



a b

Fig. 9 Propulsion system
(a. brushless motor, b. controller)

The FUTABA 6EAXP radio system to control the aerial vector on a frequency of 35MHz on 6 channels (see figure 10) and has 2 servo actuators FUTABA Standard 3003 as execution elements, (***, 2005) see table 1.

Table 1.Radio system features

TX/RX Futaba 6EAXP	
Channels	6
Current TX/RX	250 mA/ 9.5 mA
Distance	1000 m
Servo Futaba S3003 Standard	
Dimensions	40.4x19.8x36 mm
Mass	38 g
Power	4.8 – 6 V
Speed	0.23 s/60⁰ la 4.8 V
Torque	3.2kg-cm la 4.8 V

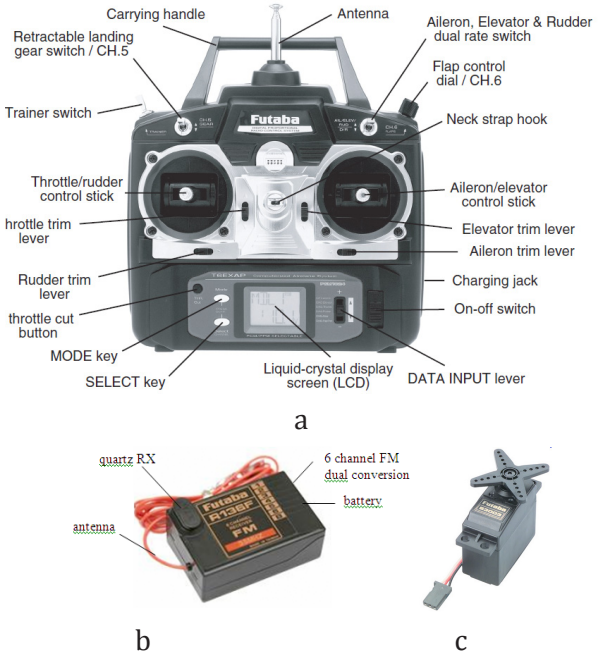


Fig. 10 Futaba 6EAXP radio system
(a. transmitter, b. receiver, c. servo S3003 Standard analogic)

Flight Data Recorder (data logger) realizes the data acquisition (figure 11, 12), it can monitor data regarding the atmosphere conditions with the help of sensors, flight parameters and the state of bearing surfaces, and are a few sensors:

GPS expander, G-Force expander, electric expander, servo current monitor expander (***, 2012).

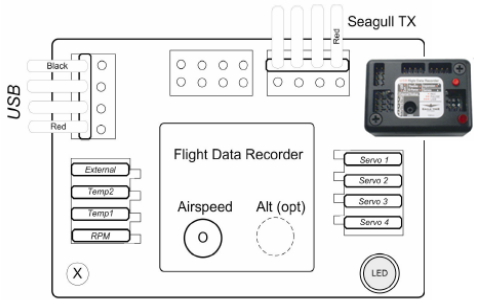


Fig. 11 Flight data recorder

Fig. 12 Flight Data Recorder system

Guardian stabilizer (figure 12) offers two functional modes: 2D back to horizontal flight and 3D for acrobatic flight (***, 2013), presents the characteristics from table 2.

Tabel 2. Guardian specification

Dimensions	41x22x11 mm
Current draw	31 mA
Input voltage range	4.5 – 16V
Weight	11 g
Max servo current	5A

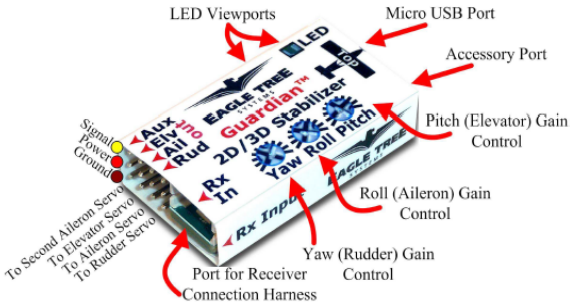


Fig. 13 Guardian 2D/3D module stabilization

The stabilization mode can be configured with a software interface (figure 13).

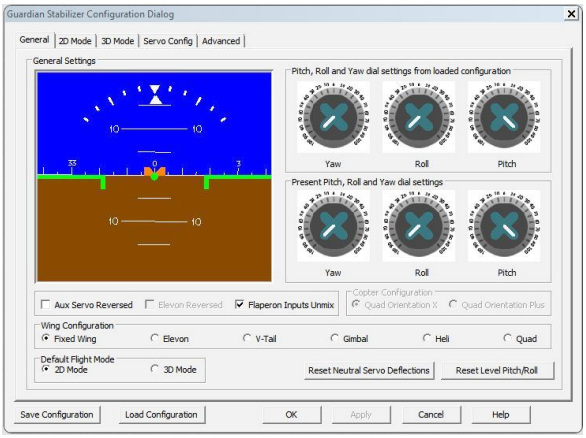


Fig. 14 Guardian 2D/3D stabilization – configuration software

The systems used are power from a 2500 mA LiPo battery with characteristics from table 3.

Tabel 3. LiPo battery features

Tensiune	*11 V*
Capacitate	*800 mA*
Curent maxim de încărcare	*4000 mA*
Curent de încărcare	*800–2400 mA*
Curent maxim de descărcare	*20 A*
Dimensiuni	*57x30x23 mm*
Masa	*68 g*

4. FLIGHT TESTS

4.1. Balance and stability. The correct balance is realized when the position of the central fuselage of the LiPo battery has the gravity center in front of the pressure center. The longitudinal and lateral stability of the flying wing are in normal parameters, the command is precise and through the digital trimmer on the emission module the flying wing could be brought on horizontal flight.

4.2. Equipment and systems.

The radio system is configured in the flying wing version according to the exploration instructions (Prisacariu, Cîrciu, Boşcoianu, 2012), see figure 15.

The propulsion system. The test traction propulsion system generated data that was recorded in table 4.

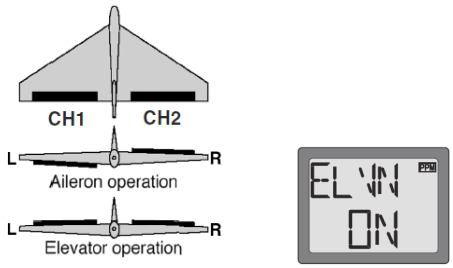


Fig. 15 Futaba system configuration for flying wing

Table 4. Brushless motor traction

Propeller	Battery	Curent	Traction
13 x 6.5	LiPo 7.4 V	30 A	1350 g
13 x 8	LiPo 7.4 V	33 A	1350 g
12 x 6	LiPo 11.1 V	39 A	1800 g
8 x 4	LiPo 14.8 V	25 A	1300 g
8 x 6	LiPo 14.8 V	34 A	1400 g
9 x 6	LiPo 14.8 V	41 A	1870 g

The flight tests of the flying wing have the purpose to check the integration mode of the system functions and equipment. The flight tests include the following stages: ground test and flight test in normal weather conditions.

Stability system. All the flight tests are executed with the help of the auto stabilization system in active and inactive mode to calibrate the command according to figure 16.

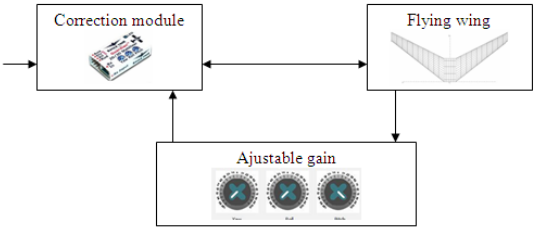


Fig. 16 Command calibration

The flight tests are analyzed based on the data taken from the board (figure 17).

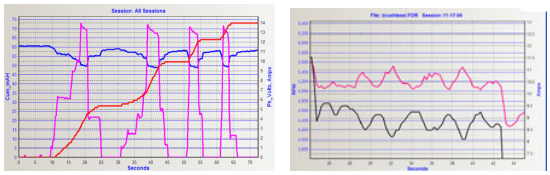


Fig. 17 Data onboard collection

CONCLUSIONS

A flying wing with morphing qualities will have better performances for a large variety of missions.

The stringency level of the test processes depend on the procedure used and the available equipment, the complexity of the installed system in the UAV and the funds for such activities.

The use of sensors and acquisition system in test together with software will raise the research activity standards in UAV.

ACKNOWLEDGMENT

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METHOD FOR DETERMINING THE ACCURACY AILERONS CONTROL MECHANISM OF THE IAK 52 AIRCRAFT

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Abstract: *In any mechanism, the dimensions of the kinematics elements are different from the given or calculated ones due to the execution errors, clearances in the kinematics couples, elastic and thermal deformations. In order to establish the optimal execution technology, which guarantees the global precision of the analyzed mechanism, it is necessary to know, from the very designing phase, the influence of these errors.*

This paper presents the way to determine, by the analytical method, the constructive error of the control mechanism of the IAK 52 instructing and training aircraft ailerons, a plane manufactured by S.C. "Aerostar" S.A..

Keywords: *execution errors, kinematics couples, position functions for ailerons mechanism, aviation technology, Taylor series expand.*

1. INTRODUCTION

A key feature in the mechanisms used in aviation technology is the accuracy of transmitting and receiving signals flow. For this reason, it is necessary to determine existing error propagation signal flow and how they affect theoretical law of transmission.

Aircraft movements of roll, pitch and yaw are possible by turning the control surfaces. Control levers in the cab with kinematic chains of transmission of movement of the levers to control surfaces on the airplane IAK-52 are:

- *order ailerons*, provides roll motion;
- *depth control,* ensures pitching motion;
- *steering,* providing a turning movement.

The stick is the pilot control lever acting on ailerons (by moving left and right) and the elevator (by moving front and back). Sticks of two cabins are trapped on a common shaft through joints that allow movement forward and back rounds. Common shaft is attached to the aircraft structure through ball, which allows rotation (left-right) together with sticks, around an axis parallel to the *x* axis plane.

Because movement is simultaneous rounds, they are caught in bottom joints with flat shank ends.

Ailerons are control surfaces are mounted on wing tips. To lateral movement of leg, ailerons are moving one up and one down. In this way creates an asymmetry of lift forces and their resultant point of application is no longer the center of gravity. The effect of this is the emergence of a roll moment. A feature on airplane IAK-52 is that it move ailerons up with an angle of 220°, and down at an angle of 160°.

Ailerons consist of metal frame and cover. In turn, the metal frame is composed of a tubular strut duralumin, nine ribs and a smooth back. Shell fabric is impregnated except leading edge is covered with duralumin sheet. They are joined by three joints console plane wing strut riveted on ailerons.

Ailerons powertrain control (Fig. 1) consists of: all rounds; mechanism task (simulation effort leg) tubular control rods, sticks. Ailerons order to ensure their steering in the opposite direction (a spoiler up the other down) and differentiated (upward deflection angle is greater than the angle of lock down).

Load mechanism is bound by a common shaft rocking the rounds near the front sleeves. He is to oppose a resistance to lateral movement of the stick. The moving leg more, with greater effort to move them.

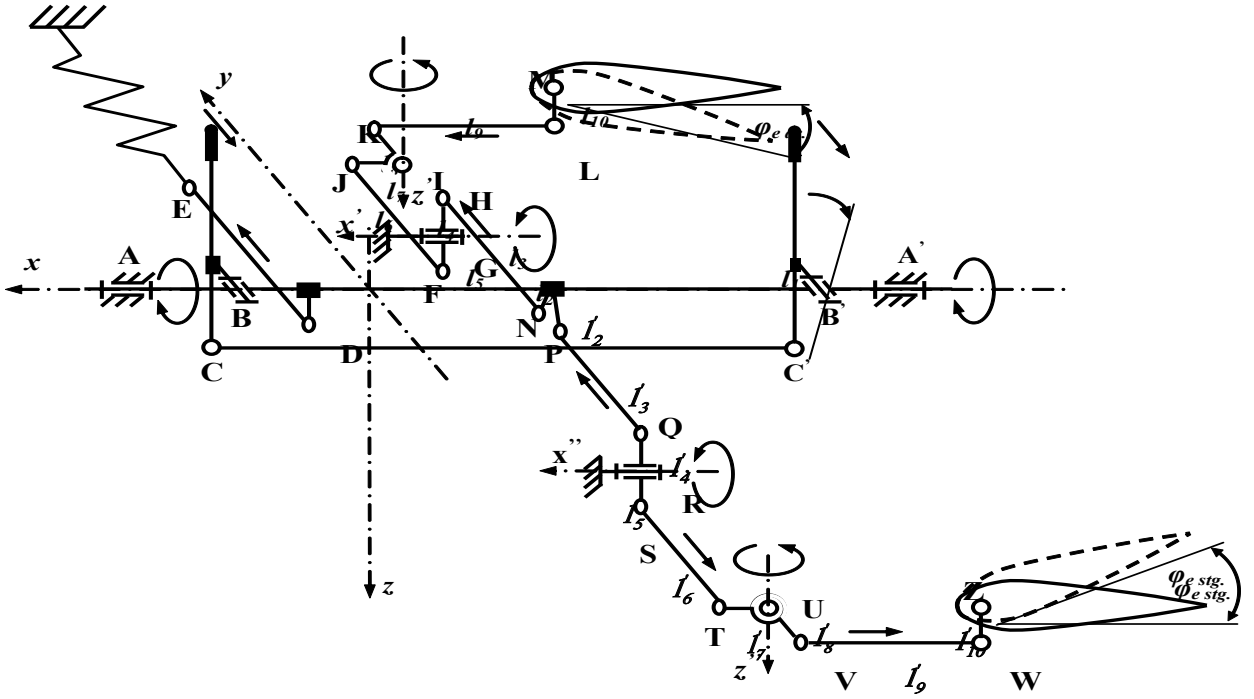

Fig.1 Diagram of the ailerons motion mechanism

Ailerons command has the following kinematics:

- move to the left leg;
- joint shaft rounds will rotate counter-clockwise;
- stick in the shape of ″*v*″ will move to the right control rods;
- vertical sticks will rotate clockwise around the axes *x′* and *x″* axis parallel to the plane;
- control rods will move to the left side of the airplane;
- horizontal sticks will rotate counter-clockwise around some axis *z′* and *z″* plane parallel to the *z* axis;
- left control rod moves back up to deflection of the control wing and right rod moves to the front spoiler move down.

2. THE ANALYTICAL METHOD FOR CALCULATING THE ERROR CONSTRUCTIVE

Position functions for both ailerons mechanism is of the form:

$$\varphi_{e\,dr.} = \varphi_{e\,dr.}(\varphi_1, l_{10}, l_{20}, l_{30}, l_{40}, l_{50}, l_{60}, l_{70}, l_{80}, l_{90}, l_{100}) \quad (1)$$

$$\varphi_{e\,stg.} = \varphi_{e\,stg.}(\varphi_1, l'_{10}, l'_{20}, l'_{30}, l'_{40}, l'_{50}, l'_{60}, l'_{70}, l'_{80}, l'_{90}, l'_{100}) \quad (2)$$

Admitting that there are theoretical and formal errors, angular displacement of the shaker φ1 is influenced by manufacturing tolerances $\Delta l_1, \Delta l_2, \Delta l_3, \ldots, \Delta l_{10}, \Delta l'_1, \Delta l'_2, \Delta l'_3, \ldots, \Delta l'_{10}$, the nominal dimensions of cinematic elements of the composition mechanism l_{10}, l_{20}, l_{30},…, $l_{100}, l'_{10}, l'_{20}, l'_{30}, \ldots, l'_{100}$.

Control mechanism that can reproduce ailerons position functions (1), (2) only the approximate each value of the driving angle φ1. These errors appear called constructive errors; random errors can be measured by the procedure described below.

Actual position functions carried out by elements of the mechanism kinematic analysis is determined by the relationship:

$$\varphi_{e\,dr.} = \varphi_{e\,dr.}(\varphi_1, l_{10} + \Delta l_1, l_{20} + \Delta l_1, l_{30} + \Delta l_3, \ldots, l_{100} + \Delta l_{10}) \quad (3)$$

$$\varphi_{e\,stg.} = \varphi_{e\,stg.}(\varphi_1, l'_{10} + \Delta l'_1, l'_{20} + \Delta l'_1, l'_{30} + \Delta l'_3, \ldots, l'_{100} + \Delta l'_{10}) \quad (4)$$

Errors introduced ailerons control mechanism is determined by the relations:

- the right wing:

$$\Delta\varphi_{e\,dr.} = \varphi_{e\,dr.} - \varphi_{e\,dr.0} \tag{5}$$

- for the left wing:

$$\Delta\varphi_{e\,stg.} = \varphi_{e\,stg.} - \varphi_{e\,stg.0} \tag{6}$$

In calculating these errors constructive develops, functions given by relations (5) and (6) in Taylor series, considering the actual dimensions of the mechanism components cinematic elements l_1, l_2, l_3,…, l_{10}, $l_1^{'}, l_2^{'}, l_3^{'}, ..., l_{10}^{'}$ as variable sizes :

$$\varphi_{edr.} = \varphi_{e\,dr.0} + \left(\frac{\partial f}{\partial l_1}\right)\cdot\Delta l_1 + \left(\frac{\partial f}{\partial l_2}\right)\cdot\Delta l_2 + \\ + ... + \left(\frac{\partial f}{\partial l_{10}}\right)\cdot\Delta l_{10} + \left(\frac{\partial^2 f}{\partial l_1^2}\right)\cdot\Delta l_1^2 + . \\ + \left(\frac{\partial^2 f}{\partial l_{10}^2}\right)\cdot\Delta l_{10}^2 + ... \tag{7}$$

$$\varphi_{eg.} = \varphi_{e\,stg.0} + \left(\frac{\partial f}{\partial l_1^{'}}\right)\cdot\Delta l_1^{'} + \left(\frac{\partial f}{\partial l_2^{'}}\right)\cdot\Delta l_2^{'} + \\ + ... + \left(\frac{\partial f}{\partial l_{10}^{'}}\right)\cdot\Delta l_{10}^{'} + \left(\frac{\partial^2 f}{\partial l_1^{'2}}\right)\cdot\Delta l_1^{'2} + . \\ + \left(\frac{\partial^2 f}{\partial l_{10}^{'2}}\right)\cdot\Delta l_{10}^{'2} + ... \tag{8}$$

Assuming that the manufacturing tolerances are endless Δ are small compared to the nominal dimensions of cinematic elements, the second and higher order terms of their Taylor series expand can be neglected. Errors constructive global chains of movement kinematics of both ailerons can be calculated with the following relations:

$$\Delta\varphi_{edr.} = \left(\frac{\partial f}{\partial l_1}\right)\cdot\Delta l_1 + \left(\frac{\partial f}{\partial l_2}\right)\cdot\Delta l_2 + \\ + \left(\frac{\partial f}{\partial l_3}\right)\cdot\Delta l_1 ... + \left(\frac{\partial f}{\partial l_{10}}\right)\cdot\Delta l_{10} \tag{9}$$

$$\Delta\varphi_{estg.} = \left(\frac{\partial f}{\partial l_1^{'}}\right)\cdot\Delta l_1^{'} + \left(\frac{\partial f}{\partial l_2^{'}}\right)\cdot\Delta l_2^{'} + \\ + \left(\frac{\partial f}{\partial l_3^{'}}\right)\cdot\Delta l_1^{'} ... + \left(\frac{\partial f}{\partial l_{10}^{'}}\right)\cdot\Delta l_{10}^{'} \tag{10}$$

Relations (9), (10) Δ parameters Δl_1, Δl_2, Δl_3, …, Δl_{10}, $\Delta l_1^{'}, \Delta l_2^{'}, \Delta l_3^{'}, ..., \Delta l_{10}^{'}$ are random sizes that vary between two sizes but known limits (upper and lower deviation tolerance fields).

Structural errors are determined considering that the dimensions of all cinematic elements are affected only limit errors. The probability of error in practical limit is relatively small, however. In kinematic analysis of the mechanism studied the flow of signals from element to element leader-led leg wing can have constant sensitivity S = ct., namely:

$$s_{e_0} = S \cdot s_i \tag{11}$$

Considering that the sensitivity of signal flow right aileron is:

$$S_{dr.} = \frac{l_{20}}{l_{10}}\cdot\frac{l_{40}}{l_{30}}\cdot\frac{l_{60}}{l_{50}}\cdot\frac{l_{80}}{l_{70}}\cdot\frac{l_{100}}{l_{90}} \tag{12}$$

and for the left aileron:

$$S_{stg.} = \frac{l_{20}^{'}}{l_{10}^{'}}\cdot\frac{l_{40}^{'}}{l_{30}^{'}}\cdot\frac{l_{60}^{'}}{l_{50}^{'}}\cdot\frac{l_{80}^{'}}{l_{70}^{'}}\cdot\frac{l_{100}^{'}}{l_{90}^{'}} \tag{13}$$

and that the dimensions l_i respectively $l_i^{'}$ are affected by random errors were Δl_i, $\Delta l_i^{'}$, the errors introduced in the mechanism studied are:

- for the right aileron:

$$\Delta s_{dr.} = s_e - s_{e_0} = \sum_{i=1}^{10}\left(\frac{\partial s_e}{\partial l_i}\right)_0\cdot\Delta l_i \tag{14}$$

- for the left aileron:

$$\Delta s_{sgr.} = s_e^{'} - s_{e_0}^{'} = \sum_{i=1}^{10}\left(\frac{\partial s_e^{'}}{\partial l_i^{'}}\right)_0\cdot\Delta l_i^{'} \tag{15}$$

or expressed as:

$$\Delta s_{dr.} = \frac{l_{20}}{l_{10}}\cdot\frac{l_{40}}{l_{30}}\cdot\frac{l_{60}}{l_{50}}\cdot\frac{l_{80}}{l_{70}}\cdot\frac{l_{100}}{l_{90}} s_i \sum_{i=1}^{10}\frac{\Delta l_i}{l_i} \tag{16}$$

$$\Delta s_{stg.} = \frac{l_{20}^{'}}{l_{10}^{'}}\cdot\frac{l_{40}^{'}}{l_{30}^{'}}\cdot\frac{l_{60}^{'}}{l_{50}^{'}}\cdot\frac{l_{80}^{'}}{l_{70}^{'}}\cdot\frac{l_{100}^{'}}{l_{90}^{'}} s_i^{'} \sum_{i=1}^{10}\frac{\Delta l_i^{'}}{l_i^{'}} \tag{17}$$

3. CONCLUSIONS

The method presented in this paper enables the identification and calculation errors that arise in building constructive linkages of the mechanisms used in aviation technology.

Depending on the size of these errors can take a number of variants and technology from design stage to compensate them.

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A NEW MATHEMATICAL MODEL FOR HIGH THICKNESS COANDA EFFECT WALL JETS

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Abstract: *The paper presents a new mathematical model for calculating the pressure coefficient distribution across a Coandã ramp. Theoretical as well as computational models are used in order to obtain a good correlation between the proposed model and the other, more labor intensive methods. Banner's theoretical model is used as a baseline and two blending functions are defined and calculated for corrections necessary near the blowing slot and the separation point. An empirical method was used to determine the angular position of the separation point in good correlation with the CFD data. Numerical simulations were carried out for a simple case which was then used to validate the proposed CEPA model. Although more experimental data should be acquired in order to increase the level of accuracy of the model, the paper shows that the proposed model fairly predicts the pressure distribution for the cases studied.*

Keywords: *Coandã effect, wall jet, RANS, CFD, CEPA*

1. INTRODUCTION

The Coandã effect is almost ubicuos to aeronautical applications, especially in the recent applications which incorporate fluidic high lift devices (Guo et al. 2011) Fixed wing aircraft are not the only applications, no tail rotorcraft also benefit from the use of this effect (Cîrciu et al. 2010).

As seen in the literature, most applications rely on fluidic pelicular jets blowing tangentially to a curve surface to either create lift directly (Drăgan[a] 2012) or indirectly, acting as a high lift device shown in Fig.1 (Drăgan[b] 2012).

Due to the ease of use of modern computational fluid dynamics methods, theoretical development of the Coandã effect was all but abandoned in recent years.

Therefore, the hereby paper seeks to extend a theoretical model and establish a frame for which it would be useful as a pre-design development tool.

Certain semi-empirical models exist in the state of the art however they are generally developed from experimental results in which the h/R ratio is close to 1% and are therefore inaccurate at higher h/R ratios. The model sought in this paper refers to higher h/R ratios, since Upper Surface Blown wing designs impose it.

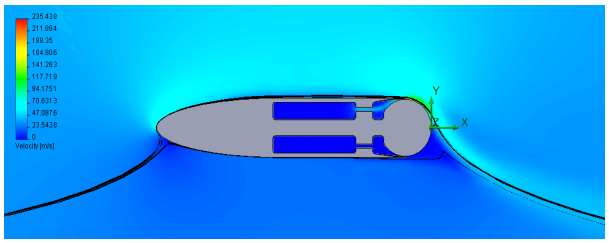

Fig. 1. Entrainment lift airfoil using the Coanda effect (Drăgan[b] 2012)

2. THE THEORETICAL MODEL

2.1 Banner's pressure coefficient calculation

The early attempts to mathematically describe the Coandã effect relied upon the

balance between the pressure and centrifugal forces exerted on an infinitesimal control volume, Fig.2. One of the first theories that dealt with the calculation of the average pressure coefficient across a circular ramp is given by (Banner, 1964). His demonstration considers a small volume of the Coandã flow of mass dm. For h/R ratios smaller than one, the balance between the pressure forces and the centrifugal forces acting upon the volume can be expressed by equalizing the two equations:

$$F_c = \frac{\rho R d\theta dR u^2}{R} \tag{1}$$

$$F_p = R d\theta dP \tag{2}$$

Where dθ is the infinitesimal angular element.

The pressure drop along the jet is then expressed by

$$\Delta P = P_{static\ jet} - P_{atm} = -\frac{\rho v^2 h}{R} = -\frac{2h}{R}\cdot\frac{\rho v^2}{2} \tag{3}$$

by introducing the thrust of an element of thickness h

$$T_H = \rho v^2 h \tag{4}$$

we can write

$$\Delta P = -\frac{T_H}{R} \tag{5}$$

therefore, by defining the pressure coefficient

$$C_p = \frac{\Delta P}{\frac{\rho v^2}{2}} \tag{6}$$

we reach the expression

$$C_p = -\frac{2h}{R} \tag{7}$$

Another equivalent demonstration is made for thicker jets (where h is comparable with the curvature radius R) by (Roderick 1961).

$$C_p = -\frac{2h}{R}\left(1+\frac{h}{2R}\right) \tag{8}$$

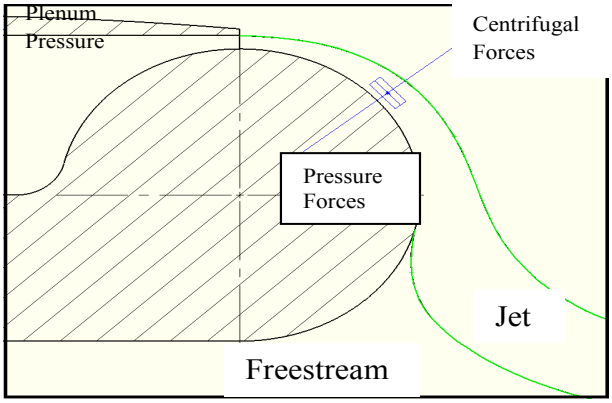

Fig. 2 The basic setup for the current case

The models presented however are crude and do not fully describe the physical problem. This is one of the reasons for which more sophisticated models, such as (Lewinsky and Yeh, 1989) and Saeed's semi-empirical model (Saeed, 2011), were created.

Although these models are designed to compute the velocity flow field around the Coandã surface they have many limitations, i.e. Saeed's model only works for small curvature radii (h/R <<1).

An alternative, semi-empirical model, is presented in (Dragan[c], 2012) however, due to the availability of the experimental data, it too is limited to h/R ratios smaller than or equal to ten.

The advantage of the Banner and Roderick models is that they work well especially for high h/R ratios. This is because the total pressure losses across the ramp are less important than in the low h/R ratio cases where the flow rapidly loses the total pressure. In order to confirm this, the hereby paper presents a series of computational fluid dynamics tests (CFD).

2.2 The Computational Fluid Dynamics comparison.

As shown by (Bakker, 2005), the conventional RANS models based on the concept of turbulent viscosity are unable to

predict accurate flow separation points due to the exacerbated turbulent production. Numerical comparative studies (Frunzulicã et al. 2011) also shows that the curvature corrections brought to the two equation turbulence models only mitigate the problem, without providing a physically correct model for Coandã flows. Therefore a different, more physically sound, RANS model was used. The five equation Reynolds Stress Model (RSM) is regarded as the best RANS viscosity model. It has also been confirmed as a tool for the numerical simulation of entrainment airfoils (Slomski et al. 2003), such as the one presented in Fig.1.

A simple ramp geometry was chosen for the 2D dp simulation which was discretized using a structured mapped mesh presented in Fig.3.

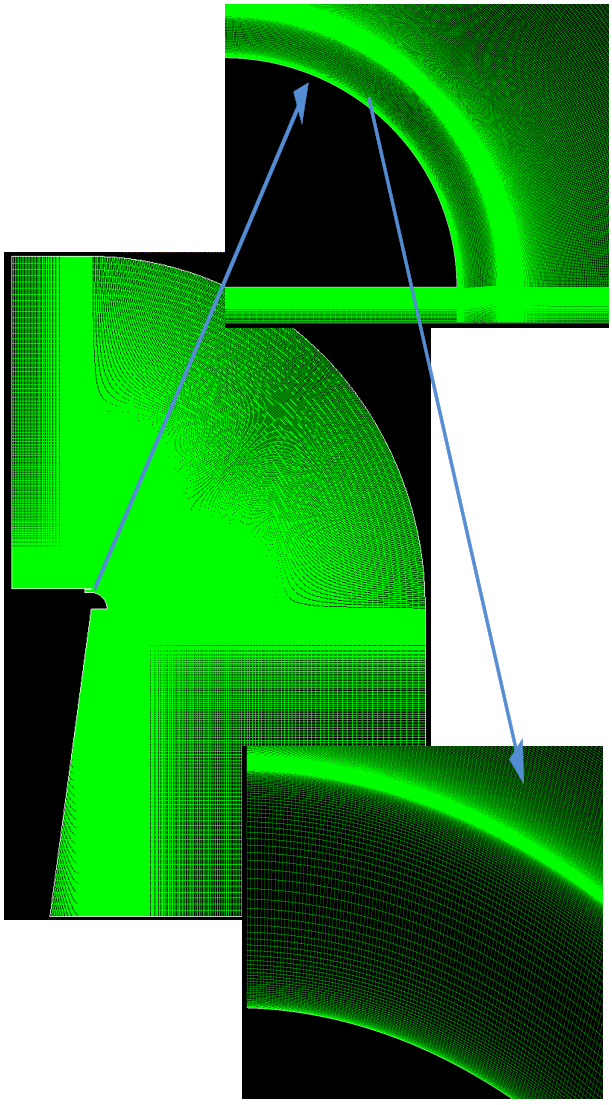

Fig.3 The computational mesh

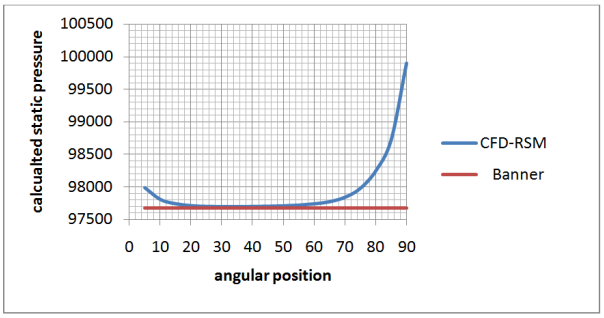

Fig. 4 The comparison between the basic Banner model and the CFD calculation performed with the Reynolds Stress Model

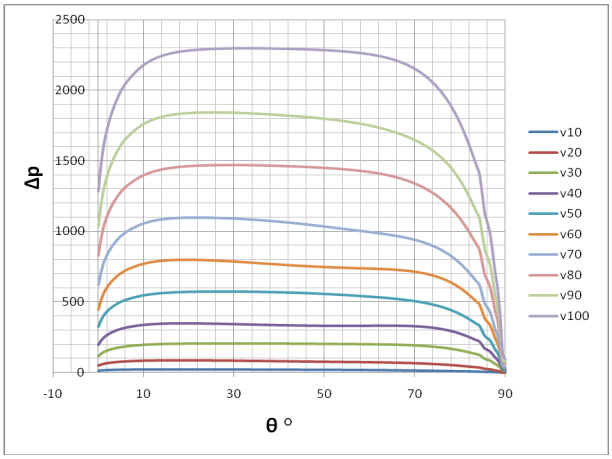

Fig.5 The pressure distribution across the ramp span for different blowing velocities

2.3 The proposed correction functions.

As seen, the Banner equation predicts quite well the pressure drop calculated by the CFD RSM method. This coupled with the fact that the pressure profile for all blowing velocities is quite flat, may be used to develop a new mathematical model.

A quick observation shows that the pressure estimates near the slot and near the separation point are not correctly calculated by Banner's model.

In order to improve on the model we must then define two correction functions, F_1 and F_2 to describe the pressure behavior in the problematic regions.

It is also worth mentioning that the velocity profile near the blowing slot is not

calculated in either Lewinsky's or Saeed's models, therefore the attempt to describe it is unique to this proposed model.

In order to construct the F_1 function we must first determine the geometric parameter that influences it – so that the equation is relative to it rather than an arbitrary length or angular position (which would lead to accuracy issues).

After studying many geometric cases it was concluded that the domain of our function spans in the interval $0<\theta<\frac{h}{R}\frac{180}{\pi}$.

This is also intuitive since the height of the slot influences the jet's boundary layer development, (Wygnanski, 2002).

By using non-linear curve fitting methods, we then determined the F_1 correction for near-slot pressure distribution

$$F_1 = 0.6014 + 0.4056 \cdot \left\{1 - \exp\left[-3.198\left(\frac{\theta}{\frac{h}{R}\frac{180}{\pi}}\right)\right]\right\} \quad (9)$$

In a similar manner, we observe that the domain of the F_2 correction function may also be linked to a geometric parameter which can be calculated individually for each case. It appears that the interval for F_2 is

$$[\theta_{sep} - 0.143 \cdot \theta_{sep}; \theta_{sep} + 0.143 \cdot \theta_{sep}].$$

One way of calculating the angle of flow separation is by using the Sleeman-Phelps equation (Yen, 1982).

$$\theta_{sep} = 6.69\left(\frac{R}{h}\right)^{1,54} \quad (10)$$

Therefore, using the same curve fitting techniques, a correction function was derived for the second problematic section of the Coandã flow:

$$F_2 = 1.02915 - 0.02915 \cdot \exp\left(\frac{\theta - (\theta_{sep} - 0,143 \cdot \theta_{sep})}{(\theta_{sep} + 0,143 \cdot \theta_{sep}) - (\theta_{sep} - 0,143 \cdot \theta_{sep})}\right) \quad (11)$$

Figures 6 and 7 shows the correlation between the deduced correction functions and the results obtained by the CFD numerical simulations. Both equations are in good agreement with the CFD data.

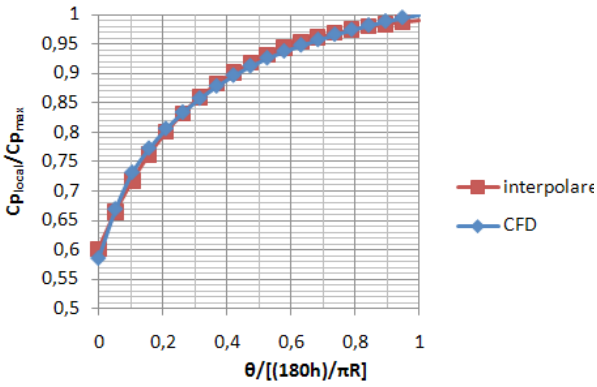

Fig. 6 The correlation between the F_1 correction function near the blowing slot and the CFD simulation results

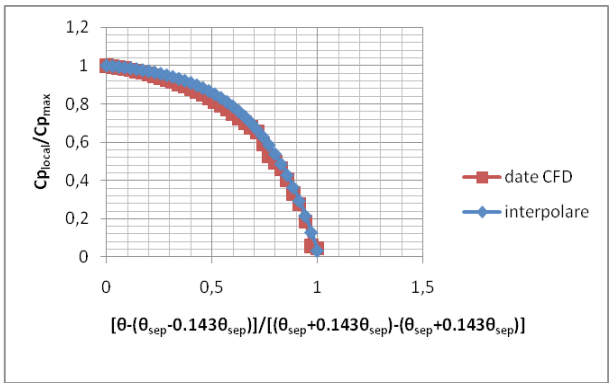

Fig. 7 The correlation between the F_2 correction function near the separation point and the CFD simulation results

As a measure for the accuracy of the proposed method we may define the Coandã effect lift efficiency:

$$\varsigma_C = \frac{L}{F} = \frac{R}{h} C_p \cdot sin\left(\frac{\theta_{sep}}{2}\right) \quad (12)$$

where

L is the absolute value of the lift force generated by the Coandã effect

F is the thrust of the blowing jet used

Table 1. Comparison between the CEPA model and the RANS simulation results

Method used	θ_{sep}	η_C
CFD Reynolds Stress Model	~80°	119%
CEPA Proposed model	79.77°	120%

3. CONCLUSIONS

The paper presents an improved method for calculating the pressure coefficient near a Coandã ramp which is circulated by a thin wall jet. The proposed Coandã Effect Pressure Approximation (CEPA) model dwells on the theoretical frame given by Banner with the addition of two blending functions for the regions which have significant deviation from the theoretical model. Another addition to the model the calculation of the separation point by using Sleeman and Phelps's experimental data. A CFD model was also tested as a benchmark, having a h/R ratio of 20%. Due to the blending functions, the CEPA model based on Banner's theory coupled with the Sleeman-Phelps equation accurately described the pressure coefficient distribution across the ramp.

The proposed model is useful as a simpler and quicker way to obtain a pressure coefficient distribution for the cases where CFD tools are too labor intensive and the h/R ratio exceeds 10%.

Aeronautical applications that may benefit from the use of this model are especially the Upper Surface Blown aircraft but the theory may be also used for the predesign calculation of fluidic devices such as the ones described in (Olivotto, 2010).

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NUMERIC MODELING IN THERMAL EFFECTS ANALYSIS OF HUMAN BODY EXPOSURE TO RADIOFREQUENCY

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Abstract: *The explosion of mobile users and users of wireless devices from the latest period, specific phenomenon of modern civilization, has led to numerous problems related to exposure to the biological field of environmental impact. The main biological effect, the sample date, the exposure to millimeter wave irradiation is a thermal matter. In this article I determined the temperature induced in a spherical model of human head exposed to 900 MHz mobile phone generic. Although the FEM numerical technique has been used for the electrothermal simulation, FDTD method has recently been very well accepted. Programming environment in which the modeling is SEMCAD produced by Schmid & Partner Engineering AG.*

Keywords: *human head, electromagnetic field, temperature, SEMCAD, FDTD*

1. INTRODUCTION

Human body irradiation with an electromagnetic field produces increasing kinetic energy of molecules, which will turn into heat. Increasing the temperature of a given tissue is directly proportional to the size of incident thermal power and heating degree result is dependent on tissue vascularization. Thermal power dissipated in the target anatomical region is eventually transferred throughout the body by blood circulation, but the irradiation is local. If poorly irrigated blood organs (e. eye), taking excess body heat by the rest is very difficult, making these organs are most sensitive to temperature increase. Another critical event, but more seriously by its generality, is when the whole body is irradiated, and the mechanism of homeostasis cannot stop increasing temperature, resulting in an overall increase in temperature.

The cells generally have an optimal development between 36.8°C and 37°C. Between 38-40°C cell growth is inhibited. At over 40°C, depending on exposure time, cell death occurs due to thermal distortion of cellular components, the irreversible degradation of the spatial conformation of biopolymers and ordered their conformation transition "chaotic ball", as shown in Figure No. 1 (Margineanu, 1980).

Intensification of molecular motion with increasing temperature break the hydrogen bonds and weak forces that maintain the cancellation of other higher order structures of biopolymers. Losing their native spatial structure, its own cellular activities involving, biopolymers lose, obviously, and functions, which involve cell death. This is why the knowledge of local distribution of temperature is so important.

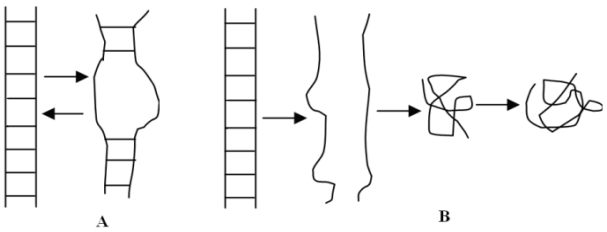


Fig. 1: Reversible thermal distortion (A) and irreversible (B) of a molecule of DNA bicatenare (Margineanu, 1980)

In vitro experiments have shown the following characteristics of microwave hyperthermia caused by:

- 42ºC temperature for one hour train maintained a level almost total cell death;
- State of malnutrition cells are more thermosensitive than cells better nourished;

- Hypoxic cells are more thermosensitive than normal oxygen;
- In the cell cycle, is termosensibility maximum DNA synthesis phase;
- Hyperthermia may increase the action of chemical agents (Margineanu, 1980, Vizitiu, 2001).

2. MATHEMATICAL FORMULATION

The heat transfer equation is:

$$\frac{\partial}{\partial t}(\rho h)+\nabla\left(\rho\bar{u}h\right)=\nabla(k\nabla T)+S_h \quad (1)$$

where:
- ρ mass density of the body $\frac{k\,g}{m^3}$;

- h is specific enthalpy $\left[\frac{J}{k\,g}\right]$;
- $\bar{u}$ is speed $\left[\frac{m}{s}\right]$;
- k is thermal conductivity $\left[\frac{J}{s\cdot m\cdot^{\circ}C}\right]$;
- T is temperature $\left[^{\circ}C\right]$;

- S_h volumetric rate of heat is generated

$\left[\frac{W}{m^3}\right]$

Physical explanation of phenomena is the following:

$\frac{\partial}{\partial t}(\rho h)$ - defines the amount of energy (heat) change per unit time and volume.

$\nabla\left(\rho\bar{u}h\right)$ - defines the process of convection within the material.
$\nabla(k\nabla T)$ – defines the heat conduction inside the material, according to Fourier's conduction law, and is related to the diffusion process.
S_h - represented all sources that generate heat

For the ideal gases and liquids:

$$c\nabla T=\nabla h \quad (2)$$

where c is the specific heat at constant pressure.

Enthalpy, if c is constant, is:

$$h=cT \quad (3)$$

The thermal module in SEMCAD implements the solution of the heat transfer equation biological (BHTE – bio – heat transfer Equation), which is a special case of equation (1) and has the form:

$$c\rho\frac{\partial T}{\partial t}+B\left(T-T_b\right)=k\nabla^2T+S \quad (4)$$

where:

- $B\left(T-T_b\right)$ is the appropriate mechanism to change the infusion of blood heat, proportional to the temperature difference between blood (T_b) and tissue temperature;

- parameter B $\left[\frac{W}{^{\circ}Cm^3}\right]$ is proportional to blood perfusion in tissue.

- $S\left[\frac{W}{m^3}\right]$ represents the total effect of volumetric heat generation sources.

For the equation (4) the boundary condition which is used is the convective boundary

$$k\frac{\partial T}{\partial n}+h\,T_{surface}=h\,T_{ambient} \quad (5)$$

where:

- h is the coefficient of convection $\left[\frac{W}{(m^2\cdot^{\circ}C)}\right]$

- $T_{surface}$ is considered the body surface temperature $\left[^{\circ}C\right]$;

- $T_{ambient}$ is ambient temperature $\left[^{\circ}C\right]$.

An important boundary condition in heat transfer is the radiating boundary. Radiation of heat is described by:

$$q_{emitted}=\varepsilon\,\sigma\,A\left(T^4_{surface}-T^4_{ambient}\right) \quad (6)$$

where:

- $q_{emitted}$ is rate of heat transfer is issued;
- ε is the emission factor of a surface;
- σ is constant Stefan - Boltzmann - $5.669x10^{-8}W/m^2K^4$;
- A is the radiant surface;

Because the emission factor the emission factor calculation is dependent on material, geometry and surface temperature, its calculation not easy to perform, from this reason the border is often replaced by a radiant border linear convection with an equivalent heat transfer coefficient, which is usually determined experimentally, given by:

$$\tilde{h} = \varepsilon\sigma\left(T_{ambient} + T_{surface}\right)\left(T^2_{ambient} + T^2_{surface}\right) \quad (7)$$

3. NUMERICAL FORMULATION

The discretization mesh

The numerical technique used by the thermal solver of SEMCAD is the FDTD method. To derive the discretizing equations of this technique the 'control-volume formulation' is chosen. In the of the control-volume formulation the principle is to divide the calculation domain into a number of non-overlapping control-volumes. The value T in Each of these volumes surrounds one grid point (or node), where the value of T is calculated. The differential equation is integrated over each control-volume. To evaluate the integrals a piecewise variation profile of T must be assumed between nodes. The remaining derivatives of the dependent variable can be approximated by the truncated Taylor series expansion in a forward, central or backward finite-differencing scheme (SEMCAD Manual Addendum V1.8, 2003:2-3)

Equations of heat transfer meshing

Derivation of the discretized equation for three-dimensional heat transfer problem following the procedure described above. Discretized equation for an interior point becomes:

$$T_{i,j,k}^{n+1} = T_{i,j,k}^{n} + \frac{\delta t}{\rho c}\frac{1}{\delta x_i \delta y_j \delta z_k}[T] \quad (8)$$

where:

$$T = \begin{bmatrix} k'^{x+}_{i,j,k}\delta y_j \delta z_k \dfrac{\left(T^n_{i+1,j,k} - T^n_{i,j,k}\right)}{\delta x_{i+1}} + k'^{x-}_{i,j,k}\delta y_j \delta z_k \dfrac{\left(T^n_{i-1,j,k} - T^n_{i,j,k}\right)}{\delta x_i} \\ + k'^{y+}_{i,j,k}\delta z_k \delta x_i \dfrac{\left(T^n_{i,j+1,k} - T^n_{i,j,k}\right)}{\delta y_{j+1}} + k'^{y-}_{i,j,k}\delta z_k \delta x_i \dfrac{\left(T^n_{i,j-1,k} - T^n_{i,j,k}\right)}{\delta y_{j+1}} \\ + k'^{z+}_{i,j,k}\delta x_i \delta y_j \dfrac{\left(T^n_{i,j,k+1} - T^n_{i,j,k}\right)}{\delta x_{k+1}} + k'^{z-}_{i,j,k}\delta x_i \delta y_j \dfrac{\left(T^n_{i,j,k-1} - T^n_{i,j,k}\right)}{\delta x_{k+1}} \\ + \overline{Q}_{i,j,k}\delta x_i \delta y_j \delta z_k - B_{i,j,k}\left(T^n_{i,j,k} - T_b\right)\delta x_i \delta y_j \delta z_k \end{bmatrix}$$

Indices n refers to the distance of time, and indices i, j, k, refers to the position of node temperature in a linear network. The term "heat generated" is represented by a spatial average: inside the given volume element of the product $\delta x_i \delta y_j \delta z_k$ of cell dimensions (three dimensions). Distances between nodes on the three-way temperature are shown in figure no.2. You can see that at the boundary between two materials is necessary for physical consistency reasons, to replace the thermal conductivity weighted thermal conductivity.

Indices n refers to the distance of time, and indices i, j, k, refers to the position of node temperature in a linear network. The term "heat generated" is represented by a spatial average: $\overline{Q}_{i,j,k}$ inside the given volume element of the product of cell dimensions (three dimensions). Distances between nodes on the three-way temperature $\delta s[x, y, z]$ are shown in figure no.2.

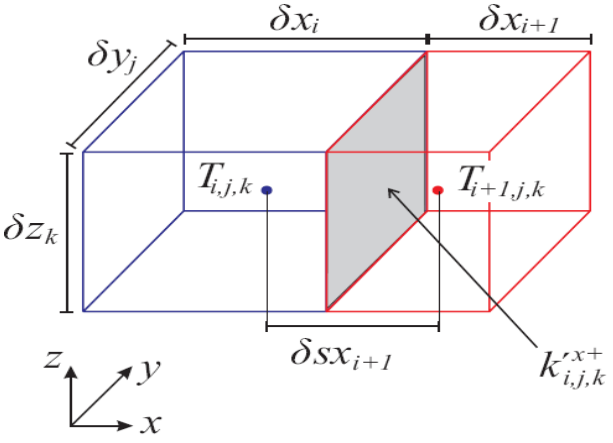


Fig. 2: Grid geometry of the thermal solver (SEMCAD, 2003:2-4)

You can see that at the boundary between two materials is necessary for physical consistency reasons, to replace the thermal conductivity $k_{i,j,k}$ weighted thermal conductivity $k'^{[x,y,z][+,-]}_{i,j,k}$.

Last term, according to one of the six neighboring nodes is given by:

$$k^{'[x,y,z]+}_{i,j,k} = 2\left(\frac{\delta[x_i, y_j, z_k]}{k_{i,j,k}\delta s[x_{i+1}, y_{j+1}, z_{k+1}]} + \frac{\delta[x_{i+1}, y_{j+1,}, z_{k+1}]}{k_{i+1,j+1,k+1}\delta s[x_{i+1}, y_{j+1}, z_{k+1}]}\right)^{-1} \quad (9)$$

$k^{'[x,y,z]-}_{i,j,k}$ and can be obtained by substituting the "i-1" by "i" in equation (9). If a uniform network, the distance between nodes in one direction is equal to the volume element size in that direction, and the effective thermal conductivity is the average thermal conductivity of neighboring volume elements. In addition, when the calculation is homogeneous, the effective thermal conductivity is the thermal conductivity of occupying the computing environment. Derivation of the discretized equation for the outer border adjacent nodes is done by introducing fictitious nodes on the sides of the element temperature of volume, not the border. These nodes are assigned null volume elements (SEMCAD, 2003:2-1- 2-4).

4. DETERMINATION OF HEAT INDUCED BY A GENERIC MOBILE PHONE IN A SPHERICAL HEADMODEL

Example of calculation used for thermal modeling is as follows: Determine the heat induced by a generic cell phone antenna at 900 MHz frequency in a sphere equivalent to the human brain.

Choosing the spherical model was made on idea to simplify calculations, according figure no 3.

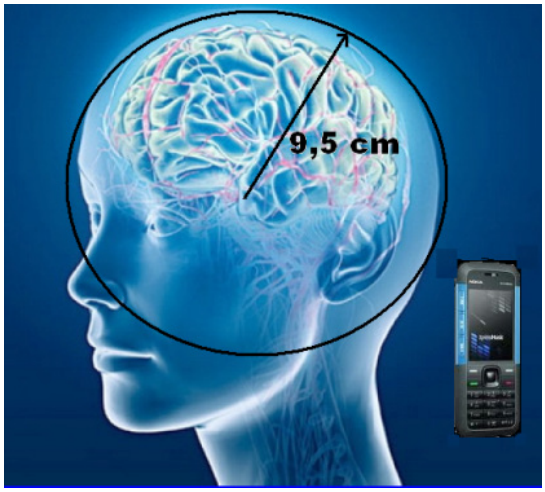


Fig. 3:The sphere that approximates the human head (http://www.sciencefocus.ro)

Thermal parameters are:

$$\rho = 1030\left[\frac{k\,g}{m^3}\right], k = 0.528\left[\frac{W}{m\,K}\right], c = 3710\left[\frac{J}{k\,g\,K}\right]$$

Model calculation with apply sensors is presented in Figures no. 3, 4.

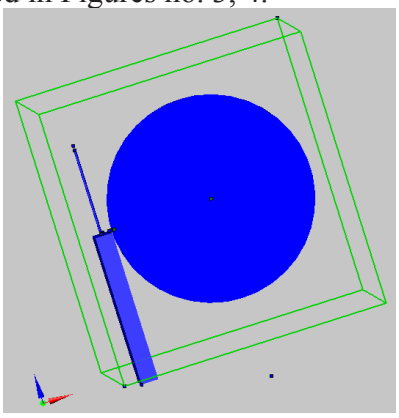


Fig. 3: The spherical model and cell phone use in calculating the induced temperature and grid computing

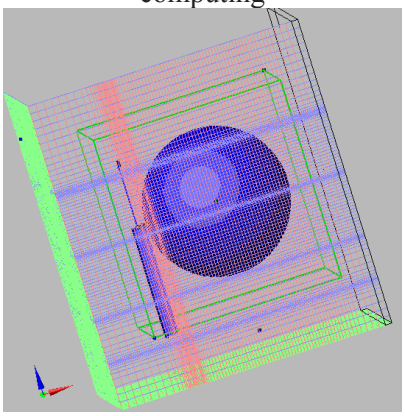
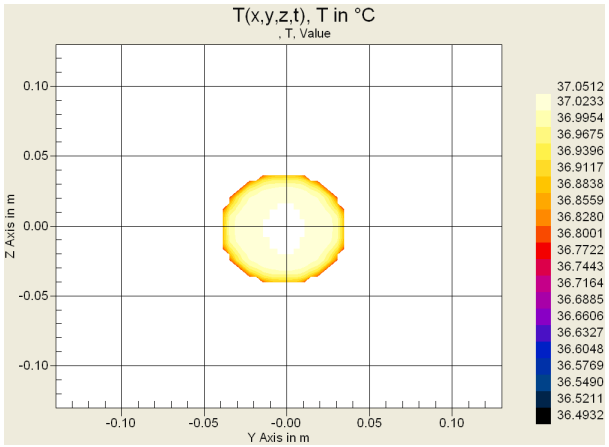


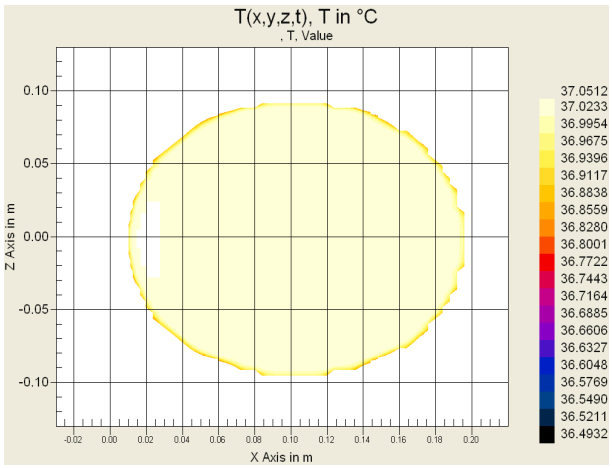
Fig. 4: The spherical model and cell phone use in calculating the induced temperature and applied sensors

The results are shown in Figure no.5, 6. Figure no.5 is the temperature distribution induced by cellular phone in the model human brain generic plans (a)yOz (b) xOz (c) XOY after 3600 sec and output power of 125mW antenna. Figure no. 6 are represented as changes in temperature sensor placed near gathered by phone (red) and collected by the sensor placed in the center of the sphere (blue) (Jeler, 2010).

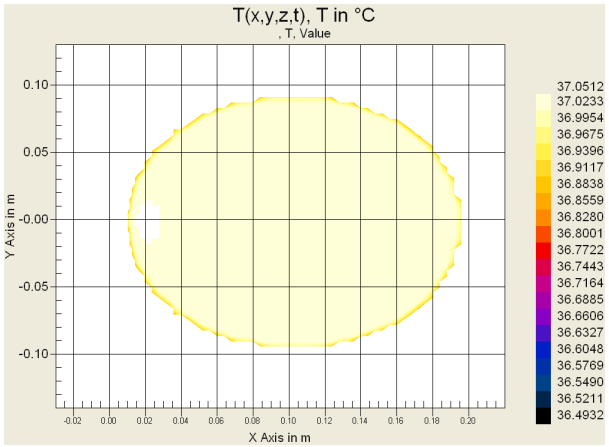
5. RESULTS:



(a)



(b)



(c)

Fig. 5:Temperature distribution induced by cellular phone at a frequency of 900 MHz generic in human brain model approximated by a sphere in plans: (a) yOz (b)xOz (c) xOy after 3600 sec

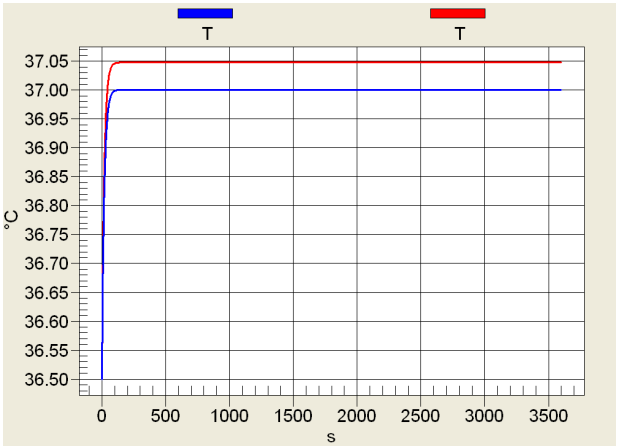


Fig. 6: Graph of temperature variation on the edge spherical model, near the phone, (red) and model center of the spherical model (blue)

5. CONCLUSIONS

Although the model was a simple calculation (a sphere that approximates the human head exposed to a generic mobile phone), the results may be useful in extracting preliminary conclusions and to use more complicated models. The study offers the following conclusions:

-Figure no. 4 we can see the distribution of heat through the model range, there is a sphere that approximates heating the human brain by about 0.5˚C after about 100s.

-Values obtained by the local sensors are 37.05ºC at the point in the middle of the sphere, and 37ºC by the phone point to a baseline of 36.5ºC, resulting in an increase in both locations by about 0.5ºC.

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CONSIDERATIONS REGARDING DATA TRANSMISSION USING THE INTERNET/WIRELESS SYSTEMS

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Abstract: *Data transmissions with frequency and amplitude modulation have a large use in command and control at long distances for unpiloted aerial vectors. The article presents an image of the theoretical and practical part of the data transmission through the sinusoidal components that are used and determine the frequency used and the speed of the data transferred.*

Keywords: *NIC (Network Interface Controller), frequency, data security, UAV (unmanned aerial vehicles), Simulink*

1. INTRODUCTION

Nowadays communications are realized through a variety of methods at low cost limiting the benefits of a network and its partners. Given the financial problems in the recent years (global crisis) we must take in consideration any opportunity that appears.

Communications means a network with a large range of widgets interconnected between them. These widgets are connected through the same medium or different mediums with different capabilities. Widgets connected between them can exchange documents, video files, and audio files and can also take over some capabilities from other widgets. For example, a normal house has at least one TV connected through cable or satellite, games, portable video games, desktop computer, laptop, mobile phone etc. In a "house" these widgets are connected between them and form a network of widgets. Some of these are connected through optical fiber (Ethernet) or wireless (Wifi). See figure 1 [1].

Data transmissions with frequency and amplitude modulation are used in a wide range in the aerodynamic domain through data acquisition from the sensors and control of the unpiloted aerial vectors from distance, figure 2 [2].

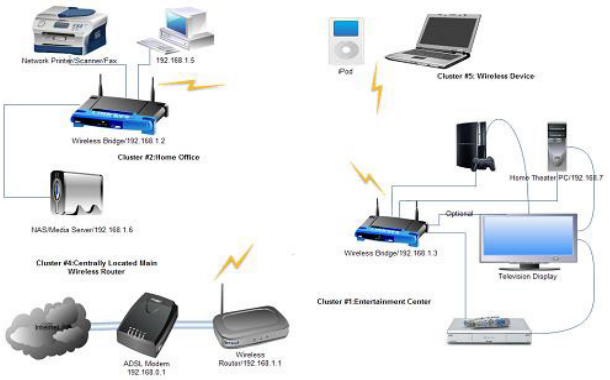


Fig. 1 Home network [1]

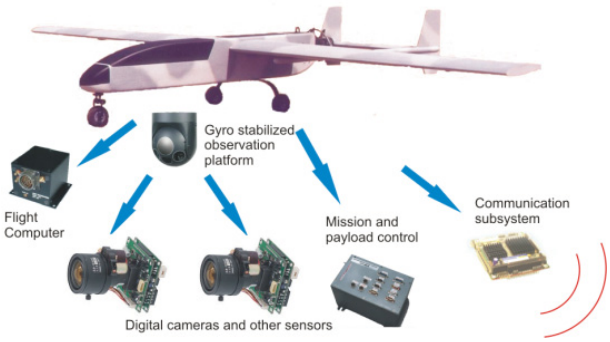


Fig. 2 UAV data transmission [3]

2. THEORETICAL REFERE

Starting from these conditions we will analyze the mathematical part of the wireless network interface to observe the range of frequency and the speed of the data submitted [4].

The frequency components of a square wave with A as the amplitude can be expressed as:

$$s(t) = A \times \frac{4}{\pi} \times \sum_{k,odd,k=1}^{\infty} \frac{\sin(2\pi f)}{k}; \quad (1)$$

2.1. Mathematical model. Using the data mentioned earlier we will analyze the sinusoidal wave forms to establish the functionality of the network interface controller knowing the frequency and the sinusoidal components.

We will present a case of wave form

Wave form with three components (sinusoidal):

$$s(t) = \frac{4}{\pi}\left[\begin{array}{l}\sin(2\pi f) + \frac{1}{3}\sin(2\pi(3f)t) \\ + \frac{1}{5}\sin(2\pi(5f)t)\end{array}\right] \quad (2)$$

If $f = 10^6$ cycles per second, meaning 1 MHz (the frequency band of the signal is 1MHz= 10^6 Hz)

$$s(t) = \frac{4}{\pi}\left[\begin{array}{l}\sin(2\pi \times f \times t) + \frac{1}{3} \cdot \sin(2\pi \times 3 \times f \times t) \\ + \frac{1}{5} \cdot \sin(2\pi \times 5 \times f \times t)\end{array}\right];$$

$$s(t) = \frac{4}{\pi}\left[\begin{array}{l}\sin(2\pi \times 10^6 \times t) + \frac{1}{3} \cdot \sin(2\pi \times 3 \times 10^6 \times t) \\ + \frac{1}{5} \cdot \sin(2\pi \times 5 \times 10^6 \times t)\end{array}\right];$$

The maximal value of the band will be:

$$(5 \times f \times 10^6) - (f \times 10^6) =$$
$$= (5 \times 1 \times 10^6) - (1 \times 10^6) = 4 \times 10^6 Hz = 4MHz.$$

The minimal value of the band will be:

$$(3 \times f \times 10^6) - (f \times 10^6) =$$
$$= (3 \times 1 \times 10^6) - (1 \times 10^6) = 2 \times 10^6 Hz = 2MHz.$$

The maximal and minimal value of the band creates the frequency range of the signal.

For f=1MHz, the period of the frequency is:

$$T = \frac{1}{f} = \frac{1}{10^6} = 10^{-6} = 1\mu s.$$

If the wave form contains a string of 1 and 0, a bit appears at $0{,}5\mu s$ for a data rate that is $2 \times 10^6 bps = 2Mbps =$ the speed of the internet, 2 representing the number of bits in 1 μs for $f = 1Mhz$.

2.2. Proposed cases. Using the theoretical information [4] we will analyze a larger area of sinusoids with different frequencies or speeds to determine the rest of the components.

2.2.1. First case. We will use four sinusoidal components and $f = 1MHz$

$$s(t) = \frac{4}{\pi}\left[\begin{array}{l}\sin(2\pi f) + \frac{1}{3} \cdot \sin(2\pi(3f)t) \\ + \frac{1}{5} \cdot \sin(2\pi(5f)t) + \frac{1}{7} \cdot \sin(2\pi(7f)t)\end{array}\right];$$

$$s(t) = \frac{4}{\pi}\left[\begin{array}{l}\sin(2\pi \times f \times t) + \frac{1}{3} \cdot \sin(2\pi \times 3 \times f \times t) \\ + \frac{1}{5} \cdot \sin(2\pi \times 5 \times f \times t) + \frac{1}{7} \cdot \sin(2\pi \times 7 \times f \times t)\end{array}\right];$$

$$s(t) = \frac{4}{\pi}\left[\begin{array}{l}\sin(2\pi \times 10^6 \times t) \\ + \frac{1}{3} \cdot \sin(2\pi \times 3 \times 10^6 \times t) \\ + \frac{1}{5} \cdot \sin(2\pi \times 5 \times 10^6 \times t) \\ + \frac{1}{7} \cdot \sin(2\pi \times 7 \times 10^6 \times t)\end{array}\right];$$

$f = 1MHz$ and, $T = \frac{1}{f} = \frac{1}{10^6} = 10^{-6} = 1\mu s$ 1 bit at $0{,}5\mu s$.

$$N \times 10^6 = 2 \times 10^6 bps = 2Mbps$$

Bandwidth:

The maximal band value will be:

$$(5 \times f \times 10^6) - (f \times 10^6) =$$
$$= (7 \times 1 \times 10^6) - (1 \times 10^6) = 6 \times 10^6 Hz = 6MHz.$$

The minimal band value will be:
$(3\times f\times 10^6)-(f\times 10^6)=$
$=(3\times 1\times 10^6)-(1\times 10^6)=2\times 10^6\,Hz=2MHz.$

Frequency range: *2MHz, 3MHz, 4MHz, 5 MHz, 6MHz.*

2.2.2. Second case. We will use four sinusoidal components and $f=4MHz$

$$s(t)=\frac{4}{\pi}\left[\begin{array}{l}\sin(2\pi f)+\frac{1}{3}\cdot\sin(2\pi(3f)t)\\+\frac{1}{5}\cdot\sin(2\pi(5f)t)+\frac{1}{7}\cdot\sin(2\pi(7f)t)\end{array}\right];$$

$$s(t)=\frac{4}{\pi}\left[\begin{array}{l}\sin(2\pi\times f\times t)+\frac{1}{3}\cdot\sin(2\pi\times 3\times f\times t)\\+\frac{1}{5}\cdot\sin(2\pi\times 5\times f\times t)+\frac{1}{7}\cdot\sin(2\pi\times 7\times f\times t)\end{array}\right];$$

$$s(t)=\frac{4}{\pi}\left[\begin{array}{l}\sin(2\pi\times 4\times 10^6\times t)\\+\frac{1}{3}\cdot\sin(2\pi\times 3\times 4\times 10^6\times t)\\+\frac{1}{5}\cdot\sin(2\pi\times 5\times 4\times 10^6\times t)\\+\frac{1}{7}\cdot\sin(2\pi\times 7\times 4\times 10^6\times t)\end{array}\right];$$

$f=4MHz$ and

$$T=\frac{1}{f}=\frac{1}{4\cdot 10^6}=0,25\mu s;0,125\mu s\,1\text{bit:}$$

Example bit 1 and bit 0, at $0,25\mu s$ being 2 bits:1 and 0. $1\mu s:0,125\mu s=8$bits:4 bits of 1 and 4 bits of 0.
$N\times 10^6=8\times 10^6\,bps=8Mbps$ is the speed of the internet or the specific network.

Bandwidth:
The maximal band value will be:
$(7\times f\times 10^6)-(f\times 10^6)=$
$(7\times 4\times 10^6)-(4\times 10^6)=24\times 10^6\,Hz=24MHz.$
The minimal band value will be:
$(3\times f\times 10^6)-(f\times 10^6)=$
$(3\times 4\times 10^6)-(4\times 10^6)=8\times 10^6\,Hz=8MHz.$

Frequency range: *8MHz, 12MHz, 16MHz, 20MHz, 24MHz.*

2.2.3. Third case. We know the speed of the internet or the specific network and use 5 sinusoidal components

$v_r=100Mbps;v_r=$ Internet speed or network speed;

$N\times 10^6=100\times 10^6\,bps=100Mbps;$

if $N=100\Rightarrow 1\mu s:100=0,01\,\mu s$ for a bit

$$\Rightarrow T=\frac{1}{f}=\frac{1}{x\cdot 10^6}=0,01\mu s;$$

$0,02\mu s$ represents the period when 1 and 0 bit work and form a square wave form

$$\Rightarrow x=\frac{1}{0,02\mu s\cdot 10^6\,Hz}=$$

$$\frac{10^2\cdot 10^6\,s}{2s\cdot 10^6\,Hz}=50Hz\Rightarrow f=50Mhz.$$

$$s(t)=\frac{4}{\pi}\left[\begin{array}{l}\sin(2\pi\,f\,t)+\frac{1}{3}\cdot\sin(2\pi(3f)t)\\+\frac{1}{5}\cdot\sin(2\pi(5f)t)+\frac{1}{7}\cdot\sin(2\pi(7f)t)\\+\frac{1}{9}\cdot\sin(2\pi(9f)t)\end{array}\right]$$

$$s(t)=\frac{4}{\pi}\left[\begin{array}{l}\sin(2\pi\times f\times t)+\frac{1}{3}\cdot\sin(2\pi\times 3\times f\times t)+\\\frac{1}{5}\cdot\sin(2\pi\times 5\times f\times t)+\frac{1}{7}\cdot\sin(2\pi\times 7\times f\times t)\\+\frac{1}{9}\cdot\sin(2\pi\times 9\times f\times t)\end{array}\right];$$

$$s(t)=\frac{4}{\pi}\left[\begin{array}{l}\sin(2\pi\times 50\times 10^6\times t)\\+\frac{1}{3}\cdot\sin(2\pi\times 3\times 50\times 10^6\times t)\\+\frac{1}{5}\cdot\sin(2\pi\times 5\times 50\times 10^6\times t)\\+\frac{1}{7}\cdot\sin(2\pi\times 7\times 50\times 10^6\times t)\\+\frac{1}{9}\cdot\sin(2\pi\times 9\times 50\times 10^6\times t)\end{array}\right];$$

Bandwidth:
The maximal band value will be:
$(9\times f\times 10^6)-(f\times 10^6)=$
$=(9\times 50\times 10^6)-(50\times 10^6)=400\times 10^6\,Hz=0,4GHz.$

The minimal band value will be:
$(3\times f\times 10^6)-(f\times 10^6)=$
$=(3\times 50\times 10^6)-(50\times 10^6)=100\times 10^6 Hz=0,1GHz.$

Frequency range:
$0,1GHz;\ 0,15GHz;\ 0,2GHz;\ 0,25GHz;$
$0,3GHz;\ 0,35GHz;\ 0,4GHz;$

2.2.4. Fourth case. We know the internet speed or the speed of the network and use 3 sinusoidal components, the cheapest wireless network or the use of computer modems to have internet access:

$v_r=7,2Mbps; v_r=$ Internet speed or network speed;

$N\times 10^6=7,2\times 10^6 bps=7,2Mbps;$ if $N=7,2$

$\Rightarrow 1\mu s:7,2=0,13888889\mu s$ for 1 bit

$$\Rightarrow T=\frac{1}{f}=\frac{1}{x\cdot 10^6}=0,27777778\mu s;$$

$0,27777778\mu s$ Represents the period when 1 bit of 1 and 1 bit of 0 forms a square wave form

$$\Rightarrow x=\frac{1}{0,27777778\mu s\cdot 10^6 Hz}=$$

$$\frac{10\cdot 10^6 s}{2,7777778s\cdot 10^6 Hz}=3,6Hz\Rightarrow f=3,6MHz.$$

$$s(t)=\frac{4}{\pi}\left[\begin{array}{l}\sin(2\pi ft)+\frac{1}{3}\cdot\sin(2\pi(3f)t)\\+\frac{1}{5}\cdot\sin(2\pi(5f)t)\end{array}\right];$$

$$s(t)=\frac{4}{\pi}\left[\begin{array}{l}\sin(2\pi\times f\times t)+\frac{1}{3}\cdot\sin(2\pi\times 3\times f\times t)\\+\frac{1}{5}\cdot\sin(2\pi\times 5\times f\times t)\end{array}\right];$$

$$s(t)=\frac{4}{\pi}\left[\begin{array}{l}\sin(2\pi\times 3,6\times 10^6\times t)\\+\frac{1}{3}\cdot\sin(2\pi\times 3\times 3,6\times 10^6\times t)\\+\frac{1}{5}\cdot\sin(2\pi\times 5\times 3,6\times 10^6\times t)\end{array}\right];$$

Bandwidth:
The maximal band value will be:

$(5\times f\times 10^6)-(f\times 10^6)=$
$(5\times 3,6\times 10^6)-(3,6\times 10^6)=14,4\times 10^6 Hz=14,4MHz.$

The minimal band value will be:

$(3\times f\times 10^6)-(f\times 10^6)=$
$(3\times 3,6\times 10^6)-(3,6\times 10^6)=7,2\times 10^6 Hz=7,2MHz.$

Frequency range:

$7,2MHz;\ 10,8MHz;\ 14,4MHz;$

The problems that appear during a transmission are: attenuation, delay distortion, noise, and channel capacity.
A signal is attenuated if the emission or receiver antenna lies in an industrial area or the building where it lies contains a special alloy that shields the signal losing a big part of its emission/ reception power.

Delay distortion is caused by the fact that the velocity of signal propagation through a guided medium varies with the frequency.
Noise is an undesired signal that is inserted into the real signal during transmission.

Channel capacity is the maximum rate at which data can be transmitted over a communication path or channel.

3. DATA TRANSMISSION WITH FREQUENCY MODULATION

The use of data transmission with frequency and amplitude modulation has a large range of use in command and control of the unpiloted aerial vectors. These offer the advantage of hardware miniaturization combined with new mission directives that were not possible in the past due to the limited technology. The software analysis medium Matlab/Simulink 2010 [5][6] offers a image of the transmission data (figure 3 and figure 4) in the UAV domain.

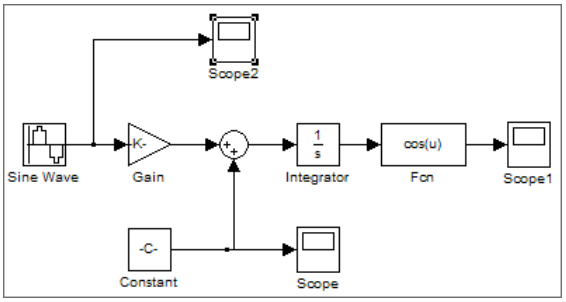
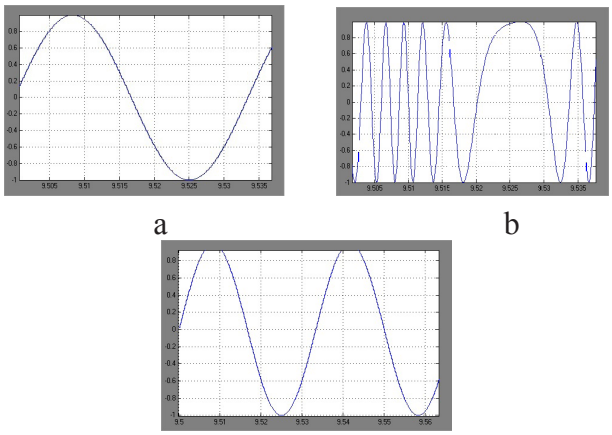


Fig. 3. Simulink model in FM modulation



a b c

Fig. 4. Modulating signal (a), output (modulated) signal (b) and carrier signal (c)

The radio command and control system is subjected to a analysis and has the following characteristics represented in table 1 [7]:

Table 1. FUTABA 6XEAP-characteristics

Emision T6EXAP	
Working Frequency	35MHZ /40 MHz
Number of channels	6
Tension	9,6÷12V
Modulation	FM / PPM
Discharge	250mA/h
Receiver R127DF/R136F	
Type	FM
Tension	4,8÷6V
Discharge	9,5mA la 4,8V
Weight	42,5g/27,8g
Servomotors S3003/S3004 Standard	
Force in action	3,2kg/cm
Operation speed	0,23s/60^0
Weight	37,2g/38g

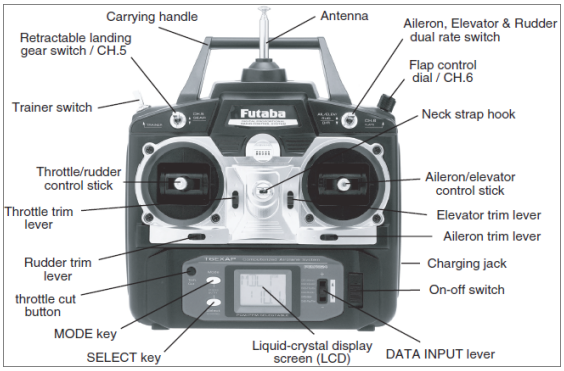


Fig.5. Radio system FUTABA 6EXAP

a b

Fig.6. Receiver R136F (a)/Futaba Servo S3003 (b)

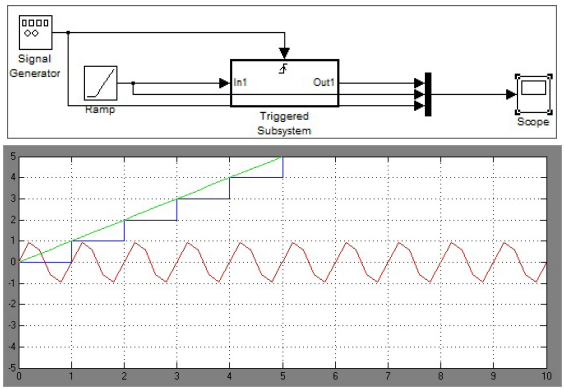


Fig.7 Simulink model for Futaba system

4. CONCLUSIONS & PROPOSALS

Worldwide wireless transmission data have applications in civilian and military life, especially in robotics and unmanned aerial vehicles (UAV).

In this article we pointed out the theoretical principles of data transmission and the elements that can influence it.

Thus, we presented the influence of the number of sinusoidal components of the band and frequency fundamentals against the bandwidth and much more against the extreme values of it (minimal and maximal).

The values have a direct influence concerning the speed of the transmission.

It is clear that a large band assures a high speed for data transmission with implications in the distortions that may appear and concerns regarding the costs.

Last but not least the simulations realized in the Simulink medium explains the FM modulation/demodulation process that is essential for a correct functionality of the transmitter mentioned and presented concise in the paper.

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EXPERIMENTAL RESEARCH REGARDING THE ANTI FRICTION MATERIALS

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Abstract: *The most important requirements are those concerning the assurance of high mechanical characteristics under special regimes (extreme temperatures, high pressures, corrosive agents, etc.), whereas the weight of the finished product must be minimized by diminishing the density of the materials.*

Another issue in view is that of material saving, of the wise use of materials by means of rationally conceived projects and scientifically elaborated consumptions.

The paper presents a few characteristics of certain alloys necessary in the production of friction bearings used in the military technique.

Keywords: *technologies, bimetal, materials, friction bearing.*

1. INTRODUCTION

At present, the main categories of metallic materials used in the production of friction (radial, axial and hydrostatic) are the following ones [3] : alloys from the Pb-Sn system, cast or sintered Cu-based alloys, Al-based alloys, other Cd, Zn, Ag-based alloys etc.

The tin based alloys – babbit – with the following composition 88% Sn, 8% Sb and 4% Cu. This alloy has rapidly become the most frequently used in the production of bearings all over the world. The white metals presented the attributes of the soft metals, with low melting point, toleration of the untreated cracks, high capacity of incorporating the foreign particles, which conferred them certain clear advantages in comparison with other anti-friction materials.

Lead based alloys – Pb based white metals – especially the alloys with As content, are still used both in the United States and Europe because of the advantages offered by the Pb which replaced Sn, the Pb which is not short. The Pb-based alloys contain, in general, Sb, Sn and Cu as alloying elements. Concerning the hardness and resistance, they are similar to the Sn-based alloys, but they are inferior from the point of view of the fatigue strength.

Bronze alloy with Pb, on steel support – is applied by casting or sintering. The Cu-Pb alloys sintered on steel support are more modern than those directly cast on steel strip or support. As related to the lead or tin –based white metals, the copper based alloys have a charging capacity and a strength resistance which are 3-5 bigger, but the high hardness of the copper-based alloys requires higher pin hardness.

The Al-based alloys – massive bearings have been cast, starting from the idea of obtaining an alloy having a structure similar to that of the babbit, that is a hard stage alloy in a soft basal mass. It has been proved that such an alloy is more resistant at greater stress than the babbit or bronze.

An important disadvantage in extending the Al-Si alloys is the fact that, having constituents with high melting points, they do not present the advantages of those with low hardness, having a more reduced conformability. Recently, in order to replace the lack of conformability, certain companies use the method of working surface galvanic coating of the Al-Si layer or the AlSn6 with an extra Pb-Sn layer thick of about 0,25 mm.

2. THE MATERIALS USED

The materials used in the production of the friction bearings for which there have been used samples and have been carried out studies and experimental research are the following ones: base on Al-Sn plated on the steel support, based on Cu-Pb sintered powders on steel support. [3]

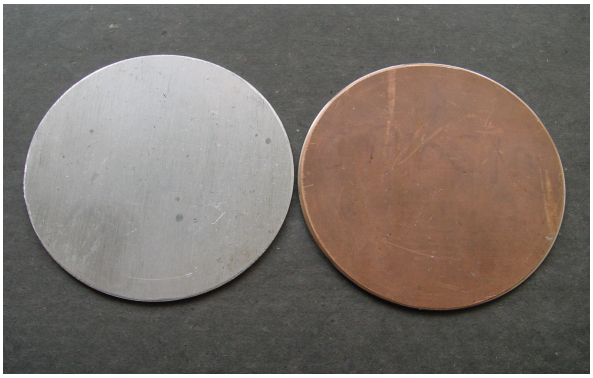
AS20 (Steel Support Plated with: 20% Sn, 1% Cu, the rest - Al).

CP10S10 (Steel Support with: 23% Pb, 10% Sn, the rest - Cu).

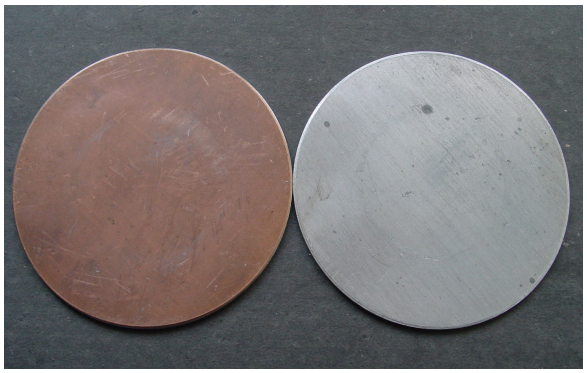
Concerning these materials, there have been studied the following aspects: chemical composition, micro-structure, certain resistance properties (hardness, stretching resistance, shearing, bending, adherence of the anti-friction layer), values of friction static quotients as well as the technologies of obtaining the anti-friction material and the bearing.

Fig.1. The mobile semi coupling made out of steel OLC 45

Experimental research studies have been made on a number of six couplings made out of different materials used when making the bushings [e.g. an antifriction material based on Al-Sn (AS20) + steel OLC 45, anti-friction material based on synthesized powders Cu-Pb (CP10S10) + steel OLC 45], presented in the figures 1 and 2.



a



b

Fig.2. Fixed semi couplings made out of anti-friction materials

In figure 2 are presented the four fixed semi couplings made out of antifriction.

3. PRODUCTION TECHNOLOGY OF THE AS20

The elaboration and casting of the AS20 alloy (Al – Sn 20%) is made in the following stages: the preparation of the charging made of the pre-alloys of Al-Ni, Al-Cu and raw material; the melting of the charging; the transfer of the alloy, degasification, de-oxidation and maintenance at the casting temperature; the casting.

The properties of the anti-friction alloy are greatly determined by its chemical composition. It decides the good behavior of the ingots at the following lamination operations in which the alloy suffers many structural transformations. [1, 2]

The alloy temperature must reach 750-760°C. The temperature plays an important role as the alloy must be transferred into the soaking furnace, period of time in which the temperature decreases. The casting of the anti-friction alloy represents a very important operation which greatly determines the quality of the cast ingots.

The appreciation of the quality of the cast ingots is made according to the English standards. There are rejected the ingots presenting gaseous inclusions, faults as "metallic beads", cold welding or other casting faults.

The elaboration technology of the Al-Sn alloy requires the use of the pre-alloy made up of Al-Ni and Al-Cu. Because of the huge differences between the melting temperatures of the alloying elements, the nickel and copper will not be introduced directly, but under the form of the pre-alloy Al-Cu and Al-Ni, respectively, which have low melting points.

The pre-alloy casting temperature is of 850-860°C. The main operations for obtaining the double strips of Al-Sn based anti-friction material are the following ones: pre-lamination of the AS20 ingots; annealing of the pre-laminated ingots; plating the alloy ingots with Al foil; lamination of the plated ingots; plating the steel strips with alloy strip; annealing the double strips.

The annealing of the pre-laminated ingots is made at the best temperature of 355-360°C, and the best annealing time duration is of 150 minutes.

4. PRODUCTION TECHNOLOGY OF THE CP10S10

The stages in the production of the thin-walled bushings made of sintered Cu-Pb anti-friction material are the following ones: production of alloy powder; sintering of the powder on the steel support (obtaining the double strip based on sintered Cu-Pb).

The technological process of obtaining the alloy powder consists of the following operations: the preparation of the cold charging, melting, casting and production of powder. [1, 2]

The melting is made in two gas-furnaces, capable of being swung open, consisting of a swinging melting tank and a collecting crucible.

This is maintained during casting in both crucibles. Throughout casting, the mode of action of the atomizers, which will form the powder from the melted alloy, is permanently monitored.

In order to obtain the powder, there should be highlighted certain parameters, such as: the pressure of the filtered water, the water softening degree, the regeneration of the de-ionized water, the pressure of the de-ionized water at the atomizers, the moisture of the powder at the entrance of the drier, the temperature at the exit of the drier, neutral air supply in the drier, powder sieving manner, the sieve quality and in the end it can be noticed if the powder corresponds to the requirements. [1]

The technological process of obtaining the double strip based on sintered Cu-Pb consists of the following stages: the preparation of the strips (coils) for sintering; depositing the powder on the steel strip having in view the sintering; the sintering of the powder on the steel strip; lamination of the double strip.

The preparation of the steel coils on which the Cu-Pb powder is sintered consists in executing certain operations aiming at assuring a continuous technological process (butt welding of the strips, straightening in order to remove the curvatures and unevenness resulted after welding, washing at the temperature of 77-88°C with water mixed with a degreasing and washing, drying at the temperature of 95°C through infrared rays heating).

The process of depositing the powder for sintering on the steel strip is made by means of a complex plant consisting of: the plant for the strip speed control and adjustment, the depositing plant proper and the suction hood.

The depositing plant proper has a tank dosing the powder quantity according to the calculated alloy thickness and the width of the steel strip.

In order to avoid the oxidation of both the powder and the steel, a neutral atmosphere is needed in the sintering furnace and the sintering speed will be established according to the heating curve of the sintering furnace.

The sintering process on the steel strip ends with the strip cooling.

The lamination of the sintered strip aims at obtaining the necessary density of the deposited powder.

According to the hardness of the alloy layer as well as to the tolerance of the double strip thickness, it is recommended to deal with: a final sintering and lamination; two sintering and two laminations.

In both cases, the lamination reduction will be made so that not to appear the melting of the lead from the alloy.

5. CONCLUSIONS

As the anti-friction material based on Cu-Pb sintered powders has a metallic structure, the relations established during the sintering process between the powder granules can be explained by the inter-atomic forces from the crystalline network of the metals. Theoretically, there is a metallic contact between the powder granules, but practically, this contact is seldom realized due to an oxide coating at the surface of the granules. The concentration of these oxides can be controlled and must not exceed the imposed value of 0.55%.

Because of the heat from the sintering furnace, the powder deposited on the steel support suffers the phenomenon of surface and volume diffusion (in solid phase). This can be explained by the fact that the atoms situated on the prominences and tips of the powder granules move on the surface of the granules, concentrating themselves in the surface unevenness. At higher temperatures, the diffusion between the powder granules and those of the steel support takes place.

The factors which influence the Cu-Pb powder sintering on the steel support are: the sintering temperature, the heating speed and the cooling speed, the sintering atmosphere, the size of the powder granules, the powder type, diffusion (at the limit in between the granules, surface limit, volume limit), chemical composition of the powder.

The mixture of alumina and tin oxide is accepted only if the surface occupied by them does not exceed 80% of the interface length.

The structures with sulphide inclusions, with foreign bodies inclusions and small cracks are accepted according to the adherence tests (chiseling, peeling).

The super-sintering is not admitted in the structure of the sintered alloy.

The double strips must not present a series of faults, such as: overlaps because of lamination, surface slag imprints, oxide traces after pickling, foreign bodies inclusions, cracks.

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EXPERIMENTAL STUDIES ON IMPROVING THE MECHANICAL PROPERTIES OF ALUMINUM ALLOYS

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Abstract: *Making modern aircraft is intended primarily to achieve a lightweight structure moving at high speeds without involving excessive costs, so the choice of materials used in the construction of an aircraft is an important factor and is justifying studies on two main directions: finding new materials, and also improving the property of the existing ones. The implementation of both thermal and thermomagnetic treatments of age hardening leaded to the achievement of improved characteristics, the results being confirmed by the XRD, SEM, EDS analyses.*

Keywords: *alloy, aluminum, heat treatment, Brinell hardness*

1. INTRODUCTION

The researches made on the establishment of modern aircraft intended primarily to obtain a lightweight structure moving at high speeds without involving excessive costs. In this sense the choice of materials used in the construction of an aircraft is an important factor and is justifying the studies made on two main directions: finding new materials and improvement of the properties of existing ones.

Through the analyses and the investigations made on the alloy we have determined from the macroscopic point of view the values registered by the studied mechanical properties and from the microscopic point of view the chemical compounds, the network parameters and the crystallite dimension.

2. EXPERIMENTAL RESEARCH

The heat treatments applied to the aluminum alloys includes hardening, recovery and annealing as in the case of steels with the exception that after the recovery treatment, the alloys have a high hardness, a phenomenon known as hardening rebound or aging [2,5]. Natural aging takes a lot of time, modifying the mechanical characteristics very little, so it is replaced by the artificial one. Parts and subassemblies used, that are subject to heat treatments can be classified as: parts and assemblies of simple shapes and small dimensions up to 500 mm, and parts of complex shape and large dimensions as fuselage panels, wings, and different components of the wing and of the construction of the landing gear.

From the aluminum alloys used in technique we have studied the influence of heat treatments on the alloys related to $ATSi_6Cu_4Mn$ [6,7]. The chemical composition of the aluminum alloy samples used in the experimental research period was determined in a physical-chemical and mechanical laboratory using a 8020 Quantometru, and the concentrations of alloying elements (Al, Si, Cu, Mn and Fe) were noted for each sample.

Samples were numbered differently depending on the concentrations determined in the laboratory and on the aging treatment applied; the influence of heat treatment hardening and artificial aging is reflecting on the hardness values, the data present in the tables being the average of three measurements.

The samples were heated in an oven at 520°C for 40 minutes, quenched and then naturally aged for 7 days and artificial at a constant temperature of 170 °C for 0,5 h.

The experimental results recorded (table 1) determines the following average values of Brinell hardness: 66,31HB after quenching and 76,82HB after natural aging.

Table 1 Prints and hardness measured, [3]

	Values after quenching		Values after natural aging	
	Print [mm]	[HB]	Print [mm]	[HB]
1	2,14	66	2,13	66,6
2	2,09	69	2,08	70
3	2,20	62,3	2,12	67,3
4	1, 96	79	1,69	108
5	2,30	56,6	2,04	73
6	2,16	65	2	76

From the results obtained is observing greater values for sample 4 (Si 6,078%, Cu 3,260%, Mn 0,580%, Al 89,46%), sample for which the Brinell hardness presents greater values than the average for each set of measurements.

A further set of samples after heating and direct quenching were kept in a warm environment at a constant temperature of 170 ° C for 0.5 h, the measurements made at the end of the period indicating an increase of the hardness as shown in table 2.

The medium values of the recorded hardness for quenched, natural and artificial aging samples were graphically represented depending on the heat treatments applied, and obtained the diagram in figure 1.

Table .2. Prints and hardness, [3]

Sample	Print [mm]	Hardness [HB]
1	2,14	66
2	2,05	72
3	2,16	65
4	1,99	77
5	2,08	70
6	2,20	63

Graphical representation of average values of hardness tests according to the heat treatments performed (measurements after quenching, after quenching and artificial aging for 30 minutes, and after quenching and natural aging) shows that after artificial aging for a short period of time, the value of average hardness differs very little from the value recorded through natural aging.

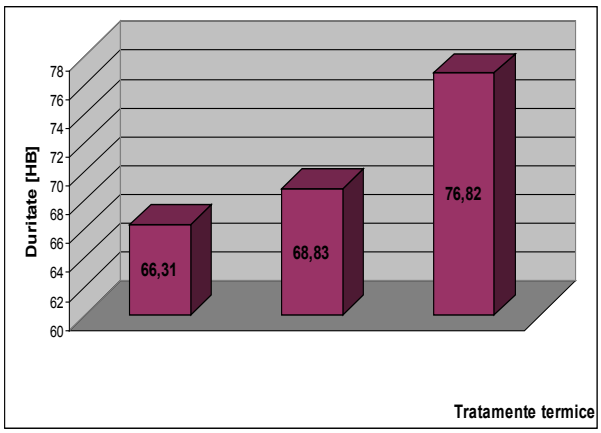

Fig.1. Brinell hardness depending on the heat treatment, [3]

X-ray diffraction performed on samples naturally aged, highlights the elements that have the largest share in the structure (figures 2, 3), compounds that appear and preferred orientation on certain crystallographic directions.

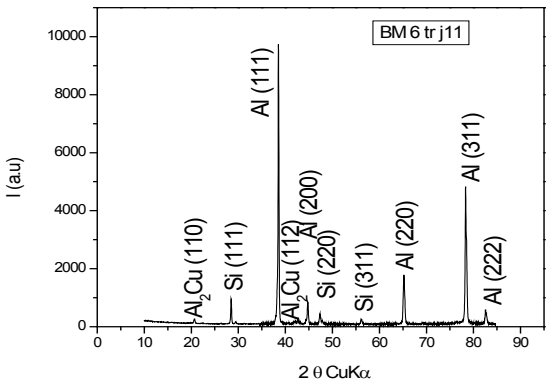

Fig. 2. X-ray diffractogram of the alloy $ATSi_6Cu_4Mn$ naturally aged (Si 5.995%, Cu 3.249%, Mn 0.494%, Al 89.70%), [3]

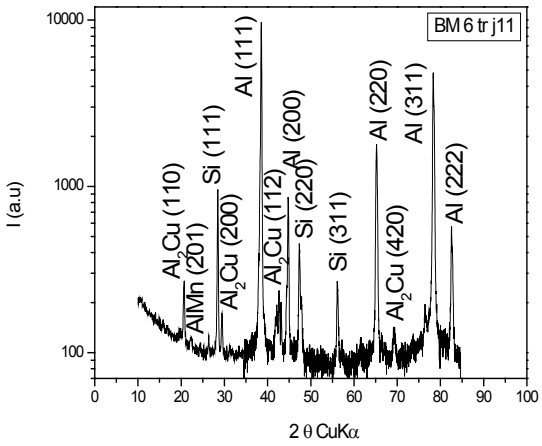

Fig. 3. X-ray diffractogram in logarithmic scale of the alloy ATSi$_6$Cu$_4$Mn naturally aged (Si 5.995%, Cu 3.249%, Mn 0.494%, Al 89.70%), [3]

The main features obtained from X-ray diffraction are [1, 3]:

- main phase has cubic structure, space group Fm-3m (225) aluminum (JCPDS 04-0787, network parameter a= 4.0494 Å);
- the main phase diffraction peaks were Miller indexed according to the spatial group;
- network constant calculated is 4.046 Å;
- the Sample appear as textured (preferred orientation on some crystallographic ways) on directions (111) and (311);
- crystallite size calculated by Scherrer formula is 74 nm.

The existence of AlMn compound is highlighted while the diffractogram is done in logarithmic scale (Figure 3).

Following the completion of recorded images with secondary electron detectors on natural aging samples, selected a small area of the sample 6.11 (Si 5.995%, Cu 3.249%, Mn 0.494%, Al 89.70%), the area shown in figure 4. (a and b).

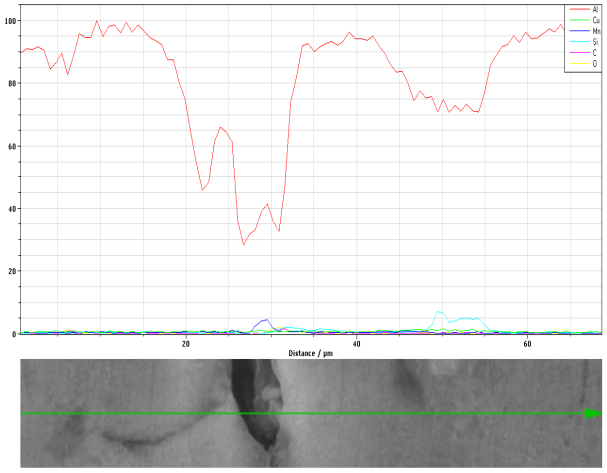

Fig.4.a) Linear scanning, [3,]

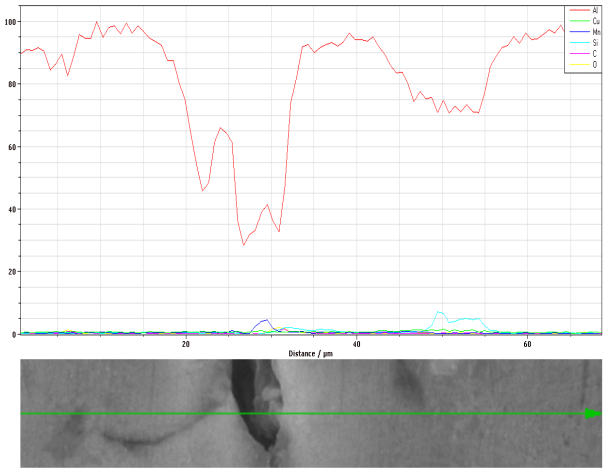

Fig.4.b) Linear scanning, [3]

The analysis of samples naturally aged using the SEM-EDX system, VEGA II LSH TESCAN model, shows that on short distance, in the selected region, the concentration of alloying elements is changing as represented in linear scanning system shown in figure 4. (a and b).

It is observed the presence of a high concentration of aluminum over the analyzed surface and also the decrease in the levels of concentration of aluminum in the darker color area, area in which is increasing the concentration of manganese.

3. CONCLUSIONS

Experimental research allowed the study of the mechanical properties of the alloy $ATSi_6Cu_4Mn$, of the heat treatments applied in improving the performance, the influence of time on the results and also obtaining further information about the resulting microstructures from heat treatments applied.

The aluminum alloy studied, $ATSi_6Cu_4Mn$ type, subject to artificial aging heat treatments on different time periods, presents superior mechanical characteristics, which requires further researches on it.

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

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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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THE IMPLEMENTATION OF THE EUROPEAN STANDARDS AND GUIDELINES FOR INTERNAL QUALITY ASSURANCE WITHIN „HENRI COANDĂ" AIR FORCE ACADEMY

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Abstract: *A review of implementation of the European standards and guidelines for internal quality assurance within "Henri Coandă" Air Force Academy is presented. The Code of education quality assurance put in practice a system of quality assurance in the field of education, which is embedded in the academy's strategic management system. This system is a complex structure of academic strategies and policies, procedures, skills and responsibilities. "Henri Coandă" Air Force Academy is engaged in an ample process of upgrading its educational quality by applying the recommendations and requirements regarding to the status of the higher education institutions, including the quality of the educational processes, by assuming accountability in terms of achieving the standards, the references standards and the performance indicators developed by ARACIS and EUA.*

Keywords: *higher education, educational process, quality assurance, European standards and guidelines, management system, control, report, regulations, students, teaching staff, assessment, learning, resources, research, information*

1. INTRODUCTION

"Henri Coandă" Air Force Academy (AFAHC) is a military institution of higher education part of the national education system. The Code of quality assurance is the framework document that describes the scope of the quality management system, the documented procedures established for the system and the interaction between the processes of the quality management system, in order to verify their effectiveness. Code of quality assurance is used both by the Academy's leadership and the teaching staff in order to conduct current educational activities, internal audits activities and management reviews of the quality management system.

"Henri Coandă" Air Force Academy is engaged in an ample process of upgrading its educational quality standards by applying the principles of total quality management, which is illustrated by our motto: "Nostrum nomen rerum est mensura nostra!" The key quality assurance and enhancement procedures benefit from the participation of external peer reviewers. The international institutional evaluation of "Henri Coandă" Air Force Academy carried out by European University Association (EUA), takes place in the context of major transformations within the Romanian Higher Education, and it is in agreement with the National Education Law, which came into force on 1 February 2011.

The quality assurance policy summarizes the academy's approach to implement a quality assurance system in order to ensure that AFAHC guarantees a high quality of education by aligning it with the European standards and requirements.

2. THE IMPLEMENTATION OF THE EUROPEAN STANDARDS AND GUIDELINES FOR INTERNAL QUALITY ASSURANCE WITHIN „HENRI COANDĂ" AIR FORCE ACADEMY

2.1 Policy and procedures for quality assurance. AFAHC has put in practice a system of quality assurance in the field of education, which is embedded in the academy's strategic management system.

This system is a complex structure of academic strategies and policies, procedures, skills and responsibilities adopted by the senate and applied within the involved components, including the role of students and other stakeholders. The ground of this activity is represented by the Code of education quality assurance.

The Rector (commandant) of the academy holds direct responsibility for the quality of education provided by AFAHC, the coordinates of this activity being stipulated in his annual public statement. The rector (commander) annually presents to the university senate the policy for quality assurance and permanent improvement, as well as the internal regulation projects and the methods to monitor their implementation. This policy statement summarizes the academy's approach to the maintenance of academic standards and to the assurance and enhancement of the quality of learning opportunities offered to students, it provides an overview and points to the policies and procedures, an operational framework to ensure consistency of standards, consistency and equivalence in the student experience and to assure a high quality education.

Academy policies and procedures for developing and maintaining academic standards and for assessing and enhancing the quality of learning opportunities are determined through its deliberative structures; faculty departments are responsible for their implementation.

The Vice-rector for education coordinates the activity of quality assurance in education, with regard to the institutional capacity, educational effectiveness and quality management, in compliance with legal provisions.

The Dean coordinates the quality assurance activity in education at the faculty level, based on the national higher education requirements and the graduate model of the academy, as specified by the beneficiaries' standards. Each semester, the dean analyzes the educational process run within the faculty and forwards improvement measures related to it.

The Head of Department coordinates the quality assurance of education with regard to the institutional capacity, educational efficiency and quality management, in compliance with the current legislation; he/she monitors the didactic activities of the teaching staff of the department.

The Commission of quality assessment and assurance (CEAC) functions within the AFAHC, whose members are discussed and approved by the senate. CEAC's role is to design and draw up documents and to implement a quality assurance system in order to ensure that AFAHC guarantees a high quality of education by aligning it with the European standards and requirements. For the better performance of specific activities, at every department of the faculty and institution offices there are people in charge with quality assurance.

Also, the academy has an Education Quality Assurance and Education Computer Aided System Office, which has its own organizing and functioning regulation.

Quality control management is done by the control/audit activities of the SMC processes, for which the academy uses its internal audit and the tools of internal / management control system. The main objective of the annually internal audit is to establish the level of standard accomplishment regarding the educational process quality in the academy (set by ARACIS and CNCS). The Commission for internal audit (CAI), has its own regulation, operates permanently, under the internal audit plan, approved by the university senate. For each audited period, the internal audit report is drawn up with regard to the quality of educational process, which also contains proposed corrective and preventive measures meant to increase the quality of the educational processes. Based on the conclusions of the internal audit report analysis, an action plan shall be drawn up containing improvement measures, with specific targets and time-bound responsibility.

The internal audit process is carried out by the internal commission of academic audit. The internal public audit is performed by the Internal Audit Division of the Ministry of National Defense through the Section V of Internal Audit of Brasov.

The annual report of internal assessment of AFAHC quality in education highlights qualitative and quantitative aspects of the quality assurance based on indicators set out by the quality assurance system of the educational services and contains optimization suggestions. The report contents are presented to all beneficiaries and external evaluators by publication on the university website.

AFAHC is a university of education and scientific research and aspire to ensure that the teaching process is informed by cutting-edge research and it takes place in a research-enriched environment. This involves ensuring that assessment and the learning development of students enables them to understand the nature of research, the opportunity to engage with cutting-edge research, to carry out independent research projects (especially at taught postgraduate level) and to feel part of a research community.

The scientific research activity is orientated on the profiles of the study programs; annually a research plan is established, the research activity involving the participation of bachelor study programs students and master study programs students.

The students' research activity is conducted in various forms, as follows: scientific research conducted independently, guided by teachers and concluded with case studies, projects, work license, dissertation; involvement and participation of students in carrying out programs/projects conducted by departments or research scientific centers.

The students scientific research results are disseminated through scientific papers presented mainly at the national and international scientific students conferences.

2.2 Approval, monitoring and periodic review of programs and awards. Regarding the quality of the educational process, as well as the educational programs and scientific research of the AFAHC, all the study programs were subjected to ARACIS external evaluation according to the ARACIS methodology, standards and quality indicators.

The initiation, approval, regular monitoring and evaluation of the study programs are subordinated activities to the strategic management and quality management at institutional level and are designed to ensure viability of the study programs offered by the AFAHC, by its constant adaptation to dynamic external environment, upon the requirements of the Air Force Staff and other beneficiaries, as well as upon the criteria and quality standards.

The academy has a formal mechanism for the approval of new academic programs and changes to the existing curriculum. This includes key issues to be taken into account in program design and guidance on approval criteria.

Regulations regarding the initiation, approval, monitoring and evaluation of the study programs are validated by the Senate, is updated annually and distributed to heads of departments and all of those involved in the annual monitoring process.

Regulations specify the algorithm and responsibilities regarding the authorization and regular evaluation of the study programs establish a uniform procedure that facilitates the elaboration and documentation of self-assessment of the study programs and make proper and operative assessment, conducted by internal and external evaluators. The first step in initiating a new study programs is the review and evaluation of external initial conditions, conducted by Air Force Staff in collaboration with the Human Resources Management Directorate within the Ministry of National Defense. The next step in initiating the study program is to analyze and evaluate the internal initial conditions. The activity of study program projecting is made within a committee, headed by the coordinator of the study program. Each degree program has an academic coordinator, responsible for the design, supervision and ongoing quality improvement program.

Effective quality assurance activities refer to regularly monitoring and periodically review (at the beginning of each academic year, after the course evaluation made by students), of : all the study programs curricula and syllabus according to students, Air Force Headquarters representatives and labor market representatives feedback; the intended learning outcomes; the availability of learning resources, securing their continuing relevance and currency. Annually, the Department of Education of the Air Force Staff organizes a gathering involving representatives of Air Force Academy "Henri Coandă", Air Force Staff, Air Force Application School, beneficiary's (commanders and specialists from Air Force bases and Air Force units, Aviation Inspectorate of the Ministry of Internal Affairs - MAI) and academy graduates. The role of this activity is to match the stakeholders requirements with the academy study programs based on participants analyze. This regular meetings revealed information that has been taken into account in designing, evaluating, organizing and conducting the educational and scientific research processes. Curricula content is constantly renewed by annual update.

The acceptance of the quality level of study programs in AFAHC is achieved by the content of the assessments of the graduates' and the beneficiaries concerning the level of competences and skills acquired in the academy. To this end, the University Senate has approved the Methodology regarding the Assessment of the Graduates' Training after Their Posting in Military Units (the monitoring and information system regarding the method of assimilating the graduate within the units' missions and activities). The Methodology is in force throughout the current academic year (2009-2010). The feeling of self-fulfillment of the academy graduates and beneficiaries concerning the educational process reveals itself from two distinct questionnaires self-administered within Air Force bases and military units. The conclusion reached by means of filling in these questionnaires are analyzed and can be considered as proper solution for enhancing the teaching performance, the curricula, and the course descriptions that are to be developed for the next academic year.

The periodic subject review process comprises a developmental and strategically focused model of review and one of its principal aims is to ensure the continuing validity and relevance of the programs on offer and to confirm their academic standards with reference to appropriate external reference points.

The academy students actively participate in the academy management by representatives in the student's council, the faculty council and the Senate. The formal election of representatives is managed by the Students' Council with support from the academy. The student's election process in the academy leadership structures is democratic, transparent and non-discriminatory. Students can raise issues of concern on courses, programs or other matters affecting their student experience. Students are involved in working groups established by different commissions regarding the educational process including the quality assurance commission.

2.3 Assessment of students. The academy evaluation of the teaching – learning process results is achieved through specific forms in accordance with legal provisions, rules of university autonomy, academic Charter provisions and curricula of the accredited academic specializations.

Student performance evaluation is conducted at all study subjects under the curriculum and throughout the period of ongoing education, by current and periodic tests, final tests (checks) final course works (projects), colloquies and exams. The way of examination and evaluation of each discipline will be done taking into account the performance of general and specific skills that are scheduled for that discipline.

Within the university training programs, in order to highlight the training results, together with the qualitative assessment system (scoring), it is used the European Credit Transfer System (ECST). The transferable credits do not replace the marks of appreciation (evaluation). The methodology for granting the transferable credits is approved by the university senate.

The qualitative evaluation process of the knowledge and skills acquired by students is completed as a result of the semester exams sessions or, where appropriate, at the end of year or at the end of the university degree program.

The performance evaluation of students and the calculation of averages are assessed using published criteria, regulations and procedures which are applied consistently presented in the Methodology regarding the assessment of knowledge and competences acquired by the students of the Faculty of Aeronautical Management within AFAHC, Regulations regarding the study programs, Regulations regarding the Students' Professional Activity. The existing systems of students' assessment are permanently improving and updating.

The evaluation forms are provided in the curriculum and courses files and ensure objective assessment of knowledge and skills acquired by students.

The syllabus is an outline and time line of a particular course. It will typically give a brief overview of the course objectives, course expectations, reading list assignments, homework deadlines, and evaluation form. It is available at the beginning of the course, and students are expected to know what is in the syllabus throughout the course. The purpose of the syllabus is to allow the student to work their schedule for their own maximum efficiency and effectiveness.

Criteria for admission of students to exam conditions to promote the disciplines, the calculation of average exam and information on review are announced by the teacher at the beginning of the course.

Students are clearly informed about the assessment strategy being used for their program, what examinations or other assessment methods they will be subject to, what will be expected of them, and the criteria that will be applied to the assessment of their performance.

For all forms of examination probative papers are prepared by teacher before the examination, approved by the department director, describing the course exam includes topics, key correction, maximum performance and minimum allowable performance for each issue separately. Every evaluation attends at least two specialist teachers and where appropriate is forming a commission.

Evaluation results are motivated to each student in relation to the criteria set and examination results are announced (published) in a short and determined period of time.

To ensure the accuracy of the procedures, the evaluation activities are subjected to verification checks conducted by the department's director who has administrative responsibilities. Deviations from ethical norms in the evaluation process, committed both by the teacher and the student are analyzed by the university ethics committee.

Representatives of students are participating in quality assurance activities which are monitoring the progress and the students achievements – all final exams results are discussed in the faculty council and university senate.

Annually, the students are evaluated through the appreciation of military service according to the Internal Regulations of "Henri Coandă" Air Force Academy.

Due to the military specificity of the institution, the military regulations have clear regulations covering student absence, illness and other mitigating circumstances.

2.4 Quality assurance of teaching staff. The academy is committed to attracting and appointing scholars who are capable of excellence in teaching and research and who support the core university values of teaching and learning.

The teaching staff of the AFAHC consists of personnel with university degrees (professor, associate professor, paper coordinators / lecturer, assistant professor) and the body of military instructors (military professor, superior instructor, chief instructor), that meet the requirements for filling positions and have the necessary level of competence.

The employment and promotion of the teaching staff are completed by competition, according to the national legislation and in accordance with the Regulations regarding the organization and carrying on of the contests for filling up higher education positions within AFAHC.

The foundation of the academic human resources is the principle of autonomy in selecting and promoting, manifested by the right to organize and hold position filling competitions, the right to appoint people on teaching positions, the right to select teaching staff for various education and training programs. The competitions for position filling take place usually twice a year, and they are public, open and legally regulated. Position filling for assistant professor and lecturer positions must have internal validation, whereas the position filling for associate professor and professor positions must have external validation from CNATDCU/MEN.

The external validation envisages meeting certain nationally agreed performance standards. The position filling within AFAHC must be approved by Air Force Staff. Staff retirement is also nationally regulated, but the university has its own staff detainment policies according to its academic and research needs.

The academic staff policy is autonomous, not subject to extra-academic criteria, observes the minimal national standards, is not discriminatory, is open and transparent, observes the institutional strategy, mission and general objectives of teaching and research activities and fosters individual growth.

Heads of Departments are responsible, primarily, for ensuring the strategic direction and development of their subject area. Their range of duties includes academic staff matters (recruitment, appraisal, mentoring of new staff, staff development and performance review), development, delivery and enhancement of the curriculum, annual monitoring of courses and programs and for internal and external reviews.

The life-long professional learning of the teaching staff is achieved by psycho-pedagogical and methodological training activities, organized by the institution on a monthly plan basis (The academic staff psycho-pedagogical and methodical development plan), approaching the latest trends in teaching techniques and methods with an emphasis on student-centered teaching and specificity of the taught subject matters.

AFAHC offers the possibilities for teaching staff to develop and extend the teaching capacity development, by participation in various projects such as: strategic project "Quality assurance in the Romanian higher education in European context. Development of academic quality management at system and institutional level", Internal evaluators training – sectorial operational program for human resources development by actions for the system, as well as by actions meant for improving institutional capacity: quality evaluators, development of the management staff in universities, decision-makers and those involved in policy-making; "Quality, innovation, communication in the life-long learning of higher education experts", which follows the national priorities in education regarding the quality assurance in the context of the knowledge based society; strategic ESF project Quality assurance in higher education by elaborating and piloting methods of empowerment and auditing coordinated by UEFISCDI unfolds, and it examines the appraisal of academic human resources, as well as the new methodologies in the field.

At the end of each semester, the students evaluate the curriculum unit they are enrolled in that semester, the resources available, and the teaching staff didactic contribution - their degree of professional dedication as fundamental benchmarks in assessing the quality of educational processes. The analyze of the level of satisfaction of students in relation to professional and personal development provided by faculty, assessment of teaching staff by students of the academy is mandatory.

The evaluation results, representing input information obtained in the process of improving the quality of study programs, are analyzed statistically, presented in table and graphical form and a ranking is produced in the case of student satisfaction with subjects and teaching staff and is carried out by the department director at the end of each semester.

The questionnaire results for teaching staff go to the individual staff members (feedback on their own performance), whereas all the rest of the results are made public in the academy in information display cases. The results of the questionnaires are analyzed and a report is presented and discussed at the Faculty Council and Senate twice a year.

The results are also discussed in the psycho-pedagogical workshops, organized at the beginning of each academic year, and have an important role in the improvement of the pedagogical practice at curriculum unit level and in taking measures in response to raise the issues found.

The teaching staff quality assessment is performed on an annually basis evaluation, according to the set of criteria specific to teaching staff evaluation methodology (Methodology of the academic staff assessment within AFAHC, Methodology regarding the assignment of teaching and scientific research tasks within AFAHC). Every academic year, permanent faculty members, academic staff submit to the department director a report detailing their activities in the spheres of teaching, research, administration and other areas of academic life. Thus, every teaching staff representative is evaluated by the department director, department colleagues and students who pursued teaching. The evaluation by the department director refers to the criteria stipulated in the job description, to student's evaluation, but also to the quality of interpersonal relationships, involvement in extra-activities etc. Peer assessment aims at maintaining harmonious relationships within the department and creating working atmosphere that allows to efficiently solving any issue and it is based on objective criteria of interpersonal interaction. Each teaching staff evaluation by hierarchical superior, annual assessment results, are recorded in the personal file of the HR office.

2.5 Learning resources and student support. The AFAHC library collects and records books, periodic publications and other graphic and audio-visual documents, as well as foreign publications relevant to the graduate and master programs offered by the university.

The adequacy of learning resources to support new study programs, is a requirement of the study program approval process. For each course defining a study program, library has an adequate background in national and international books and subscriptions to professional journals at home and abroad.

Library resources for learning and teaching are prioritized, acquired and managed on the basis of notification of new demands which arise through the program approval process.

There is an ongoing dialogue with departments in order to manage demand for the existing curriculum where course reading lists are submitted by teaching staff and there is a termly management cycle for the receipt, checking and processing of these reading lists.

Manuals, university courses, anthologies, informative documentation specific to military environment are provided by the university library and classified information library, which, by the number of their volumes, provide not only students' self-study, but also teachers'. The academic staff, permanent faculty members, as teaching loads, is responsible to prepare textbooks, course books, collections of problems, laboratory guide books, atlases and other works necessary to conduct the educational process, according to the records of the subjects. Some of these learning resources are also in electronic format and may be borrowed free for students. Information characteristic to the book collection available to the library is placed in a database and it can be accessed by several methods (keywords, author, etc.).

The library has a collection of periodicals corresponding to each study programs they are purchased under annual subscription agreements with suppliers. Learning resources are available in sufficient copies for student's documentation with free access. The scientific collections are accessible to all the students, teaching staff and the entire AFAHC free of charge. The bibliographic search is now facilitated by the online catalogue of scientific publications.

A range of mechanisms and procedures are used to evaluate the effectiveness of the Library: Regulations regarding the organization and functioning of the University Library, Regulations regarding the functioning of the Scientific Council of the University Library.

The budgets for the Library are set through as part of the academy's multiannual planning programing, evaluation and budget structures process. Textbooks, manuals, lectures and other works necessary to the educational process are printed in the Academy Publishing House, (recognized CNATDCU, Class A2 - Publishing prestigious nationally recognized in the "Military Science, information and public order") and multiplied as learning resources support for students. Its activity is coordinated by the dean faculty under the Regulations regarding the organization and functioning of the Publishing House within AFAHC.

Regulations and methodologies are updated annually and provide comprehensive information for students on their responsibilities as students, the full range of services and support available, key academy regulations and policy documents, progress and assessment matters and details of complaints and appeals procedures.

IT Services resources to support learning and teaching are monitored and updated throughout the year, with major changes such as the upgrade of computers and changes to computer software. Each academic year, each department of the Faculty, conduct a review of the applications software which includes new software identified from the course and program approval processes, and as a result of this review, a list of proposed application software for the following year is agreed provision is updated.

Students are provided with advice and guidance at strategic points in each academic year when they need to choose course options. This may take the form of briefing documents, option fairs or other for a where advice and guidance is available to assist students in making an appropriate choice.

The students are offered support activities such as counseling, as each group has its own tutor in charge with the students' vocational and professional counseling and presentation of the opportunities from which they can benefit (Methodology regarding the tutoring activity).

In order to improve their academic education, the students are involved in weekly tutorial sessions at the level of department, regular meetings with the dean etc. They are also involved in scientific activities in workshops, international scientific conferences AFASTUD on an annually basis etc.

For a better professional orientation of the AFAHC students, a Career counseling commission has been set up, whose purpose is to examine their personal and professional skills, interests, knowledge and personality by means of interviews, questionnaires, and various types of tests. Also, the commission facilitates the students' access to the career path opportunities provided by the DMRU within the MApN.

Students can also benefit from psychological counseling in case they encounter personal difficulties and need specialized advice.

An important aspect of the educational process is the students' training: flight practice for pilot students, specialty practice, shooting sessions with antiaircraft artillery equipment, training camp, documentation and research for the graduation papers. Camps and military instruction sessions have proved to be very useful for the development of warrior skills, which takes place according to the NATO standards of "Leadership program".

2.6 Information systems. The academy uses an information system in order to collect and analyze information to be used as the basis for all the quality assurance processes. Based on the aggregated data, the Educational Management Department, drafts the required reports for academy management and higher echelons within MApN and MEN (Minister of National Education). The information system benefits from the existence of an integrated intranet and computing system fitted to the organizational requirements and the particularities of the military educational processes. All the relevant bodies within academy management are the beneficiary of the reports drafted by the Educational Management Department.

Educational Management Department through its Planning, conducting, and data collecting Office, is responsible for aggregating all data regarding relevant information about student progression and success rates, in order to draft reports to be used and analyzed by CEAC as part of the quality assurance system. Based on this reported data, CEAC will propose the necessary corrective measures to be endorsed by academy management. Student success rate is under constant supervision by faculty council and university senate.

Analyses of these data enable the academy to monitor standards and provide the academy with evidence which can be used to monitor its support structures.

Constant monitoring of the quality management process, observations and documents review, periodically debriefing of the findings, all of them enable the review of the information systems at least on an annually basis.

Annually, at the beginning of the academic year, as part of the results control process, AFAHC drafts the self-assessment report regarding the organization performance during previous academic year.

Within this report the academy management is performing a comprehensive approach to all aspects of previous activities such as: academic and military capabilities and limitations, available logistic support including learning resources and their costs, efficiency of the entire educational and research activity, study programs evaluation and development, learning outcomes and effectiveness of teaching and supporting staff, efficiency of specialty practice activities, efficiency of the financial management.

The above mentioned self-assessment report benefits from data and information collected and made available by the Education Quality Assurance and Education Computer Aided System Office. The structure of the report follows the guidelines of quality assurance in terms of references standards and the performance indicators for educational process quality evaluation, set by ARACIS. This self-assessment report sets out the level of proficiency regarding the standards and points out the necessary corrective measures in order to accomplish our mission.

The entire self-assessment process is under constant supervision by the higher echelon, Air Force Staff in terms of the quality of educational and scientific services, the operating efficiency, and the benchmarks of the military aspects.

Annually, the data base used for assessment of educational and scientific activities is reported to MEN.

On the self-assessment report basis, the relevant academy-level committees receive data and information on trends and patterns in first degree outcomes and also on undergraduate progression data. The academy's overall performance is benchmarked and, in the case of award outcomes, subject performances benchmarked against national classification distributions. Progression, retention and award data are also presented at academy level on students' scientific research activity.

The Education Quality Assurance and Education Computer Aided System Office is responsible also with the collecting the data regarding the rate of employability of our graduates. The percentage of employability of the graduates within MApN and other institutions of public order and national security, since the establishment of the academy, has been 100%.

The education improvement measures result also from the partnerships with the beneficiaries, Air Force base and unit commanders, Air Force Staff experts and the Aviation Inspectorate of the MAI. From the meetings held periodically with all of them, information is obtained in order to support the design, organization and performance of the educational and research activities.

Feedback regarding the quality of educational services in AFAHC is collected by means of the graduates' appraisals and beneficiaries' content assessments in terms of the level of competencies and skills acquired in the academy (Methodology regarding the assessment of the graduates' competencies after their graduation and distribution in military units). In this respect, are applied the provisions according to the graduates' evaluation methodology after their appointment to military units, approved by the university senate. The conclusions drawn from this process are examined and used to improve the teaching activity, curricula, syllabi and the contents of subject matters for the following year. After distributing self-administered questionnaires, one may notice that the beneficiaries are satisfied with the graduates' professional training and education and, at the same time, the graduates are satisfied with the way in which the academy contributed to their development in terms of military specialists, leaders/subordinates skills, military skills, and performance oriented motivation.

The results of a psychological test applied to students, using a questionnaire designed by the academy psychologists, confirmed that the academy students positively assess learning in a percentage of 82.21%. The questionnaire was conducted on the fields of educational curricula, educational and research activities, educational resources and accommodation.

2.7 Public information. "Henri Coandă" Air Force Academy respects the principle of transparency of all categories of information (except those classified), which regards the members of the academic community, the potential candidates, the graduates, the institutions it collaborates with, as well as the public, ensuring consistent and accurate information sending. Thus, the equality of chances is facilitated in competition and equal access to the academy resources is assured.

The academy, through its own website, www.afahc.ro, constantly updated, provides all specific information to the educational process. Irrespective of the way of asking information, (by email, written document, etc.), The Secretariat and Public Relations Office shall give substantiated answers by the responsible factors of the Academy.

The information provided by the academy refer to the study programs developed in the Academy, the qualifications they acquire, the diplomas they obtain after graduation the study programs, the accommodation, food and recreation facilities, available in the Academy for the students, the organization and composition of the chairs, university teaching staff, etc. The information and data provided to students are accurate and constantly updated and they are media public by the Academy website.

Each academic year, the Aeronautical Management Faculty has developed brochures, posters and promotional materials designed to inform students of military and civil colleges and high schools about the educational offer and the conditions of admission into the Academy. The activity of informing the prospective candidates for admission to the Academy was performed also by media, on local television and local press. The Academy organizes periodically the "Open Day" an activity that presents to the potential candidates for admission and to other interested persons, the content of the educational process of the institution, by visiting the educational and accommodation facilities.

For a quicker adaptation to the specific activity of the Academy, The University Charter, all the regulations and methodologies regarding the students' professional activity, the teaching, learning and assessment procedures used in the educational process, tailored for each study programs, are published on the academy website.

In respect of impartiality and objectivity, the contents of the annual report of internal assessment of AFAHC quality in education are presented to all beneficiaries and external evaluators by publication on the university website.

The ARACIS external evaluation reports, about the quality of the educational process, as well as the educational programs, scientific research, functioning of the academic leadership and management, and institutional, technical, administrative and economic procedures, were published on the academy website. The study results of the strategic project National monitoring study of labor market insertion of the higher education graduates – Graduates and labor market, about the students' satisfaction regarding the quality of the educational programs and their insertion in the labor market via, the correlation of academic knowledge and finding a corresponding job, as well as the number of graduates employed in the corresponding field of activity, were published on the academy website.

4. CONCLUSIONS & ACKNOWLEDGMENT

AFAHC observes and promotes the EU conventions and recommendations regarding to the status of the higher education institutions, including the quality of the educational processes, by assuming accountability in terms of achieving the standards, the references standards and the performance indicators developed by ARACIS and EUA, according to the European higher education standards.

Thus, in order to accomplish the mission and objectives, the Air Force Academy "Henri Coandă" must respect and meet the requirements of two systems: the European higher education system and the military system.

The major strategic direction is the integration of the academy system education in the national, European and Euro-Atlantic context, according to the Declarations of Bologna (1999), Berlin (2003), Bergen (2005), Lisbon (2007) and Leuven-Lauvain la Neuve (2009).

AFAHC has taken measures in order to become a European university and to increase the educational and research activities efficiency and the prestige of teaching and research staff.

AFAHC focused on the requirements of the European standards and guidelines for internal quality assurance within higher education institutions, preserving the elements of Romanian military higher education identity and characteristics.

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THE IMPACT OF INTENSIVE CARE INTERNSHIP ON THE TRAINING OF MEDICAL STUDENTS

Maria Dorina PAŞCA

U.M.F. Tîrgu Mureş

Abstract: *Introduction: The aim of this paper is to highlight the imperative role of internship in general and of the one regarding intensive care in particular, through the medical-psychological training of the 5th year medical student from the perspective of informative segment, targeting vocational orientation (specialization – residency).*
Materials and methods: In determining the logistics support of the impact of ICU (Intensive Care Unit) internship on the training of medical students, the entire approach was based on using different methods: conversation, call, observation and questionnaire as part of the investigation; the subjects being a number of 150 medical students from the 5th academic year.
Results: Processing the gathered information by decoding, results in a wide range of expression starting from the perception, involvement and getting to awareness and responsibility, quantifying largely the maturity and cognitive development of the student following his age particular peculiarities.
Conclusions: Our structural and attitudinal approach surprised defining elements that generate the quality of internship program, in this case ICU, highlighting both the good specialty training of the academic teaching staff of the faculty and also the direct involvement of the student in carrying out the internship; the feedback being represented by the impact of internship on the future specialty/residency choices.

Keywords: *internship, student impact, professionalism, ICU*

1.INTRODUCTION

In the academic field, the main "actors": the teacher and the student represent the matrix of cohabitation and qualitative evolution of the relationship as "The Disciple comes to you to ask you something. You have to teach him that he has nothing to receive, that he has to grow and develop. The Disciple wants to become the ivy, though he should only become himself" [1], however he feels the need to report to you, which can cause a marked attitude and conduct of awareness of its existence under these special auspices.

Thus, in the cognitive development plan "students have the ability to identify problems to be solved, to analyze their components, to think strategically. They have to develop a rational thought, which needs changing and organizing information.

At their age are fit, to acquire scientific theories, examine them critically and build new visions. Their thinking and intelligence potential is expressed in the in-depth study of an area and exposure of what they perceived and assimilated in front of the teachers, the highly qualified specialists, based on the training level of confrontation and understanding of issues of science" [2].

In this context, the linking between desire and fulfillment, develop attitudes that appear on the student's background **as the concept that he has the power to change the world, prompting changes in the self**, through the idea that his entire personality is a history.

Basically, the students' preparation level, deepening in the field study, reflexivity on what they learn elaboration of personal work on topics requested by teachers is a strong pathway towards its assertion, without being directly linked to the society, which can be indifferent or insignificant to them.

In the same time, he feels the need to have a product of its activity social reverberation. In this continuous balance between self and social esteem develops his intellectual future [3].

Because it is a constant "actor" in the academic environment, the student through its psychosocial profiles "defines a world in which the other partner, must start with all the confidence and responsibility, knowing and understanding the human being and not an object" [4].

In his whole attitudinal-behavioral approach in the academic environment, the student assimilates, accumulates and structures in a constant balance thoroughly built on cognitive and commitment processes, on adaptation and absorption between theory and practice so as one is complementary to the other in the context in which learning should be completed by the motricity and intellectual mobility.

Under these circumstances, the university must remain open towards the future, the coexistence between the two "actors" must be real and effective, so that the future of the student responsibility to be drawn into a logical-cognitive approach, ever since the beginning of his studies, the purpose being represented by progress.

Therefore, the training in a domain like medicine implies a "sine qua non" participation of all factors and parties in achieving maximum efficiency in terms of quality of medical care, and maintaining high standards of quality of human life. That is why clinical internship enrolls in the vocational training strategy in developing and guiding the professional future of current students, having a special impact on the value of future vocational orientation.

2. MATERIALS AND METHODS:

The present study aims to highlight the positive impact that the ICU internship has on the fifth year medical students, in terms of their medical and psychological preparation, involving them directly in subsequent vocational orientation (specialty/residency).

As psychological methods of investigation: conversation and observation were used; with a special emphasis on the questionnaire, as a defining element in achieving and evaluating the influence of students internship ICU training upon their general preparation and professional development.

The questionnaire consisted of 10 questions with multiple answer choice:

1. What is your opinion regarding ICU internship?
   a. it was instructive;
   b. it wasn't useful;
   c. it was satisfactory;
   d. other opinions.
2. What impressed you most during your ICU internship?
   a. the medical and academic staff;
   b. the medical cases, patients and pathologies;
   c. the staff professionalism;
   d. the team spirit of collaboration;
   e. other situations.
3. Were you emotionally involved in a case?
   a. yes;
   b. no;
   c. I don't know;
   d. I am not interested.
4. Do you consider that emotional involvement is welcomed?
   a. yes;
   b. no;
   c. I don't know;
   d. I am not interested.
5. Why do you consider that emotional involvement is useful/not useful?
   a. helps the communication relationship between doctor and patient;
   b. reduces work efficiency;
   c. other situations.
6. Do you consider that is necessary to modify the structure of ICU internship?
   a. yes;
   b. no;
   c. I don't know;
   d. I am not interested.

7. What did you disliked during the period of ICU internship?

a. the lack of involvement of medical and academic staff in the relationship with students;

b. the uncooperative patients;

c. the lack of cooperation between the medical staff and students;

d. the existence of organizational problems;

e. other situations.

8. Would you like to become a ICU physician in the future?

a. yes;

b. no;

c. I don't know;

d. I am not interested.

if yes, why?

a. it suits me;

b. it represents me;

c. I want to be accomplished professionally;

d. is a lucrative branch of medicine;

e. other situations.

9. Do you consider that your ICU internship can influence your decision? (in correlation with question 8)

a. yes;

b. no;

c. I don't know;

d. I am not interested.

10. Do you consider important the hospital where you did the ICU internship?

a. yes;

b. no;

c. I don't know;

d. I am not interested.

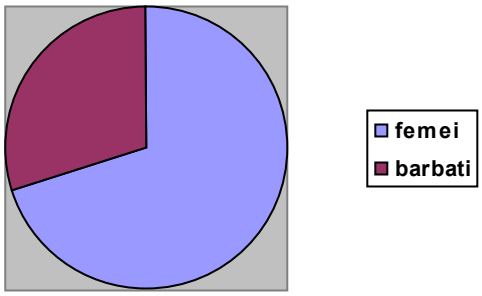
Under this identity, the questionnaire monitors the student's ability to be involved in the ICU internship in the context of a future vocational orientation.

3. RESULTS

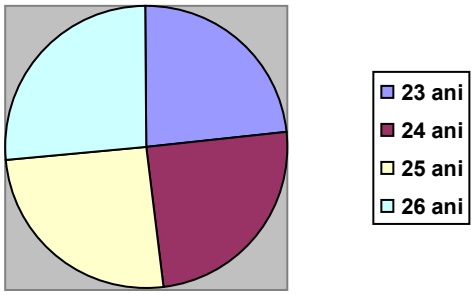
Decoding the questionnaire items reveals the cognitive elements of the interviewed student age, starting from perception, involvement and reaching awareness and responsibility, quantifying in an appropriate measure, the maturity of the subject in question at some point in progressive-human evolution.

Thus, as the identity element we started from the fact that the sample consisted of 150 students from the fifth year of the Faculty of Medicine grouped as it follows:

a. after gender:
- females – 105, representing 70%,
- males – 45, representing 30%.



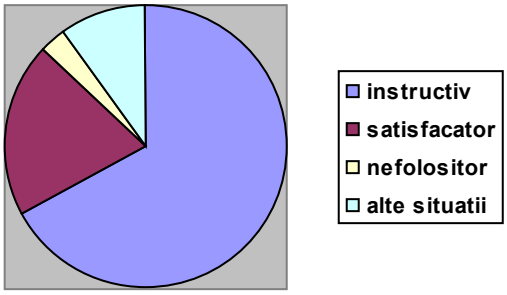
b. after age:
- 23 years – 65, representing 43%,
- 24 years – 70, representing 47%,
- 25 years – 10, representing 7%,
- 26 years – 5, representing 3%.



Decoding the items comprised in the questionnaire we captured the following answers:

1. What is your opinion regarding ICU internship?

67% of the respondents considered the internship as instructive, 20% satisfactory and only 3% considered it useless; which demonstrates the utility of ICU internship in the complex training of fifth year medical student.



2. What impressed you most during your ICU internship?

57% of the respondents answered that the medical cases, patients and pathologies encountered during the internship, which also certifies the involvement of the medical and academic staff 23%, completed with the professionalism of the medical staff 20%, and only 3% highlighted the team spirit collaboration, probably due the existing caseworks when applying the questionnaire.

Decoding the two items, we can capture the positive element regarding the two parties involvement "so that efficiency to be the expected and preparation to be adequate". Question three, four and five address to the volitional-emotional state of the student so that outdated or no, emotion has or no positive impact on communication between physician and patient. In this register we are able to apply the identity of physician-patient relationship, based on the structure of the five W:

a. **who ?** = who do I interact?

b. **what?** = what happens during the interaction?

c. **where?** = where (the location) takes place the interaction based on communication?

d. **when?** = when (in time) can I develop a relationship and then turn it into a relationship on the principle of cooperation and longevity?

e. **how?** = how the relationship can provide communication and communion relationship between people, leading to various interactions between them?

f. **why?** = why a communication relationship based on a correct communication relationship, consistent, stable and consistent is needed?

, as the message being or not the reason for a future relationship, so that:

3. Were you emotionally involved in a case?

70% of the respondents answered negatively, while,

4. Do you consider that emotional involvement is welcomed?

74% considered that it is not necessary, because:

5. Why do you consider that emotional involvement is useful/ not useful?

67% appreciating through correlation that emotional involvement can decrease working efficiency.

Regarding from the perspective of the ones who considered that personal involvement can be useful 23% considered that it is due to a necessity, while 13% considered that it helps the communication relationship between doctor and patient. We can observe also the existence of "I don't know" where: passivity, lack of involvement and inadequacy can create situations of: 3-7% and 4-13% in conjunction with other situations - 5 to 10%, which capture the opinions certifying an age doubled or not with a specific experience as:

a. for no:

- it is important to maintain a distance so as not to influence the medical act;
- emotional involvement is just not needed;
- involvement destabilizes psychologically;
- you can not think objective;
- involvement affects objective decision making;
- long-term involvement affects your personal life and emotional state causing undesirable effects.

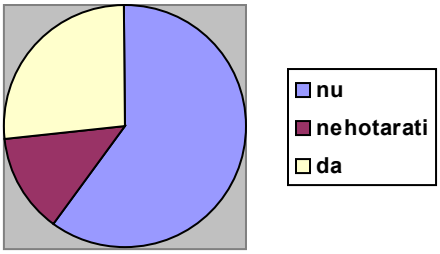
b. as well as emotion and involvement - yes:

- a better relationship between physician and patient;
- when you have some compassion for the patient, you are helping him.

The sixth question evaluates directly the involvement of the student in the internal structure of ICU internship:

6. Do you consider that is necessary to modify the structure of ICU internship?

60% of the respondents gave a negative response, 13% were undecided and 27% respondent positively an argument being that viable existence of:



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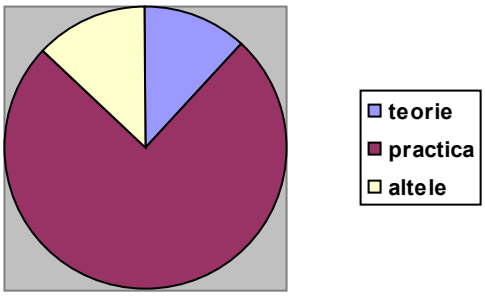
a. more hours of theory - 12%;
b. more hours of practical training - 75%;
c. other situations - 13%; stating that it is necessary that:
- students to have a different role than being a spectator at the patient bedside;
- theoretical verification to be held first, then the practical ones;
- synchronization of practical training and theoretical instruction;
- better collaboration between student and resident,



as well as the desire that presentations and discussions to start earlier, in terms of time as a factor in the implementation of the ICU internship, as important is the involvement and relevance of the argument concerned.

In counterpart, question **7. What did you disliked during the period of ICU internship?** 30% of the respondents answered the existence of organizational problems, 23 % the lack of cooperation between the medical staff and students, 17% the uncooperative patients, and also other situations 17% are highlighted as:
- disagreements with the room physician;
- the particular stress that the student and the physician are submitted;
- lack of communication between colleagues;
- the need of interactive case presentations,

in correlation with different time factors:
- the internship starts too early in the morning;
- had to wake up at 6.30 in the morning;
- the clock terrorized me,

but what really brings value to the questionnaire are the pertinent remarks:
- the time window between the end of the visit and beginning of presentations is approximately one hour, and it would be useful to read something about the case, but there is no quiet place where I could do that, it would useful if a study hall for students would be created;

It's time to implement on this item a few opinions from other situations - items 1 and 2:
1. stressful, exhausting, tense;
2. involvement of academic staff in the action: the teacher puts us to introduce new cases,

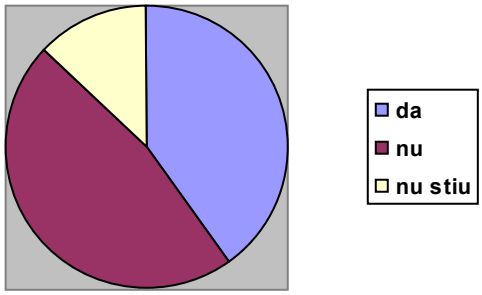
Through its complexity, question **8. Would you like to become a ICU doctor in the future?** submit to our attention the choice, encoding responsibility by evaluating the impact of ICU internship on the future development and the final decision regarding the professional career of the student; paradoxically only 10% would like to become a ICU doctor motivating their choice by:
a. it suits me – 10%;
b. it represents me – 7%;
c. I want to be accomplished professionally – 7%;

while the overwhelming percentage of 70% that do not want this career, recognizing that:
a. they do not fit – 40%;
b. it doesn't represent them – 27%;
c. it's beyond their professional capabilities – 3%,

and also because it is not a lucrative branch of medicine 3% and other situations 3% reflected by:
- it is too painful;
- no time for personal life and family;
- it is a specialty that keeps "plugged-in" all the time.

Gratifying is that the student has the opportunity to decide knowingly and wittingly about his future, reducing random elements, with fortitude and accountable to the gesture through making a decision, so regarding the answers to question **9. Do you think that your ICU internship can influence decision?**, percentages may overturn previous syllogism as:

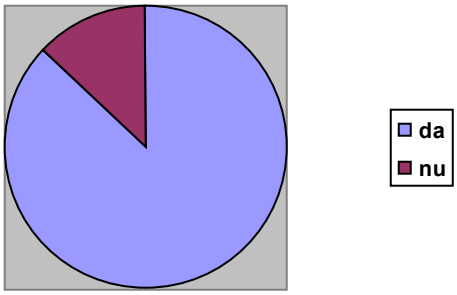
a. yes - 40%;
b. no - 47%;
c. I don't know - 13%,



in the idea that a summer practice, another internship during the sixth year or another situation according to the particular period of time, may influence the decision of the fifth year student which may not become decisive.

10. Do you consider important the hospital where you did the ICU internship?

87% of the respondents answered yes and only 13% stated that the location of the hospital has no influence at all.



The decoded results capture in a certain equation the contextually of the first contact of the fifth year medical student during his ICU internship, the impact it has on student experience a year before its decision on through residency specialty choice, both positive and negative arguments are cognoscible plausible in the their approach of maturity vs. immaturity being found in a particular structural situation.

4. CONCLUSIONS

Our structural - attitudinal approach surprised a constructive attitude defining elements that generate quality internship program, in this case, ICU internship, highlighting both good specialized academic training and direct involvement in the development stage of the students, his feed back representing the impact on his future elections by targeting vocational orientation (specialist, resident), so the relationship between the two actors from the academic field to be a bi-univocal structural identity with a barometer and ultimately causing an efficient academic training and certifying performance value and human progress.

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INFORMATION AGE VIEW OF THE OODA LOOP

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Abstract: *In this paper I present a point of view of OODA loop from an engineering perspective. In my opinion, Jon Boyd was right when he splinted the processes which change the environment in four parts, Observation, Orientation, Decision and Action. Also he was right when endorsed the Orientation as key of his loop. For this reason he gave a more attention to Orientation part of the loop. In Orientation phase of the loop did he elaborate components like: Cultural Traditions, Genetic Heritage, Analysis/Synthesis, New Information and Previous Experience. All of these elements are interconnected and have a great influence on Orientation phase. Based on his previous experience Boyd created his loop. He used a feedback way in order to create close loop system but he put this four phases in a linear way which create all confusions related to OODA loop. In fact in order to use the feedback in a proper way as the nature created and used it in so many examples we should put the Observation in a feedback way of the loop. In this way we put the OODA loop in accordance with control theory. Also the Observation phase is not a step in a loop is a continuous process because it is focused on the exterior of the loop. An analysis of this new configuration of OODA loop will be presented in this paper using tools from control theory.*

Keywords*: Observation, Orientation, Decision, Action, Control Theory, Feedback, Information Age*

1. INTRODUCTION

In order to find a way to increase the victories ratio in air fight during the Vietnam War the pilot Jon Boyd discovered the four steps which are applied to every confrontation. Later he observed it can apply his loop to other situation or systems. He paid more attention in order to refine his OODA loop and he recognized the importance of orientation. For this reason he gave a more attention to Orientation part of the loop.

In Orientation phase of the loop did he elaborate components like: Cultural Traditions, Genetic Heritage, Analysis/Synthesis, New Information and Previous Experience. All of these elements are interconnected and have a great influence on Orientation phase. Also he was right when he represented his loop. Instead to put all four phases of the loop in a circle he was wise and depicted a feedback way from action to observation like in fig. 1.

2. OODA LOOP IN INFORMATION AGE

Before to make any commentary to OODA loop first let present every step of the loop. First step according to Boyd's loop is Observation.

During this step the information are collected. In order to keep things simple let assume the information refer to real word. This information should give us a picture of real word very close to reality.

Even if this step was depicted first in OODA loop it is true the Observation do not stop. It is a continuous process which never ends. By putting Observation as first step lead us to a wrong way. For this reason a lot of people represent the OODA loop like a circle.

This is a big mistake an also do not respect Boyd's representation of the loop. The action of gathering information always implies the existence of a sensor.

Generally speaking in order to complete the Observation step we need some sensors to measure the outcome of process and to give us the most real picture.

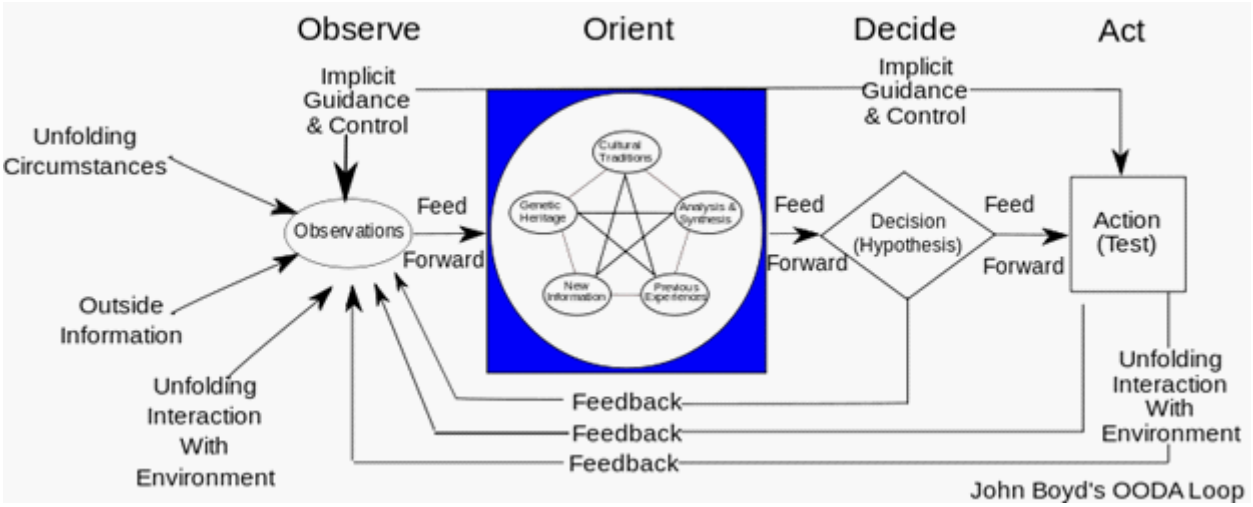

Fig. 1 John Boyd's OODA loop

Now I hope is obvious the Observation is a continuous process which never ends. The Observation has a great influence on the speed of the loop.

The OODA loop create a lag and if this lag is bigger than time of the outcome process change the Action will be based on a reality which is no longer available. The speed of changes of outcome process is measured during the Observation and this information is feed forward to Orientation phase of the OODA loop.

Based on this information the speed of OODA loop can be adapted to the speed of changes of outcome process in order to achieve a great efficiency and effectiveness of the loop.

We should take into account the OODA loop is used in Information Age. For this reason the Observation phase is more important than Boyd predicted.

Now the Orientation phase does not make prediction based on little information, during the Orientation the large amount of information provided by the Observation should be analyzed in order to extract the valuable information and this is not an easy task.

Here I agree with dr. Donald A. Maccuish and I support his analyses related Orientation phase in the paper "*Orientation: key to the OODA loop – the culture factor"* but his analyses is based on how certain organization use OODA loop even if they are aware or not about this.

If an organization alter the OODA loop because of cultural traditions that do not mean the loop is wrong. Instead to try to change the OODA loop in order to be adapted to our organization we should change our organization to become much agile and this is not an easy task.

What is the general purpose of Orientation phase?

From my engineering point of view Orientation phase should create an error signal. In order to provide this error signal two information should be compared.

First is the mission of the organization which represents the entrance of the loop.

This information should be compared with information provided by the Observation phase.

How this process of comparison should be done is another story but at a very general level this is the meaning of Orientation phase. From here result also the importance of Orientation phase; an error at this level can lead entire organization in to a wrong way. Even if the goal is right and the information about real world are very accurate because of Cultural traditions and Genetic Heritage the result can be wrong. These mistakes are possible because at this moment of development the computers cannot replace yet the humans involved in this phase. Finally the humans will be replaced because the amount of information provided by the Observation phase will increase and in order to process this large amount of information we have two ways: to increase the number of people involved in process (less efficient) or to use computers.

If we put computers in Orientation phase the general purpose emerge and all discussions related with this phase are useless.

Even with this assumptions the Orientation phase remain the main important phase of the OODA loop because all available information should be analyzed and only the valuable result should be forwarded to the Decision phase.

At the beginning I want to stress the fact that the Decision phase is only for humans' even if they can be helped by a computer program. At the end the decisions belong to humans.

During this phase the difference between the reality and our goal is analyzed and proper commands are issued forward. From this point of view we can see how the importance of Decision phase increase and Orientation phase decrease but Boyd are still right.

All components from Orientation phase would by find in Decision phase, Cultural Traditions, Genetic Heritage, Analysis/ Synthesis, New Information and Previous Experience, because we can find these components where the humans are involved.

At the end the Boyd's OODA loop is still available but should evolve according to the evolution of information technology. We must adapt the OODA loop to the Information Age.

With proper commands issued, during the Action phase we will use the available tools to change the reality according to our dreams. According with all this the Information Age OODA loop will look like in fig. 2.

In fact the loop is the same but the importance has shifted to the Decision phase.

All external actions to this process are represented by Disturbance. That Disturbance can affect all phases of the loop but for simplicity were represented after Action phase because at the end the result of Disturbance will affect the interaction with environment.

3. FEEDBACK ANALYSES

If we depicted the OODA loop in this way we got a strong feedback. The Observation phase represents the feedback of the process.

This feedback will protect the system against the external disturbances and also against the malfunction of one of these phases. In order to prove this affirmation let make some notation on OODA loop like in fig. 3.

Where:

G – Goals; E – Errors; R – Results; S – Sensors; C – Commands; D – Decisions; A – Actions; T – Tools; P – Perturbation.

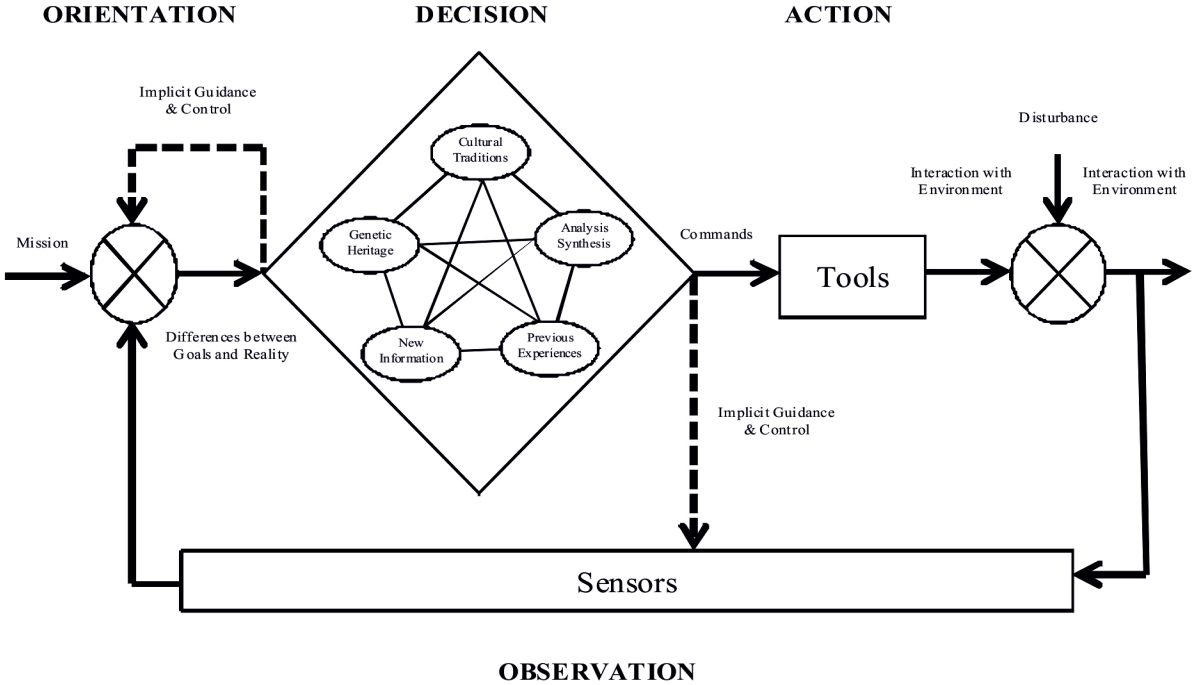

Fig. 2 Information Age OODA loop

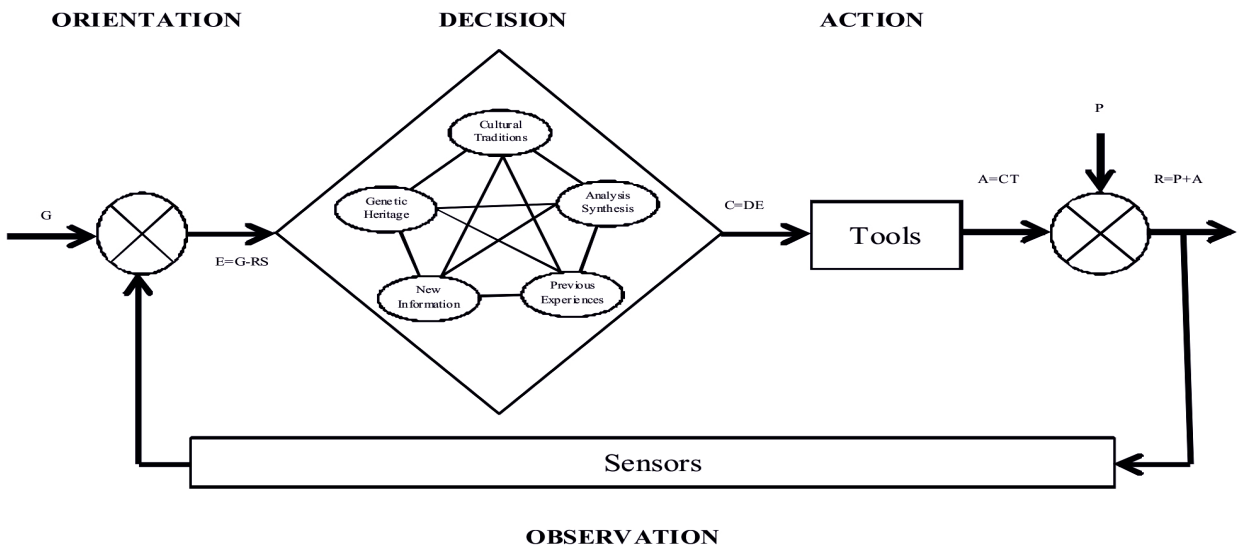

Fig. 3 Feedback analyses of OODA loop

According with these notations we can write:

$$E = G - RS \quad (1)$$
$$R = P + A \quad (2)$$
$$A = CT \quad (3)$$
$$C = DE \quad (4)$$

From 2, 3 and 4 result:

$$R = P + DET \quad (5)$$

And from 1 and 5 result:

$$R = P + DT(G - RS) \quad (6)$$
$$R = DTG - DTRS \quad (7)$$
$$R + DTRS = P + DTG \quad (8)$$
$$R(1 + DTS) = P + DTG \quad (9)$$
$$R = P / (1+DTS) + DTG/(1+DTS) \quad (10)$$
$$R = P\ 1/(1+DTS) + G\ DT/(1+DTS) \quad (11)$$

The values of DT product are 1 for bad decision and improper tools and 100 for best decision and proper tools. Let assume the value of S is 1. That means the sensors measure the reality very accurate.

First analysis is about the influences of perturbation in the result in two cases 1 and 100 for DT product.

$$R = P\ 1/1+1 + G\ 1/1+1 \quad (12)$$
$$R = P\ 1/2 + G\ 1/2 \quad (13)$$

We can observe only half of the perturbation affect the achievement of goal. The perturbations are cut in half even in the worst scenario with bad decision makers and improper tools.

$$R = P\ 1/1+100 + G\ 100/1+100 \quad (14)$$
$$R = P\ 1/101 + G\ 100/101 \quad (15)$$

We can observe the perturbation influence the result with only 1 % and the goal is achieved in proportion by 99 %. In this way the loop is protected against external perturbations but is also protected against bad decisions and improper tools.

We assume the difference between results (reality) and goals (desires) during Orientation phase is correct. In fact this difference must be correct because the output information of sensors should be presented in such a way to be easy to compare with goals.

4. CONCLUSIONS

The Boyd's OODA loop should be changed to fit the requirements of Information Age. The Observation phase should be the feedback of the loop in order to protect the loop against external disturbances.

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CRITICAL AVIATION INFRASTRUCTURES VULNERABILITY ASSESSMENT TO TERRORIST THREATS

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Abstract: *The main purpose of risk assessment methods is to identify the breaches of the system, to estimate the likelihood of a threat and to propose solutions for risk mitigation. One of the critical components of the risk assessment process is to determine the vulnerability of critical infrastructure/system based on possible risk scenarios. The solutions presented by the vulnerability assessment are divided into two categories: a quantitative model built on the basis of the theory of multi-parameter values and adapted to complex systems by using morphological analysis and a model based on probability theory of assumptions.*

Keywords: *vulnerability assessment, terrorism, aviation infrastructure*

1. INTRODUCTION

The airport, as a main infrastructure of aviation system, is a favorite target of terrorist attacks first because of the human losses and material damage, but also because of the powerful psychological impact in case of a success. Any disturbance to the stability of the whole air transport systems will have a leverage effect: decrease the safety of passengers and reduce the demand of air transport services, losses in the aviation industry and ultimately disturbing economic stability (Patriot Act, 2001).

Predictive models for assessing the risk of terrorism are particularly useful, but they have limitations in case of events of unknown typology or events which happen once. A possible solution could be to identify a causal link between the initial events (movement of people considered suspicious, transfers of money in their accounts, trying to purchase some dangerous substances, etc.), frequent and observable enough in terms of consequences, and extreme event (terrorist attack), so that the results can be extrapolated (JASON, 2009).

Frequency-magnitude distribution model, originally developed for natural disasters (Newman, 2005), has been adopted and for terrorist events (Clauset et al., 2008).

The morphological model (Ritchey, 1997; Zwicky, 1969) is another descriptive analysis model of the complex situations by dividing the problem into the parameters/ variables/ components and identification all of those relationships. The use of repetitive cycles of analysis and synthesis, as well as building an internal structure as matrix type, is the main advantage of this method.

The U.S. Department of Homeland Security used for terrorist risk assessment a model built on events tree architecture, in terms of annual frequency of occurrence, the probability of successful attack and failure of countermeasures, and consequences (Cheesebrough and Wise; 2012).

Quantitative assessment approach of the level of vulnerability, identifying physical characteristics and operational attributes that expose critical aviation infrastructure to terrorist threat (DHS, 2008), become essential in achieving security and safety.

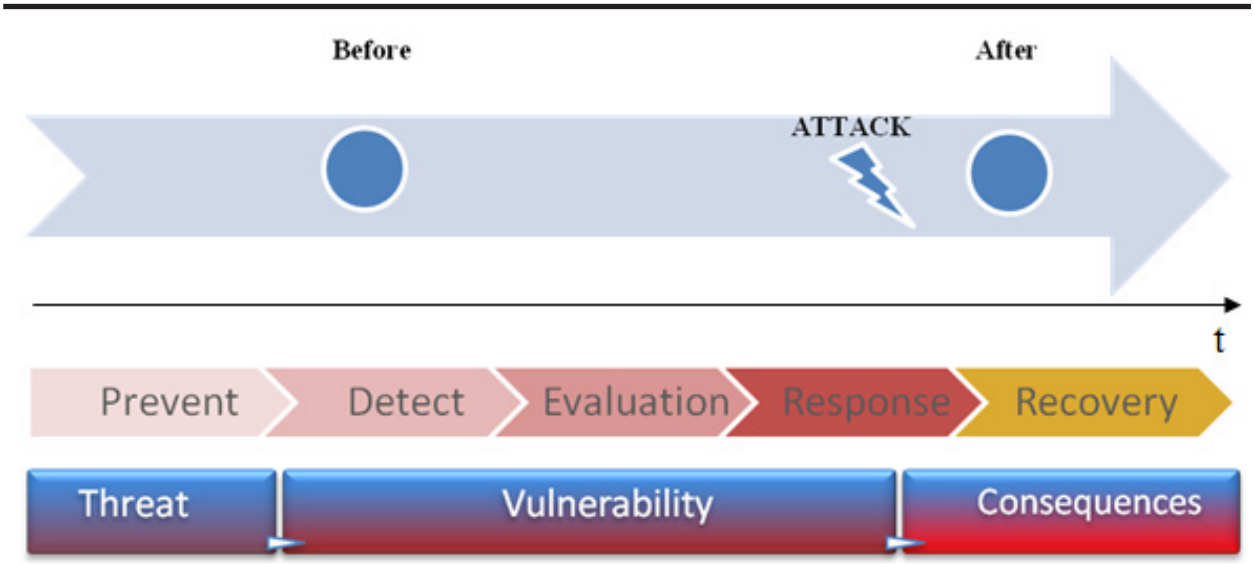

Fig. 1. The architecture of terrorism risk evaluation

In order to release the risk analysis by external pressures in setting the levels of threat, especially to assess vulnerability and consequences of possible attacks, we use a quantitative approach. Application of quantitative techniques to evaluate the risk of terrorism can bring the following advantages: reduction of attack risk for some targets, by converting them into less attractive targets for terrorists; increasing resilience of system; reduction of recovery time after the attack; preventing the spread of cascading effects.

The process of terrorism risk assessment can be thought in the context of a general framework, in which the level of vulnerability determines the effectiveness of the system (Fig. 1).

Stages of evaluation of the threat, vulnerabilities and consequences are particularly important in risk quantification approach because it requires, on the one hand, the availability of specialists in intelligence structures and to interact and provide timely information needed for further tests, and on the other hand, the definition of normality. We can talk about such a process of risk management in order to increase the level of understanding of the issue of risk. Better understanding of the threat, vulnerability and consequences of an attack by using quantitative and qualitative assessments allow decision factors to initiate mechanisms of prevention and detection before becoming a reality the potential consequences (Morar and Stefan, 2012).

2. DEFINING A SYSTEM IN TERMS OF VULNERABILITY

The main parts of the paper will be introduced by numbered titles with Arabic figures and printed in capitals, font 12pt, bold, centered. A free space will be left above the text and another one below it. Paragraphs will be 6mm indented.

The security risk is viewed as a function of the nature of the threat (T), vulnerabilities to attack of a system (V) and the consequences (C) associated with a possible attack scenario (Willis et al., 2005).

In risk analysis, vulnerability is assessed in probability known or perceived of a breakthroughs existence or a malfunction in the system/infrastructure review for a certain period of time in the context of a threat scenario type.

Vulnerability = Probability (successful attack)

Vulnerability assessment refers to the ability of the system to detect the initial event (IE), to delay it in order to prepare the answer and to act in such a way as to interrupt the spread of the system

To assess the vulnerability of aviation critical infrastructures, the following construct which defines the five functions of survival of a system is considered: detection, evaluation, response, recovery, prevention (DERRP).

Detection is the likelihood of establishing that an IE has been or will be held on the basis of the warnings. Evaluation is given by the probability of the occurrence of false alarms. The response is defined by the reaction time of the system necessary to limit or eliminate the effects of propagation. Recovery is the time to return the system to the normality. Prevention is expressed through the totality of measures taken to reduce the vulnerabilities of the system, perceived by adversary as being very difficult to pass.

Since the vulnerability is the likelihood of success of an event, once it has been initiated (V = psuccess/IE), then it can be calculated as:

$$V = 1 - \left[\begin{matrix} p(det|E) \times p(eval|E) \times p(resp|E) \times p(rec|E) \times \\ p(prev|E) \end{matrix} \right] \quad (1)$$

An event is initially combated if all stages are completed, or it becomes a failure if any of the phases fail.

3. DETERMINATION OF VULNERABILITY BASED ON PROBABILITA ASSUMPTIONS

3.1 The probability of future events. The assumptions theorem does not provide the possibility of determining the probability of events occurrence, but their distribution. Thus, in terms of the air transport system, whether within a time interval Δt occurred N events (attacks), K times that being controlled (when one or more combination of several survival functions), the question arises of determining the probability of k times controlled the next n events.

The number of possible variants to occur is C^k_n, and the probability of k times from n possible event is $p^k q^{n-k}$.

The connection between the known data (N, K) and those meant to be calculated (the probability of any variants) is attested in equation (2).

$$p^k \cdot q^{n-k} = \frac{p^{K+k} \cdot q^{N+n-(K+k)}}{p^K \cdot q^{N-K}} \quad (2)$$

The occurrence probability p is calculated by integrating the distribution densities ($p^{K+k} \cdot q^{N+n-(K+k)}$, $p^K \cdot q^{N-K}$) of the probability for a single variant in range of values from 0 to 1. The most likely value of the probability of an occurrence variant of k times of event n is given in equation (3).

$$p = \frac{\int_0^1 p^{K+k} \cdot q^{N+n-(K+k)} dp}{\int_0^1 p^K \cdot q^{N-K} dp} = \frac{\int_0^1 p^{K+k} \cdot (1-p)^{N+n-(K+k)} dp}{\int_0^1 p^K \cdot (1-p)^{N-K} dp} \quad (3)$$

Thus it can determine the occurrence probability of any variant, as the product of the number of variants and the occurrence probability of the variant (eq. 4).

$$P = C^k_n \cdot p = \frac{C^k_n \cdot C^K_N (N+1)}{C^{K+k}_{N+n} (N+n+1)} \quad (4)$$

The sum of all probabilities of possible cases should be equal to 1.

3.2 Case study: Assessing the vulnerability of the air transport system to a terrorist attack. The case study is based on data about terrorist attacks on aviation infrastructure in Europe and North America during 1990-2009. The scenario considered is bomb attack. Statistical data are presented in Fig. 2.

Of the total of 34 attacks launched, 29 have been controlled (with no loss of life or injuries). The question is to determine the probability of combat and the following four possible attacks.

Under these conditions, the problem data are as follows:

$N = 34; K = 29; n = k = 4$

Then:

$$P_4 = \frac{C^4_4 \cdot C^{29}_{34} \cdot 35}{C^{33}_{38} \cdot 39} \cong 0{,}5$$

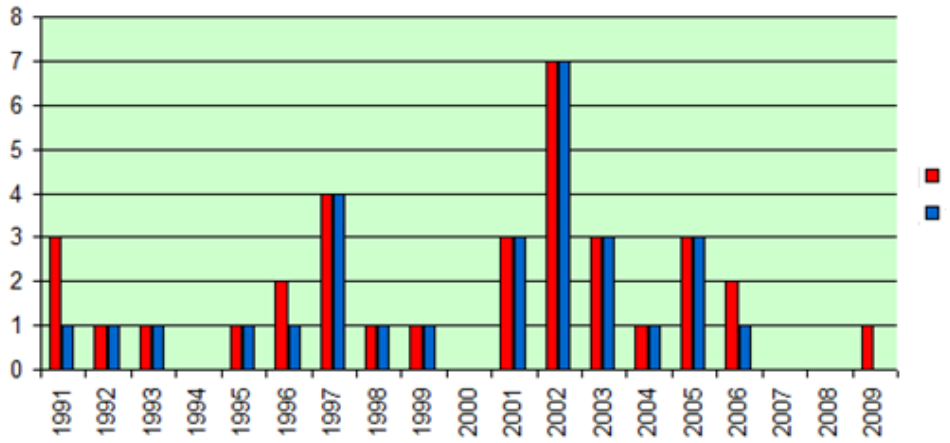

Fig. 2. Bomb terrorist attacks over aviation infrastructure in North America and Europe during 1990-2009
Source: RAND Database of Worldwide Terrorism Incidents

The result can be interpreted in terms of vulnerability, as follows: the next four attacks can be controlled entirely with a probability of 50%, which denotes a vulnerability of the system by 50%.

Similarly it can determine probabilities for other possible variants (no attack controlled in the following 4, controlled 1, 2 or 3 attacks).

4. DETERMINATION OF VULNERABILITY BASED ON THE THEORY OF MULTI-PARAMETER VALUES

4.1 I-VAM model application. The vulnerability is a state of the system/ infrastructure and can be quantified by using the model for assessing the vulnerability of the infrastructure I-VAM (Ezell, 2007). The model is quantitatively, based on the theory of multi-parameter values and adapted for complex systems by using morphological analysis.

Model's architecture is projected onto five functions that measure the level of protection of each subsystem/component. To each of these functions (detection, assessment, response, recovery, and prevention) values are assigned, in a scale of 1 to 100 based on experience or opinion of the experts. The data acquisition process from experts (NUREG 1150, 1990) takes place in six stages:

1. identification and selection of experts;
2. lecture about probability theory;
3. presentation of the risk scenarios and system architecture;
4. collection and analysis of data (software support);
5. presentation and discussion of results;
6. development of risk plan.

The DERRP model is constructed so that each stage contributes to changing the perception of the attacker, in the sense of transmitting the feeling *unable to pass*.

The aggregate value of the function is expressed in relation (5), where m is the size of the assessment, x_m the level of m measurement, $v_m(x_m)$ value of the function at x_m level, and w_m is the product of the weights for each hierarchical level above the calculated (Parnell, 1998).

$$V(x) = \sum_{m=1}^{n} w_m v_m(x_m) \tag{5}$$

The initial data required for the model, represented by the relative importance score and weight of components, are provided by experts and obtained on the basis of an assigning procedure.

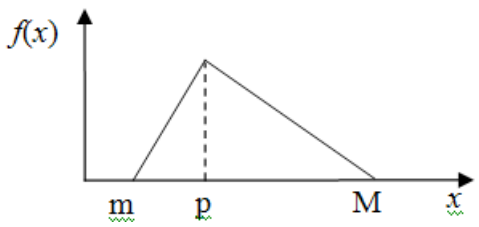

Fig. 3. Triangular distribution

The calculation of the expected conditional value is made using triangular distribution (Haimes, 2004). Considering the minimum (m), maximum (M) and probable (p) values provided by experts as representing values of a triangular distribution, resulting probability density function *f(x)* depending on the random variable *x* (Fig. 3).

The calculation of the expected value E[x] for a triangular distribution is made using the equation (6).

$$\mathrm{E}[x]=\int_{x}^{\infty} xf(x)\mathrm{d}x \tag{6}$$

To create the structure of the value model, a functional decomposition of the system into subsystems and components is required. For example, it is considered the airport infrastructure as a complex system whose functional structure is shown in Fig. 4 (Nisalke, 2009).

On the basis of functional architecture, the I-VAM model can be build. Thus, considering the *aircraft* (1.1.1) as being made up of the *fuselage* (1.1.1.1), *engines* (1.1.1.2), *flight control equipment* (1.1.1.3), you can calculate the value of this component according to the equation (7).

$$v_{1.1.1}(x_{1.1.1}) = w_{1.1.1.1}\cdot v_{1.1.1.1}(x_{1.1.1.1}) + w_{1.1.1.2}\cdot v_{1.1.1.2}(x_{1.1.1.2}) + w_{1.1.1.3}\cdot v_{1.1.1.3}(x_{1.1.1.3}) \tag{7}$$

The vulnerability of the *aircraft* ($\Omega_{1.1.1}$) is calculated (eq. 8) according to the value of the maximum possible score (v^*) and the calculated value ($v_{1.1.1}$).

$$\Omega_{1.1.1} = v^*(x) - v_{1.1.1}(x) \tag{8}$$

The score value of *air operations* subsystem (1.1) is the sum of the products of all the associated components and weight associated. For this case, the subsystem value is given by equation (9).

$$v_{1.1}(x) = w_{1.1.1}\cdot v_{1.1.1}(x) + w_{1.1.2}\cdot v_{1.1.2}(x) + w_{1.1.3}\cdot v_{1.1.3}(x) + w_{1.1.4}\cdot v_{1.1.4}(x) \tag{9}$$

Calculate the subsystem vulnerability ($\Omega_{1.1}$).

Similarly to all other subsystems, resulting in final the vulnerability of the system, expressed in the relation (10).

$$\Omega = V^*(X) - V(X) \tag{10}$$

where $V^*(X)$ represents the maximum value (100) and $V(X)$ is the total value of the system (eq. 11).

$$V(X) = w_{1.1}\cdot v_{1.1}(x) + w_{1.2}\cdot v_{1.2}(x) \tag{11}$$

The following assessment is used to verify the model:

- on every hierarchically level, the sum of the weights must be equal to 1 (eq. 12);

$$\sum_{i=1}^{m} w_m = 1 \tag{12}$$

- the sum of values' products at component level has to be equal to the sum of the products at the subsystem level (eq. 13), and parameters are positive (eq. 14).

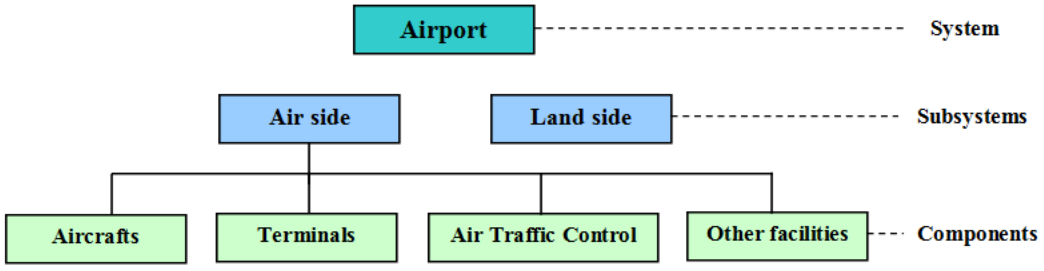

Fig. 4. Simplified functional architecture model of an airport

$$\sum_{i=1.1}^{1.2} w_m \cdot v_m(x_m) = \sum_{i=1.1.1}^{1.2.3} w_m \cdot v_m(x_m) \quad (13)$$

- $x, v(x), w \geq 0$ (14)

I-VAM model carries out the vulnerability assessment of a critical infrastructure/system according to possible scenarios, which realize in fact the link between vulnerability and risk. In the example shown, we have demonstrated that the vulnerability can be quantified through measures contained in the management of extreme events, and the omega value of vulnerability can be easily compared to the system score.

4.2 Case Study: Assessing vulnerability of an airport to a terrorist attack.

The initial data required for the model, represented by relative importance score and weights of components, were supplied by three experts in the field of airport security, on the basis of an assigning procedure. Determination of submitted scores weight was carried out according to the specialty and experience in the security field.

In the shown example was considered, as a measure of protection for each component in the system, the function of detection.

The scenario considered is a terrorist bomb attack on an international airport.

Vulnerability assessment stages are:

1. The functional architecture of the attacked system (theoretical model) (Fig. 4).

2. Assigning relative importance and the calculation of weights for detection function (Table 1).

Table 1. Assigning relative importance

Component	Relative importance	Weight
Aircraft (1.1.1)	10	0.33
Terminal (1.1.2)	9	0,30
Air Traffic Control (1.1.3)	6	0,20
Technical Support (1.1.4)	5	0,17
Access Point (1.2.1)	7	0,39

3. System analysis - data provided by the 3 evaluators were modeled after a triangular distribution (Table 2).

Table 2. Assigning values for each component

Component	Assessor 1 (0,3)		
	Min	Prob.	Max
Aircraft (1.1.1)	0,0	0,1	0,3
Terminal (1.1.2)	0,2	0,5	0,7
Air Traffic Control (1.1.3)	2	10	20
Technical Support (1.1.4)	1	5	15
Access Point (1.2.1)	20	45	90
Registration area (1.2.2)	10	30	45
Public facilities (1.2.3)	15	35	60

4. Calculation of expected value (Table 3).

Table 3. Determine the expected value of vulnerability

Component	Weight	*v(x)*	Ω
(1.1.1)	0.33	0,16	0,14
(1.1.2)	0,30	0,46	0,24
(1.1.3)	0,20	13,0	6,5
(1.1.4)	0,17	6,96	5,94
(1.2.1)	0,39	46,0	32,0
(1.2.2)	0,33	30,1	19,4
(1.2.3)	0,28	39,8	29,2

The value of vulnerability for entire system is 82.89%. The model highlighted a very large system vulnerability (the airport) to the threat (bomb attack) for two reasons:

1. only the detection function was taken into account;

2. identification of the fact that the *land side* induces a significant vulnerability in the system, with all the security measures taken so far.

5. CONCLUSIONS

Quantifying the vulnerability of critical infrastructure according to the threat scenario and the measures of protection that can be applied (detection, evaluation, response, recovery, prevention) is the great reward of the study.

The aim of this study is to define the most appropriate model for the analysis of the vulnerability of the aviation system from the risk of terrorism, allowing an improvement in security and safety. Quantification does not mean certainty, but the adequate surprise growth processes, allowing an understanding of the mechanisms of risk assessment of terrorism in aviation.

Vulnerability assessment challenges come from: reduced number of terrorist attacks and the diversity of strategies used, the fact that one cannot extrapolate the data to estimate the risk of terrorism in the future; the danger of underestimation (to avoid criticism), or overrating (to justify security investments); the call to the community of information (some data collected cannot be used due to the classified nature).

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ASPECTS REGARDING THE SECURITY OF INFORMATION AND DATABASES OF THE STRATEGIC INFORMATION SYSTEM

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Abstract: *The permanent objective of any information system is to ensure, in conditions of maximum precision and efficiency, the information required by management and executive structures in order to decide and act efficiently and in a proper manner. Direct and indirect methods of action used against this desideratum, although it seems unimaginable under the current conditions of "total transparency" of the battlefield, are actions of masking and deceit in order to achieve surprise and to avoid being caught by surprise.*

Keywords: *information; information channels, information security, information systems, databases, security mechanism, information environment, information culture.*

1. INTRODUCTION

The information system, as part of the whole management of the military structure, contributes to directing and focusing the effort of decision and action, under maximum convenience and efficiency. Increasing the performance of an information system is given by the need to adapt to the new conditions of the current security environment, the continuous development of techniques and information technologies, structural, economic and financial limits.

The structure of the security mechanism is hierarchically functional with structured security elements that are able to cover the physical, technological, and personnel information and ensure all security services: protection, deterrence, detection, delay, stops; limiting or annihilating consequences of unwanted security events; resuming the production and post factum analysis to improve security reactions.

2. INFORMATION SECURITY WITHIN THE STRATEGIC INFORMATION SYSTEM

Regarding *information security* during their movement through the information system, (given that the information system is vulnerable, especially in terms of ensuring security of information circulation outside the structures of the Ministry of National Defense), the main problem is ensuring protection of data content in the transmission of information. This environment may consist of national communications network, allocated or leased trunks from fixed telephony operators, or air environment for radio communications.

Analyzing this perspective, we believe that information security can be achieved, depending on the nature of the information conveyed, primarily through *cryptography*. The digital encryption allows information to be reduced to a stream of binary data. Specialized cryptographic mechanism creates a long stream of binary repetitive digits, based on a traffic encryption code (TEK - Traffic Encryption Key).

Data flow along with string of random numbers, properly mixed, creates the encrypted data or cipher text. A binary stream carried in this way will be unpredictable, providing a very secure way to defense information. The entire analog signals specific to information systems are more predictable and obviously less secure.

A new type of key control system, used due to its efficiency, is the cryptography made with public keys. Under this level, each user produces two keys. One is the public key "Y" and the other is the private key "X". Using this system, one can communicate a piece of information, from anywhere, encrypted with the Y key, which can be decrypted only by the user who holds the X key. Thus, in a system that uses this way of working with the public keys, exchanges classified on two levels are possible. This is called asymmetric key set. On the other hand, there is a set of symmetric keys which, by working with the same key, encrypts or decrypts data. Since both the operator and the operator issuing the received message must have the same key, this set offers the highest level of security.

An effective solution, recently developed for the radio networks, uses radio system reprogramming (OTAR - Over The Air Rekeying). This technical way of working almost eliminates the requirement to manually load the keys, providing secure management. OTAR is a way of key distribution that contains an encryption / hide key (KEK - Key Encryption Key) used to hide the encryption key of work, and more functional keys, TRANSEC or COMSEC. Such process is called 'packing' to be distinguished from traffic encryption. The unique initial key to be accessed both in emission units and in the receiver is the key KEK. After packing, the phase that follows is distribution, a process that can use any physical or electronic means. In OTAR, the "wrapped" keys are trapped in a message transmitted by radio link and to the desired station; using link protocols without error (any error would bring the keys in an ineffective situation). The link is permanently encrypted by the available traffic encryption key.

The content of the key is twice protected during radio transmission, effectively eliminating any possibility of discredit.

For higher security level, it is customary to digitize through a coder, the digital signal being then treated as a real data stream.

Basic security services for each local computer network of the information system included in the security architecture OSI (Open Systems Interconnection) are as follows:

- *authentication*, away identity verification of a communication unit (message) and its source;
- *access control*, which provides protection from unauthorized use of resources;
- *data privacy*, data protection against unauthorized reading;
- *data integrity*, ensures true content of all data belonging to users of the network or of selected fields in messages exchanged by a link connection-oriented or non-oriented, ensuring detection of any changes, insertions or deletions of data;
- *provenience or delivery confirmation.*

3. DATABASE SECURITY WITHIN THE STRATEGIC INFORMATION SYSTEM

The overall objective of the management system for distributed databases is to obtain full software support to enable developing database exercises. But this objective cannot be achieved without taking into account the operational objectives of the information system. Mainly, these operational objectives consist of providing security for circulating data and ensuring the achievement of strategic information in real time.

The database security means protecting databases against unauthorized use and especially against unwanted changes and destruction of data or unauthorized data readings. Technical and administrative measures are taken in order to gain information security. Database security is generally associated with the following conditions: illegal access to data, loss of confidentiality, loss of character of data, loss of data integrity, loss of data availability. It is more difficult to protect the data against fraudulent access. In fact, it is known that there can be no safe protection systems, but only security measures and information protection with greater or lesser effectiveness.

Fraudulent access to databases is represented by: unauthorized data reading, unauthorized data editing, unauthorized data deleting. The database security concept is associated with bad intended access, while integrity means avoiding accidental loss in the data consistency.

Security measures for database protection are taken on many levels: *physical level* – the room in which the PCs are situated is protected against unauthorized access; *human level* – limited information access is recommended, while authorizations should be given carefully, with written evidence of authorized persons; *operating system level* – data protection weaknesses may be eliminated or compensated with other measures; *database management level* – the system should allow privileges in order to consolidate data protection.

Regarding data security only authorized and controlled access should be allowed, the main responsibility belonging to the database administrator. The main aspects of providing database security, according to us, are: authorized building access, through passwords, operator classes and operator profiles; use of views for external database schemes; special access procedures and data encryption through encryption/decryption schemes.

For *authorizing building entrance* by passwords, classes of operators (with certain privileges) and operator profiles (name, password, class, code, level of access, potential resources), each user is given different operating limits for portions of the database, at certain levels, such as: relation, record, page, attribute, etc.. Limits or data access rights refer to the possibility of reading, insertion, deletion or modification of data, and editing of reports. Identity verification is usually done by codes or passwords approved either by the database head / administrator or system administrator.

Using views for external database schemes is achieved by defining logical partitions of a database for different users (how does an operator see the information in the database at a specific moment). Ability to "protect" part of the information in the database is used for setting a certain degree of data protection. In this perspective, we can discuss about relationship-based access (table) or view-based access.

In human resources management system, for some users, view changes are not accepted.

Such views are read-only and are used mainly in applications where data can be accessed by all users (such as vacancies, graduates of educational institutions etc.), but changes are made only by authorized persons and with upper echelon approval. Information changes are not permitted as they can cause side effects that concern parts that are not visible for database users. For example, deletion of information may involve removal of other components related to the deleted item which are not visible for users at the time.

Special data access procedures govern access to the database management system only for certain authorized users. In this respect, a strict record of operating rights for each user is kept, for each portion of the database. Rules and procedures are also set for transmitting the operating right from one user to another.

Data encoding is done by indexing schemes and procedures for encryption / decryption. Specific input algorithms and keys (passwords) to routines are used in order to encrypt data. Because one may access data by other means than database management application (eg direct reading from the electromagnetic environment), security can be achieved by keeping the data encrypted in the electromagnetic environment. Decoding of information is performed only after user identification associated with individual passwords.

Database integrity involves ensuring the accuracy of the information and involves detection, correction and prevention of errors that can distort data in databases. In this respect, we believe that the data is validated relative to any restrictions formulated by database design and, therefore, data is regarded as valid.

The integrity conditions are rules or restrictions that prevent entry into the database of false information and are expressed in terms of data conditioning. Structural conditions are connected to certain equality between values and are expressed by functional dependencies or by declaring some unique fields (in some cases these are key fields). They can be classified by the unit to which the restriction refers: restrictions on areas (targeting specific attribute values) or table restrictions (relations).

Given the need for data security between computer networks, we consider as relevant the following activities: providing semantic

data integrity, concurrent access to data, saving and restoring data. Ensuring semantic integrity of data is achieved by: determining an *application code* that can be implemented as stored procedure in the database or as software applications; executable *operational programs* (eg PL / SQL by ORACLE) only when an event occurs, such as: insert, update, delete and so on; *statement integrity restrictions* designed to improve operating performance of databases, which are introduced according to the data structure of the database. These are easy to be stated and modified in the application and can be automatically verified and respected for all operations performed in the database when manipulating data.

To conclude, database security can be achieved primarily through authorization policies for operators. In this respect, they will receive adequate operating rights, according to hierarchical level and nature of data and operating information that they work with. To accomplish this goal, one may be given the following types of authorization: read (consultation), insert (add), update (without deletions), authorized deletions (*tuple* level) and authorized editing (obtaining reports). This does not involve scheme changes in the database. Also, database security is achieved through data encryption by using (automatically or on operator demand) encoding or decoding routines that make the access impossible for unauthorized users.

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ENSURING THE SECURITY OF TECHNICAL EQUIPMENT OF THE STRATEGIC INFORMATION SYSTEM

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Abstract: *The information society, through the influences of information technology, has caused profound mutations in the military domain. Ingenious use of new technologies, coupled with significant changes in the military doctrine and operational and organizational concepts, cause fundamental changes in the character and conduct of current and future armed combat, signing us up for the so-called concept of "military affairs revolution".*

Keywords: *Information society; the technical and military domain; operating system; network server; network administrators; equipment security; communication systems.*

1. INTRODUCTION

In the "Unique Perspective - 2020" (Joint Vision - 2020) document developed by the Joint Chiefs of Staff of the U.S. Army, it believes that the fundamental objectives in the military domain are full domination in all spectra, information superiority and technological innovation. To achieve an effective military force in 2020, a full intellectually, operational, doctrinal and technical integration is necessary. In the military and technical domain, communication and information are particularly important, their unquestionable importance being caused by the multitude of vulnerable targets, quickly accessible in a broad and increasingly spectrum that requires more resources of protection (techniques, tactics, procedures, weapon systems, and means of warfare).

The confrontation for obtaining and maintaining dominance, information superiority and supremacy and the increasing dependence on systems and information technology, machinery and related software have led to risks, threats and vulnerabilities that require appropriate measures in the context of new Military Affairs Revolution and the War Based on Network.

From the military perspective, these technologies of the Informational Revolution, will be the means leading to military efficiency, reducing losses and decreasing budgets, a unitary cohabitation of the military and social perspectives for the benefit of more efficient military structures and the directions in which this structures can develop, will be essential.

2. TECHNICAL METHODS OF SOLVING COMPUTER PROBLEMS

No matter how well designed and implemented a computer network is, situation in which a user cannot access the local server or a hierarchically placed above or below server can be reached at any time, or multiple users will not have access to the peripherals resources of the system (printers, faxes and so on). This problem can be caused by a user error, a software problem or a physical connection problem. Errors generated by users can be solved by preparing users to operate applications as well as rights of access and operation. These errors can be avoided by preparing users within level courses as well as preparation in structures where they belong, during the trial period of the application or on specialized training.

Software generated problems will be solved by network administrators using operating system utilities software of the network server. For this purpose, it is necessary to purchase complete software package of the operating system and network documentation and updates provided by manufacturer.

Regarding servers, monitoring activity focuses on tracking processor performance, paging files, for diagnosing memory and HD problems. For this purpose, overuse of components that would reduce system performance is taken into consideration. Monitoring the functioning of components can be viewed as histograms, charts or reports through programs under which the servers operate (for example, Windows Server uses system performance monitoring application).

By setting up a performance alert to a preset threshold, depending on the tracked feature, overloading the system hardware components can be avoided. In this sense, if we follow the overload of file server HD by setting a minimum threshold of 30% of free space in Windows Server an alert is enabled from log workstations application. By comparing system components performances with default usage standards, system crashes, premature wear of parts or replacement of parts that prove to be insufficiently dimensioned within maximum traffic conditions, can be avoided. Network monitoring can be done using software and protocol packages. Through these programs, capturing and analyzing network data frame is done.[1]

Analyzing traffic between network components during communication sessions can determine a baseline network (Habraken Joe, 2002). When there is a significant difference between the basic standard of the network and information provided by another data frame capture, the network administrator must determine whether intervention is required in the system. For example, if there are an excessive number of messages sent from an address corresponding to a workstation, an intervention is required because the network card is defective.

1 www.ethereal.com

Connection problems related to hardware, network cables, hubs, switches, amplifiers, and network interface cards other hardware devices important for network communications can be solved largely with the help of software tools[2], by adequate training of users and personnel destined for the technical implementation of network infrastructure. However, there are a number of physical cabling issues such as network disconnections, interruptions, faults or other issues that, although detected by software, it can only be solved through the intervention debugging groups equipped with special devices. These devices can be fitted to cables to detect any faults or interruptions. To troubleshoot these problems voltmeters or reflectometers can be used. The Domain Reflectometer[3] can pinpoint where the cable is cut, greatly facilitating debugging circuits. Another accident could occur by random or deliberate disruption of supply or failure of one of the network components).

To ensure optimal operation of strategic information system, given that its technical support is achieved by a system sensitive to power supply, it is necessary to solve the problem of power supply. We believe that this problem can be solved by providing uninterruptible power supplies for servers and workstations.

3. SECURITY POLICIES OF THE STRATEGIC INFORMATIONAL SYSTEM

From the analysis it appears that ensuring the security of the strategic information system for real time management of human resources and of its computer networks, specific policies must comply with NATO and the EU, and the legal framework of Romania, according to the CERT model of response to accidents protection of the Ministry of Defense systems.

2 ww.cisco.com/warp/public/44/jump/ciscoworks.shtml

3 www.tm.agilent.com (time domain reflectometers)

By respecting the commitments assumed by the Ministry of National Defense ,,The capability to respond to security incidents "concerning information and communication technology, for the ,,Cyberdefence and Information Assurance in the NNEC Framework" objective assumed by Romania in the ,,The proposals of the 2008 Force" it is believed that strategic information system security can be assured. Also a very important problem consists of information security measures during traffic in the informational system. The system is vulnerable, especially by intercepting communications in the transmission medium. A viable solution to this problem is data transmission and information encoding.

The safety of the technical equipment is achieved mainly through training and equipping maintenance groups of the information system as well as training system operators. Given the system requirement to operate in times of peace, crisis and war, uninterruptible power sources as well power generators that allow powering the equipment in any condition, must be provided. Structures using the strategic information system must take security measures to reduce the risk of dissipating information or to degrade data and information.

The security problem includes legal, social and ethical issues concerning physical control (guarding and opportunity to block access / of entry terminals), setting access conditions, operational procedures (attachment of passwords) criteria for hardware control (hardware mode of accessing different components), protecting operating system (information and cancellation of intermediary results for data secrecy) issues relating to the concept of ownership of the information from the database and others alike.

INFOSEC is a basic domain in ensuring the security of data and information from the informational system and it is one of the key domains (***, 2011:25) of information operations. Because the concept raises confusion, it would be useful to see, first of all what INFOSEC is not. First, NATO experts say INFOSEC is not an abbreviation, they say INFOSEC does not mean "Information Security" and also that INFOSEC does not mean "Information Security Sistems,, (Information Systems Security).

INFOSEC includes measures and procedures to protect the information as well as the systems. Therefore INFOSEC covers not only information but also communication and information systems (CIS). As a wide area of interest comprises four parts: computer security, transmission security, emission security and cryptographic security.

NATO considers INFOSEC as *"security measures to protect information processed, stored, or transmitted by computer systems, communications and other electronic systems against loss of confidentiality, integrity or availability, whether accidentally or intentionally, and also to prevent loss of integrity , availability of information processed, stored, or transmitted to those systems and non-repudiation. INFOSEC measures include measures related to computer, transmission, emission and cryptographic security. INFOSEC measures also include the detection, documentation and annihilation of threats to information and systems."* (***, 2002:3)

We believe that the application INFOSEC in the strategic informational system will be to implement specific procedures and measures in four functional areas: computer security - aiming denial of access and unauthorized exploitation of own computers and computer networks; transmission security - with measures to ensure the protection of data and information transmitted by the information system against unauthorized interception and exploitation; emission security - to prevent unauthorized exploitation of information that can be obtained through the interception and processing of electromagnetic emissions of electronic equipment from the endowment of the information system; cryptographic security - with results in the endowing of the information system with encryption equipment and proper usage of equipment. The implementation of these procedures will be done according to NATO security directives, and all nations within the alliance must comply with the alliance's directives in this domain.

In conclusion, to ensure a security environment in which the strategic information systems can operate without the risk of affecting information, a series of measures, procedures on different domains - physical personnel organization, information security and INFOSEC - should be developed and implemented. In this way confidentiality, availability, integrity and non-repudiation of classified information stored, processed or transmitted by the strategic information system will be ensured.

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THE IDEAL ABILITY PROFILE OF THE STUDENT FUTURE MILITARY AIRCRAFT PILOT

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Abstract: *The objective of the research was to outline an ideal ability profile of the student future military aircraft pilot from "Henri Coandă" Air Force Academy, and comparing it with the position profile of the Air Force jet pilot, drawn off from an Indian study. The research included the assessments of abilities from 20 subjects, students at "Henri Coandă" Air Force Academy, with the specialization "Aviation pilots on aircraft with jet engines/planes", third year of study, and comparing them in terms of abilities. The theoretical concepts involved in the construction of the inventory used for the assessment of the basic abilities (AB11) are those subsumed to Fleishman's ability taxonomy (F-JAS). The results show the following hierarchy of basically skills necessary for a student future military aircraft pilot: psychomotor skills, perceptual skills, social skills, cognitive skills and physical skills. I also found relatively large differences between the ideal student profile and the position profile of the Air Force pilot made by Indian specialists. The main findings of this research may be useful to people involved in the development of the evaluation tests, in the evaluation and selection of applicants, and also to persons interested in becoming students at "Henri Coandă" Air Force Academy, by providing practical insight on abilities needed in this area.*

Keywords: *cognitive abilities, psychomotor abilities, physical abilities, perceptual abilities, social abilities*

1. THEORETICAL BACKGROUND

In 1992, Morrison and Brantner proposed a model of the factors that facilitate or inhibit learning related to taking up a new job. These factors are time on the job, inter-individual differences, job characteristics, context and environmental factors. After the relevance criterion first ranked was seniority, which explain 27% of the ease with which job tasks are learned, followed by inter-individual differences, job characteristics and environmental factors, which explained 24% of variance of the ease of job learning. Job characteristics, such as role complexity and lack of job challenge and inter-individual differences such as self-efficacy or prior similar experience was strongly associated with the learning ability of the job.

Other empirical studies have shown significant impact of inter-individual differences (skills, abilities, knowledge, personality characteristics, beliefs and attitudes) on job performance (Tett et all., 1991; Motowildo et all., 1997) and on adapting to organizational changes (eg, the acceptance of new informational technologies) (Agarwal and Prasad, 1999). The importance of inter-individual differences as a catalyst factor in job learning, professional success and adapting to organizational changes should make us lend them a greater attention in the context of staff recruitment and selection.

This study deals with such an inter-individual difference – the basical abilities – attempting to define the ideal ability profile of the student future military aircraft pilot.

Abilities represent a set of physical and mental traits, relatively stable, which allow the individual to achieve success in one or more fields (Golu, 2005). In short, abilities designate inclination, disposition, and talent.

Often the concept of "ability" is confused with the concept "skill" or "capacity". Although there is a clear link between the three, they are still different. Ability is the innate potentiality to achieve success in a particular area, being a mandatory precondition for capacity (to be able to accomplish a task), while skill is acquired competence (declarative and procedural knowledge) that leads to high levels of performance on tasks.

The individual abilities level reflects the development, structuring, integration and operation of all mental processes and functions. It is relatively stable (so it is a good predictor of future performance), but may be enhanced in some way by exercise (Neveanu, 1969). The skill level is proving to be an important resource for organizational psychology, offering the possibility to be used successfully in both recruitment actions and prediction of future performance, but also in training activities and training of employees.

Moreover, abilities play a significant role in the educational and vocational orientation service. To have a successful career in areas such as the military career it is not enough to show passion and grow interest, but also requires the presence/formation of specific abilities and skills.

After conducting several studies in the ability field, Fleishmain (2000, cited in Caughron et all., 2012) offers a taxonomy of basical abilities (F-JAS - Fleishman Job Anaysis Survey), which will become one of the most used nowadays. It contains five types of abilities: cognitive, psycho-motor, physical, senzorio-perceptual and social abilities. Initially the model included only the first four categories of abilities, but considering the relevance of social/interpersonal abilities in professions with an emphasis on teamwork, sales, working with the public, counseling, and so on, they were added later.

Each skill is described by three specific examples of anchors representing low, medium and high level of ability presence in subjects examined. The model was developed over several years, based on rigorous correlational and factor analysis studies on human abilities and performance in different tasks (Fleishman, 1964, 1972, 1975 Fleishman and Mumford, 1991; Theologus and Fleishman, 1973; Theologus and co., 1973, cited in Caughron et all., 2012).

F-JAS has been successfully used to analyze a wide variety of jobs and in the development of numerous ability tests for different jobs, from public sectors - military, government and private - factories and refineries, communication, electric energy, supermarkets (Fleishman and Mumford, 1988; cited in Caughron et all., 2012). Thus, it becomes a vital tool in recruitment, transfers, promotions and for identifing training needs.

Research tools based on Fleishman's Taxonomy obtained adequate reliability and validity coefficients.

Reliability coefficients obtained (between .70-.90) among different evaluators quotations reported by different studies (eg on supervisors to prison, Gebhardt, 1982; telecommunications staff, Inn, 1982; technical staff of the army, Mayers , 1981, cited in Pitariu, 2006) were fairly high. Also, Hogan (1978, cited in Pitariu, 2006) indicates the concordance between the assessments of the job holders, superiors and job analysts.

The ability instruments tested showed also a good content, external and construct validity (Messick, 1989, cited in Caughron et all., 2012). The instruments allow an exhaustive description of the abilities responsible for different performance dimensions, measure indeed the proposed ability categories and provide accurate predictions of the future job performance. Divergent and convergent validity is satisfactory – tasks of which content belong to the same 'family' have similar ability profiles. Also ability profiles describing the same job, but in different organizations, are consistent (Berndin, 1988, cited in Pitariu, 2006).

Theologus and co. (1971, cited in Pitariu, 2006) found a significant relationship between the experts abilities quotations and the factors saturation from the factor analysis of performance. The validity of the tests chosen, based on job analysis done with F-JAS has been highlighted in various employment situations (Cooper, 1983, Zedeck, 1976; cited in Pitariu, 2006).

1	The understanding of short and simple verbal messages Eg: audio informative messages		The understanding of the details and latent meanings from complex verbal messages Eg: ambiguous and technical speeches

Fig. 1. Exemple of AB11 item

2. THE RESEARCH APPROACH

2.1. The research objective. The present study is an exploratory one aimed to obtain an ideal ability profile of the student future military aircraft pilot at the Air Force Academy "Henri Coandă", from Braşov, and comparing it with the ideal ability profile of the Air Force jet pilot drawn off from an Indian study.

Given the difficulty and complexity of piloting military aircraft requirements, it becomes vital to know the necessary skills to obtain a good performance in this area, by both those involved in the development of the evaluation tests, evaluation and selection of applicants, and by those who wish to move towards such a profession.

2.2. Participants in the study. The group of subjects consisted of 20 participants (5 girls and 15 boys), students at "Henri Coandă" Air Force Academy, from Braşov, with the specialization "Aviation pilots on aircraft with jet engines/planes" in the third year of study. They voluntarily participated in the research.

2.3. Research Methodology. The research instrument used was AB11 Inventory (job evaluation version) - an inventory of basical abilities, built by me and my colleagues from the Association of E-team Psychology, based on Fleishman's taxonomy presented above. AB11 measures five categories of basical abilities (cognitive, psychomotor, physical, perceptual and social abilities) through 73 items, with responses on a 7-point Likert scale of intensity.

The measured cognitive abilities were: oral and written language comprehension, oral and written expression, richness of imagination, originality of ideas, memorization, problem identification, mathematical reasoning, number facility, inductive and deductive reasoning, information classification, cognitive flexibility, speed of closure, flexibility of closure, spatial orientation, visualization, perceptual speed, attention focusing and attention mobility.

The psychomotor domain included: control precision of movements, coordination precision of movements, multilimb coordination, response orientation, and timing of movements, reaction time, arm-hand steadiness, manual dexterity, digital dexterity, wrist-finger speed and speed of limb movement.

The physical abilities category included: static strength, explosive strength, dynamic strength, trunk strength, extent flexibility, dynamic flexibility, gross body coordination, gross body equilibrium and stamina.

The perceptual skills assessed were: near vision, far vision, visual color discrimination, night vision, peripheral vision, depth perception, glare sensitivity, hearing sensitivity, auditory attention, sound localization, speech recognition and speech clarity.

The social/interpersonal abilities measured were kindness, behavioral flexibility, coordinationability,responsibility,assertiveness, negotiation ability, persuasiveness, sociability, social conformity, social responsiveness, self-control, social trust, developing others, obtaining information through conversation, desire for achievement, openness to experience, independence, perseverance, resistance to make premature decisions, verbal reasoning and the ability to restore one's mood.

AB11 has been also applied in other fields, showing a high internal consistency (for example, in a study involving 53 workers in construction, the instrument reported an α Cronbach coefficient of .91>.70). Also, a factor analysis of the main components was performed using the responses of 251 subjects (106 students, 112 workers, 13 dentists and 20 students of the Academy of Aviation in the current study), based on the five dimensions, corresponding to the five categories of abilities underlying the instrument construction. This revealed a total explained variance of 52.929%, which represents a significant proportion of explained variance.

The data just presented indicate that we can trust AB11 Inventory as a valid and reliable instrument.

2.4. Procedure. Research approach consisted of three steps presented below.

In the first stage of the study, the 20 subjects assessed using AB11 Inventory, the necessary abilities level for the student future military aircraft pilot. Each research participant was assured anonymity and confidentiality of results.

As a second step, I analyzed the results obtained and made on this base the ideal ability profile of the student with the specialization "Aviation pilots on aircraft with jet engines/ planes".

In the third stage, I compared the ability profile of the student future military aircraft pilot obtained with Air Force pilot position ability profile, drawn off from an Indian study (Awasthy and Kaur, 2009). For the last one, job requirements included 14 skills, most of it of cognitive nature: alert observation ability, spatial ability, form perception, perceptual speed, spatial learning, memorization, specialized skills, and knowledge of English, visualization, general reasoning, mechanical knowledge, eye-hand coordination, and visual discrimination.

3. RESULTS

To start I calculated α Cronbach coefficient including all items (α = 0.91), which showed a very good internal consistency of the AB11 inventory. Forward, I checked the internal consistency of items from each category of basical abilities. Except for items in the category of physical abilities, which recorded the lowest coefficient of internal consistency (α = 0.65 <0.70), the other items describing cognitive abilities (α = 0.85), perceptual abilities (α = 0.72), psychomotor abilities (α = 0.75) and social abilities (α = 0.79) had adequate internal consistency coefficients.

After that, for each category of abilities it has been calculated the average, which was subsequently used to classify their importance inside the ideal ability profile of the student with the specialization "Aviation pilots on aircraft with jet engines/planes", in the military area.

Abilities necessary for a student future military aircraft pilot were ranked in the following order: psychomotor abilities (M = 5.74), social abilities (M = 5.42), perceptual abilities (M = 5.3), cognitive abilities (M = 5.1) and physical abilities (M = 4.86).

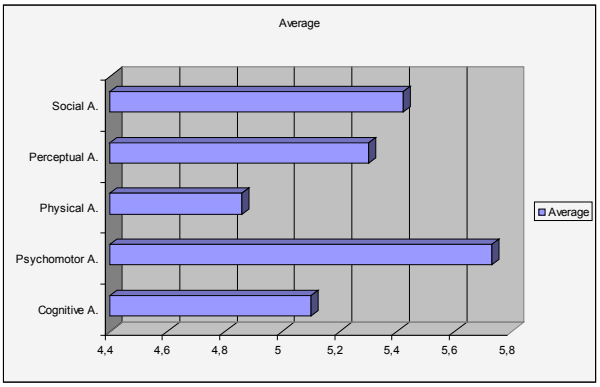

Fig 2. Ability profile of the student with the specialization "Aviation pilots on aircraft with jet engines/planes", in the military area

Highest scores in each category of abilities were recorded as follows.

Psychomotor abilities with the highest scores were: reaction time, digital dexterity, and manual dexterity, control precision of movements, limb motion control and limb movement speed.

Social abilities, who achieved the highest scores, were: autonomy, perseverance, resistance to make premature decisions, behavioral flexibility, verbal reasoning, responsibility, self-control, kindness, social responsiveness, assertiveness and desire for achievement.

In the case of perceptual abilities highest scores were recorded by: perception far, auditory attention, speech recognition, depth perception, peripheral perception, the perception of close perception and perception nighttime glare.

Inside the category of cognitive abilities the highest scores were obtained by: visualization, memory, spatial orientation, and flexibility of closure, focus, speed of perception, richness of imagination, speed of closure, attention mobility and cognitive flexibility.

The most important physical skills, depending on their score were: physical strength, extent flexibility, gross body equilibrium, gross body coordination and static force.

Compared to the ability profile for the Air Force pilot position, described in the Indian study, this ability profile includes less cognitive abilities and more psychomotor and perceptual abilities.

4. CONCLUSIONS

The current study provides a comprehensive picture of the abilities needed by a student with the specialization "Aviation pilots on aircraft with jet engines/planes" in the military area, outlining an ideal profile.

This profile was obtained using an basical ability inventory AB11 (job evaluation version), built after Fleishman's taxonomy (2000) and applied to 20 students with the specialization "Aviation pilots on aircraft with jet engines/ aircraft" within "Henri Coandă" Air Force Academy, from Braşov, in the third year of study.

By relevance, the five types of basical abilities outlined the following hierarchy: psychomotor abilities, social abilities, perceptive abilities, cognitive abilities and physical abilities.

Compared to the ability profile of the Air Force pilot position, included into the Indian study, this one offers a different perspective, but a much larger and specific one, about the necessary abilities to ensure military aviation performance.

An unexpected aspect highlighted by the study is the importance given by the students to social abilities, ranked even before the perceptual, cognitive and physical abilities. This can be attributed to the novelty inclusion of this ability class in studying abilities of future military aircraft pilots, or to a desirable attitude displayed by the subjects, but it is very important to not neglect their real importance in the field of military aviation. Social abilities such as autonomy, perseverance, resistance to premature decisions, behavioral flexibility, self-control, certainly make an important contribution to performance in this area. The relationship between social abilities and performance in the military area deserves more attention from future studies.

5. THE STUDY UTILITY

Firstly, the study provides a practical perspective on the skills needed in this area, useful to people interested in becoming students at "Henri Coandă" Air Force Academy.

It also provides to current students, by presenting the job analysis conducted by 632 experienced Indian military instructors, a practical perspective on the skills really needed into military aviation domain.

Moreover, it may have implications for the improvement of the entrance examination of candidates to the Air Force Academy "Henri Coandă", from Braşov, and not least, it is informative to the interested public.

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A STUDY REGARDING THE ANALYSIS OF THE FULFILLMENT OF THE OPERATIONAL MILITARY REQUIREMENTS BY THE LIGHT OFF-ROAD ARTICULATED VEHICLES

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Abstract: *Why would be interesting to use this type of vehicle (light off-road articulated) in the military field? In order to answer this question we have to analyze the capacity of the light articulated off-road vehicle to fulfill the general operational military requirements. A light off-road articulated vehicle is a vehicle with the maximum weight less than three tones and consisting of two equal vats connected to each other through a pivoting bearing which allows both parts to move around the longitudinal central axis of the vehicle. This type of vehicle is quite rare in the world. Generally, they are prototypes or limited series. One of these type of prototype is DAC 2.65 FAEG which were made in Brasov, Romania and it is studied inside of the laboratories from "Henri Coandă" Air Force Academy.*

Keywords: *light off-road articulated vehicle, operational military requirements, fulfillment, DAC 2.65 FAEG…*

1. INTRODUCTION

The special wheel vehicles have a high viability to fulfill the military missions and they emerged as a real necessity of the fulfillment of combat missions in off-road conditions with high speed, without any technical malfunction, with a range as high as possible and a good protection of their passengers. There are some technical solutions as the special vehicles are completely different concepts than normal wheel vehicles because these vehicles must act in extremely off-road conditions, in many situations it could be necessary to pass different kind of obstacles (ditches, berms, channels, streams, lakes etc.).

A light off-road articulated vehicle is a vehicle with the maximum weight less than three tones and consisting of two equal vats connected to each other through a pivoting bearing which allows both parts to move around the longitudinal central axis of the vehicle (Fig. 1).

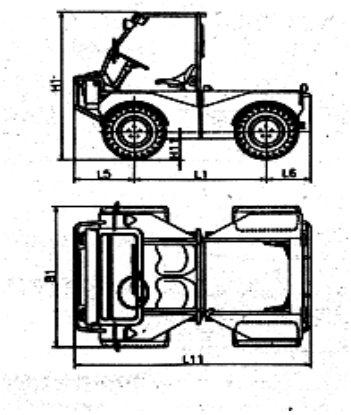

Fig. 1. The light off-road articulated vehicle

This type of vehicle is quite rare in the world. Generally, they are prototypes or limited series. They were suggested for the military area but so far they have not been successful.

The working environment general requirements for the military vehicles are [1]:

- environmental temperature: $+50^0$C ↔ -40^0C;
- the air relative humidity: maximum 98%;

- in mountain area the engine must work without ignition failure and power reduction;
- the act of the ambient must be characterized by heat, cold or/and much noise.

Also, for the light off-road articulated vehicle, the engine must give a specific output of 22-30 kW/t in order to assure a normal dynamicity [1].

2.THE LIGHT OFF-ROAD ARTICULATED VEHICLE MADE IN ROMANIA – DAC 2.65 FAEG

In the late 80's, the designing engineers from the National Institute of Road Vehicles (INAR) and ROMAN/DAC Truck Factory conceived a light off-road articulated vehicle named DAC 2.65 FAEG. It was made in some variants depending on the existing subassemblies. They were inspired by the CROCO/RHINO/ ALLIGO vehicle which was made in Germany. The body of the vehicles is identical. But it is only the body and the general conception that are identical.

Only five units were made and another two ones as empty bodies. Two of them have Wankel rotary engine (probably identical to the CROCO/RHINO engines). Another unit has Fiat Panda 1,4 liters engine and other two were made using Dacia 1400 cmc, 65 HP, engine. Only one from the last two ones is still functioning and all the following details refer to this one (Fig. 2).

Fig. 2 DAC 2.65 FAEG

The studied DAC 2.65 FAEG vehicle has a conception of the power unit and a body identical to CROCO and RHINO vehicles.

The other subassemblies are completely different because they were assimilated from the repetitive manufacturing of that time: the engine is Dacia 1400 cmc, the calipers are Dacia model but they were modified and placed on the all four wheels, on the planetary shafts (similar to Oltcit vehicle), the central break pomp (double circuit) is ARO model etc. The vehicle has a fluid converter (unknown model) connected with a gear box with 2x2+1x2 not synchronized velocity steps and a front rear splitter unit. This ensemble has a common oil sump. At the same time the ensemble of gear box and front rear splitter unit is a two steps transmission reduction and a distributor gear through front and rear axles.

The front and rear axle differentials are 'worm and wheel' limited slip type and they have power take-off (PTO). The front PTO was designated for a capstan and the rear PTO was designated for the propellers (water propulsion).

Weights and dimensions:

- wheelbase: 1634 mm / front overhang: 750 mm / rear overhang: 565 mm;
- overall length: 2950 mm / overall width: 2060 mm / overall height: 2050 mm;
- ground clearance: 270 mm;
- unloaden weight: 1600 kg / trailer weight: 1000 kg.

The declared performances:

- speed in 1-st velocity step = 0-20 km/h (off-road);
- speed in 2-nd velocity step = 0-50 km/h (on road);
- maximum declivity = 33^0;
- maximum lateral declivity = 30^0;
- braking runaway (50 km/h) = 19,3 m;
- exterior acoustical level = 81 dB.

3. THE ENCODING OF THE GENERAL OPERATIONAL MILITARY REQUIREMENTS

Why would be interesting to use this type of vehicle (light off-road articulated) in the military field? In order to answer this question we have to analyze the capacity of the light articulated off-road vehicle to fulfill the general operational military requirements. These ones will be encoded as in table nr. 1.

Tabel 1 The encoding of the general operational military requirements

The encoding of operational requirements	**Operational requirement**	**Operational "subrequirement"**
1	Constructive simplicity	
2	High reliability	
3	Compactness	
4	Tactical-operational mobility	
4.1		- marching
4.2		- in different climatic conditions
4.3		- at night
4.4		- off-road conditions
4.5		- deformable terrain (eg: swamp)
4.6		- on the water
4.7		- no adherence conditions
5	Low overall dimensions	
6	Low weight	
7	Easy exploitation	
8	High maintainability	
9	The uniformity of components used as spare parts	
10	High ergonomics for the crew	
11	Protection of transported materials	
12	High range	
13	The possibility to use different fuels (multi-fuel engine)	
14	Crew protection	
14.1		- against projectiles
14.2.		- against radiation
14.3		- against shock wave
14.4		- against CBRN attacks
15	Transportability	
15.1		- by their own means
15.2		- by landing means
15.3		- by aircraft
15.4		- bt naval means

4. THE FULFILLMENT OF THE OPERATIONAL REQUIREMENTS BY THE LIGHT OFF-ROAD ARTICULATED VEHICLE - particularization for DAC 2.65 FAEG

The fulfillment of the operational requirements by the light off-road articulated vehicles will be analyzed as follows:

1. This requirement is fully accomplished by all these types of vehicles because they have as main characteristic the constructive simplicity. **Requirement accomplished (RA).**

2. Theoretically speaking, all these vehicles must have a high reliability because of the constructive simplicity. The DAC vehicle could have some problems because of the low quality of components. (Eg.: the engine and brake system). **RA**

3. The compactness is a specific characteristic of these types of vehicles. **RA**

4. The mobility requirements are accomplished because:

1.1 The vehicles do not have a high marching mobility as they are designed to be driven in off-road conditions. They do not have the possibility to move with high speed and they do not have a high range on the road. **Unfulfilled requirement**.

1.2 The vehicles do not have problems with cold weather starting because they have Otto engines but they do not have covered bodies, so, they cannot protect the carried passengers. The result is a low mobility during winter. Furthermore, the DAC vehicle has problems with engine cooling during summer because the cooling system has to be redesigned. **Unfulfilled requirement**.

1.3 The vehicle has a good illumination system. The travel during night, even in off-road conditions, is done without problem. **RA**

1.4 The travel in off-road conditions can be done without problems due to the special profile of the tires, to the very high approach and rear overhang angle, fair ground clearance, lower robustness area of the body and mainly due to the pivoting bearing which permit the vehicle to follow the conformation of the crossed area exactly. **RA**

1.5 It is impossible for the vehicle to be stuck in the mud (according to manufacturer declarations) due to the special profile and very wide tires (the overall surface of the tire contact patches can be compared to the low surface of the vats) and due to the fact that the vehicle transmission (and planetary shafts too) is inside the vats. In extreme situations the vehicles can "crawl" on the mud effectively. However, tests have not be done yet (in case of the DAC), therefore, these considerations are only theoretical. But the requirement can be considered accomplished. **RA**

1.6 The vehicles are designed to be amphibious. The propulsion can be done using only the wheels or the wheels combined with a propeller or a system of propellers which are trained by a power take-off from the rear axle differential. **RA**

1.7 The vehicles have high performances in non-adherence conditions due to the special profile of the tires, their compactness and the descended center of gravity. **RA**

We have to mention that 4.1 "subrequirement" is not mandatory to be accomplished because the vehicle was not designed to move in marching conditions using its propulsion systems. It is going to be transported on the truck platform (the dimensions are not a problem).

Regarding the 4.2 requirement, all the light off-road articulated vehicles have the possibility to have mounted a covered body in order to protect the passengers. But in this situation the dynamic performances will decrease.

The DAC technical failures (regarding the inadequate engine cooling) are due to the wrong designing of the cooling system. The engine position does not encourage the fresh air cooling because it is really "sunk" into the front vat which is completely tight by the superior driver and co-driver floor. In this situation the engine must work into a not ventilated place. The radiator is located out of the body and its link with the engine is done by metal tubes and rubber couplings. The problem is that one of the metal tubes is located next to the muffler (3-4 mm) at approximately 60 cm. That's why a supplementary heating of the cooling liquid is done.

5. The dimensions of the vehicles are very low due to their remarkable compactness**. RA**

6. Pressure per unit on ground area is very low due to high width of the tires. The weight is very low for this type of vehicle. **RA**

7. The exploitation is very easy because the vehicle is very simple mainly due to the automatic transmission. **RA**

8. The vehicle maintainability is very high due to easy access to the subassemblies. In an extreme situation the entire power unit system can be lift using a light crane in order to make maintenance operations easier**. RA**

9. The uniformity of the components depends on the modality of designing the vehicle. Taking into account that the manufacturers of these types of vehicles do not produce them "starting from nothing", it is assumed that the mounting was done by using the parts which are on the automotive market. For example, for the DAC vehicle there were used components which were produced on the Romanian automotive industry in '80's when this vehicle was designed. Only few components were projected particularly for this prototype. **RA**

10. Unfortunately, the ergonomics cannot be very high because of the lack of suspension and shortage of space. But these types of vehicles are not used for endurance missions. **Unfulfilled requirement**.

11. The transported materials cannot be protected very well because the vehicles do not have a covered body. **Unfulfilled requirement**.

12. The range in off-road conditions is remarkable (until 500 km) due to the flexibility of the fuel tanks capacity (supplementary canisters can be added very easily). **RA**

13. The use of different types of fuels depends on the adopted engines. Because of the limited space this requirement depends very much on the technological progress in the engine domain. The electric engine could be a good solution mainly because there is enough space into the rear vat in order to place the engine and the batteries there. **Undetermined parameter**

14. The requirement regarding the crew protection cannot be accomplished because the body is not covered and the passengers are vulnerable (shock waves, projectiles, CBRN attack, radiations, climate conditions etc.). **Unfulfilled requirement**.

15. The transportability of the vehicles is remarkable due to low dimensions and weights and compactness. The vehicle can be palletized very easily and carried on the platform of the ordinary truck. It could have problems only during the road marching because of its low maximum speed. **RA**

5. CONCLUSIONS
– identification of the possibilities to use the light off-road articulated vehicles in the military field.

Taking into account the results of the analysis made in the chapter 4, there could be identified the next areas where this type of vehicle can be used:

- desant missions; the low weight, the compactness and the maneuverability allow these vehicles to be easily transported by the chopper; it seems that some successful parachuting tests were done at the beginning of '90's;
- engineering vehicle; mission vehicle - disaster response, forestry - monitoring uprooting, fire suppression, open pit mining surveillance, driving in coastal areas, maintenance of pipelines, telecommunication masts and critical infrastructure, expeditions, film industry, geological examinations, rescue operations and as towing and carrier vehicle for a large variety of add-on equipment;
- mobile platform (Fig. 3) capable to be used as:
  - fighting mobile cell able to act in mountain and forest areas where it could successful fight against low altitude targets ("helicopters hunters");
  - mobile point observer for the mountain artillery battalions;
  - reconnaissance missions subunit (using an UAV system);

- light rocket launcher capable to act following the principle “hit and run”.

Fig. 3 Mobile platform (technical revision)

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STUDY REGARDING THE DEVELOPMENT OF A STRATEGY SPECIFIC FOR THE FREE AND INDEPENDENT PRACTICE OF PHYSICAL EXERCISES IN THE UNIVERITAR MILITARY LEARNING

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Abstract: *The purpose of this article is to put in the light the results of the research based on a questionnaire in order to project new content for the general physical training. The study also wants to find new strategies and methods to motivate students for the free and unconditioned practice of physical exercises under the guidance of specialist teachers.*

Keywords: *physical exercise, propellent skills, independent, individual physical training, strategy.*

1. INTRODUCTION

Sorin Şerbănoiu and Virgil Tudor support the idea that "the educational activities, projected and programmed" involve first of all the sketching of the final aims and then, choosing the strategies that lead to their accomplishment. The self note of the objectives is given by the fact that they precede the result of education in terms of behavior, predicting how the subject should react after passing through a sequence or stage of learning." (Şerbănoiu, Tudor, 2007:29).

The most of the field specialists agreed that the objectives of the physical education are classified from different criteria:

A. after the degree of generality we distinguish:

- The general objectives- put emphasis on the essence of the physical education, the common dimensions of its subsystems. These objective are:
  - ✓ the maintenance of an optimum health condition;
  - ✓ the foster of an harmonious physical development;
  - ✓ the development of the propellent skills; the development of the basic propellent skills specific to some sports branches;
  - ✓ the formation of the capacity of systematic and independent practice of the physical exercises;
  - ✓ the harmonious development of the personality.
- The specific objectives- represent the practice of the general objectives, at the level of subsystems of the physical education.
- The mediate objectives act at the level of the learning cycles of the years of study.
- Operational objectives- they watch the immediate behaviors that can be seen in short time that can be traceable and measured.

B. After the sphere of influence and the type of behavior expected:

- Objectives for constitutional-functional development of the organism report:
  - ✓ harmony between the somatic and functional indices;
  - ✓ harmony and proportionality inside every indices category;
  - ✓ the maintenance of an optimum muscular tonus;
  - ✓ the formation and the maintenance of a right body attitude;
  - ✓ the prevention and correction of the postular and physical lacks;
  - ✓ the loss of body weight excess and the obesity."

(Dragnea *et all*., 2006:25-26)

All things considered, in order to create a strategy that target students capacity of practicing with pleasure physical exercises and also other ways of exercising, during the session of physical education and sports, and also outside the academic schedule, independent or under the guidance of the specialists in the field, we focused our attention upon the students from the first and the second year of study from the AIR FORCE ACADEMY "HENRY COANDA", where we have done a research based on a questionnaire, on an exhaustive sample with a number of 145 respondents. The content of the questionnaire targets 9 subjects, expressed through 9 items.

HYPOTHESIS

We propose the following work hypothesis:

If the interest and options of students are known, it will be possible to obtain a strategy with the base of free, independent and unconditioned practice of physical exercise or some sports branches.

The data obtained from the research have been statistically processed and interpreted qualitatively and quantitatively. The charts obtained show the preferences of the subjects from the two years of study, about some optional sessions that take place among the department "SPECIALTY AND MILITARY BASIC INSTRUCTION" from the AIR FORCE ACADEMY "HENRI COANDA".

The first question: "Which of the following optional sessions: basketball, handball, football, taebo, martial arts, fitness, swimming, gymnastics, athletics, sky, gliding, plane modeling, tennis, table tennis, climbing would you practice?"

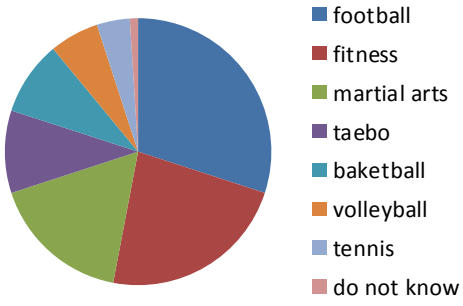

Fig.1. Subjects options for the sports.

Analyzing the first image we saw that football, being very popular and being given the possibility of practice on every season, outside and inside, it earned the first place in the students preferences, followed by fitness which is very advertised and the martial arts have the third place because their complexity and the practice conditions.

The second question: "Do you believe that the number of hours a week for physical education is big enough?"

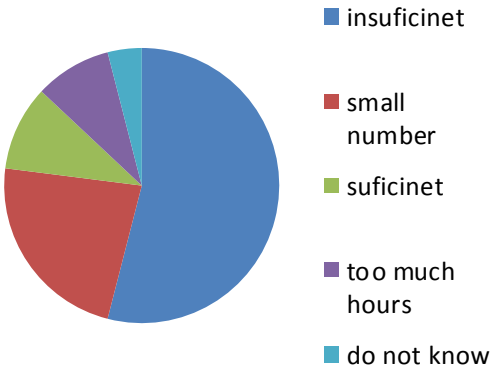

Fig. 2. The opinion about the time given to physical education and sports.

According to the second image, after processing the responses we have the following data: 54% of the questioned ones have considered that the amount of time for physical education and sports is not enough, 23% are really sure that the time given to this subject is a small one, 10% think that there is enough time, 9% support the idea that the effort is a high lever, 4% do not know, do not answer. In conclusion, we can see that over 75% of the students have appreciated objectively the value of the physical education and also decided to spend their time in a pleasant and relaxing manner, with a serious involvement.

The third question: "If the number of sessions is insufficient, how much of your spare time would you give for the optional sessions of physical education and sports?"

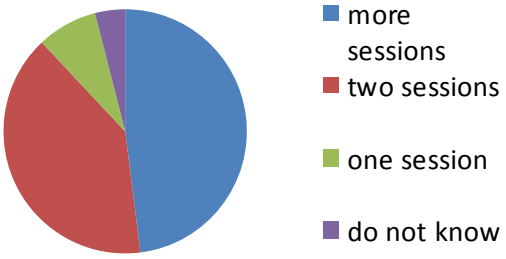

Fig. 3. The preferences regarding the number of physical education sessions given from the spare time.

The third image shows that: 48% of the respondents have manifested their wish for more sessions a week, 40% only for two more sessions, 6% for one session and 10% were not sure. We notice that more than 75% of the answers are for more additional sessions from the optional disciplines, led by specialist teachers, which proves that the accomplishment of the aims the students proposed is done by a consequent practice.

Question number 4: "Which are, in your opinion, the benefic effects obtained after practicing the optional discipline

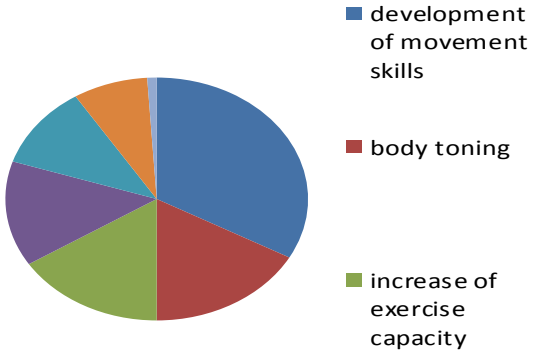

Fig.4. Benefic effects of the practice of the optional disciplines.

The image number 4 reveals that the highest percentage of 33% was in favor of the development of the propellent skills (force, speed, durance coordination, flexibility and mobility), 17% for the body toning, 16% for the increase of the exercise capacity through the activity specific to every optional discipline, 14% self-defense and the development of the fighter spirit, 11% for the increase of the speed of decision and efficient thinking, 8% for the development of the team spirit and friendship, 1% do not know, do not answer. From the data analysis we see that the student's option for the development of the propellent skills is fair, having as an objective the creation of a basis of free practice of the optional disciplines, which will represent a serious support in their future career.

Question number 5:"Do you think that the discipline you chose is an element of progress in your development and for defining your personality? "

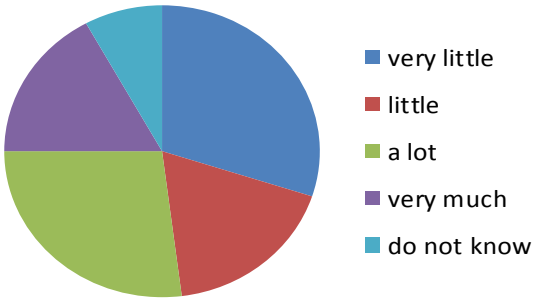

Fig.5. The development of the personality through the optional discipline.

The fifth image reveals that 30% of the respondent think that the choice of the optional discipline represents very little for the development and definition of their personality, 18% believe that it is possible in a small measure, 27% think that this option in a great measure an element of progress, 17% support the idea that their favorite discipline represents a lot for them and 8% of their preferences are not decided, they do not know, do not answer. We can see that 44% of the questioned ones have positively appreciated the practice of an optional discipline. The 8% of the ones who do not know is considered high, from the point of view of the age of the young future officers. In order to cover these lacks, the teachers must help them with clear training programs and they must be explained which are the advantages of practicing physical exercises generally, and especially of an optional discipline, some positive effects are visible on the spot, others on a long term, on which occasion, the objectives of the physical education will be accomplished.

Question number 6: "Which are the propellent skills you consider of the highest importance and absolutely needed for your future career?"

According to image number 6, the respondents have manifested their preferences as it follows: 27% chose the , 20% have considered speed important, 14% had their options for coordination and only 4% decided for flexibility and mobility, 1% do not know, do not answer.

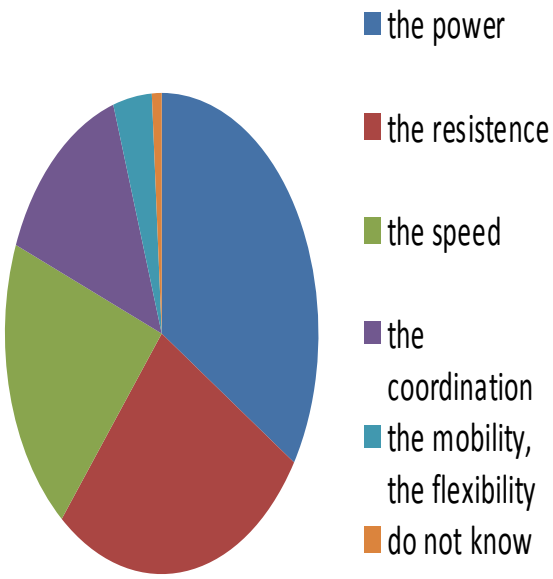

Fig.6. The importance of the motric skills in students opinions.

It is a quality we are born with and less improvable. The coordination has a high importance, its place being a good one. If it is educated right, it will have as a result the minimum consumption of energy in the propellent acts and actions. The mobility and flexibility have been preferred by a small number of subjects because of their complexity.

Question number 7: "Do you think that the independent practice of the physical exercises learned during the sessions of physical education is useful and needed?"

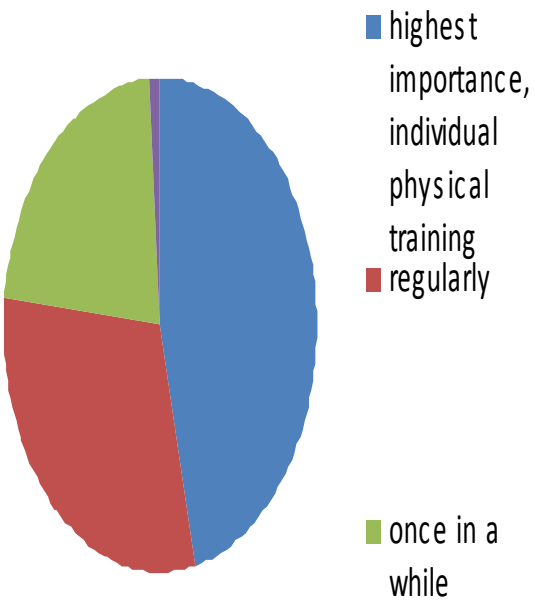

Fig.7. The preferences of independent practice of the physical exercises and some sports disciplines, individual or in a team.

The answers processed in percents of those questioned result from the image number 7 as it follows: 30% of the respondents have manifested their will of independent practice of a sports discipline, like team games or other ways of individual exercising, with regularity, 22% have chosen the once in a while practice of physical exercise, while 46% think it is of high importance the individual physical training and only 1% do not know, do not answer. Consequently, we can figure out that the students, in a number of over 75%, want to get involved systematically and consciously in the physical education in general and especially in the independent practice of the disciplines led by the field specialists.

Question number 8: "What do you think that there should be done in order to optimize the lesson at the sports discipline you chose, to make it more pleasant and attractive?"

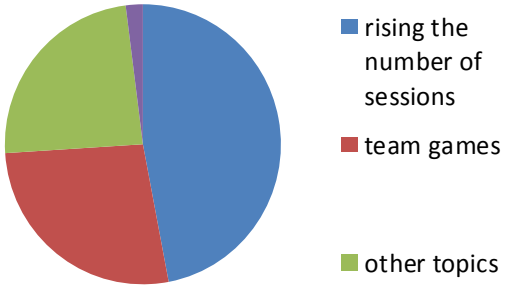

Fig.8. The optimization of the physical education lesson according to students opinions.

According to the image number 8, the students options turned into percent are the following: 47% had their preferences for raising the number of sessions, related with the specific activity, 27% chose the team games, 24% wanted to use other topics during the physical education sessions and 2% do not know. About this situation, we believe that the students suggested be more innovation and creativity during the sessions, with a higher percentage for the team games and a various range of topics.

Question number 9:"How do you appreciate the lessons of physical education at the discipline you chose, on the scale of effort intensity: easy, very easy, hard or very hard?"

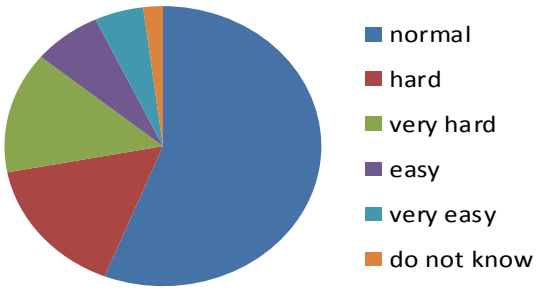

Fig.9. How the students appreciate the intensity and density of the effort during the physical education sessions.

According to the image number 9, the answers are the following: 56% have considered the effort as being normal, 16% hard, 14% very hard, 7 % easy, 5% very easy and 2% do not answer.

We consider that the appreciation of the students about the intensity and density of the effort has been done right, which reveals that the schedule of the optional lessons stick to the training standards, and where there are adaptation issues, the physical exercise and the training programs will be adjusted to the somatic and physiological characteristics of the age of the subjects.

CONCLUSIONS

1. From the research based on questionnaires realized among the students from the AIR FORCE ACADEMY " HENRI COANDA", come up the following conclusions: The students have shown their practical options for some of the sports disciplines;
2. Tthey have shown interest for the independent practice of the physical exercises, alone or under the guidance of specialists.

They have realized that a right development of the propellent skills leads to harmonious building of the body, and also to a development and definition of a complex personality.

SUGGESTIONS

After this research based on questionnaire we can formulate the following suggestions:
- making up a syllabus based on the close research of students options and those which are compatible with the academic demands should be also added to that document;
- the physical education sessions should contain topics through which the team spirit will be developed and also the competition and creativity, which responds to the role of fighter and the skills required by the pattern of the one who graduates the AIR FORCE ACADEMY "HENRI COANDA";
- inside the gyms should be put posters that would contain physical training schedules well structured and comprehensible for students;
- the teachers must be very careful that the presented exercises are well learned by students;

- inside the gyms should be put some boards and posters where the side muscle groups that are activated during exercising are presented and also all the muscle groups of the human body;
- in the academic library must be enough specialty literature with the news from which the young will be able to inform themselves about everything connected to physical exercising;
- the specialist teachers ought to present information about sports medication;
- during the evaluation of the young who are part of the sport groups or who train individually, they should be given as models and they should be awarded with a bonus at their grade;
- the teachers should promote a modern concept of the physical education with scientific basis which are linked with the culture and civilization values that will lead to the integration of intellectual, moral, socio-economic, artistic and civic values, to the development of a fighter personality, with the thinking of a fighter specific to the modern armies.

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THE CURRENT STAGE OF AIR DEFENSE SYSTEMS' STRUCTURE AND PERFORMANCES. S.A.M. SYSTEMS COMPARATIVE ANALYSIS IN ROMANIAN INVENTORY

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Abstract: *The integrated systems especially Surface-to-Air Missile Systems (SAMS), destined to combat the aircraft and other aerial assets, went through an accelerated loss of their performance. In this perspective I tried to define the **A**erospace System and Integrated System concepts. The financial crisis has forced an extension of the system operation even if the system is outdated. Many times, it is better to improve an existing system than buy a new one. From the institutional point of view, the main problems are: including the cost versus performance and the cost versus the remaining lifetime or technical resource.*

Finally, an important conclusion supports the possibility and necessity of the SAMS up-grade, given the change in the characteristics of the threat.

Keywords: ***Ai****rspace system, Integrated System, S.A.M.S. (Surface-to-Air Missile Systems), Technical and Institutional challenges;*

1. INTRODUCTION

The primary threat concerning the safety of numerous states around the world is one of the modern era most disputed subject, being in a constant evolution. The most important factors affecting the development of the SAM systems are the following:

- destabilization of the global security;
- the importance of aerial warfare is higher as ever even there has been a reduction in the number of aircrafts each air force has;
- the higher importance of the ballistic missiles, surface-to-air missiles, jamming missiles, cruise missiles and UAV's;
- These new technologies used on the modern battlefield are more effective and cheaper, more states being able to acquire them.

But what does Airspace system mean!

The outstanding spatial system is defined as an ensemble of air defense missile, early warning and space monitoring, interconnected networks including groups of algorithms and technical means, oriented on airspace research and aircrafts identification and on launching and targeting vehicles equipped with active propulsion systems from ground to enemy targets.

The above stated system, could give access to outer space and also optimization legislation regarding responsible behavior and maintaining interoperability of military capabilities. Spatial capabilities are a real strategic advantage for long-term security. Spatial systems have applicability in land navigation, smart ammunition guidance and also in transmitting information from the UAV to potential beneficiaries of land. It should not be overlooked that in space are located elements of early warning systems on ballistic missiles.

Is more often used the concept of collective security when speaking about space.

Integrated system

The moment we assert about some elements that are integrated we mean that there are included, embedded in a whole.

In my opinion, an ***integrated system*** represents an ensemble of systems/subsystems whose components are permanently interconnected, having well defined functions and very clearly delimited. The output of an integrated system is directly proportional with the functionality of components. All system elements contribute to achieve the goal initially established. The system components include the organization, resources and processes.

Of course, appear a series of questions such as: Why should Management Systems be integrated?

Why do we need a management integrated system? and ineluctable Whom is addressed this kind of system?

There are some reasons for which any good manager should develop his own Integrated Management System:

- reduces the copies and therefore associated costs;
- reduces the risks and increases the efficiency;
- helps defining goals;
- eliminates inappropriate responsibilities and internal relations;
- focuses the entire attention on goals;
- optimizes the decisional process;
- creates the required management consistency;
- optimizes the dissipation of used resources stress;
- improves staff training and their skills;
- allows coherent planning of activities by taking into account aspects of quality, environmental, health and security in work, information's security, social responsibility.

2. THE EVOLUTION OF THE AERIAL WARFARE MEANS AND AIR DEFENSE WEAPONS

The evolution of launching procedures of munitions used in aerial warfare and the enhancement of the aerial threats demands the analysis of the following aspects:

- effective range of the SAM systems as well as the type of munitions used;
- tactics used for the emplacement of these systems;

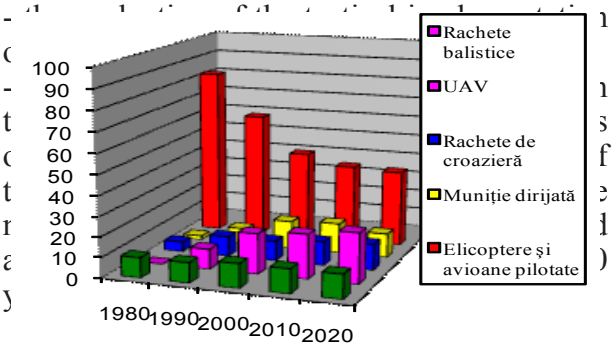

Fig 1 The evolution of the aerial warfare means

The figure nr.1 emphasizes the transition from piloted aircraft to the unmanned ones. During the 1980 combat aircrafts and helicopters represented 85% of the total attacking force, this percentage being continuously falling ever since and it is expected to reach 39% till 2020. In the future the aerial warfare means won't have a spectacular evolution. The development of threats demands the enhancement of the anti-missile systems such as missile shields.

The next graph shows the raising importance of the integrated anti-missile systems starting from 1980 to 2020.

The more organized and well synchronized aerial attacks will put an even higher strain on the integrated air defense systems. The enemy will use will use in the first phase of combat jamming systems to neutralize radar and communication systems.

Considering these risks the primary objective that needs to be fulfilled by the aerial defense will be the reaching of the so called "Near Zero Leak" (no undefended area).

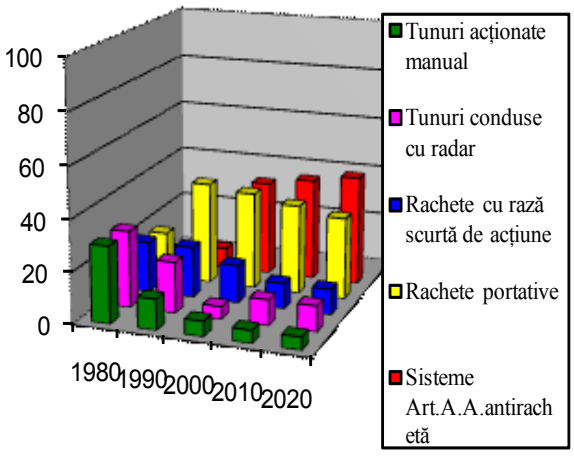

Fig 2 The usefulness of the anti-missile systems

This level of protection will be easily obtained by a joint force of surface-to-air missiles and artillery. During the acquisition programs carried out, our country focused on upgrading the medium range missile systems, but unfortunately the enhancement of the aerial defense systems stopped after the HAWK system was bought. Also the SHORAD (Short Range Air Defense)/ VSHORAD (Very Short Range Air Defense) were in the pending status for a long time but were abandoned before signing any contract. The acquisition of long range missiles never reached a status worth mentioning.

Whatever the reasons may be this issue still persists as time passes and the Russian production missiles systems come close to their demise. The next step is retiring the S-15 (Neva) or the extension of the operational period for this system.

At the moment Romania need a replacement for the SA-2 , SA-9/CA-95 systems and at least an upgrade for the SA-7/CA-94 if there won't be any acquisition programs targeting new missile systems.

Even though the SA-6 and the SA-8 are quite efficient they still need enhancements, considering the fact that the electronics on these systems are outdated. The best option is to replace these aerial warfare means with modern era ones, considering that spare parts are very scarce if a life extension program is considered.

3. S.A.M. SYSTEMS COMPARATIVE ANALYSIS IN ROMANIAN INVENTORY

For an objective comparison I chose to present the diagrams of the dynamic performances (maximum range, operational ceiling, and single shot probability) as they are presented in public sources (different from specifications mentioned by the producers). I have also mentioned the price for each missile system, and the fact that the money spent on each missile depends on the negotiations carried out by each client (the price may vary and may not be very precise).

In graph number 3, I presented a comparison between the most likely to be bought long range missile systems.

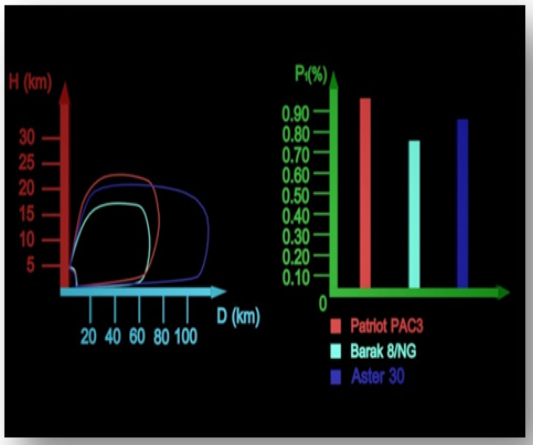

Fig. 3 Long Range Air Defence LRAD Missile Systems

Considering the fact that the American suppliers prefer the Patriot PAC-2, this system has the most chances to be bought or to be implemented at the same time with the so called "missile shield". The main issue is constituted by the fact that this system can only be bought from other current users, being no longer in production.

One of the advantages would be the low price given the fact that it is a used product.

If buying new products is considered, the best option would be the MBDA(Matra British Dynamics Alenia) Aster-30, which is the main competitor for the Bumar project in Poland. A great bonus of this program is the fact that MBDA offers a technological transfer to the one's buying their system.

The primary threat for MBDA is the fact that Poland may decide to buy cheap second hand patriots from Germany. Meanwhile beside the imminent stoppage of the MEADS program, Germany is less willing to sell its existing surface-to-air systems, meaning that Bumar and MBDA have more chances of succeeding.

The most advanced version of Patriot, PAC-2 MSE is still in its early stages of implementation and has a high price that will certainly decrease in a few years.

A surprise for the acquisition program could be Barak-8, one of the competitors in Poland, but its drawback is the fact that this missile is still in the testing phase.

In graph number 4 I have presented a comparison between medium range missile systems

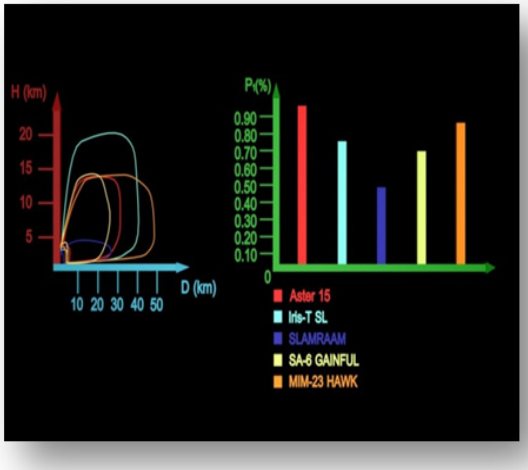

Fig. 4 Medium Range Air Defense (MRAD)

The modernization stages for the HAWK system involves the reaching of the so called XXI level (produced by Raytheon and Kongsberg), an important step leading to NASAMS II (Norwegian Advanced Surface-to-Air Missile System), which uses AMRAAM missiles launched from surface, having the same electronics.

Despite its drawbacks regarding the maximum altitude it can reach, Finland acquired this system due to its low price and the possibility to be used in a dispersed network.

A more efficient option would be the ESSM, a recent development of Kongsberg, which besides its superior performances, has as an advantage the fact that the SA-6 system can be modernized is the same time with the same missile (a similar project war proposed by the polish producer WZU and Raytheon).

Fig. 5 The modernization of the SA-6 system

Another option is the acquisition of the Spyder-MR, the drawbacks being the lack of integration with the existing HAWK system and the fact that there will be two similar systems with the same role.

The next comparison is made between SHORAD

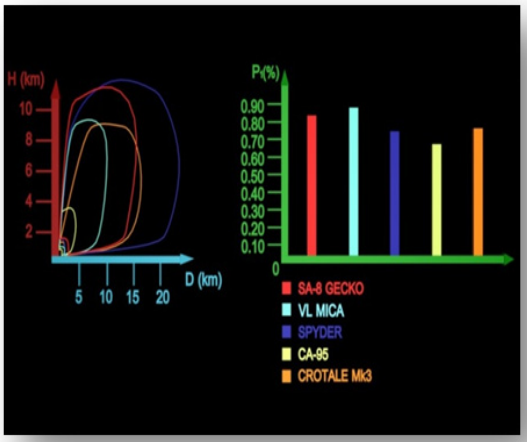

Fig 6 Short Range Air Defense (SHORAD)

In this field the contest is between VL-MICA(Vertical Launch-Missile d'Interception de Combat Aerien) and Spyder-SR both systems having the advantage of the reuse of some air-to-air missiles that are already in the Romanian Air Force inventory. A drawback of the MICA-VL system is the high price. Meanwhile, Spyder-SR won the competition in Singapore against MICA-VL and SLAMRAAM, and it was already bought by India to replace the SA-8.

The last comparison refers to VSHORAD *systems*

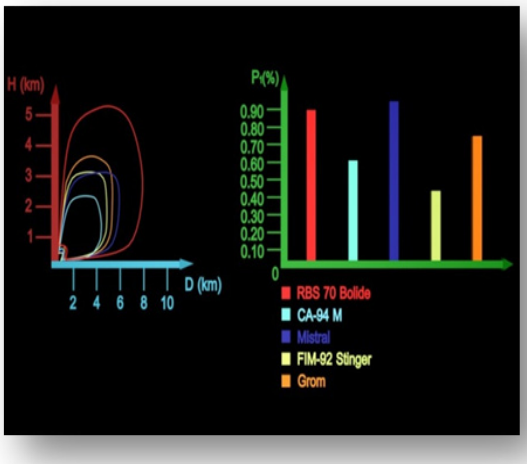

Fig. 7 Very Short Range Air Defense (VSHORAD)

Basically the competition is dominated by three systems: Stinger, Mistral and RBS-70

RBS-70 has the advantage of the newly designed laser guiding system, impossible to be jammed according to the producer (SAAB), but it requires well trained personnel . The NG version has the advantage of the automatic search and track system and the night operation mode. Another advantage of the RBS-70 system is represented by the modern warheads which is more efficient against aircrafts designed for CAS, such as SU-25 although due to its weight and sizes it requires a special launch pad.

Stinger has the advantage of portability, weighting less than RBS-70 and Mistral systems, but has the drawback of having a small warhead causing less damage

The infrared guiding system is user friendly unlike the RBS-70 but has the disadvantage of being very sensitive to electronic countermeasures.

Mistral has the advantages and disadvantages of the laser guiding system, similar to Stinger, but its sizes are similar to the ones of the RBS-70 system. Its unique advantages such as higher velocity, large warhead and high damage inflicted to the target gives this system an edge over its opponents. As well as the RBS-70 system, Mistral requires a special launch pad.

The modernization cost (mil euro) involving three types of integrated systems in the future four years is presented in the next graph

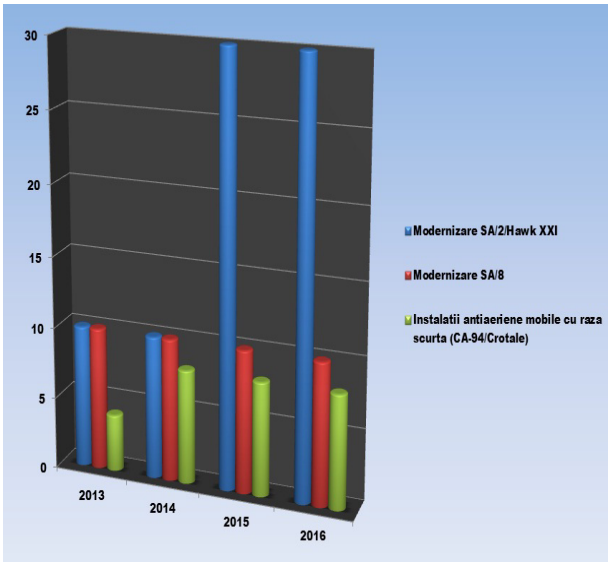

Fig. 8 Budget related to modernization systems

In figure 8 we offer an example of commands for equipments which will allow a four years respite for defense industry and it also allows Romanian Army to benefit to benefit from extra equipment, at lowest costs.

These commands, embedded in a multi-annual plan, would gradually increase the pace of production of defense industry, allowing young staff recruitment and specialization, depending on the availability of MApN budget, giving medium-term outlooks for the defense industry, alongside possible external commands and research for new equipment.

Table 1. Proposed Acquisition budget

Modernization cost / system / year	**2013**	**2014**	**2015**	**2016**
SA/2 /Hawk XXI	10 mil. euro	10 mil. euro	30 mil. euro	30 mil. euro
SA/ 8 SA-6	10 mil. euro	10 mil. euro	10 mil. euro	10 mil. euro
SHORAD (CA-94 / Crotale)	4 mil. euro	8 mil. euro	8 mil. euro	8 mil. euro

Such a production plan would avoid sudden volume increases, followed by periods of low production, (except for external orders) that would affect the stability of jobs and maintenance of skills.

To quantify the gain of such a strategy should be considered beside the industrialization and the growth of industries with very high added value also the fact that the production in our country can provide the lowest purchase price and low operating costs, the advantage being the high availability of equipment of the Romanian Army endowment, due to the independence for external factors, important things in case of conflict and also in case of peace.

4. CONCLUSIONS

Analyzing the defense integrated management we concluded that the main goal is represented by the defense resources which in turn have to be included into an integrated system which will allow their usage with maximum efficiency at the right moment for their foremost mission, in full interoperability with other similar systems belonging to the armies of the allied countries.

An Integrated Management System (IMS) brings together all the components of a mission in a coherent system in such a manner as to permit achieving the mission's goal. More, everything that has effect upon mission's goal should be integrated into a manage

In conclusion I have grouped into a summarizing table, according to the public sources, some of the technical and operational performances of the presented sy

If the medium range ary defense systems can fight with some efficiency in air operations, well organized by number, firepower and destruction probability, This equipment's cannot be replaced easily when their characteristics no longer keep pace with the progress of potential targets.

The cost of these systems can get between 50-150 million dollars.

Up-grading of such a system becomes an option both to preserve the operational performance and to save funds in the current financial crisis, instead of buying a new system.

Table 2. Technical and operational performances of systems

Systems/ performances	SA- 6	SA-7	SA- 8	SA-9
Missile	3M9M	A-94	9M33M3	A-95
Range (km.)	16	4,2	10,9	4,2
Missiles speed (mps)	950	500	550	500
Guidance	semiactiv guidance	pasive	radio comand guidance	pasive
Single shot probability	0,7	0,4 -0,7	0,3 - 0,7	0,4 -0,8
Technical resource (years)	20	5-10	10-15	5-10

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MILITARY ACTIONS IN THE CIRCUMTERESTRIAL SPACE AND THEIR INFLUENCE AT STRATEGIC, OPERATIVE AND TACTICAL LEVEL

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„Carol I" National Defense University

Abstract: *The theatre of cosmic warfare around the Earth is one of the newest battlefields, where the need to implement new types of operations at a strategic, operative, and tactical level is extremely evident. Therefore, most developed countries are already taking actions not only in order to gain certain technical and tactical advantages on the new battlefield, but also in order to develop weapons systems, as well as reconnaissance, observation, alert and tracking systems specific to military actions, which are instrumental in gaining influence and acquiring supremacy in space.*

Keywords: *Cosmic warfare, space, weapons, satellite, missile*

1. INTRODUCTION

Whether we are talking about war as in and out of space, star wars or "future" wars, the physiognomy of these wars, the defining elements of "tomorrow's" confrontations or the zone where "the front line" will be established, all these have become realities that cannot be ignored and for which the leading military parties of the world are already taking preventive measures with the purpose of acquiring knowledge, anticipating and preparing to impose domination and gain supremacy in the field of war.

We are at the dawn of a new era for the exploration of the extraterrestrial space. We have not reached other planets, but we have reached the moon and established a permanent orbital station- The International Space Station and filled the Earth's orbit with satellites that make communications, surveillance, and navigation possible. We can now also study the evolution of our planet especially, the development of military operations in and out of space.

In the new millennium, the space zone is understood as a vertical extension of the air space, a place where military operations can be deployed.

Achieving domination in this new area implies the use of power in space which benefits from a variety of high tech materials and technologies.

The concept of power in space or aerospace power focuses more on the vertical dimension of the military operations based on a dimensional perspective (space-time-fight) which will allow armed forces to act wherever necessary without any geographical and physical limits as in the case of other military forces.

Thus, the outer space around the Earth has become a dimension of real interest and the exploration and research that are undertaken in this new dimension already shape a different projection for military operations. The expanded analysis and research of the space dimension are: hyper-altitude, immensity, hostility, geocentricity, emptiness along with the relationship between them, thus creating numerous and important aspects for military operations that are not isolated, but in a tight inter-dependency.

To have a chance to respond to these challenges in such a dimension, the new force, that is the space force, must adapt perfectly to the demands resulting from the action domain, have the capability to explore the space dimension, act permanently in engagement zone, continue or develop actions together with the air force, navy and the army.

The hegemonic aspirations of the great military powers will ensure a strategic importance to the space land circumstance, in the future the space operations being essential in determining the successful outcome of a confrontation, regardless of the place or the dimension of the battlefield.

2. THE ECONOMY AND MANAGEMENT OF THE SPACE LAND CIRCUMSTANCES

While the world financial system is still fighting against a profound economical and mortgage crisis, the international space industry has been evolving and developing based on an independent scenario. According to the Space Foundation organization, in 2007 the space land circumstance economy was approximately 251 billion dollars[1] worth.

Ever since, space economy has increased in size for the sixth consecutive year, growing at a faster rate than in the previous years, most likely due to improving conditions in some sectors of the broader global economy. The total for the global space economy in 2011 was $289.77 billion in government budgets and commercial revenue, an increase of 12.2 percent from the 2010 total of $258.21 billion and an increase of 41 percent from 2006[2].

As in past years, the majority of this growth resulted from commercial success rather than increases in government spending.

The governments of Brazil, India and Russia all increased their space budgets by more than 20 percent. Some space agencies experienced more modest growth, as was the case for the European Space Agency (ESA), whose budget increased by 7 percent in spite of the ongoing fiscal problems in some of its member states. Space agencies in other nations, such as the United State of America and Japan, operated under flat or diminished budgets. Spending in the U.S. on government space projects was 47,25 billion in 2011, a decline of less than 1 percent from the amount spent in 2012.

Orbital launch activity increased by 14% in 2011, and is rising up to 84 launches from a total of 74 in 2010. Russia conducted the most of launches with a total of 31. China followed with a total of 19 launches, outpacing for the first time in history. While the U.S. a total of 18 successful launches was not the highest, it contained the greatest launch vehicle diversity, with eight different types of orbital rockets.

At the end of 2011, there were estimated 994 active satellites in orbit around the Earth.

The broadcasting industry is a huge driver of demand for communications satellites, largely due to global growth in the number of high-definition television channels, which require more bandwidth than their standard definition counterparts.

Development of observatories and robotic exploration systems continued in 2011, with plans for several observatories with capabilities that will exceed those of existing telescopes. In July 2011, Russia launched a radio telescope called Spektr-R, marking the return of the Russian space program to scientific missions after a hiatus of several years. As with many scientific missions, other countries will participate in the research, in this instance by providing ground-based observations that can be combined with those from Spektr-R to produce images with ever greater detail and clarity. The year 2012 was an active one from the space activity point of view. Thus, on 19 January it started with the launch from Cape Canaveral, Florida of a Delta 4 rocket with the purpose to transport the military satellite Wideband Global SATCOM 4 in Earth's orbit.

Wideband Global SATCOM (WGS-4) was built by the Boeing company and is, as its name suggests, the fourth tactical communication satellite from a constellation of satellites that offer communication capabilities that are ten times greater than its predecessor SATCOM 3.

On the other hand, on 28 July Russia launched into the orbit two satellites: Gonets-M a science and research satellite and the military satellite from the Kosmos series, built as its predecessor on the Yantar 4KM2 platform, a "spy" satellite equipped with a powerful optic camera; practically, it is a telescope with high resolution used by the Russian army with the purpose of gathering information from other countries and competitors. Also, it is an alert post in case of national defense against nuclear bombs launched from the other parts of the world. Europeans also wished to possess their own GPS system, a more advanced and especially more independent system compared to the American military one. Financed by the European Commission and implemented by the European Space Agency, the Galileo satellites can offer a better coverage and precision due to a tighter constellation and a higher orbit.

Thus, the ESA launched the first two from a series of four satellites on 21 October 2011 and 13 October 2012, the other two being destined to validate the functionality of the system on the orbit and providing the first operational services of the Galileo micro constellation that would include the alignment of 30 satellites at 23.222 km distance from the Earth's surface.

1 http://incomemagazine.ro/articles/exista-o-economie-a-spatiului-circumterestru, accessed at 23.02.2013

2 The Space Report 2012 – Executive Summary, http://www.spacefoundation.org/programs/research-and-analysis/space-report, accessed at 23.02.2013

China is another key player with regards to space activity, making an unexpected launch on 30 April 2012 of two navigation satellites on o rocket called "The long march-3B" from the satellite launch centre in Xichang, the Sichuan province. This is the first time when one rocket has carried two satellites destined to stay at medium and high orbit. These are the 12th, and the 13th satellites in the "Beidou" navigation network, a structure that has been functional since 2012. The satellite network provides a large amount of data from various domains, such as: telecommunications, transports, meteorology, etc.

Japan, India and France are countries with a vast and quite recent activity in the field of space, countries that in 2012 and at the beginning of 2013 launched into the orbit civilian and military satellites destined to naval surveillance and communication or, as in the case of Japan, launched spy satellites to supervise its neighbour, North Korea.

The last launch took place on 15 January 2013 when a Russian Rockot Breeze KM rocket placed into the orbit three military satellites for the Russian army. The separation of the three satellites, dubbed Cosmos 2482, Cosmos 2483 and Cosmos 2484, was confirmed by the Russian Space Agency Roskosmos. The satellites are destined for military communication and have the Strela 3M platform, the newest version of the Strela standard[3].

Space activity, as perceived from the point of view of the number of satellites, be it military or civilian, and launched into the orbit over the last years, has revealed a permanent interest for space domination on the part of the great actors on the international military stage.

Thus, the U.S. has so far launched 429 satellites into the orbit, Russia over 100 satellites, China approximately 70, Japan 40 and India 26. Their destination varies and it can be adapted based on the course of actions in the space land circumstance.

Depending on the organization and destination, there are approximately 1000 satellites that orbit around the Earth and most of them can be grouped, as follows:

Communication Satellites – 562;
Satellites for studying Earth – 86;
Early Warning Satellites – 8;
Amateur radio satellites – 3;
Astrophysics satellites – 15;
Meteorological Satellites– 10;
Satellite Navigation / GPS – 79;
Research Satellite (espionage), surveillance and remote sensing – 89;
Scientific research satellites – 96;
Satellites for other purposes – 27[4]

The high rate of satellites, their characteristics, role and their organization into constellations prove the fact that there is a genuine interest in developing this new domain, in which major investments are made, especially state-of-the-art technology, which will undoubtedly trigger major changes not only in the field of space, but also in the air, naval, and army domains.

3. THE INFLUENCE OF SPACE ACTIVITY ON THE AIR, NAVAL AND ARMY FORCES AND ITS ROLE IN THE OPERATING MODE AT A STRATEGIC, OPERATIVE AND TACTICAL LEVEL

The new global security threats will require appropriate evaluations and answers from the technology sphere and the space land circumstance, which would subsequently form the basis for an aerospace power capable to be used at a maximum efficiency at a strategic, operative and tactical level.

The implemented aerospace technologies in the new aerospace power perimeter are giving birth to a new generation of airships, smart weapons, C4I high tech systems, electronic surveillance systems, search and hit systems etc. that will ensure superior airspace control, complete visibility, both night and day, thus reducing the time to make a decision and allowing for action integration of high intensity and complexity regardless of the time factor or the type of force.

The new power can only act together with all the other military forces and can increase the decisive nature of the confrontation by concentrating on the effects and operating with minimal losses.

The new technologies are aimed at creating space surveillance sensors and advanced telescopes, space ship fighters with no pilot and systems that are specific to Electronic Warfare, communication and process for gathering information, and combat capabilities with a high precision (missiles and rockets launched from satellites and guided by them and other controlled weapons),etc.

3 http://romanian.ruvr.ru/2013_01_15/Prima-lansare-in-spatiu-din-anul-2013-a-decurs-cu-succes/, accessed at 23.02.2013

4 http://ro.wikipedia.org/wiki/Satelit_artificial, accessed at 23.02.2013

For the American aerospace technology, which transfers the war to the extra atmosphere, the aerospace technologies of the future envisage rockets, satellites and radars but with special qualities (communications, laser, infrared), anti-missile capabilities and space interceptors to destroy the kinetic energy, aerospace lasers, etc. Space Centric Radar (SCR) will be included in networks of systems to be used launching attacks from space and will generate a wealth of information, as well as real time images of the aerospace activity from the ground or naval level[5].

The development of anti-satellite technology offers more protection to the aerospace power, which consequently becomes capable to protect itself and dominates the battlefield through superiority, speed, position and control of information. Thus, the space systems will create that instant presence from the above anywhere on the planet.

The introduction of advanced technologies in the aerospace sphere will continue. Therefore, through the extension of space power, an important dimension of warfare will be achieved, the integration of space defense systems with the modern air defense systems ultimately being possible.

Space power together with air, ground and naval power will contribute to the total domination of the adversary in all military operations. Such a thing will be possible due to the military cooperation from the industrial, technical and technological standpoints, especially given the impossibility of producing in an isolated manner weapons and technologies necessary for a modern war.

Nevertheless, in the foreseable future, impossible as it may sound, the aerospace power will make us dependent to new vulnerabilities deriving from the myriad of space equipment, satellites and orbital platforms.

The fundamental condition for the existence of a new space power is represented by the necessity to have space supremacy and the quick evolution of the other military categories that will need a precise remote coordination in order to be as effective as possible.

The configuration of future space power will be built based on the requirements of the modern military confrontations and will be defined as:
-high performance command and control systems for space operations;
-control and surveillance systems to offer supremacy on this new battlefield with important influence at operational and tactical level for air, naval and ground operation;
-the capability to hit and destroy objectives in space with maximum precision and minimal colateral damages, from distance, through missile and weapons systems of very high precision, regardless of the time factor;
-specialized personnel adapted to space war conditions;
-an adequate space platform equipped with modern telecommunications;
- performant space fighting techniques with stealth capabilities and safe counter-measures systems, which will also ensure protection against jamming and impact from any environment.

All the aforementioned aspects will lead to a conclusion that will sooner or later be confirmed. A strategic confrontation in space will be difficult to avoid. According to Wu Tianfu's [6] , a representative of the second artillery division which controls the nuclear arsenal in China, "the development of forces in space is a clear sign that a military competition for space domination will emerge."

We can say that acquiring space combat equipment is already inevitable, and that „in the not so distant future space will definitely turn into a battlefield", as Xu Nengwu, a representative of the University of Science and Technology for National Defense in China[7], stated.

Thus, in the future he who controls the space will hold the power!

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6 http://www.mediafax.ro/externe/expertii-chinezi-considera-inevitabila-o-confruntare-in-spatiu-2679544, accessed at 23.02.2013

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SOME ASPECTS OF RESEARCH AND DEVELOPMENT AT ENTERPRISES AT REGIONAL, COUNTRY AND EUROPEAN LEVEL

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Abstract: *The economical development and success of a firm are strongly influenced by research and development, dealing with renewals technology, keeping and raising market competitiveness, developing new ways to exploit.*
This paper presents statistical analysis and conclusions on research and development at enterprises in the 7th Center Region of Romania, at country (Romania) and at European level.

Keywords: *research, development, region, country, EU*

1. INTRODUCTION

An organization must be good at developing and managing new products. Every product seems to go through a life cycle -it is born, goes through several phases and eventually dies as new products appear that serve better user needs. This cycle has two major challenges: firstly because all products eventually decline, a company must be able to develop new products to replace old ones. Secondly, the company must be able to adapt its marketing strategies to changing and to compete with the help of the research function.

In literature research and development are defined as key factors for competitiveness and long-term benefits of customer and preference for technology and costs. (Mares, 1973)

2. CONSIDERATIONS ON RESEARCH AND DEVELOPMENT

Fundamental Inspection by Mares seeks knowledge and understanding of the world around us, as opening a new perspective by expanding the universe explaining reality. (Mares, 1973)

Stages of research are: documentation and observation of facts, data collection and classification of these, the preparation of conducting research.

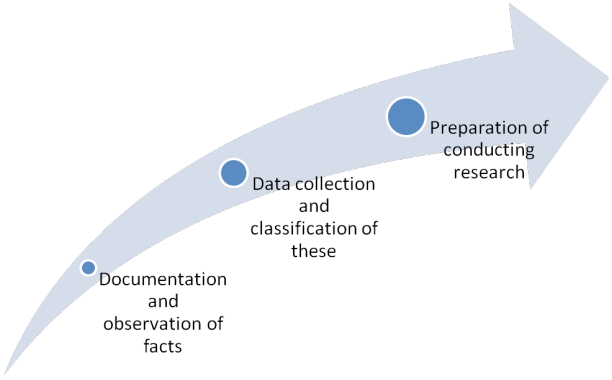


Fig.1. Stages of research

The best known definition of sustainable development is certainly the one of the World Commission on Environment and Development (WCED) in its report "Our Common Future", also known as the Brundtland Report: "Sustainable development is development that aims to meet the needs of the present without compromising the ability of future generations to satisfy their own needs". Given the rapid changes in consumer tastes, technology, and the competition among companies need to produce a steady stream of new products and services. A firm can obtain new products in two ways. One is the purchase and through its own research and development department. When we say products we mean original products, better products, product changes and to new brands that the company created through its research and development efforts.

Research and development function is represented by the activities taking place within the organization to achieve the objectives of the production of new ideas and transform ideas into useful news its future development. (Mares, 1973)

Activities of research and development function are:

Fig. 2. Center Region: Alba, Sibiu and Mures, Harghita, Covasna, Brasov counties

Central Development Region, with a total area of 34,100 km^2 (14.31% in Romania) includes Alba, Brasov, Covasna, Harghita and Sibiu and Mures counties. It's an area with specific plateau landforms, east-west oriented valleys, the region has important reserves of natural gas, gold and silver and therapeutic mineral springs, and over a third of the area is occupied by forests. (ROP, 2007:96)

With a population of 2,530.486 inhabitants in the region is concentrated 11.7% of the total population. Regional average of 74.2 inhabitants/km^2 is lower than the national highest density is in Braşov (111.4 inhabitants/km^2) and Alba is below the regional average (60.7 inhabitants/km^2), Covasna (60.3 inhabitants/km^2), Harghita (49.2 inhabitants/km^2).

From an economic perspective, the region is well balanced, with a still important weight of industry.

In 2008, the GDP / capita in the Central Region, expressed at standard purchasing parity (conventional currency unit which excludes the influence of price differences between countries), was 11,250 Euros (44.8% of the EU average). (ROP, 2007)

In industrial terms the region is represented by the construction industries of machinery, metal processing, chemical, pharmaceutical, building materials, timber, mining, textiles and food industries. (ROP, 2007)

Industrial specificity is more pronounced in Brasov and Sibiu counties, with significant industrial tradition. Rich natural resources in the region, particularly natural gas and salt, led to the development of chemical industry. In 2007, in the Central Region were obtained 42.2% of the volume of gas extracted nationwide and 40.8% of the national production of fertilizers. Wood processing industries recover important forestry coverage of the region. Thus, in the Central Region is obtained 46% of the national production of timber and about 20% of the furniture. (ROP, 2007)

The potential of the Centre Region is diversified as it has natural resources and human, social and economic resources as well. University network of Central Region is well developed; the universities from Targu Mures are renowned in the fallowing domains: pharmaceutical, medicine and theater arts, Brasov is known for its technical profile and forestry, Sibiu for human profiles.

With a tradition in wood processing industry, it is understandable the presence of three research institutes dealing with this area.

Table 1. Research - Development in 7 Centre Region

-mil. lei-

Total R & D spending	2006	2007	2008	2009	2010
Total	1565802	2177335	2980674	2356907	2413467
Northeast	107503	163561	214619	157869	158149
Southeast	54303	80630	99211	91591	89095
South-Muntenia	145750	231770	229496	220771	240751
Southwest Oltenia	53961	67793	88164	75738	70137
West	69434	11583	153300	89027	115808
Northwest	116664	193458	253612	194256	197378
Center	60920	74256	80256	170057	110483
Bucharest-Ilfov	957267	1254284	1862016	1357602	1431666

The 7 Center Region ranks 5th of the 8 regions, after the total expenditure in research - development, with a downward trend in the last few years.

In 2006 the Center region of Romania had a 60920 million lei spending on research and development, in 2007 this increased to 74256, in 2008 to 80256. In 2009 took place a significant increase to 170057, than it decreased to 110483 million lei.

4. RESEARCH AND DEVELOPMENT IN ROMANIA

In 2011, Romania spent 2.786,8 million lei for research and development. Research and development expenses represented 0.48% of GDP), up 0.01 percentage compared to 2010, and up 0.02% compared to 2009.

In late 2011, 42,363 employees worked in research and development, the number of employees increased by 3298 compared to that recorded at the end of 2010.

In 2011 2,786,8 million lei was spent on research and development in the four areas of performance, of which 2,251,5 million lei current expenditure respectively 80.8% and 535.3 million lei capital expenditure 19.2% respectively.

The share of capital expenditure for equipment for units that have carried out research and development increased by 3.9 percentage in 2011, compared to 2010.

In 2011, basic research has increased slightly by 0.5 percentage in total spending compared to 2010 and from 42.9% to 43.4%.

Applied research in 2011 had decreased markedly by 10.8 percentage in total expenditure, and from 50.0% to 39.2%.

Experimental development, showed a significant increase of 10.8% percentage of total expenditure in 2011 compared to 2010.

After funding sources of total R & D expenditures in 2011, public funds have the highest proportion, namely 49.1,%, followed by sources from enterprises, a slight increase of 1.1 percentage compared to 2010 (33.4% to 32.3%).

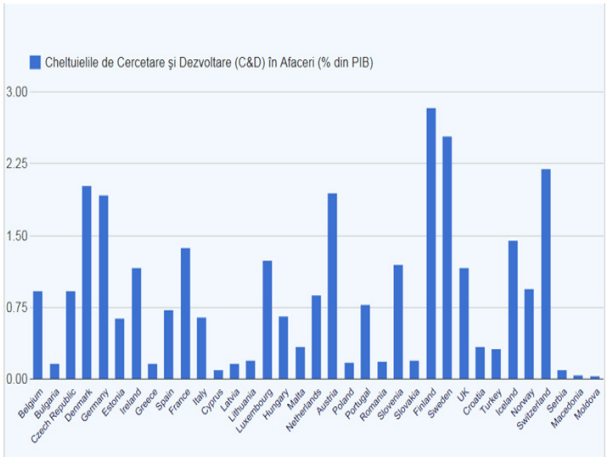
Government sector (55.4%), received the largest amount of money from public funds followed by higher education sector (31.1%).

Sources of funding for R & D from abroad were mostly oriented towards higher education sector units (43.4%) and the government sector (34.1%). Research intensity (the ratio of total R & D expenditure to gross domestic product) in 2011, had a share of 0.48%, similar to that recorded in 2010.

Expenditure from public funds has a share in GDP of 0.23% in 2011, with 0.05 percentage less than in 2010.

5. CURRENT STATUS OF RESEARCH AND DEVELOPMENT IN THE EUROPEAN UNION

Expenditure on research and development (R & D) at enterprises (% of GDP) include all expenses/costs incurred for research and development in the real sector (enterprises, business) of the economy.



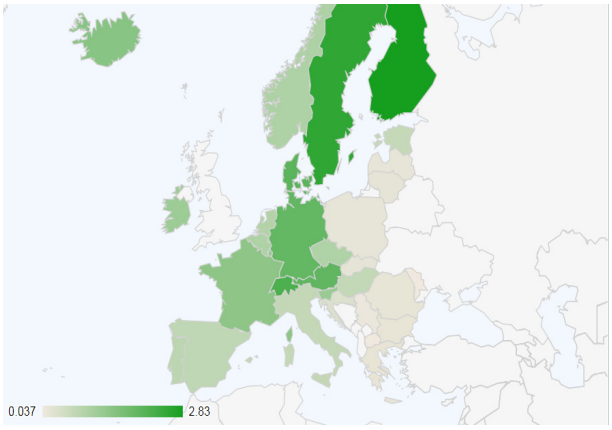


Fig. 3. (a), (b) Expenditure on research and development (INNOBAROMETRU)

The treaty of Lisbon provides for spending 3% of GDP on research and development. In 2010 the 27 EU countries are placed at the level of about 2.01% of GDP. Romania is placed at level of about 0.5 % of GDP. Finland is at first place of the chart, he has spent around 2.75 % of GDP on research and development, while Moldova is at the bottom of the classification.

6. CASE STUDY: THE CORRELATION BETWEEN R&D EXPENDITURES AND GVA. IN ROMANIA (2009-2011)

Gross value added (GVA) is a measure in economics of the value of goods and services produced in an area, industry or sector of an economy.

It can be determined by the synthetic method: add margin trading and margin leasing activity and minus the intermediate consumption of the production year. It can also be determined by the distribution method (additive) that summarizes personnel costs, taxes, depreciation and profit operation.

Considering the literature, we can say that there is a close connection between R & D expenditures and gross value added, if we consider GVA as a quantified, measured result of investments in R & D.

Knowing that research and development expenses, gross value added and GDP in the last three years (2009-2011) in Romania were:

Table 2. R&D expenses, GVA and GDP in the last 3 years - mil. lei-

	2009	2010	2011
R&D expenses	2356907	2413467	2786800
GVA	431763,7	445119,4	483364,1
GDP	480853,4	492875,4	535386,4

Graphical representation of the relationship between the two variables is shown in figure 4, where on OX is placed research and development expenses and the gross value added on OY.

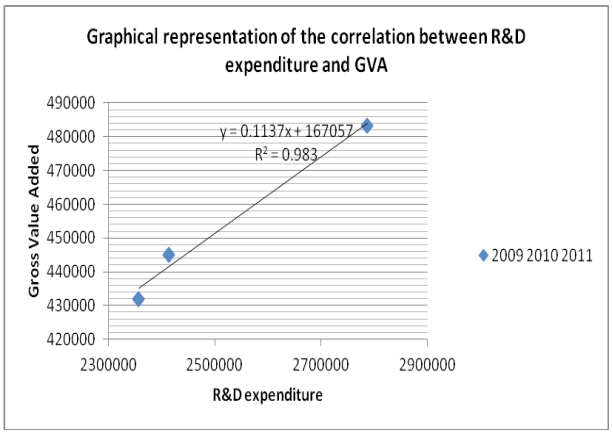


Fig. 4. Graphical representation of the correlation between R& D expenditure and Gross Value Added.

From table 2. we extracted the values, between 2009-2011, using Microsoft Excel's Correl function, we achieved that the coefficient is close to 1 (0.98), which means a direct connection, of high intensity. We can conclude that based on the trends of R&D expenditure we can forecast the trends in Gross value added, which is important in GDP's calculation.

7. CONCLUSIONS & ACKNOWLEDGMENT

In conclusion we can say that the importance of research and development function lies in the need for permanent adaptation of enterprises at regional, country and European level to the new achievements of modern science and technology, because science is a vector of social development.

Research and development is one of the most significant factors of innovation. It is assumed that they have a direct impact on the activities performed in a business and spending on research and development is a way to measure a country's innovative potential. Furthermore based on the trends of R&D expenditure we can forecast the trends in Gross value added, which is important in GDP's calculation.

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HOW LINGUISTICS MAY HELP IN CASE OF WAR

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Abstract*: The present article is a review of the book* Evaluation and Stance in War News: A Linguistic Analysis of American, British and Italian Television News Reporting of the 2003 Iraqi War *(2009/2012), edited by Louann Haarman and Linda Lombardo. This is an innovative study combining corpus linguistics and discourse analysis and also taking into account cross-cultural differences in the reporting of an international event. The corpus is formed by the evening news reports presented by CBS, BBC, RAI Uno and TG5 starting from 20 March 2003, when the bombing of Baghdad began. The results show clear differences between the four channels in adopting more or less explicit stances pro or against the military intervention in Iraq.*
Keywords*: war, Iraq, corpus linguistics, discourse analysis.*

1. INTRODUCTION

The volume belongs to the Continuum Research in Corpus and Discourse Series and it presents the findings of a sub-project on television news conducted within the larger research project CorDis ('Corpus and Discourse: a quantitative and qualitative linguistic analysis of political and media discourse on the conflict in Iraq in 2003'), supported by the Italian University and Research Ministry. The corpus examined for the sub-project is formed of news broadcasted during the first month of the Iraqi war by four different channels from the United States (CBS), the UK (BBC) and Italy (RAI Uno and TG5). The hardback edition of the volume was published in 2009 and the paperback edition in 2012.

2. SUMMARY

The volume comprises seven contributions preceded by an introductory unit. The editors begin the introduction by providing a general overview of the CorDis project, considered to be 'the first extended comparative study of ongoing television news coverage of a global event' (p.1).
They further review the theoretical literature on stance and evaluation, the methodology used and the characteristics of the present research.

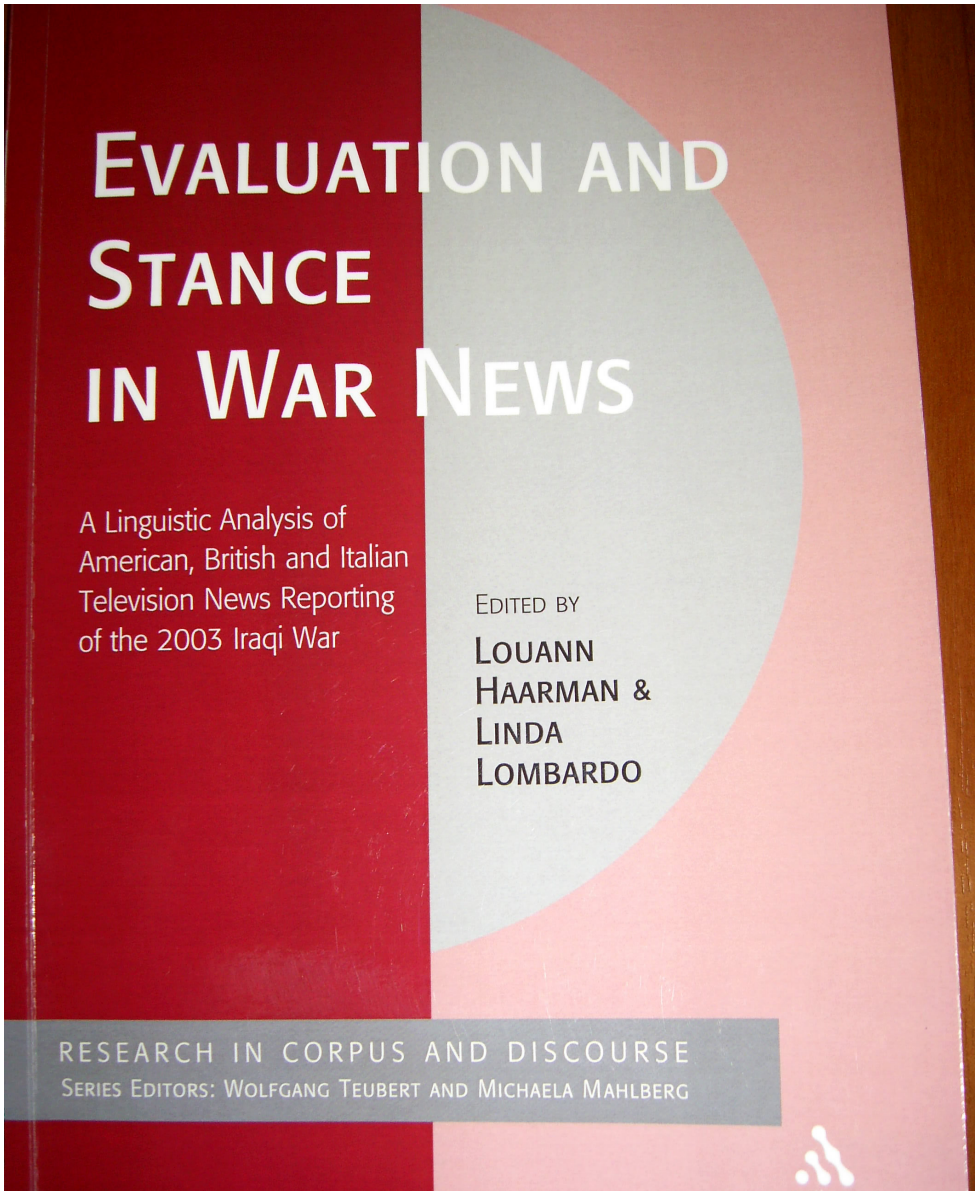
The next section outlines the evolution of the 2003 Iraqi war between 20 March and 9 April and its significance for the three states. The final section of the introduction gives a clear account of each contribution in the volume.

In chapter 1, 'Mark-up and the narrative structure of television news', Anna Marchi and Marco Venuti describe and explain in detail the method used for the analysis of the television sub corpora. The analysis was consistent with the Text-Encoding Initiative (TEI) Guidelines, an international standard for encoding electronic texts and with eXtensible Mark-up Language (XML), the metalanguage of the latest version. The authors highlight the advantages of using mark-up for the examination of multimodal discourse such as television news.

Chapter 2, 'The news presenter as socio-cultural construct', by Linda Lombardo, contains the analysis of the words spoken by the news presenters in the four sub corpora. Quantitative analysis is a starting point, through the realization and comparison of frequency and keyword lists for the four broadcasters.

Lombardo further examines the use of negation as a means of evaluation in the corpus along three parameters: the news coverage of the progress of the war, the coverage of civilian casualties and the representation of the coalition and the Iraqi behavior.

The results show clear differences in the war reporting styles, due to cultural differences but also to the degree of each nation's involvement in the war.



The presenter in CBS relied on official sources and adopted an explicit patriotic stance, by backgrounding negative information or hedging the coalition responsibility for civilian casualties. The BBC news presenter tended to practice an investigative journalistic style, with a greater concern for objectivity and more critical towards the official discourse than CBS. RAI Uno presenters also adopted a more traditional reporting style, trying to present different stances on the topic, while the anchors in TG5 took an explicit negative stance towards the war.

The research on the four sub corpora is extended in the next chapter, 'The news presenter and the television audience: a comparative perspective of the use of "we" and "you" ', by Laura Ferrarotti.

She investigates the use of 'we' and 'you' forms in news presenters' discourse, as inclusive, potentially inclusive and exclusive pronouns. The frequency of these categories and the contexts in which they appear show different modes of constructing the relationship between the presenter and the audience. CBS constructs a more distant relation, except for the 'human interest' stories inserted in the news programme, regarding military personnel and their families.

The high frequency of potentially inclusive 'we' for the BBC presenters shows that they position themselves as representing the audience during interactions with the reporters.

The frequent use of inclusive 'we' and 'you' forms for the two Italian broadcasters helps to construct a more personal relationship between presenter and viewers. At the same time the presenters are positioned as 'teachers' or authority speakers guiding the viewers' interpretation of facts.

In chapter 4, 'Wide angles and narrow views: the Iraq conflict in embed and war zone reports', Caroline Clark shifts the object of analysis from the news presenters' utterances to the embedded and war zone reporters' interventions. Comparing the interventions made for BBC and CBS, Clark focuses on three specific aspects: the attribution of utterances to a source which is different from the reporter, assertions made by the speaker-reporter and the use of concession, especially the conjunction 'but' as a particular type of attribution. The findings show that BBC reporters express negative evaluation more frequently, especially in regard to the effects on Iraqi civilians. This supports the results of other CorDis subprojects which have found that BBC reporting of the Iraqi war expressed an anti-interventionist stance.

In chapter 5, 'Decoding codas: evaluation in reporter and correspondent news talk', by Louann Haarman, the corpus selected consists in edited instead of live reports from all four broadcasters. The term 'coda' refers here to the last utterances of a report, which have an evaluative and concluding function. In line with its positive representation of the war, CBS codas were often formed by interventions of US military personnel and their families. The negative stance towards the war was implicit in the stylistically marked BBC codas. Italian televisions codas were less elaborated and tended to have a brusque ending; they also implicitly expressed 'a moral commitment against war in general' (p.135).

Chapter 6, '"If it wasn't rolling, it never happened": the role of visual elements in television news', by Maxine Lipson, is the only one analyzing how images contribute to the creation of meaning in news reports. Lipson presents the methodology and the findings of three studies.

The first one reveals that the most frequent images in BBC news reports during the period 29 March – 11 April were those of machines or other military hardware, which supported the official Anglo-American discourse of the military technical superiority; moreover, 'the machine emerges as soldier, victim and casualty of the war' (p.147).

The second study regards the construction of the war participants in BBC and CBS evening news reports during 5 – 11 April 2003. Not surprisingly, the visual elements show a polarization of the combatants: while coalition forces are presented as serious, friendly and helping the civilians, the members of the Iraqi Guard appear as disorderly and emotional. Iraqi men are presented in action, while women appear as still subjects, suggesting sadness and despair. The third study focuses on the representation of coalition forces during 31 March – 4 April in CBS and BBC reports. The results suggest that both broadcasters tend to present the military in the foreground; in the CBS images, the relationship between soldiers and viewers is more direct, while in BBC images it is mediated by the embedded reporter.

Chapter 7, 'News is reporting what was said: techniques and patterns of attribution', by Roberta Piazza, aims to investigate how voices of other parties than reporters are inserted in the discourse.

The study is focused on five days of news reports broadcasted by RAI Uno and TG5, in comparison with the two Anglo-American channels. The author examines the frequency of attribution, the identification of the newsmakers, the manner in which different sources are voiced and the reporting verbs in the quoting frames. The findings indicate that the Anglo-Saxon journalists tend to resort to 'very direct discourse' more often, letting the interviewed persons speak for themselves, while Italian journalists reconstruct the sources' discourse verbatim. The Italian journalistic style, especially for TG5 reporters, attributes the reporters the role of interpreters or commentators of the events they witness.

3. EVALUATION

This is a volume addressing especially researchers or postgraduates. Although the scientific terminology and the theoretical framework are clearly explained, some previous knowledge of topics as stance, evaluation or appraisal theory is needed.

The volume is well-structured and highly coherent; the order of the contributions makes them complete each other, as each article refines or extends previous analyses.

Regarding its content, it must be noted that the researchers made a good selection of the corpus, which is not too broad and not too small either. The period chosen manages to cover all main events during the 2003 Iraqi war. The choice of an unitary corpus which is the same for all contributions makes the volume different from other collective volumes on stance like Jaffe (2009) or Englebretson (2007). Haarman and Lombardo propose a complex way of investigating stance in discourse, integrating quantitative and qualitative analysis.

This approach matches other recent opinions on the topic, for instance Hunston (2007) who suggests that the analysis should not be limited to the quantity of evaluative terms, but also pay attention to the contexts in which these terms appear.

The research undertaken by the team is interesting also from the perspective of media and conflict studies, because it proves that linguistics and in particular discourse studies may provide a way of explaining and understanding social and political events. It reveals that the same events and the progress of the war have been depicted differently depending on the broadcast channel's policy and also on the cultural values and the national politics.

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