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Dear readers,

I am very glad that after half a year I can again present the new edition of Science & Military. As the editor-in-chief I am especially glad that the journal is popular with more and more readers – experts from foreign countries as well as Slovak experts. It proves that the quality and readers´ vigorousness is growing.

The end of the year 2011 closed the 6th year of editing the journal Science & Military, which is an opportunity to balance and take a think. The journal Science & Military was first issued in 2006 as the only military periodical in the Slovak Republic that deals with military topics and with military science. By editing the journal Science & Military we tried to create space for publishing articles by Slovak and foreign authors who deal with the research in the field of armament and machinery, communication and information systems, military logistics, economy, management, national and international security and other fields of military science. After some time I am pleased to say that the journal Science & Military is actively used for the development of scientific knowledge on the national as well as international level. The proof for it is the growing number of articles from foreign authors from Poland, Ukraine, Russia, Hungary, Czech Republic and Romania. The international editorial board supervises the quality and scientific erudition of the published articles. The statistical data on the usage of Science & Military in the databases of ProQuest for the previous year also prove the growing interest in our periodical. Among the countries and regions that downloaded articles from our journal we can mention the USA, China, India, Australia, New Zealand, Great Britain and Japan.

The main long-term goal of the editorial office continues to be including the journal in the Current Contents databases. We realise that achieving the goal is only possible with joint effort because a good journal is not the result of work of editorial board, nor the editor-in-chief. A good journal is represented by good articles that address the scientific community, but also the general public and provoke discussion. Thus, dear authors, readers, members of the editorial board and reviewers, the expertise and quality of the journal Science & Military is in your hands, too. Your work and dedication is guarantees our journal a long perspective.

I wish the journal Science & Military and its readers creative success and inspiration, useful information and pleasure while reading this periodical.

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THEORETICAL AND METHODOLOGICAL APPROACH TO DEFENCE AND SECURITY IN A TIME OF GLOBALIZATION

Radoslav IVANČÍK

Abstract: Nowadays, at the time of deepening globalization, defence and security belong to the most frequent words used all over the world. Practically, there is no TV channel or radio station which would not use these words in their programs several times a day. There are no daily journals and weekly or monthly magazines which would not inform their readers about changes in the field of defence and security. As a development in those areas is directly influenced by a development of the whole human society, an author, in his contribution, deals with theoretical and methodological aspects of defence and security, define them, and simultaneously, due to the worsening of global security environment, points out the necessity to pay maximal possible attention to support of defence and security.

Keywords: defence, security, globalization, global security environment, human society, risks, definition, crisis.

1 INTRODUCTION

Since its very beginning, the development of human society has, in its natural as well as social environment, been closely connected with the impacts of adverse phenomena of very diverse nature. While unfavourably affecting the life of mankind, initially, these adverse phenomena were mainly linked to nature and the natural environment, where people lived. Back then the existing threats mainly manifested in the form of natural elements, occurring as natural disasters, shortages of animal and vegetable foods, and drinking water. Another type of threat was represented by wild animals or predators, against which people were unable to protect themselves. Similarly, there were also diseases for which people had no effective medicine. Their lives were, both positively (enough food from the natural environment) or negatively (natural disasters, famine, wild animals), wedded to nature.

As the evolution of mankind progressed, the list of the negative factors threatening the lives of people widened. Man himself became their originator. By forming groups and communities, acquiring and amassing property, subjugating labour and property, man was no longer in conflict with nature only, but also with himself, i.e. with other people and communities. Thus, the sources of potential threats were no longer only natural but also social. Undoubtedly, the widening gap in property wealth and living standards had a negative impact on all strata – individual, family and tribal. Later, the situation was even more exacerbated by religious, ethnic and value differences at the level of regions, nations, states, communities, alliances and civilisations. Based on these negative experiences, the deepening differences led people and societies to realise a whole spectrum of threats. With their own defence and security in mind, they began to take corresponding measures against them.

However, attempts to deliver one's own defence and security are, to some extent, counterproductive. The more individuals or societies enhance their defence and security by building up their power and security potential, the more they provoke other individuals and societies. By becoming far too powerful, they also become far too dangerous to their own neighbours. History has proved that excessive security measures and armaments production on one side result in security measures and armaments production on another side. To illustrate this point, consider the Cold War and the arms race between the two antagonistic groupings – the North Atlantic Treaty countries and the Warsaw Pact countries – a period of history when the United States and the former Soviet Union had reached critical levels of military power.

With the development of human society new threats were added to the list of security challenges. Thus, besides the military ones, there were also the new non-military threats, initiated by human society itself. A gradual increase in trade, marked by a shift from barter to monetary transactions and, later on, from cash to non-cash transactions, combined with the development of crafts, labour division, manufacturing, industrial and scientific and technological revolution, and a large number of discoveries and inventions applied in everyday life, as well as the deepening globalization, these all have caused the modern industrial society to shift from a natural to an artificial environment. There, the new risks and threats greatly differ from those which worried the human society in its earlier stages.[1]

The individual and collective security environment is markedly changing, and individual actors, i.e. individuals and societies, must respond adequately to these changes. This is also true of the national and global security environment. As a result, individual states and coalitions, and

[1] HOFREITER, L. 2006. *Securitology*. Liptovský Mikuláš : Armed Forces Academy of General M. R. Štefánik in Liptovský Mikuláš. 2006. 138 pp. ISBN 80-8040-310-4.

even integrated groupings, must adopt a series measures to prevent the new and to alleviate the existing risks and challenges. As the risks and threats can neither be eliminated territorially nor socially, it is indeed impossible to constrain their negative impact on a particular area or on a particular social group. Hence, it is inevitable that all states, including the Slovak Republic, adopt effective measures to provide for their defence and security. However, implementing such measures, while using human, material and financial resources efficiently, is not possible, unless we thoroughly analyse the security environment.[2]

Today, the worldwide security environment is significantly influenced by the emergence of new military and non-military threats, deepening globalization, the prevailing global economic crisis, the permanent threat of terrorism, failing states, instability of developing countries, and society's growing vulnerability. Since the collapse of the bipolar world, the traditional balance of forces, risks and threats known to us have changed radically. Globalization and new security challenges significantly influence the contemporary developments in the world. Therefore, it is necessary that governments, ministries (not only defence and interior), and other institutions pay more attention to the provision of defence and security than before. At the same time, the altered security conditions impose increased qualitative requirements on capabilities and capacities of armed forces and on the state's other security components, as well as on the skills of military and civilian personnel.[3]

2 DEFENCE

The simplest definition of defence, one which is very often cited when teaching tactics at military establishments, is very straightforward: defence is the opposite of an attack. But, to be more precise, defence is a multi-dimensional phenomenon composed of political, military, economic, humanitarian, information, energy, technological, environmental and other dimensions[4] which manifest themselves in a wide spectrum of activities, ranging from the defence of the entire human community, alliances, states, territories, facilities, through the defence of social systems and spiritual values, to the defence of citizens.

From the economic and political point of view, defence is defined by complex, multifaceted activities that presuppose the use of a large number of society's economic, military and diplomatic means, forces, and resources in order to ensure its survival, should it be exposed to threats to its existence or the existence of its members.[5]

From the military and economic point of view, defence manifests an active involvement of the state's armed forces and their members in a war or in preparations for a war, in an attempt to deliver national defence during or prior to an attack of an enemy force, while using the human, material and financial resources allocated by the state.[6]

From the social and security point of view, defence is envisaged as a set of political, military and economic measures, which, besides the defence against military and non-military threats, are aimed at defending the country's democratic system, citizens' fundamental rights and freedoms, as guaranteed by the constitution, as well as society's spiritual values, people's lives, health and property, public property, living environment, should the state be invaded or threatened to be invaded by an external enemy.

From the national security point of view, defence represents a comprehensive system engaging the state's military, political and economic components in the execution of missions in the area of external security, with the aim of preserving the conditions essential to the state's functionality, stability and development, sustainment of peace, sovereignty, territorial integrity and inviolability of borders, internal state order, citizens' constitutional rights and freedoms, while respecting human lives, health and property.[7] At the same time, defence supports the social, economic, political, technical, technological and other systems, which, under particular internal and external conditions, provide for the country's assigned functions and tasks to be accomplished and further developed in the interest of all people and security.

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[2] IVANČÍK, R. 2011. External Security Environment of the Slovak republic. In *Ušiak, J. – Lasicová, J. : Security Forum 2011, Collection of Contributions from International Scientific Conference*. Banská Bystrica : Matej Bel University. 2011. ISBN 978-80-557-0136-3.

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[7] NOVÁK, L. 2005. *Crisis Planning*. Žilina : Žilina University. 2005. 208 pp. ISBN 80-8070-391-4.

From the legislative point of view, according to § 2, Act No. 319/2002 Coll. governing the defence of the Slovak Republic as amended, national defence is construed as a set of measures, by means of which the Slovak Republic preserves peace, security, sovereignty, territorial integrity, and the inviolability of its borders, while at the same time performing its obligations of collective defence against an attack, as set out in international agreements and treaties of military nature.

3 SECURITY

There are some factors that determine one's own development. Some of them have a positive effect on people, enhancing their quality of life. On the other hand, some factors tend to transform themselves into different security risks and challenges, and are, more or less, threatening human society. Both of these types, whether positive or negative, emerge under certain circumstances.

According to numerous definitions, listed in specialised publications, environment is generally construed as a set of factors, phenomena, processes and influences existing in the close or distant surroundings of a person (subject), with which the person (subject) is in interaction, and which exert a direct orindirect impact on the subject and are capable of influencing or changing his or her behaviour.

The environment itself is no final reference, since it is subjected to gradual changes and developments. From the historical point of view, there initially existed a natural environment, which was neither created nor shaped by people. It was created by nature. However, in the course of history man began to shape his surroundings, creating a superficial environment. This means that people began to gradually live in a place combining different environments – original nature-made, human-shaped, and artificial. The latter encompasses the social environment, which has a decisive influence on one's own development, on the evolution of social relations, as well as on the social system as such.[8]

The individual security environment represents an environment in which the subjects of reference (individuals or states) pursue their security interests in interaction with the sources (spreaders) of security threats.

The collective security environment, on the other hand, represents an environment in which subjects of reference (teams, communities, groupings and coalitions of states) pursue their security interests in interaction with the sources (spreaders) of security threats.

After considering the arguments above, one may characterize security threats as identified, potentially destructive, and undesirable phenomena in relation to the security interests of a pertinent subject of reference.

A security threat may arise when a subject of reference realizes that a particular phenomenon has the potential to cause damage to one's own security interests. In other words, this may occur when a security threat stands in the way of the security interests of a particular subject of reference, whereas it applies that in case of a country, e.g. the Slovak Republic, the subject is defined by the country's domestic, political as well as foreign policy status.

A security risk quantifies the possibility of an undesirable phenomenon to arise. This suggests the probability of incurring damage to security interests by an identified threat.

Another definition of the security environment is built around the idea of security environment forming a part of the natural and social environment, where the conditions of existence and the development of social subjects and their activities, relations and interests are predominately determined by security.

This means that this definition denotes a special dimension of security, one which is combined with the workings of individual subjects at a given time and under certain conditions. This is the broadest sense of the definition in which the security situation is characterized by a given space-time region and construed as the result of activities undertaken by relevant security actors (security bodies, institutions, states, integrated groupings, coalitions, etc.).[9]

Bearing in mind that the definitions mentioned above are closely linked and derived from the term security, we need to elaborate on the basic definition of this term. While according to the Concise Dictionary of the Slovak Language security has three associated meanings – assurance, protection, and provision, the English language uses two terms – security and safety. These two examples clearly demonstrate that the term security is very broad and that it denotes a number of things.

As a result, specialized articles provide a wide array of definitions for security. These reflect the authors' personal view as well as their distinct professions – whether they are soldiers, politicians, doctors, economists, technicians, sociologists or IT

[8] HOFREITER, L. 2006. *Securitology*. Liptovský Mikuláš : Armed Forces Academy of General M. R. Štefánik in Liptovský Mikuláš. 2006. 138 pp. ISBN 80-8040-310-4.

[9] HOFREITER, L. 2006. *Securitology*. Liptovský Mikuláš : Armed Forces Academy of General M. R. Štefánik in Liptovský Mikuláš. 2006. 138 pp. ISBN 80-8040-310-4.

specialists, they all have come to define the term security differently.

Porada defines security as a system of mutually interrelated and affected factors and their qualities combining to exert an impact on social developments, while negatively influencing health, life and other values of subjects of reference in particular cases.[10]

Korzienowski defines security as a given objective state, grounded in the absence of a threat, which is subjectively felt (viewed) by individuals or groups.[11]

Šimák and et. al. perceive security as a state of social, natural, technical, technological or other systems, which, under given internal and external circumstances, enable the state's assigned functions to be executed in the interest of mankind and society.[12]

Constitutional Act No. 227/2002 Coll., governing national security in a time of war, a state of war, an exceptional state and emergency, defines security as a state in which peace and security, democratic order, sovereignty, territorial integrity, inviolability of national borders, fundamental rights and freedoms are upheld, and where life, health, property and natural environment are safeguarded.

A number of definitions maintain that the state may only be deemed secure as long as there is no need for it to sacrifice its fundamental values in order to avoid war, or it is capable of winning the war, when challenged. Other definitions claim that the state is deemed secure when it is not confronted with a threat or when it is capable of defending its independent identity and functioning integrity. Yet other definitions highlight the absence of threats posed to the state's fundamental values or the absence of fear of losing these values.[13]

In spite of a wide variety of definitions based on the general meaning of security, two distinct approaches toward security were identified and distinguished at the end of the 20th and the beginning of the 21st century:

The first approach, designated as *traditional, negative and narrow*, views security as the opposite of danger, and is grounded in the absence of outer threats. It emphasizes the need to preserve the existence of a subject of reference, when faced with outer threats. As a result, it is well elaborated on in military and military-political theories. In this context, security is construed as a world without wars or armed conflicts, while national military force and military potential are considered to be major security instruments, interconnected with the state in multiple ways. This approach envisages a confrontational (conflicting) element in delivering security.

The second approach, termed *new, modern, positive and broad*, goes beyond the traditional emphasis on the military dimension of security and military threats as their fundamental characteristics. Security is characterized from a number of aspects, putting a greater emphasis on other than military causes of tensions, conflicts or crises in international relations. Hence, the traditional conception of security threats of military character is extended to incorporate new types of threats of political, social, economic, environmental and information character. Based on this broader view, security also entails setting the conditions for a long-term, continuous and dynamic growth, while sustaining economic development and providing access to modern technologies, natural resources, and preventing environmental degradations.[14]

4 CONCLUSION

In today's world, the issue of providing defence and security is ranked, undoubtedly, among highly risk factors, and therefore, the inability to adequately respond to any emerging crisis situations may have a markedly negative impact on the entire society. While the international security situation in the 1960s and the 1980s was referred to as the Cold War Era, the current international security situation at the beginning of the 21st century, in connection with the emergence of new security challenges, especially those of non-military nature, is called the Hot Peace Era[15].

For the Slovak Republic, the European geopolitical and geostrategic environment in a time of deepening globalization is seemingly safe. Although the new international political situation in Europe after the end of the Cold War and the division of the bipolar world removed the

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immediate, direct threats to the Slovak Republic, but the threats and risks, arising out of the deteriorating global security situation, to its security and stability cannot be ruled out. All in all, it is impossible to approach the provision of defence and security as a secondary issue. Indeed, defence and security must take the highest priority and not only from practical, but also from theoretical and methodological point of view.

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OPTIMISATION OF CONTAINER UNIT FORMATION USING DECKING SYSTEM ANCRA

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Abstract: This paper analyzes the possibility of using decking beams ANCRA in ISO 1 C storage containers of version "A" to achieve higher loading efficiency and proposes a load plan of container for storing pallet units created using wooden EURO pallets sized 1200 × 800mm. The model comparison of methods currently used is included in the paper, including model calculations of return of invested funds to purchase decking beams ANCRA. Finally the paper presents directions for further research into safe and effective creation of container units.

Keywords: ISO 1 C container, europallet, decking beams ANCRA, load plan, total interior space.

1 INTRODUCTION

Loading of containers in Armed Forces of the Czech Republic (ACR) and the arrangement of compact container units is carried out using appropriate means of transport (in particular ISO 1 C storage containers and various types of pallets), handling means (low- and high-lift trucks etc.) and binding means (undetachable equipment ANCRA).

Tactical-technical data and the selection of the above-mentioned technical means is a crucial precondition for effective use of the interior space of the container. In particular, when using standard flat wooden pallets (e.g. EURO sized 1,200 × 800mm), the effectiveness of use of the total interior space is restricted [7].

2 THE ANALYSIS OF TECHNICAL MEANS DESIGNED TO BIND LOAD IN ISO 1 C CONTAINER OF VERSION "A"

At present, undetachable equipment ANCRA is utilised in ACR for binding pallet units in a container. ACR makes use of ISO 1 C storage containers of version "A", fitted with three multipurpose side strips ANCRA (hereinafter referred to as "side strips") installed 280, 930 and 1,580mm above the floor [4], and 22 pcs of fastening straps ANCRA (hereinafter referred to as "straps") to be attached to holes in the side strips [7].

Another version of the ISO 1 C storage container – version "B", which is not utilised in the ACR, is fitted with additional vertical system of side strips and 18 pcs of decking beams ANCRA (hereinafter referred to as "beam") [7]. The beams are installed to make a "second deck", where more pallet units can be placed making stacking unnecessary. The beams are attached, like the straps, to horizontal and vertical side strips. The beams, designed for version "B" under standard conditions, can also be utilised in ISO 1 C storage containers of version "A" in order to exploit the total interior space more effectively. The position of horizontal side strips is identical in both versions of the ISO 1 C storage containers [5]; there are no vertical strips in version "A", thus the possibility of installation of the decking system in ISO 1 C storage containers of version "A" is limited (refer to Fig.. 1).

In theory, the beams can be installed in any of the three horizontal side strips. However, in practice, only the middle side strip can be utilised to make the "second deck". Should the upper, or the lower side strip be used, insufficient space would be left above, or below the strip (575mm, or 235mm – refer to fig. 2). Furthermore, it would be impossible to fix the pallet units placed in such confined space by straps as the horizontal side strips would not be available.

According to the producer of storage containers DAHER KARBOX, s. r. o., minimum internal dimensions of the ISO 1 C storage container of version "A" are 5,870 × 2,330 × 2,200mm [7]. It follows from fig. 1 that the installation of the beam sized 65 x 90mm in the middle side strip restricts the height of pallet units in the lower layer to **885mm**. Maximum theoretical stacking height of pallet units in the lower layer, if flat wooden pallets EURO (hereinafter referred to as "europallet") were to be utilised, is then 885 – 144 = 741mm, where 144mm is the minimum height of the pallet. According to ČOS 399 006 – *Military Pallets, Packages and Containers,* the dimensional tolerance of europallets is +7mm [1], i.e. the pallet may be as high as 151 mm; the stacking height of a pallet unit would thus be 885 – 151 = 734mm.

Analogically, the maximum height of pallet units in the second layer is calculated as follows: **1,225mm** and their maximum stacking height including the tolerance: 1,225 – 151 = 1,074mm.

The beams may not only be utilised as the technical means to make the "second deck", but may also serve as binding means, in particular to secure the door area of the container. In case a beam is utilised to secure the door area, possible loosening of a pallet unit(s) on the "second deck" by the door area will not endanger the unloading team. The maximum load capacity of a beam guaranteed by the producer is 1,000kg [6], and the beam can serve as additional binding means to secure the load in a container against the effects of inertial force during haulage.

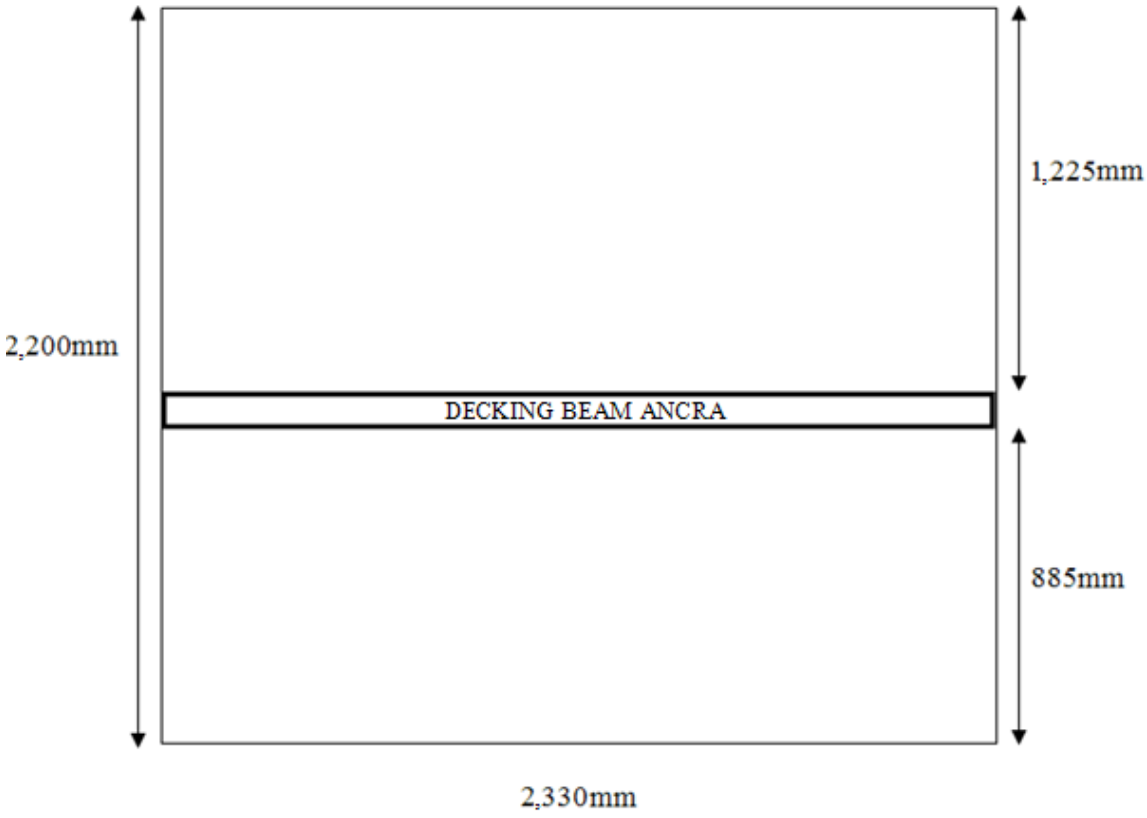

Fig. 1 The installation of decking system ANCRA in the middle multipurpose side strip ANCRA (front view of the ISO 1 C storage container of version "A")

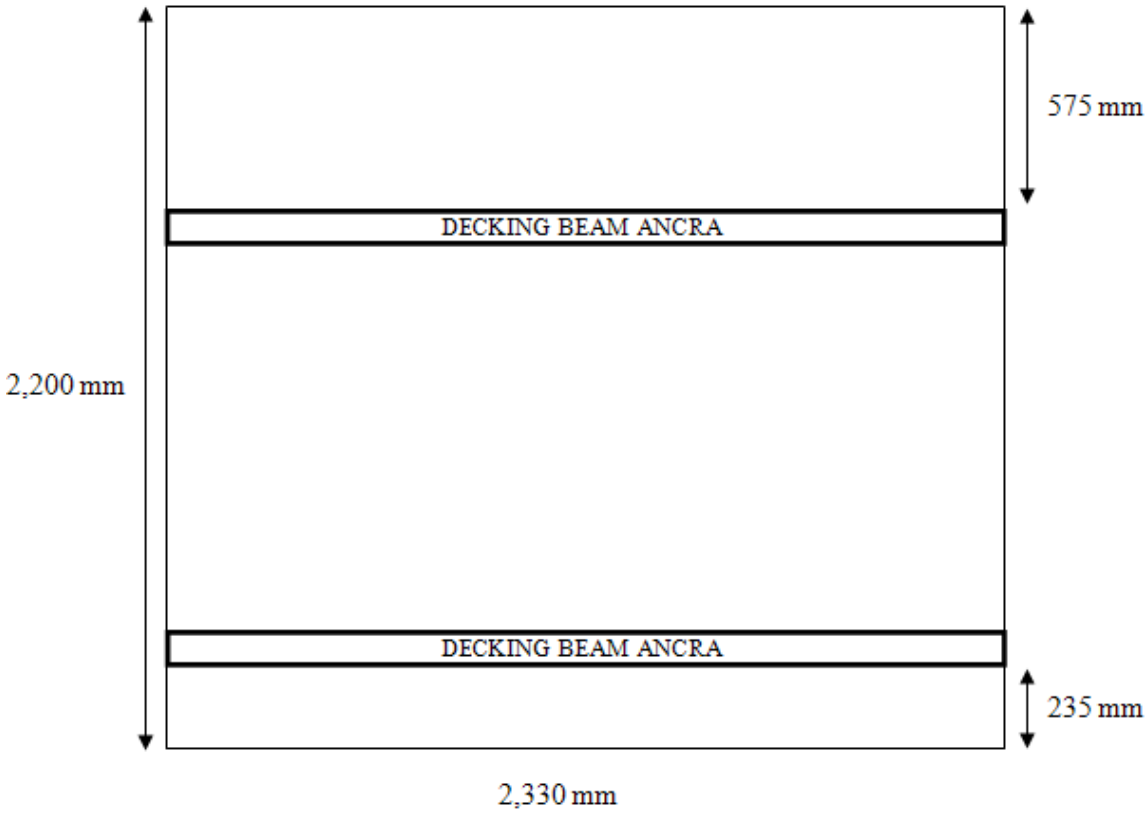

Fig. 2 The installation of decking system ANCRA in the lower and upper multipurpose side strips ANCRA

3 USE OF THE TOTAL INTERIOR SPACE OF A CONTAINER AND DECKING SYSTEM ANCRA

When loading an ISO 1 C storage container of version "A" with 11 pallet units of standard size 1,200 × 800mm without overlap and of maximum height complying with ČOS 399 006 (1,600mm [1]), **56.2%** of the total interior space of the container is utilised. Only **16.90m^3** of the total **30.09m^3** of the container [3] is filled.

When the "second deck" is made by means of the beams, the use of the total interior space of the container becomes more effective, and up to 22 pallet units may be placed in the container. The total height of pallet units shall be lower due to restricted space. When applying an analogical model (refer to [3]) of pallet units without overlap, i.e. with ground plan dimensions 1,200 × 800mm and maximum theoretical stacking height taking into account the possibilities of the first and second deck in the container, the usability of the interior space of the container is as follows:

In the first layer (deck), 11 pallet units sized 1,200 × 800 × 885mm can be placed (refer to fig. 1). The load plan is shown in fig. 3. The last pallet unit (no. 11) can be placed both by the right and left side of the container.

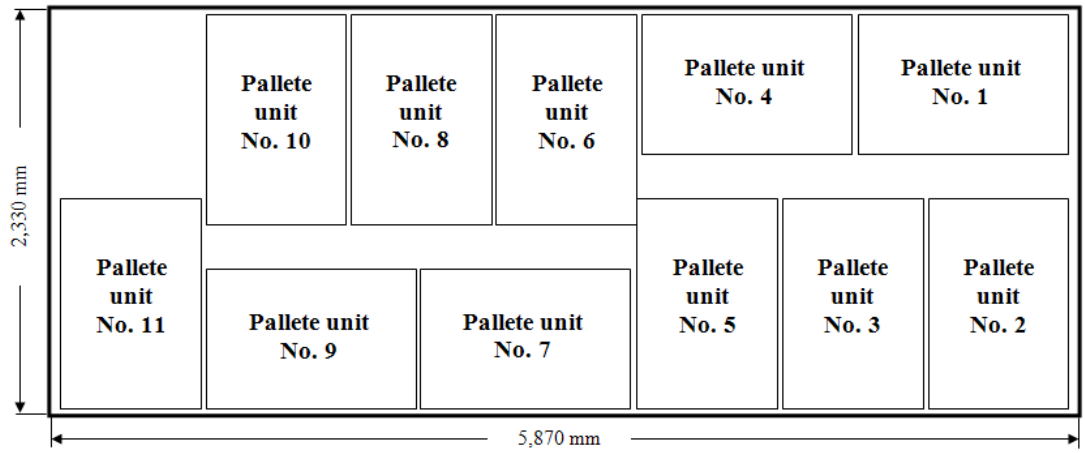

Fig. 3 Standard load plan of an ISO 1 C storage container of version "A" using europallets and fastening straps ANCRA (first layer)

Second layer (deck) can be, in terms of arrangement of the pallet units, identical or mirror-reversed (in axis x or axis y) for the sake of better distribution of the total weight of the load in the container. In particular, the height of the pallet units will be different, as the second layer is by 340mm higher, i.e. 1,225 mm. 14 pcs of beams (refer to fig. 4 – grey colour) are needed to allow placing 11 pallet units in the second layer. 1 pc of the beam placed between the container door and pallet unit no. 11 may be utilised to secure the door area.

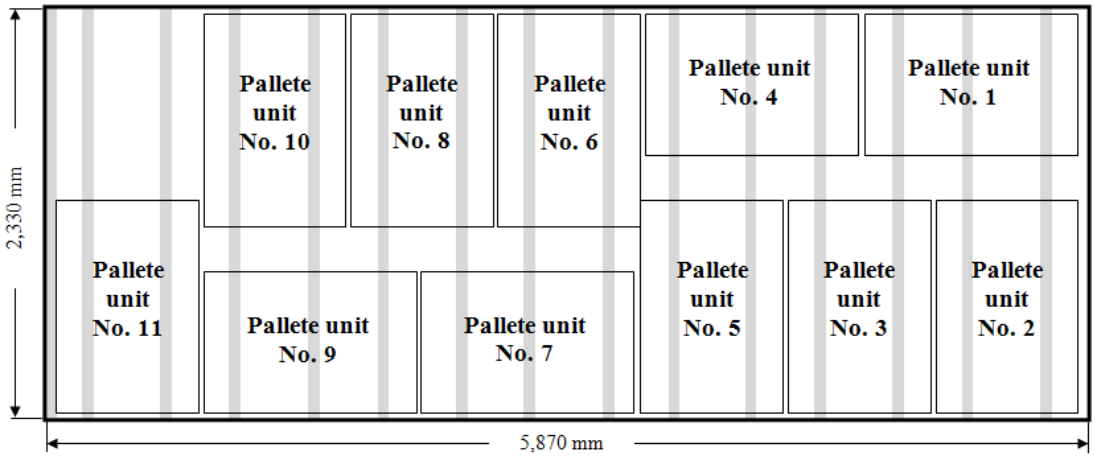

Fig. 4 Standard load plan of an ISO 1 C storage container of version "A" using europallets, fastening straps ANCRA and decking system ANCRA (second layer)

In compliance with the diagram in fig. 4, the total number of beams needed is **15 pcs.** The price of 1 pc of beam from the supplier of containers DAHER KARBOX s.r.o. is CZK 4,543 (incl. VAT). The total sum required for the purchase of 15 pcs of beams for one ISO 1 C storage container of version "A" would then be 15 · 4,543 = **CZK 68,145** (incl. VAT).

Making use of maximum potential of the ISO 1 C storage container of version "A" by means of the decking system, the total loading space of 22 pallet units is calculated as follows:

$$V_{P1} = d_{P1} \cdot s_{P1} \cdot v_{P1} \cdot n_1, \qquad (1)$$

where V_{P1} stands for the total loading space of n_1 pallet units (including the pallet proper) in the first layer (deck), d_{P1} stands for the length of each pallet unit in the first layer (deck), s_{P1} stands for their width and v_{P1} for their height (including the height of the pallet proper).

The total loading space of pallet units shall mean maximum possible use of the space in the container loaded with europallets without overlap. Upon substituting, the total loading space of the first layer of pallet units is as follows:

$$V_{P1} = 1.2 \cdot 0.8 \cdot 0.885 \cdot 11 \qquad [m^3]$$

$$V_{P1} = 9.35 m^3$$

Analogically, the total loading space of pallet units in the second layer (deck) is calculated as follows:

$$V_{P2} = d_{P2} \cdot s_{P2} \cdot v_{P2} \cdot n_2, \qquad (2)$$

where v_{P2} stands for the total loading space of n_2 pallet units (including the pallet proper) in the second layer (deck), d_{P2} stands for the length of each pallet unit in the second layer (deck), s_{P2} stands for their width and v_{P2} for their height (including the height of the pallet proper).

Upon substituting, the total loading space of the second layer of pallet units is as follows:

$$V_{P2} = 1.2 \cdot 0.8 \cdot 1.225 \cdot 11 \qquad [m^3]$$

$$V_{P2} = 12.94 m^3$$

The total loading space of pallet units in the first and second layer (deck) can be calculated by simple summation of the total loading space in both layers:

$$V_P = V_{P2} + V_{P2}, \qquad (3)$$

where V_P stands for the total loading space of pallet units in both layers. V_P represents maximum capacity of the ISO 1 C storage container of version "A" using the decking system and europallets without overlap, and maximum stacking height given by the limits of the first, or the second deck. Upon substituting:

$$V_P = 9.35 + 12.94 \qquad [m^3]$$

$$V_P = 22.29 m^3$$

Maximum theoretical space of the container total interior space to be utilised with installed decking system is 22.29m^3, i.e. **74.1 %** of the container volume. The total use of the container interior space will increase from 16.90m^3 to 22.29m^3, i.e. by **31.9 %**.

In cases where the height of some pallet units exceeds 1,225mm, both versions can be combined, i.e. not to use the decking system for higher pallet units, and store them on the container floor. In such cases, however, the effectiveness of use of the container is reduced depending on the number of pallet units stored in one layer only.

The model abstracts away from handling areas required for the performance of the loading proper. In practice, while loading the container in compliance with the procedure described above, it would be necessary to reduce the height of pallet units depending on the handling means used and the load. The reduction of pallet unit height would be relatively small even with regard to the fact that the container internal dimensions, the model calculation was based on, are stated to be minimum by the producer. Due to the fact, the handling space can fully or at least partly include the dimensional tolerance.

Also, the model abstracts away from the lap of pallet units, which would increase the percentage of use of the container total interior space, and the difference against the current version would thus be even more significant. In order to maintain the integrity of the model, it would be possible to assume certain overlap of pallet units in both versions, but in the first version, there are only 11 pallet units as opposed to 22 pallet units with the decking system installed.

4 ECONOMIC RETURN ON THE PURCHASE OF DECKING SYSTEM ANCRA

The return on the investment into the purchase of the decking system depends primarily on the sphere of their use. The decking system is generally used during haulage, when the container is not fully exploited in terms of the totalinterior space or in terms of maximum load. The most profitable use is then in the sphere of road or railway transport. As far as air transportation is concerned, aircraft load capacity sets significant weight limits, and the use of the decking system would be in such cases very limited.

The profitability of the use of the decking system can be illustrated by the following model based on actual supply transport to KFOR operation. The total financial demands of supply transport of two standard ISO 1 C containers on Tatra 815

MULTILIFT (T815 MLF) and a trailer, including all relating costs (lodging, boarding allowance, spending money, etc.), is around CZK 100,000.

For the needs of the model, data from "Evaluation of KFOR supply transportation" dated 3 February 2011 has been applied. Within the delivery, 4 pcs of the ISO 1 C container were transported on two vehicles T815 MLF and two trailers. Financial demands of the transportation of the first vehicle with a trailer amounted to CZK 102,234 (incl. VAT), and of the other vehicle with a trailer to CZK 104,014 (incl. VAT) [2]. The average financial demands per one ISO 1 C container are as follows: (102,234 + 104,014)/4 = **CZK 51,562**.

As a rule, the supply transport involves an attendant that is transported in the vehicle proper. The financial demands of the transportation of persons – attendants – are calculated separately, and they shall be abstracted away from for the sake of comparison of currently utilised procedures and the proposed ones.

Based on the previous calculations, the usability of the total interior space of the ISO 1 C storage container of version "A" can be compared with regard to currently utilised procedures and newly proposed procedures. On the condition that all 4 storage containers in the supply transport contain maximum possible quantity of the load (with current procedures): 16.90 m^3 (refer to [3]), only 56.2% in each of the containers will be utilised. The total volume of load in 4 storage containers is: 4 · 16.90 = 67.60m^3.

In ideal case, upon the installation of the decking system, up to 74.1% (22.29m^3) of the storage container total interior space can be utilised (see above). With more effective use of the total interior space of a storage container, it is possible to place the same volume of load (67.60m^3) in 67.60/22.29 = **3 storage containers**. In such case, one storage container would be spared. Provided that the costs decrease proportionally, and based on the financial demands calculated for the transport of one storage container, the saving is CZK 51,562, as calculated above. The initial economic intensiveness of the decking system purchase for 3 calculated ISO 1 C storage containers of version "A" would be: 3 · 68,145 = **CZK 204,435** (incl. VAT).

The return on the investment into the decking system may be determined by a simple division of the initial economic intensiveness of the decking system purchase by the saving reached during one supply transport: 204,435/51,562 = **3.96 of the supply transport**. In other words, the financial means invested in the purchase of the decking system shall return, under the conditions stated above, within 4 transports.

5 CONCLUSION

The model applied illustrates the profitability and relatively quick return on the investment into the purchase of decking system ANCRA intended for optimization of loading of an ISO 1 C storage container of version "A". The total usability of the container interior space will increase by 31.9%, and the investment into the decking system shall return in less than 4 supply transports to KFOR operation.

Despite the fact that version "A" of the ISO 1 C storage container is not primarily intended for the use of decking system ANCRA (there are no vertical multipurpose side strips ANCRA), the beams may be installed for the sake of more effective use of the container total interior space. The use of decking system ANCRA and flat wooden pallets EURO would enable the standardization of the entire system of container loading. There would also be a better link-up to the civil sector, where flat wooden pallets EURO are one of the most common transport means in Europe.

Further investigation shall be made in the possibilities of use of the decking system ANCRA as binding means in ISO 1 C storage containers of version "A", or the application of other types of technical means intended for load binding. At present, non-standard binding means (such as flat wooden pallets, discarded mattresses and packages of gear) are utilised operatively where the binding by fastening straps ANCRA is insufficient. ACR lacks any further standard technical means (air bags, blocks, crossbars etc.) for this purpose.

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VSWR MEASUREMENT WITH FERRITE CIRCULATOR

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Abstract: Matching of antennas to feeding transmission lines is crucial factor that limits utilization of RF generator power. In the paper, there is described a design of *VSWR* measurement scheme with ferrite circulator. It is dedicated for impedance matching measurement of antennas in the microwave region. The measurement scheme is completed with mathematical apparatus that is employed into evaluation of impedance matching. Furthermore paper presents measurement results, which were obtained with suggested *VSWR* measurement method.

Keywords: Voltage Standing Wave Ratio, microwave antenna, ferrite circulator, reflection coefficient.

1 INTRODUCTION

Voltage Standing Wave Ratio (*VSWR*) is the one of the basic antenna parameters. Let an impedance of RF generator is the same as an impedance of transmission line. When a RF generator with the transmission line is terminated by antenna impedance that does not match the characteristic impedance of the transmission line and RF generator, not all of the power is absorbed by the antenna. Part of the power is reflected back into the transmission line toward the generator. The forward (or incident) signal mixes with the reverse (or reflected) signal to cause a voltage standing wave pattern on the transmission line. The ratio of the maximum to minimum voltage is known as *VSWR*, or Voltage Standing Wave Ratio [1], [2].

This parameter can get values from $\langle 1, \infty)$. It can be evaluated by [3]

$$VSWR = \frac{1+|\Gamma|}{1-|\Gamma|} \tag{1}$$

where $\Gamma = \sqrt{P_R / P_I}$ is so-called a reflection coefficient, P_I is a power at the antenna output in [W] and P_R is a power in [W], reflected from antenna input due to its mismatching.

VSWR and Γ values dependency from the percentage reflected power P_R [%] is shown at Fig. 1.

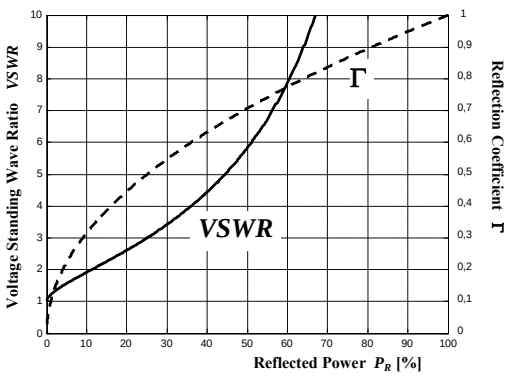

Fig. 1 Dependence of *VSWR* and Γ from reflected power percentage P_R [%]

A sufficiently exact measurement of *VSWR* in relatively wide bandwidth is usually quite complicated task, which in many cases requires using intricate equipment or quite expensive network analyzer.

The goal of this article is to provide an easy *VSWR* measurement scheme to measurement of antenna mismatching to transmission line (50Ω) with sufficient measurement accuracy.

2 VSWR MEASUREMENT PRINCIPLE

The working principle of *VSWR* measurement is based on ferrite circulators exploitation in desired frequency band. The ferrite circulator is three-terminal device. Its properties are described by S_{12} and S_{23} parameters [4]. The S_{12} parameter is a transmission loss in forward direction. It can be calculated as

$$S_{12} = \frac{P_2}{P_1} \tag{2}$$

where P_1 is a power at the input (N^1) of ferrite circulator in [W] and P_2 is a power at its output (N^2) in [W].

The S_{13} parameter is a leaking in inverse direction. Its value is given by

$$S_{13} = \frac{P_3}{P_1} = \frac{P_3}{S_{12}P_2} \tag{3}$$

where P_3 is a power at the ferrite circulator output (N^3) in [W].

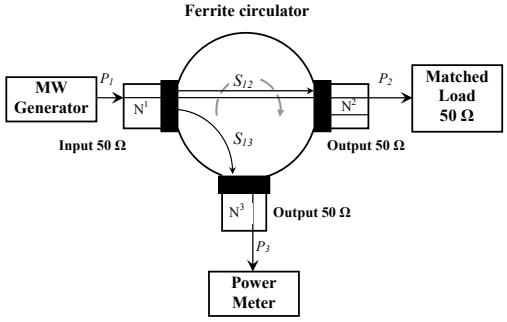

Fig. 2 Calibration scheme of ferrite circulator

The knowledge of above discussed parameters is the fundamental prerequisite of the accurate *VSWR* measurement. These parameters can be evaluated by proper calibration of ferrite circulators as is shown in Fig. 2.

If S_{12} and S_{13} parameters in given frequency band are known, it is possible to do the *VSWR* measurement of unknown antenna [5]. In this article, the measurements of *VSWR* were done with microwave *VSWR* scheme that is shown in Fig. 3.

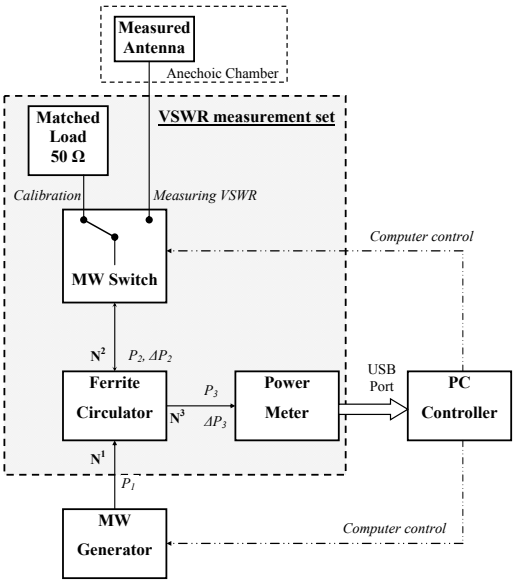

Fig. 3 Circuit scheme of designed *VSWR* measurement site

The *VSWR* measurement works in the two mode of operating. In the first mode, the output of ferrite circulator (N^2) is connected through microwave (MW) switch to matched load (50Ω.) If one to expects the zero attenuation and a perfect matching of MW switch, the value of the measured power P_{3C} is evaluated by power meter and it is given by

$$P_{3C} = S_{13}P_1 = \frac{S_{13}P_2}{S_{12}}. \qquad (4)$$

In this mode, it can be figured out the reflection coefficient Γ_{FC} of used ferrite circulator by

$$\Gamma_{FC} = \sqrt{\frac{P_{3C}}{P_2}} = \sqrt{\frac{P_{3C}}{S_{12}P_1}}. \qquad (5)$$

The second mode of the *VSWR* measurement is a *VSWR* measurement of unknown antenna. If one can suppose the zero attenuation and perfectly matched MW switch, the value of measured power P_{3M} that is evaluated by power meter is given by

$$P_{3M} = S_{13}P_1 + \Delta P_3 = \frac{S_{13}P_2}{S_{12}} + \Delta P_3, \qquad (6)$$

where the power ΔP_3 is the power difference at the (N^3) output of ferrite circulator due to mismatching of measured antenna.

The total reflection coefficient Γ_{SUM} measured in this mode is given by

$$\Gamma_{SUM} = \Gamma_{FC} + \Gamma_{MA} = \sqrt{\frac{P_{3M}}{P_2}} = \sqrt{\frac{P_{3M}}{S_{12}P_1}}, \qquad (7)$$

where Γ_{MA} is a reflection coefficient due to mismatch of the measured antenna.

In the control computer, there is evaluated the power difference between values measured at the (N^3) output of the ferrite circulator, in both modes of operation. This difference can be formulated by

$$\Delta P_3 = P_{3M} - P_{3C}. \qquad (8)$$

By means of equations (5), (7) and (8) it is possible to yield the relationship for the reflection coefficient of measured antenna Γ_{MA}

$$\Gamma_{MA} = \sqrt{\frac{P_{3M}}{P_2}} - \sqrt{\frac{P_{3C}}{P_2}} = \sqrt{\frac{\Delta P_3}{P_2}} = \sqrt{\frac{\Delta P_3}{S_{12}P_1}}. \qquad (9)$$

By substitution of equation (9) into equation (1) it can be derived the relationship for the measured antenna *VSWR*

$$VSWR = \frac{1+\sqrt{\frac{\Delta P_3}{P_2}}}{1-\sqrt{\frac{\Delta P_3}{P_2}}} = \frac{1+\sqrt{\frac{\Delta P_3}{S_{12}P_1}}}{1-\sqrt{\frac{\Delta P_3}{S_{12}P_1}}}. \qquad (10)$$

This relationship is valid for measurements in which the power losses of transmission line ($L_C = P_{OUT}/P_{INP}$) can be neglected. If one uses the loss transmission line (a few meters long cable) it is necessary to consider these losses. For this case, the equation (9) changes to

$$\Gamma_{MA} = \sqrt{\frac{\Delta P_3}{P_2 L_C^2}} = \sqrt{\frac{\Delta P_3}{S_{12}P_1 L_C^2}}. \qquad (11)$$

Similarly to this operation the equation (10) changes into

$$VSWR = \frac{1+\sqrt{\frac{\Delta P_3}{P_2 L_C^2}}}{1-\sqrt{\frac{\Delta P_3}{P_2 L_C^2}}} = \frac{1+\sqrt{\frac{\Delta P_3}{S_{12}P_1 L_C^2}}}{1-\sqrt{\frac{\Delta P_3}{S_{12}P_1 L_C^2}}}. \qquad (12)$$

3 MEASUREMENT RESULTS

According to the functional diagram in Fig. 3 and with utilization above listed equations, there was realized microwave *VSWR* measurement with the PE 8400 ferrite circulator. For evaluation of power levels at (N^3) output of ferrite circulator it was used power meter Anritsu MA24106A.

Considering the frequency band of used ferrite circulator, the measurements was done in L-band (1 000 to 2 000 MHz). The S_{12}, S_{13} parameters and *VSWR* of ferrite circulator after its calibration are given in Figs. 4 and 5.

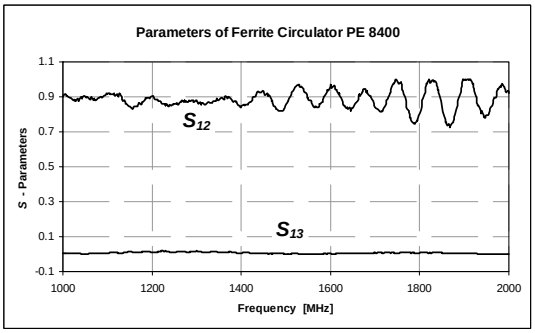

Fig. 4 Measured parameters S_{12} and S_{13} of used ferrite circulator

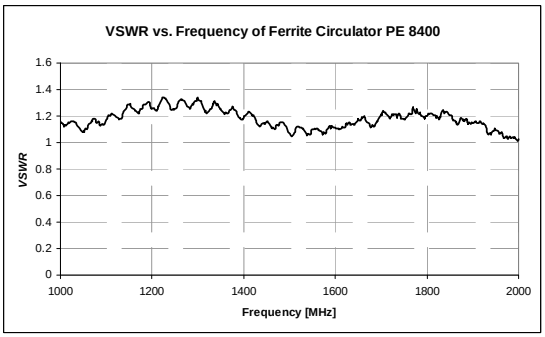

Fig. 5 *VSWR* graph of PE 8400 ferrite circulator

The accuracy of realized measurements is significantly influenced by parasitic electromagnetic emission that surrounds the measured antenna. It includes the primary excitation emission from generator, too.

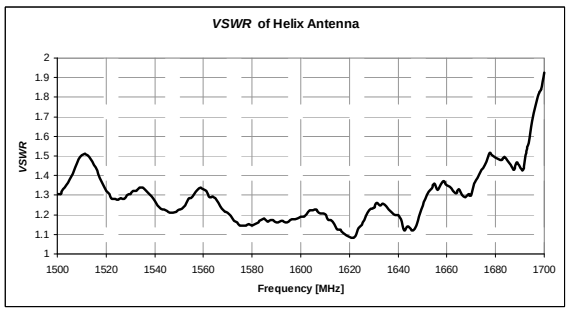

Fig. 6 *VSWR* of conical helix antenna measured by ferrite circulator *VSWR* measurement

This emission is consequently reflected by the near surroundings of antenna. From above listed reasons it is necessary to place the measured antenna into anechoic chamber during measurements. Fig. 6, presents results of *VSWR* measurement of a conical helix-antenna which was designed for the frequency band of the Thuraya system.

4 CONCLUSIONS

All measurement procedure is controlled by master computer using Matlab® environment. The results of *VSWR* measurement can be shown in the graphical or tablet form.

Practical experiences showed, that it is necessary to optimize power levels at the ferrite circulator output (N^1). The reason is to provide sufficient power levels during the P_{3M} and P_{3C} power level measurements at the output of ferrite circulator. Considering standard values of S_{13} parameter of available ferrite circulators (≈ -20 dB), the optimum power level from the generator is min. 1 mW up to 10 mW.

The *VSWR* measurements was done for unknown and known certified antennas. The results confirm correctness of the designed method.

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THE IMPACT OF TECHNOLOGICAL SYNERGY ON THE MILITARY MANAGEMENT IN THE CONTEXT OF TRANSFORMATION

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Abstract: The present paper lays emphasis upon the concepts, the transition methods and the adaptation to the new technological developments in the context of military operations highlighting the new balance of powers which emerged from the revitalization of the political, social and military strategies as well as their adaptations to the current objectives. The present paper aims at creating a research study regarding the influence of the new technological achievements in the field of military operations.

Keywords: transformation, technological synergy, high tech, RMA.

1 AN INTRODUCTION TO THE PROCESS OF MILITARY TRANSFORMATION

The late 20th century and the early 21st century military conflicts (Yugoslavia in 1999, Afghanistan in 2001-2002, and Iraq in 1999 or 2003) underline the vital role of technology, as a result of human and artificial intelligence, on the battle fields.

The new horizon of military planning (the point until the process of planning is vital) has to adapt to the new battle environment. It is vital to get a better use of the military resources as well as a more efficient planning process determined by the new strategic goals, by the necessity of imposing peace, and by the strong connection with the other social fields.

The new political, strategic and tactical trends have oriented the military activity to a more basic stratagem typology initiated by Sun Tzu. By the strategic, tactical and political asymmetry, the world comes practically back to a confrontation stratagem typology which has once existed, that is, in Sun Tzu's age.

The revolution in military affairs - *RMA* - is a process which represents more than inventing and revitalizing technology. It is a vital process in the way warfare is conducted. Thomas Keaney and Eliot Cohen consider that RMA requires new technology (internal combustion engines or vehicle armor), its integration to new military equipment, the use of the most efficient operational concepts (breaking the defensive line using vehicle armors), the use of organizational structures, and finally, the concept of brigade transitional force grouping.

Unfortunately, some of the transformations may bring negative consequences. This is determined by the complex operational environment. It is believed that the nowadays operational environment will be also used in the following period of time. It is worth to mention some of the elements belonging to this environment, like globalization, which brings developments and threats, the outburst of older conflicts (territorial, religious, ethnical, international crime activities), the technological availability on the international markets for both national and private representatives, or the modernization of the military forces (despite the modern economic issues).

2 THE EFFECTS OF THE VOLATILITY OF THE OPERATIONAL ENVIRONMENT ON MILITARY TRANSFORMATION

Every operational environment can be defined by using a set of critical variables, which are interrelated. By analyzing these elements, and using them properly, we can prevent the enemy from using them against our forces. These variables are represented by the stability of the state, the international and regional politics, economy, social stability, information, the physical environment, the technological achievements, international organizations, the will to fight, time, or military power.

The context represented by modern military operations involves complex organizations, which cannot be included in an operational pattern. This context includes social units, different organizations, media resources, and the powerful units representing the civic society, interests, which could affect the efficiency of the military environment.

It is necessary to handle with a better precision the military operations components, in order to not exaggerate the effects provoked to the enemy, as well as to diminish the risks of being overtaken by the enemy. The modern warfare environment includes the necessity of neutralizing the enemies' computer-aided capacity, and constructing a powerful defense against this threat.

When dealing with long conflicts, it is important to mention the importance of the civilian support. Therefore, it is important to have a strategy, which will gain the support of this element, as well as a good strategy concerning the post-war society.

a) When analyzing the military operations environment, it is necessary to analyze not only geographic elements, such as: topography, climate, weather, terrain, hydrology, altitude and vegetation, but also elements regarding the human component, such as: density, the impact

of this component on the surrounding environment, the use of the natural resources or the use of the terrain.

b) The time which is required to plan and apply a military operation depends on the type and complexity of those operations.

c) The political influence in planning these operations depends on the following elements:
   - The risk of not achieving the objectives in order to minimize the impact on the enemy;
   - Protecting its own troops;
   - Protecting certain enemy artifacts (social, cultural, or economic);
   - Managing the conflict in response to the public opinion;
   - Planning operations against the enemy's movements, which could affect the internal public image;

d) The economy, finance and logistics take into consideration the following elements:
   - Identifying and analyzing the enemies' economic poles in order to adapt the armies' behavior and violence intensity to the enemies' economic reality;
   - Identifying and neutralizing the enemies' economic resources;
   - The use of the military equipment found in warehouses, depending on the complexity of the operations, by their performance, age, expiry, shelf, the warehouse deposing capacity, or the future budgets.

e) The hi-tech offers new opportunities represented by computers, nanotechnologies, and the perfection of gathering, analyzing and transmitting data. These elements increase the army's capacity of becoming more powerful. The military operations will experience a transition towards an environment which will be characterized by: the impact of the domination created the computer science field, the reaction to act rapidly according to the updated information, the possibility to react when the flow of information is interrupted.

f) Information is the result of the observation, evaluation, analysis, integration, experimentation and interpretation of the data, facts and events which are related to one or more phases of the military operation. The information is related to the access, use, distribution, manipulation and data support.

g) Demography. The important crowded urban area encourages the weak maneuver structures and the light armed structures, such as: terrorist groups, paramilitary groups or guerillas.

3 THE SYNERGY BETWEEN KNOWLEDGE, TECHNOLOGICAL TRANSFER AND MILITARY SPENDING

Technology represents the amount of knowledge (belonging to a culture) used in science in order to achieve military, social and industrial objectives. Technology needs an 'actor' to coordinate the research and developments in order to adapt the findings to the civic and military society. This actor creates the scientific and industrial foundation which develops and applies technology, and that also develops the resources required in this process.

The hi-tech is represented by nations which have adapted the findings in order to achieve their objectives. This could be a risk in the military field when it comes to nations which focus too much on technology. This risk is represented by nations with weaker technologies. Hi-tech is usually associated with strong countries or 'actors' with a strong economic power. The new technological achievements applied on radio-electronic systems or on aircrafts have created a new mentality regarding the initiation of new military conflicts.

This change of mentality also implies the concepts regarding the threats and aggressions directed to the air space, and the defensive response to these elements. This defensive stance implies from the beginning (and throughout the conflict) the use of the air force (aircrafts and helicopters), of missiles and anti-aircraft weapons, etc. These elements create the surprise element, vital for achieving the military objectives.

We can no longer ignore the factors which nowadays shape the art of war. These factors are among others, the development of hi-tech and data transmission tools, or the role of computer science.

The limited technology describes nations and actors which try to obtain and use hi-tech necessary in achieving certain objectives. But, these actors cannot rely on a strong economic power, and therefore are limited to the use of old technology. They can sometimes have technologies used by powerful nations, but in general, they prefer to invest in modernizing their old equipment.

The process of modernization requires the use of hi-tech weapons and ammunition in order to compete with other groups in fields, such as:

- Tanks, which require a strong weaponry system, mobility, reliability, efficiency on the battle field;
- Aircrafts, which require a bigger range and transporting capability, superior avionics, and higher maneuverability;
- Battle ships, which have to survive in hostile environments, to handle various threats, and use their weapons more efficient and on longer distances.

Low-tech nations or actors have armies with weak or no technology. These limitations determine such nations to compensate this lack of equipment with an asymmetric warfare. These nations are poor states (or with internal problems) which do not have the economic power necessary to obtain hi-tech technology.

Information, as previously mentioned, is basically the result of the analysis made on several domains of the operational environment. This info is also based on the analysis regarding the role of the civilian in the military-civilian relation. It also describes the way data are transmitted between the systems and actors, standing for a necessary element in consolidating the actors' foundation.

The consolidation of the info technologies allows the adaptation of the traditional factors to the new research and surveillance technologies. This act is based on the concept called *global information network*. The qualitative changes regarding the informational environment (the amount of individuals, organizations and systems gathering and transmitting information) extend the informational superiority beyond the raising of data.

Superiority means that the equilibrium of forces is interrupted, one group experiencing certain advantages in contrast to its competitors. The information technology superiority is short living, and therefore, the army has to use information technology actions in order to create and consolidate it. Gaining superiority should not be a goal in itself. It can initiate advantages only when it is used in the right decisions.

However, this superiority will never be exact, and therefore, will never eliminate the issues regarding certain operations. Information or other developments will add more such issues or doubts. We believe that the future armies should direct information in deciding the best usage and coordination of the command-control capacity, and to reach the full potential of the dominant maneuver, precise offensives, multidimensional protection and focalized logistics. The informational superiority allows an improvement of the air operations, through successful, inexpensive, faster actions. The main result is that these operations become more efficient, and the enemy activities are therefore neutralized faster.

The increasing global interactions will shape future threats. The access to hi-tech, collaborated with the possibility of having and using weapons of mass destruction, will increase the number of actors capable of threating the regional equilibrium. Modern weapon systems can change the nature of the threats regarding armies.

The most dangerous enemies will be those who can rapidly incorporate the new technological developments, and therefore can neutralize our armies, and other political or diplomatic actions. Also, new technologies allow armies to take advantage of the enemies' vulnerability. The element of surprise, initiated by new technology and operational innovations, will probably occur more often in the future. The armies will have to handle various types of threats, unpredictable and of different intensity, based on new technologies.

4 THE ROLE OF TECHNOLOGICAL SYNERGY AND RESOURCE ALLOCATION IN THE BOYD CYCLE - OODA

The army has been in a continuous modernization process, starting from the 19th century, when their leaders started to focus their attention on involving the new technological and industrial achievements of the period. Their offensive and defensive stances had to adapt to the new trends and to the findings. Since then, technology has evolved, and therefore, the strategies got more and more complex. In history, there have been several military personalities which underlined the need of modernization, by implementing new maneuvers and using several technology elements.

Napoleon Bonaparte revolutionized the art of war, based on the concept of *total war* (the use of all resources in the war effort). He used these resources, and the maneuver superiority, in applying the idea of total opponent annihilation. It is important here to underline the importance of the maneuvers. Napoleon's strategy represented the foundation for the work of many military theorists. In his famous work entitled *On War*, Clausewitz mentioned the concept of *total war* and underlined the moral and political aspects of the war. The *total war* idea was generated by the industrial achievements, the armies becoming more and more mechanized. Therefore, during wars, the industrial cities become main targets because of their support given to the war industry. Neutralizing these areas (and their human resources) became a main objective.

Jomini divided the military operations into two main categories: military strategy and tactical strategy. He coins the term *war theater*, which is also divided in *offensive war theater* and *defensive war theater* with a special distinction between *war theater* and *operation theater* (the territory where an army initiates its operations). Jomini also created twelve types of war formations, adapted to different types of environment. He believed that the victory could be obtained by occupying the lines which threaten the vulnerable enemy points. Attacking those points would mean total enemy annihilation. Jomini disagreed with the idea that an army will capitulate if its components will be destroyed. He believed that the final victory could be achieved by

occupying the enemy territory, enemy lines which would push back the opponent armies.

Robert Scales presented his modern war perspective in his *Future Warfare*. In this book, he presents the famous offensive-defensive cycles, based on the technological developments. Technology makes these cycles more efficient. This efficiency can be measured with the help of the *killing zone* (the distance which a soldier has to overcome in order to determine his enemy to leave the defensive position, the *no man's land*). When two opponents have the same technology, then the advantage belongs to the army situated on defensive positions. This fact was underlined during the WWI. Towards the end of this conflict, Germany tried a new strategy: bombing the enemy defensive positions, and afterwards, launching a major offensive. This strategy was enforced by the emergence of armored vehicles and revolutionized the cycles. This strategy was further used during the WWII, in Germany's famous *Blitzkrieg.* After the second global conflict ended, the armies tried to find new alternatives to stopping these armored vehicles. The solution was found in the *Microchip technology*, which expanded the killing zone because the targets were easier to identify and neutralize. This new offensive cycle could be observed towards the end of the Vietnam War.

John Boyd was a US air fighter and, afterwards, a Pentagon consultant and military theorist. One of his first theories was the *Energy-Maneuverability Theory* (EM)*,* which would later provide standard elements for all aircrafts. Boyd's greatest work, which revolutionized the warfare operations, is considered the OODA Loop (the cycle **o**bserve-**o**rient-**d**ecide-**a**ct). The armies, if they react rapidly according to the information they acquire during the steps of this cycle, can interfere with the enemies' decisional process, and therefore gain the victory. Boyd's main idea in this theory was to create an efficient way to direct the armies' energy in order to achieve a fast victory and without major risks. The first 'O' comes, from the fact that the armed forces have to observe the evolution of a battle, and this data has to be processed in order decide the next steps. The second 'O', from orient, standing for the part of the cycle which creates the filter (built on different conceptions, from the battles' goals to the cultural heritage of one person) for the analysis of the data acquired in the observation step. The last two components come as a natural reaction. Boyd presents the role of OODA as a way of interfering with the enemies' own observe-orient-decide-act cycle. An army has to act faster than its enemy, using the info acquired in the initial steps of its own OODA and therefore, it will be able to confuse the opponents. Other military theorists, like Harry Hillaker, underlined the idea that OODA's main role is to keep an army unpredictable to its opponent, while knowing every step made by the enemy.

Nowadays the society is experiencing a transition from industry to information. The technological progress was pretty much influenced by information. The weapons got more efficient, and therefore the killing zone expanded. The military strategy had to be adapted to this new trend. Scales believed that the main objective should be the annihilation of the enemies' will to fight. Technology should be used in obtaining a moral advantage over the opponents. This idea has to be corroborated with the combination between knowledge regarding the enemies' position and the fast reaction of using this advantage.

This would create a new offensive-defensive cycle, divided into two big groups. The first group will handle the logistical part of the operation, it will not engage in direct confrontation. It will provide information to the second group, which will participate in the actual combats.

As a conclusion, it is worth to mention that nowadays, the modern warfare is more preoccupied with gaining victory over the enemy's mentality. The armies want to determine their opponent to surrender or to determine it to become an ally.

5 TARGETING AND CENTERS OF GRAVITY

The modern war objectives have evolved from the idea of total destruction of the enemy to the so-called paralyses of the opponent (for example at the level of leadership). This transition occurred among others, with the development of the air combat technologies. This transition can be identified in the following sentence *destruction-based warfare' toward strategic Paralysis and Effects-Based Operations EBO.*

The *strategic paralysis* has its roots in the writings of the Eastern philosopher of war - Sun Tzu. It combines the psychological paralysis with the physical paralysis in attacking the vulnerable enemy points. It is not based on mass destruction, but on neutralizing these points. This triggers the protection of the human resources involved in the battle, and it also implies budget savings. Among the theorists who revolutionized this concept, it is worth to mention *Boyd and Warden*.

As previously mentioned, Boyd also strengthened the concept of ODDA. This concept was the foundation for the innovation of control *warfare,* which contains all the military tactics that use communications technology. These could be used in gaining advantage over the enemy through methods which disorientate him, and by the rapidity with which these tools are used.

Among other theories which strengthened this idea, of enemy paralysis, it is worth to mention Warden's *Five Ring Theory* and Deptula's *parallel war theory.*

Warden created his theory on the strategic military attack, distributed on five levels of system attributes (leadership, system essentials, infrastructure, population and Fielded Military Forces). Each ring was one of the enemies' centers of gravity. Warden underlined that each of these centers has to be neutralized in order to obtain physical paralysis, and eventually, victory. The attack would be optimized if the army would engage in neutralizing as many rings as possible, in the same time.

One of the methods for obtaining the physical paralysis is also the *theory of near-simultaneous attack across multiple target sets*. This means that instead of launching several sporadic aerial attacks, an army would launch in one day, the same number of attacks which otherwise would had been launched in one week, or more. This was possible once technology evolved. The number of attacks increased from a total number of 124 distinct targets, with six weeks between attacks (during the WWII) to 148 distinct targets in the first 24 hours of the Gulf War.

Another technology or development which strengthens the idea of physical paralysis refers to the *swarming networks* representing an operational concept (tactics and strategy), which is both effective and feasible at all levels of war; it leverages strengths of mobility, small force size, long-range weapons, rapidity of attacks from different directions, and use of psychological warfare in a flexible and synergistic manner. Also, as provided by its etymology, the swarming networks base their operations most of the times on artificial intelligence. This technology is used on a number of distinct phases, such as: locate, converge, attack, and disperse.

The military swarming has its foundation on *pulsing,* through which swarming networks are able to come together rapidly and stealthily on a target, then rebuild and be able to recombine for a new pulse; swarm units converge and attack simultaneously. It must be mentioned the fact that, today, this concept of military swarming is still at a starting point, the armies being able to use it in only a few contexts.

A last concept in this perspective is the *network centric warfare*, a war doctrine implemented by the US Department of Defense. It is based on information technology, which of course, provides the advantage of having information. This advantage is put into practice through compact networking units, spread through the battlefield. It suggests interlocking links between a sensor network, a weapons network as well as a command, control and planning network to increase the tempo and responsiveness of forces.

6 NEW CONCEPTS AND PARADIGMS REGARDING THE IMPACT OF TECHNOLOGY ON LEADERSHIP

The art of war has out-passed the *old attrition warfare* concept, in which an army is preoccupied with gaining victory by obliterating the opponents' human resources and military equipment. During the industrialization period, a similar concept was used, the *total war method,* in which an army mobilized all its resources (human, industrial, economic) in the war effort.

Things changed when *airpower theories* evolved. Early airmen like Billy Mitchell, Hap Arnold, Ira Eaker, and Curtis LeMay saw the potential of the use of the air space. These theories evolved from the old ideas that the role of aircrafts was similar to the one had by bombers during the WWII. Another old idea was that aircrafts were just an extension of the other military forces operating in the battle field. In reality, the air force has its vital role in achieving the battle objectives.

The other technological developments have revolutionized the warfare activity. Such an example is the C2's upgrade. C2 (or command and control) can be defined as the exercise of authority and direction by a designated commanding officer over particular units which have the goal of achieving certain objectives. The new developments have made C2's reactions more effective, and therefore, victory can be obtained more easily.

7 CONCLUSIONS

The military processes are complex continuously changing due to the developing technology and the spread of information. The RMA or the Revolution in Military Affairs has the role of creating the warfare transition from the old military conceptions or ideas to the non-linear mentality.

The increasing role of information has contributed to the modernization of warfare. As mentioned before, information analyzes the data from different fields regarding the operational environment, but it also analyzes the role of the civilians in the civil-military relation. These factors consolidate the foundation of the actors involved in the military operations.

The role of modern RMA and information, corroborated with the continuous hi-tech development, has changed the way wars are conducted. This change has occurred during the last periods of time, and if technology evolves, than the dynamics of the war will change.

Among the new military concepts, which have shaped the modern battlefields, it is worth to mention *EBO* or Effect-Based Operations. This concept was developed during the 1991 Gulf War, and it mentioned the combined forces of both military and non-military elements in the process of gaining victory. The non-military elements refer to new technological innovations, modern weaponry, or tactics. The evolution of EBO has its foundation in the *Information Age*. Another concept is, as previously mentioned in the paper, the *network-centric warfare*.

Future work should be more focussed on the optimal allocation of resources for defense and the costs related to the transformation. The recovery after the last global crisis is not a fast nor a moderate one. The debt crises in some EU countries and the turbulences in US will put an aditional pressure on the bugets and again, a new optimal resource allocation fgramework should be design.

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SENSE OF SECURITY THE CITY'S INHABITANTS AND THEIR ATTITUDE TOWARDS THE JUSTICE OF INSTITUTION

Franciszek KOZACZUK

Abstract: Safety is a lack of danger to prevent normal function and the need of safisfy, certainty, stability, support, a lack of violence and catastrophic events. Need of safety is a natural human need. It affects common crime and organized crime. Threats of crime especially in big cities depend on effective police work and juistice. Attitudes towards the inhabitants of this institution are reflection of the sense of security.

Keywords: safety, crime, sense of security threat, attitude towards law and police.

1 INTRODUCTION

In recent years the problem of safety in terms of objective and subjective has become an important issue on global scale. In such a state was affected by many factors threatening the foundations of human existance, health, and normal functioining of the micro and macro social. These include: threat of state sovereignity, terrorism, crime, natural disasters, environmental contamination, economic threat (degradation of social individuals and social groups) and sociocultural: (lifestyle and mental diseases, pathologies and addictions, suicide and aggression). Such a wide range of threat becomes the subject of many theoretical studies, empirical research, preventive and compensatory problems of different disciplines (legal, medical, economic, technical, social-sociology, psychology, pedagogy).

The issue of safety can be considered either in the sphare of objective- through the prism of emergency situations in individual and collective life or in the sphare of subjective, as a sense of security threat to personal safety. Pedagogy and psychology the needs of security class to the group of original needs of human and recognized it as the search base on confidence in the possibility of meeting. According to Z. Dąbrowski [1, s.17] needs for security (congenital and acquired) is a normal condition and mental functioning depends on a lack of danger situations (inability to needs the satisfy) and a lack of difficult situations (hinder or impede the normal psychophisical functioning). The threatening factors are: abnormality situation, a lack of acceptance and kindness, a lack of stability, support and health, no friends and belonginng to a group of reference, awareness of uncertainity and limited ability to protect their own goods, a lack of success in life, a lack the ties with relatives, diseases, traumatic conditions, feeling of loss of livehoods, violence, aggression and violence from people, natural catastrophic [1, s. 17-18].

Someone safety consider as an important needs of existance [2, s.32].

Accordind to Law Encyclopedia (3, s.53) public safety" is an ideal situation and a lack of threats in life of communities and units. In practice, the contemporary state of this country does not exist and occure in a wide range of efforts to protect the collective and individual value. This striving for protect or even the same protection is conceptually equated with thepublic. In this sense, it means the most general state of readiness of the competent authorities of public administration to counter threats and to immediate and effective containment measuers affecting the welfare state, public order, life, health and property of citizen."

Safety is a very wide term, refers both to the daily existance of people and the functioning of social groups in the near and longer term [4]. Safety in the objective and subjective field and is not a stable state. Factors of security and threats are mutually interwined, one after another are dominant in their lives. There are two important skills: the first lies in the predispositions of people, is a negation of inactivity, overcoming difficulites and active solidarity and coping with threatening situations, the second depends on government policies, creating a public sense of security (economis, social, medical, law, proffesional, cultural, educational) without difficulties and threats. Thus, for satisfying the needs of security is determine by several groups of factors:

a) Existential -material side of life: flat, jobs, material possessions, complex system of medical treatment;
b) Psychiatric -good psychophisical condition, positive personality traits, sense of own certainty;
c) Social - family, friends, acceptance, proper ties, success in family life and professional, lack of social pathology in life (alcoholism, drug addictions, crime)
d) Educational – cultural - suitable level of educations, upbringing, participation in cultural life, upholding the traditions. [5,s.330]

A characteristic feature of contemporary reality is a lack of stability in the security sphare in various dimensions: international, European, social, economic, health and personal. Existing data indicate a widening scale of the risks of natural disasters mainly long range (drought, earthquake,

blizzards, floods, fires, and industral disasters) and terroristic attacks where one after the other cause their effects impinge on the lives and health of innocent people, destabilize the institution of economic, social and govrenment, disrupt the normal functioning of society. In face of contemporary threats man dos not feel safe, especially since their number indicates on upward trends [6].

2 CRIME AND THE SENSE OF SECURITY

One of the factors including the citizens' sense of security is both a common and organized crime. Nowadays, we observe that the size of crime disclosed. Intensity of violent crimes was brutal attack in use (murders, beatings, robberies, assaults). Organiozed crime has gain in strength and also on an international scale. After a period of political breakthrough the system of norms and values, patterns and behaviours were destructed. There were axionormative chaos both in consciousness and in the sphare of law. In the 90's and later reported the weakening of social control, low efficiency of police work, slowness of the courts, the liberalization of criminal justice, simultaneously with impunity of criminals.

These factors (tangible and intangible) increase especially the violent crime and the importance of the state in a confrontation with a crime. In addition, it has an effect on shaping of human consciousness in a distrust of law enforcment and justice.

Many studies show that police statistics are unreliable, underestimate the real extent of crime [7, s.103]. In Poland, public confidence to the police is much lower than in Western countries. For this reason, the victims do not report many causes, especially contact crimes, e.g. muggings, beatings, rapes and corruptions. Therefore, the police did not know the actual number of crimes (dark numbers) and among the reasons for not reporting come to the force a lack of faith in the effectiveness of policing and for fear of revenge from the side of offenders and convinced that culprit will not be punish.

This elements impinge on attitudes towards the police and justice of institutions.

In 2010 police recorded 36855 crimes about 1,817 fewer than in 2009. Delectability was 73,3 % and 72,2 % in 2009. The data contained in tab 1. shows that Podkarpacie is reasonably safe. With the increase of criminal detection the number of unlawful acts are slowly declining. Several years ago the percentage of thefts, burglaries, robberies are alarming. The numbers of drug offences are increasing.

In 2010 conducted research on the sense of security citizens of Rzeszow and their attitude toward police work and judicial staff.

Tab. 1 Crime in Podkarpacie

Category of crimes	years			
	2007	2008	2009	2010
Total offences	27559	27892	28244	27281
Murders	12	26	19	14
Rapes	57	51	46	44
Thefts	2127	1827	1724	1809
Car thefts	57	35	36	21
Burglaries	1368	1404	1397	1406
Robberies, extortion	416	390	356	400
Drugs crime	1191	1101	1105	1370

Sourse: www.policja.pl [8]

Asked the question: Do the sense of security has an impact on attitudes towards law and justice institution?. In thesis used: PWP scale (Attitude toward the law scale) and sense of security questionnaire. The study involved 100 randomly selected respondents (49 women and 51 men age between 20-60).

Several years earlier a similar study was done by Moczuk [9] and Polakiewicz in Rzeszów [10]. Their findings indicate a high sense of security residents of Rzeszów (71,6 %). The greatest sense of security exist in the day, while at night the place like parks and walking areas was dangerous (89,9 %) train stations and bus stations (88 %). Nearly one third of the respondents fears that may be a victim of crime, hooligans offences -69,7 % assaults and beatings- 52,5 %.

Analyzed: sense of security in the place of residence, sense of security after dark, fear of becoming a victim of crime, threat posed by deviant groups, assessment of police work (patrols, raids, detestability) and confidence to it.

These results confirm findings from earlier studies. They found that respondents from Rzeszów feel safe in their city. 64 % of respondents did not feel the fear of victimization in the evening. However, more often men (25,5 %) than women (12,2 %) have concerns about it, that they may become victims of crime. Worries about the coming threat of crime is at its third respondents (33 %). In address the greatest threat are posing: aggressive youth-30%, uncultured neighbours-10 %,prostitutes- 6 % Social groups have deteriorated safety and potentially dangerous by following: youth of the vertebrae- 33 %, unemployment-26 %, addicts- 24 % prisoners- 17 %.

Knowledge of respondents about the danger crime came from several sources: mass media information(newspaper, radio, television)- 49 %, own observations and experiences- 33 %, opinion of neighbours, friends and family members- 18 %.

Similar results obtained A. Szymanowska [11, s. 24]. Older people (32-50 years) knowledge about the state of security in the city derive mainly from press releases and television, while knowledge younger respondents (20-30) is mainly base on their own experience and observations of everyday life on dangerous places, which should be avoided.

The most popular sources of information of crime in the city was a regional television and radio. These mass media do not only inform but also shape the attitudes of people towards certain phenomena: crimes and social groups that threaten law and public order. A significant numbers of respondents (70 %) feel that the media provide accurate information of crime in the city.

An important issue is to determine the attitudes of respondents to an institution that largely determine the state of crime and public order. These are police and judiciary. The quality of their work has a major impact on citizens' sense of security.

Tab. 2 Evaluations of the police work and confidence to it

Subject of evaluation	Category of evaluations	Sex				Total
			Women	Men		
		l.b.	%	l.b.	%	%
General evaluarions of Police work	positive	31	63,3	34	66,7	65
	negative	18	36,7	17	33,3	35
Frequency of partols	sufficient	19	38,8	28	54,9	47
	too rarely	30	61,2	23	45,1	53
Citizen knows the constable	yes	16	32,7	12	23,5	28
	no	33	67,3	39	76,5	72
Trust to police	yes	37	75,5	36	70,6	73
	no	12	24,5	15	29,4	27

Respondents show a high level of confidence to the Police. The vast majority of both women and men, positively evaluates the work of the officers (65 %) and has for their high confidence. (73 %). Slightly worse falls to access the frequency of appearance the police patrols in residence. Generally, every second test finds that the number of patrols and their frequency is quiet sufficient.

The law safeguards the security of people and attitudes towards law are generally positive public perception, when it is enforced effectively and fairly. For a long time, attitudes towards the law and officials depends on the social climate in the local environment, when the levels of personal security, social and physical are decreasing. Confidence to the authorities and the law are changing.. Mostly older people are in favors for moral norms and legal.

Tab. 3. Attitudes towards law and justice

Attitudes towards	positive	negative
Legal of law	86	14
Necessity of law	91	9
Corruption of clerks	57	43
Dependability of clerks juistice	59	41
Reliability of court verdict	54	46
Discrimination against disadvantaged people	30	70

Respondents overwhelmingly (91%) approve the need for statutory rights as a guarantor of public safety. People deemed most equitable norms and approve the legality of positive law.

Less favorable presents attitude of respondents to an institution of justice. These is a belief that court judgments are not always fair. Objections raised the low dimension of penalties against the perpetrators of serious crime. That is generally believed that the sentences in courts are reliable by 54% of respondents. Also with low confidence referenced to a fair hearing in court (54%). However, the decline in confidence in the work of the whole justice (weak effects of the fight against corruption, mafia, robberies) bearing on the level of risk associated with the social life of crime. More than every second respondents (57%) believe that corruption is digested by justice officials. This phenomenon is understood as a promise, giving and receiving undue financial benefit in return for favorable action or omission of specific actions. It is associated with greed, venality and susceptibility to the influence of reward practice of unfair.

Established correlations between the following variables:

1. Sense of security and the place of residence. $\chi_e^2 = 16{,}166 > \chi^2_\alpha = 13{,}277$, df=4, p<0,01, C=0,465. Average strength connection. People living in houses they feel safer than respondents who living in the block of flats. According to their

opinion, single family houses are better protected against crime (fences, baron the windows, safe closure) than flats in blocks. High concentration of people, the anonymity and a lack of social ties among neighbours triggers aggressive behavior of young people tend to reprehensible. Frequently, these incidents for fear of revenge are not reported by police.

2. Place of residence and the fear of becoming the victim of crime. $\chi 2e = 16{,}164 > \chi 2\alpha = 13{,}277$, df=4, $p<0{,}001$, C=0,373. Average strength connection. Respondents living in large housing estate to a greater extent than those with single family buildings are afraid that they might become a victim of crime. The greater concerns expressed by older people over 50 years old.
3. Attitude towards the reliability of the judiciary and the age of the respondents. $\chi e\ 2 = 8{,}541 > \chi 2\alpha = 7{,}842$, df=2, $p<0{,}05$, C=0,369. . Average strength connection. Attitudes refer mainly to the police who impose fines and enforce the provisions. Young respondents from Rzeszów also have a negative attitude towards the judges holding that court sentences against offenders are too lenient.
4. Discriminatory attitude towards the socially disadvantaged people and sex. $\chi 2e=7{,}563>\chi 2\alpha=6{,}635$, df=1, $p<0{,}01$, C=0,275. Men more likely than women express opinion that people with low socioeconomic status are discriminated against socially, both in offices and in the relationships with law enforcement and justice. More often attributed to them the blame for the devastation of property, inappropriate behavior, petty theft. There are suspected by the police for behavior they did not commit. They cannot expect the leniency from the law. On the other hand, the environment of the unemployed, former prisoners and people with so-called lower social closer are often penetrated by the formal agenda of social control.
5. Attitude towards the need for the law and confidence to the police. $\chi 2e=13{,}189>\chi 2\alpha=10{,}827$, df=1, $p<0{,}001$, $\varphi=0{,}329$. Average strength connection. With the growing acceptance to the police work has increased positive attitude towards the need for law. Police successes was publicized in the media trigger a positive response in the attitude taken towards the need for enforcement.
6. Trust to the police and the sense of crime risk. $\chi 2e=33{,}206>\chi 2\alpha=10{,}827$, df=1, $p<0{,}001$, $\varphi=0{,}576$. High strength connection. Police performed a serious tasks for the public and include: protection of human life and health, their property, crime detection, prevention. Low level of fear of crime has meant that confidence in the police has increased. Although, there is concern that in every place you can become a victim of a crime, but this sense of personal security threat is low (36 %). In the last few years have increased defection of common offences, which to some extent increase the level of security.
7. The results showed that sense of security has an impact on attitudes towards the police, the judicial institutions of law and justice. There are two reasons of the high level of insecurity the Rzeszów inhabitants: high rate of crime, detection and prevention of the police activities in the local environment. These factors and the influence of the media (showing successful police) and decided about the high level of confidence to the police. It turned out that the best predictor of a sense of security (fear of victimization) are positive attitudes towards: a)effective police work and b) the necessity of applying the law. Confidence to the police is relate to the frequency of appearance (visibility) of police patrols. Expression of attitudes towards the inhabitants of justice officials and police reflect sense of security is crucial for prevention and operational work. They fulfill function: cognitive-orientation, adaptive and protective and express the protected values.

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MEDIUM TO INCREASE THE SAFETY OF AIR TRAFFIC CONTROL HUMAN FACTOR, SIMULATORS & TRAINERS IN AIR FORCES

Matúš GREGA, Tomáš SCHÓBER, Tomáš BAŇAS

Abstract: Virtual simulation is the latest and most dynamic area of training and therefore also to air Visual Information System (LETVIS) are and will be placed high demands, especially as regards the extension of additional functionality, as regards the introduction of new security features and also interconnection with virtual flight simulators MiG-29, TL-39 and Mi-17 and the reconfigurable simulators. Interconnection of simulator LETVIS with air units, reconfigurable simulators, virtual control tower and training center of central ground controlled interception is possible to create a platform for building a federation of simulations that will permit not only joint training of all air traffic controllers and pilot training, but also increase the safety of flight personnel and thus the safety of air traffic services operators.

Keywords: simulators, safety, air traffic control, virtual simulation, trainers, pilots.

1 INTRODUCTION

Air traffic control (ATC) is a specific field of activities requiring both, precise and fast reactions. To meet the mentioned qualities, there is a demand for a kind of comfort that enables to all the ATC members maximal concentration on responsible and safe accomplishment of the job.

There is a need to realize all kinds of training using the ATC on credible and certified simulators of the type "real High – fidelity Simulator" (R Hi Fi Sim) or similar ones. That is crucial for the ATCs in order not to catch or get bad habits, as well as not to acquire skills that are different from the real situation.

A multimedia laboratory equipped with a projector, a computer that is able to process multimedia data in real time, and an internet access to watch the real Air Traffic is enough to meet the goals of ATCs´ theoretical preparation. Specialized subjects can be taught in the classrooms primarily determined for those subjects.

More difficult is to manage the practical preparation. That cannot work without a flight simulator. Slovak Armed Forces (SAF) are using as a flight simulator Air Visual Information System (LETVIS). Also, LETVIS is being used – via its various modules – for the ATC itself. The system is primarily being used for radiolocation data capturing, their processing and distribution in order to commission tasks of the Air Traffic Services, and the ones that are related to command and control of active means of both, the Air Force and the Air Defence (AD).

It is clear that no simulator is able to replace a real training. However, and undoubtedly, it has become its integral part. Basic and following training of an ATC are the first moments of using the simulator as a teaching device. The ATC is memorizing and adopting real phraseology, as well as he or she is getting routine that will simplify his or her transition to real operation conditions. We can depict the importance of the Maintaining Simulation Training that is still being not preferred kind of training within the SAF. It is aimed at keeping the high standard (respective at elimination of bad routines) of an ATC during the period of low flights frequency, not talking about practising procedures for special flight situations and other activities that may occur during "live" operations rarely, but it is really difficult to simulate them without the violation of flights safety.

2 INCREASING THE SHARE OF TRAINER'S TRAINING FOR AVIATION SPECIALISTS PREPARING

Air safety has a priority role that is confirmed by the opinion of the International Civil Aviation Organization, which calls for improving the quality of the educational process and highlights the authority of aviation training centers, that in its view, have an irreplaceable role in enhancing flight safety, noting: "If the human factor involved in 80 % of air accidents, then this issue to participate in value from 25 to 30 % gaps in professional training", and attributed this state shortfall, lack of technological facilities as well as failure to appreciate the professional training aviation professionals.

Generally, a person within the system ergatic seems weakest. Errors pilot controlling the aircraft are closely linked to the incident or condition to it. On the basis of analysis of much air traffic situations can be concluded that pilot error may or may not immediately lead to the accident. That the flight ended in an accident, must satisfy several conditions. Accident in most cases was not the result of only one defective intervention in the management of aircraft, but a series of bad acts on the one hand and inadequate defence mechanisms and stop the accumulation of errors becomes a second (Figure 1).

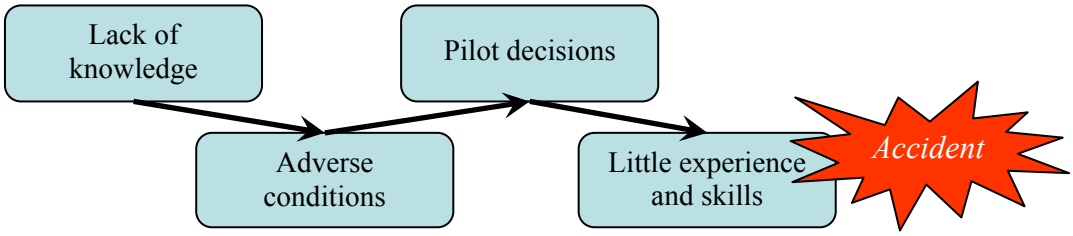

Fig. 1 Chain pilot errors

The first element of errors in decision-making skills are inadequate due to poor preparation, lack of interest or by the student. Correct and the quality of training affects not only knowledge but also the ability to acquire the right experience and skills, and thus indirectly affects the decision in this case the pilot. If, on the beginning of the preparation process errors occur due to insufficient or incorrect training chaining error probability will be that much higher and the process will be exponential. More chaining errors occur under adverse conditions cause by the human factor such as for example providing staff (air traffic controllers, technical staff). In this case, may be incorrect chain reaction of all cells and the resulting control error is the sum of all errors (Figure 2).

Internal mechanisms of control in training and learning phase for all cells involved in the preparation and operation of aeronautical products may be the creation and accumulation of training errors minimized. It is therefore necessary to optimize the process of preparing aviation specialists for the needs of conscripts, so that was good and sustainable.

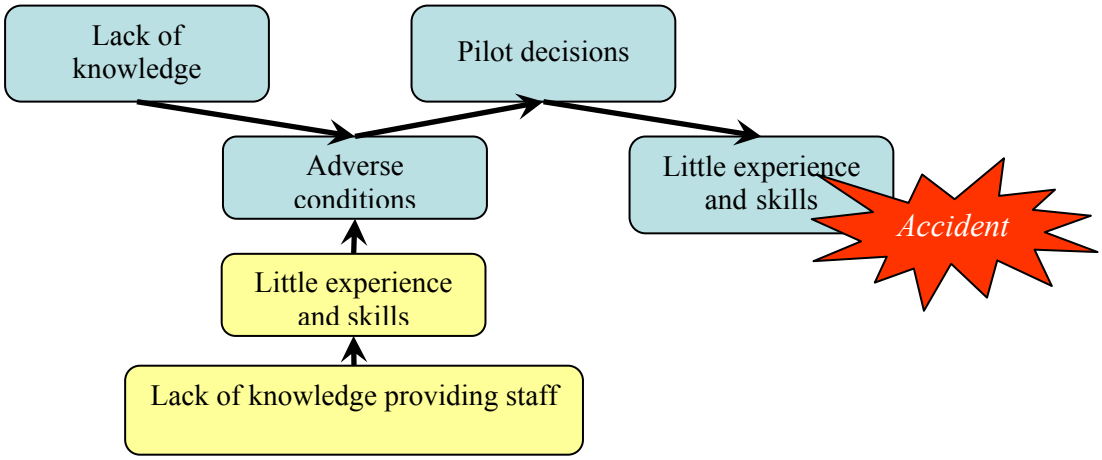

Fig. 2 Chain errors Articles manage

Taking into account generally valid theory of didactic education, expressed system (Figure 3) is the efficiency of the systém (E) function of the optimal functioning of all elements that are determinants (without considering system features) (Table 1) and transform this system to the increasing demands placed on aviation specialists when you need to meet all the objectives should be raising the level of individual determinants of the teaching function. Generally, each trainer as a practical way of teaching and training increases the effectiveness E of points in 3, 4 and 5, and directly affects the point 6, which represents 57 % of the determinants, processes that are practiced in it but the return in terms of perception so plausible that the largely contribute to a true addiction, and ultimately the case to the pilot's or air traffic controller's correct decision. We conclude that the trainers training, which usually takes place in one location and one or a pool of technical resources to increase technology level of training, thus contributing to improving aviation safety.

$$E = fx\left(C,\ O,\ M,\ F,\ P_r, P_{\check{s}}, S_{\check{s}}\right) \qquad (1)$$

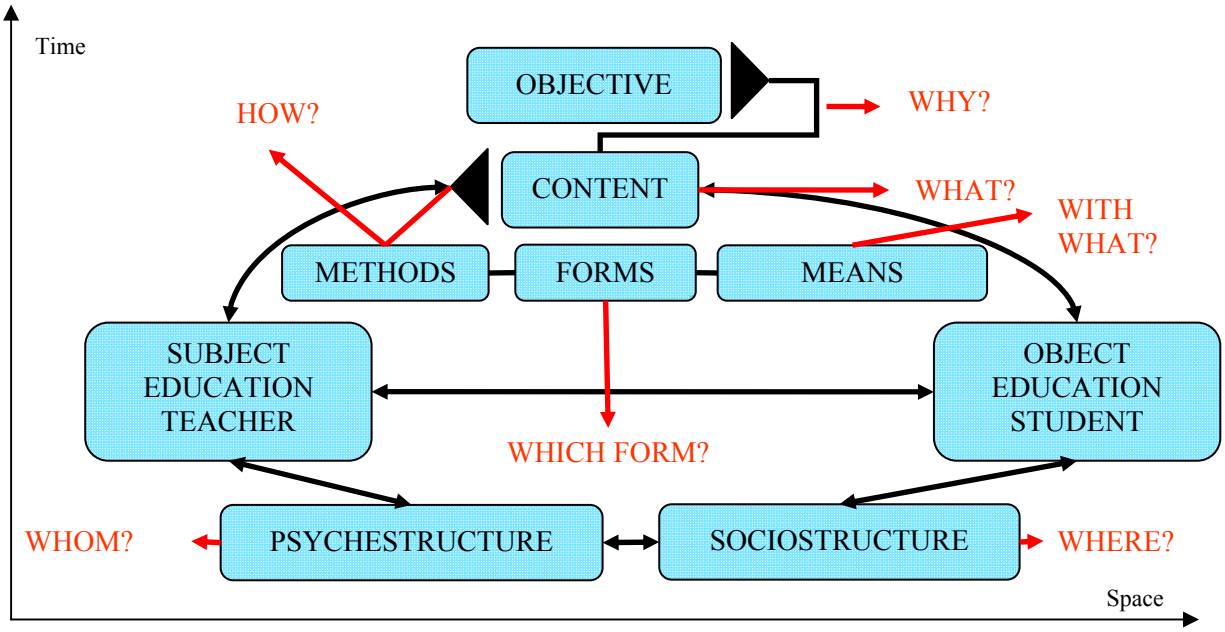

Fig. 3 Didactic system

Tab. 1 Elements and determinants of a didactic system

	Element		Determinant	Symbol
1.	Goal		Why teach	C
2.	content of the curriculum		What teach	O
3.	Teaching method		How teach	M
4.	Type of course		Which form of teaching	F
5.	Teaching material resources		With what to teach	P_r
6.	Psychestructure teaching		Whom teach	$P_š$
7.	Sociostructure		Where (Which soc. environment) to teach	$S_š$
8.	System creative elements	Subject	—	S
		Object	—	O

3 CURRENT POSSIBILITIES

3.1 ATC TRAINING

The existing choice of simulators being used for training ATC:

FACULTY OF AERONAUTICS KOSICE

Simulator LETVIS (Air Visual Information System) administrated by Faculty of Aeronautics, Technical University Kosice, that was directly conceived as a simulator for ATCs. Training of the Air Forces ATCs was running there till 2006. Regarding only limited upgrade since that simulator construction it has become morally out of date. According to its history and grading demands to provide complex training of ATCs is nowadays, the use of that simulator restricted to a certain extent. In this year the Faculty expand their possibilities and purchased new ATC simulator, the configuration is:

- 1 station for radar data display (RDD),
- 1 station for instructor, where is implemented pseudo-pilot module.

Nowadays simulator is in basic version, work stations are not set into working tables and there is no modul for after action review (AAR). Present configuration is appropriate for the Faculty fully satisfactory, but does not meet the conditons of the simulator by standards of ATC. In the future should be designed to upgrade the previously established simulator and link these two systems, which would be largely to provide training possibilities expanded ATC.

GROUND CONTROL INTERCEPTION ZVOLEN

There has been a local eventuality for training at the Ground Control Interception (GCI) in the town of Zvolen since 2004. The existing training system is being used at all kinds of the operational air campaign radio navigation commanders training. It

enables the simulated flights management at both, autonomous and manual modes, via emphasizing the individual navigation methods. There is no vision of future perspective on more extensive upgrading of the equipment itself.

ARMED FORCES ACADEMY LIPTOVSKY MIKULAS

In 2010 there was installed an ATC simulator (Sim Mil) at the Armed Forces Academy of Gen. M. R. Stefanik and its construction was divided into several stages, so that the final phase would meet the conditions of the simulator type R Hi Fi Sim. This (Sim Mil) simulator will provide complex functions for the SAFs Air Force staff training. Among the staff there are not only Intercept Controllers, Tower and Radar controllers, air command and control operators and, of course, the pilots themselves. The goal of above mentioned activities is based on creation of a complex workstation to provide high level training for the SAFs ATCs. The centre will allow practicing a variety of trainings while keeping the valid international regulations in compliance with the Joint Aviation Requirements (JAR) norms.

Also, it will guarantee a high quality and complex training, oriented to the local conditions, with short-term courses aimed at practical training, that would become the base of an ATC preparation.

The main task of simulation on Sim Mil is to obtain basic practical, pre-qualified, qualified and maintaining training. The simulation of unusual and extreme situations to broaden and sustain practical skills of the SAFs ATC staff is being included, too. To keep controllers´ routines and their following upgrading, it is necessary to take a kind of practical training, that is crucial not only from the point of view of their own experience. We cannot skip that step, due to the recommendation of the EUROCONTROL programmes, concerning Air Traffic Control safety.

The architecture of the Sim Mil system is modular, in order not to restrict the number of pseudo-pilots, parallel independent exercises or modes of data input/output.

The system configuration enables to conduct the training of:

- 16 pseudo pilots
- 2 independent exercises.

There is a facility of

- 250 system targets
- 8 radars

for each exercise.

Sim Mil is designated for training at the following types of ATC and ground control workstations within the AFs of the Slovak Armed Forces:

- ATC of the Operational Air Traffic (OAT) sector at the Area Control Centre (ACC),
- ATC at the workstation Tower (TWR),
- Radar and Approach Controllers at the Radar Centre (RC),
- Intercept Controllers at the Ground Control Interception (GCI).

The Centre provides one workplace for each of mentioned ATC centres with the possibility of a radio communication using voice communication via aeronautical locations simulated air radio networks, as well as an alternate device, type Frequentis.

Simulated air situation is being generated by the simulator, where, except the simulation server, the following modules are available:

- pseudo-pilots modules
- instructors modules,
- modules for planning military air traffic operations,
- modules for completion of an objective documentation, regarding the process of the exercise with the voice communication evaluation included

Also, the additional goal of Training Simulation Centre (TSC) is to provide a kind of supplementary functions for LETVIS workstations, that are being used within the Slovak Air Forces, as follows:

- data examination at the system configuration upgrading (e. g. air traffic service airspace allocation), so as at changes in both, radar data processing and planned flight data, and software customizing – all that preceding the implementation of
- the above mentioned into the real operations,
- development and checkout of user interface changes,
- engineering simulation, technical and reliability tests, and verification of the functionality of the workstations, while being upgraded and innovated.

3.2 PILOT TRAINING

At present, to learn to fly on a particular type of jet plane is not allowed without appropriate training on an aircraft simulator. Despite improved aicraft reliability and advanced technology, pilots judgement, reaction time and decision making process remain the key causal factor to most of aerial accidents and catastrophes. To put it simply, simulator helps the pilot earn the needed experience to fly safely and prevents serious accident. There are dozens of scenarios pilots have to pass before they can advance to real plane. Besides the take off, landing, basic navigation and communication with ATC the missions focus mainly on crash landings, flying under bad weather conditions and various types of extraordinary and emergency situations. Since these kinds of scenarios cannot be

practiced in real traffic, the simulators are efficient and cheap substitutes of real training.

In short, main mission of flight trainers is to simulate aircraft`s behaviour under similar or comparable conditions to those in a real aircraft while saving the money and service life of a real aircraft.

FULL MISSION SIMULATOR FMS-M29

From basic navigation flights to complex modern warfare missions – those are the essential demands for today's Full-Mission Simulators (FMS). In principle, the goal of the system is to configure, monitor, evaluate and record the task being trained. Slovak air force`s fighter pilots are using the jet trainer L-39 Advanced Flight Simulator (L-39 AFS) and the supersonic fighter MiG-29 FMS-M29 simulator. Whereas the L-39 FMS is designated to train pilots from the basic flight level up to the weapons-handling, combat and advanced tactical level exercises, the FMS-M29 provides a complex training and combat tool for the Mig-29 pilots. The variety of missions is huge. From elementary basic and advanced piloting techniques training, navigation flights to formation flying and higher piloting techniques. Simulator is also capable to fulfill various air-to-air and air-to-ground missions, dogfights and is invaluable in planning, creating and evaluating new combat tactics. A mater of course is the possibility to change all of the flight conditions like daytime, visibility, clouds, wind, temperature and near the ground pressure. The very important part of simulator is the instructor's station, designed as an independent subsystem working in several modes as an independent flight simulator. The instructor can follow the task being practiced, interactively change some parameters of flight or actively enter into the task using his own controls functionally equal to those in the cabin. Moreover, he is able to conduct another virtual MiG-29 to fake the enemy plane or simply to practice formation flight. Modular architecture makes the simulator possible for upgrade and addition of specific functions and promptly react to changes like it happen during the modernisation of real MiG-29`s. This product can also be used for a post flight debriefing system of a real aircraft. Finally, the simulator has a technological capability for future unification to a simulation network together with L-39 AFS, Mi-17.

ADVANCED FLIGHT SIMULATOR TL-39

This simulator is capable to fullfil wide scale of missions pilots have to pass to qualify to supersonic jets - from basic flight level up to combat and advanced tactical level exercises. Realistic fire control and weapons-handling systems plausibly simulate the real L-39 and all of its armament – firing cannon rounds, unguided rockets and dropping small bombs with the noise corresponding to those in the real aircraft. All possible emergencies and safety procedures can be launched by instructor. Simulator was originally installed on air force academy base in Kosice occupied mainly by pilot students and „White albatroses“ aerobatic team members. The workstation was mounted on a moving platform with 180 degree panoramatic view. Right after closure of the university, simulator was relocated to Sliač air force base, where is situated only on static ramp. A few years ago, L-39 AFS underwent a partial modernisation concerning new navigation equipment and transition to anglo saxon units to be fully compatibile with the real aircraft. In Slovak air force conditions, combat pilots widely use the simulator especially during non-flying days or in cases the flying activity is cancelled i.e. due to bad weather or technical maintenance.

COMPLEX AIR SIMULATOR TV-17

The most recent acquisition of advanced simulation technology by the Slovak Air Force is a new complex flight simulator designed for training the flight crews of the upgraded Mi-17 M medium transport and multiple-purpose helicopters. The TV-17 Complex Helicopter Flight Simulator is installed at Prešov. The simulator is designed as a static tool with vibration seats and without a moving platform. The simulator is installed and designed to train efficient helicopter wing pilots and to improve their skills. The simulator is the only one of its kind that enables the crew to be trained in combat activities under all kinds of weather conditions in daylight or night environment, except for training flights using night-vision device. Possibility to install this update to the simulator depends on financial resources. The simulator consists of a fully functional cockpit, advanced visualization and full-fledged audio system. Pilot´s perceptions inside the cockpit are very similar to those in the cockpit of the real helicopter, because the device, signalling, switches and control correspond with the real situation. Unlike a real helicopter, simulator provides additional features and extra options. First of all, the simulator allows training of basic and advanced piloting techniques without the risk of human or material losses as well as training of non-standard and emergency situations, training group coordination and air combat manoeuvres.

4 HOW TO ACHIEVE INTERACTIVITY OF ATC TRAINING PROCESS AND PILOTS

Air traffic control simulators are ranked among high level financial investments. Thus, it is crucial to divide the new modules incorporation, as well as the enhancement and interconnection with other

simulators, that are using virtual reality, to several stages. Consequently, step by step, a so called "Air training centre" would be established as a complex system. We might divide into several stages:

- 3D display installation to perform tower controllers training,
  - the above mentioned stage would not deal with tower approximation; the TWR would be supplied by a 3D display view via huge LCD screens that would enable to simulate view from any of predefined Control towers. Such interconnection would be able to simulate both, day and night modes, the sunset, low visibility as well as wide range of weather conditions, such as rain, fog and snow. The training at the above mentioned type would be up to standard according to the fact, that the aircraft, being controlled from the Control Tower are in the TWR vicinity. Also, the controller is disposing by Radiolocation information. Thus, there would be created a unique workstation that would be identical with the Tower Controller real acting. Nevertheless, there is nowadays no workstation within the SAFs disposing with that kind of simulator. The flight simulation training of the Tower Controllers (besides the procedural one) practically does not exist. Therefore, the extension of the kind of Flight Simulator might represent an immense contribution to the training of ATC; not talking about cost economies.
- the centre interconnection with the AF units
  - such interconnection would be followed by existing Operational Systems extension as to the possible simulation aimed at providing MNTN training of Air Traffic Controllers
- interconnection of pilot training simulators for common training of ATCs and pilots
  - in some AF units of the SAFs are installed pilot virtual simulators. The centre network interconnection with the MiG-29 (FMS-M29) and L-39 (TL39) flight simulators would be definitely an outstanding contribution to the combat operations training improvement.

Especially, the immediate feedback would have enormous importance for Intercept controllers of combat engagement. The ATC would get radar and voice information exactly just like at real Navigation and Control, instead of data given by a pseudo-pilot (with time delay), which are pre-calculated with minimal possibility to influence the flight data. Thus, the information would be transferred without any time delay. Time delay is a very important factor. Nevertheless, it has negative impact on Intercept Controllers of Combat Engagement and it is highly restricting their inter-operability. We cannot omit the significant benefit from the above mentioned interconnection regarding pilots, such as training of new navigation methods or applying the Avionic Weapon Systems. These are normally not being used, because of no extra time or resources to realize them.

- interconnection of ATC simulator at Ground Control Interception (GCI) in Zvolen in order to provide common training of ATCs.
  - as stated above, the GCI in Zvolen is using an LETVIS simulator, however it has been upgraded by GCI function. All that is working at Department with Special Capability. Thus, the real time simulation for several self-sustaining or simultaneously cooperating groups of ATCs, participating at a complex training with one or more training targets completion.
- the interconnection of the TSC with the Ground Control Interception units, equipped with Automated Management and Command Systems of Active Air Defence (Astra and Tatrapan AD) to provide both, ATCs and Air Force Operators´ training, as well as the AFs and the AD cooperation.
  - by means of the final stage of the above mentioned, the AF or the SAFs would capitalize on a complex and fully-fledged training, accomplished via interconnection of all actives of the AD within a distributed interactive simulation. Nowadays the systems of AD Command and Control of active means are equipped by simulation modules. These ones are capable of ground line and radio connections with real air information. However, that is possible only on an autonomous level.

5 MODERN SIMULATION CENTRE FOR AIR PERSONELL

Through the interconnection of Sim Mil in Armed Forces Academy of Gen M. R. Stefanik in Liptovsky Mikulas, the GCI in Zvolen and virtual simulators FMS-M29, TL-39 and TV-17 located at Air Wing in Presov is established the Distributed Interactive Simulation (DIS) (Figure 4). DIS is representing a Live collective training environment. All functions are satisfied with common hardware and software that are compliant with industry practices and standards. The provision of this training package is in higher level of participants interaction in order to meet the common goal of the exercise; all that regardless the participants different locations. All TSC simulations and exercise development tools are DIS compliant.

By means of DIS the Slovak Armed Forces would gain a complex and modern system that would enable practicing wide range of missions. The

total contribution would not stop at the level of partial exercises. Actually, it would help to point out any Command and Control inadequacies in the field of interoperability, concerning any of both, Control and Command levels. We can depict several of possible scripts:

- COMAO (Composite Air Operation) – employment and cooperation of higher number of both, aircraft and helicopters from various Air bases under the common Operational Control and Command with the support of AD means,
- SAR (Search and Rescue) – practice exercises upon the execution and coordination at natural disasters conditions, where the fast decision making process is emphasized,
- superseding the AD of the simulated enemy and vice versa and operations of AD against aircraft and helicopters,
- the Air Force and Air Defense actions, aimed at their interoperability,
- simulation of complex flight situations within all the ATC workplaces, pointing at special cases, that might occur during the flight maneuvers, and replaying the problem situations,
- simulation of an intervention against RENEGADE regarding all the elements of the federation simulations involved.

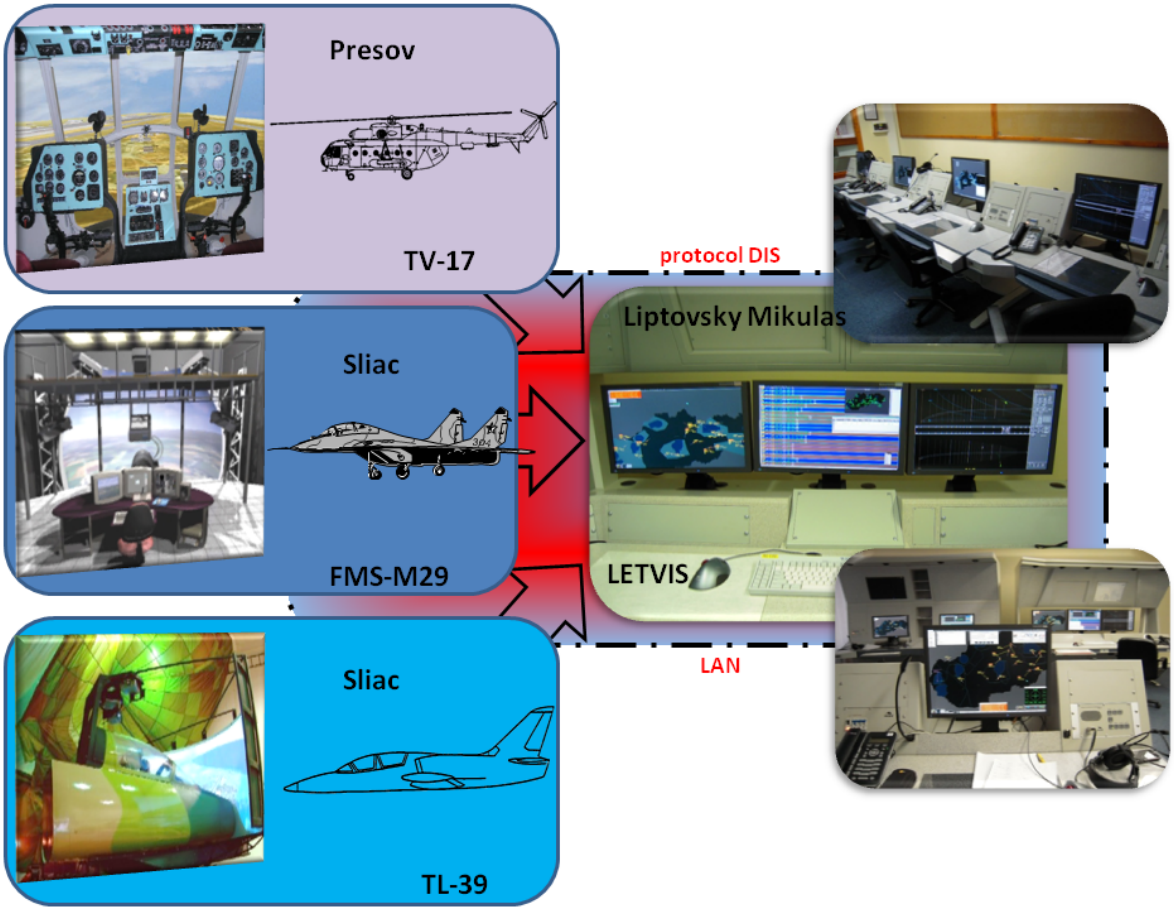

Fig. 4 Interconnection LETVIS to flight Simulator

Connecting system LETVIS to One Semi Automated Forces Tesbed Baseline constructive simulation system, so called OTB 2.5.1 including its 3D visualization of synthetic environment subsystems seems to be a cheaper alternative to achieve the above-mentioned wide range of missions. Currently the system is linked with OTB Reconfigurable Virtual Simulators (RVS) that were recently purchased by the Armed Forces Academy (AFA) (Figure 5). The AFA has 10 RVS in the configuration of ground and air units (Mi-17, Mi-17 weapon). The next step of planned RVS expansion is to purchase licenses for fighter combat units. RVS is a cheaper variant of FMS, AMS or BFS, functionality of which is somewhat limited compared to basic flight simulators. However, the functionality is adequate in terms of ensuring the full training of air traffic control staff, especially given the fact that the interaction between pseudo pilot-pilot and air traffic control staff will be preserved. Based on the connection of constructive and virtual simulations, it is possible to carry out extension of the TWR workplace where the 3D imaging system of constructive simulation would serve as a live view of the airport from the TWR and the OTB would be used to control the ground forces, which are practically controlled by the TWR. This connection would be financially more effective alternative, especially as the LETVIS, RVS and OTB simulators are directly implemented at the AFA and thus the potential problems with the synchronization of systems that are deployed elsewhere should be minimized. Instructor, in the role of the exercise director could immediately analyse the situation and call a de-briefing with pseudo pilots and air traffic controlers.

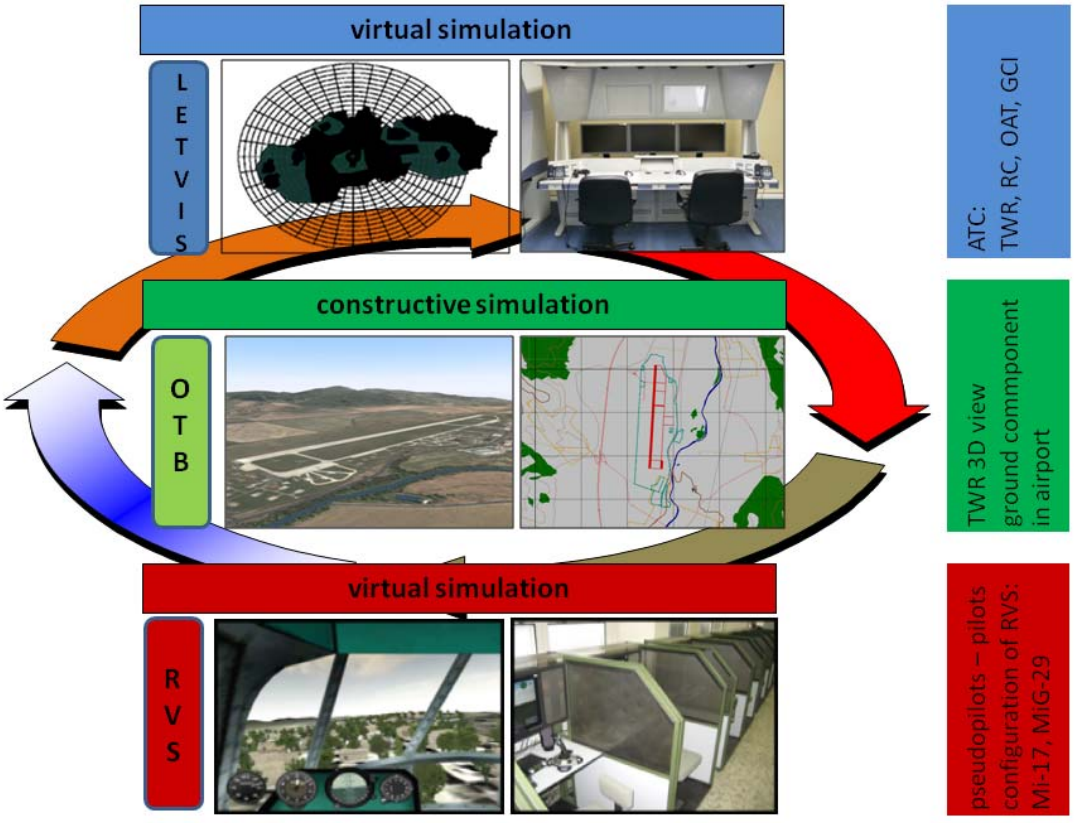

Fig. 5 DIS in AFA

6 CONCLUSION

The existing and evolving TSC can be more advanced through the incorporation of other virtual simulators within the SAFs, as indicated above. Thus, the flight and the other units training integration of virtual and live simulations would expand.

Qualification and education, as well as exercises being performed via virtual simulation, are fundamental at safety precautions. Aviation and ground personnel should be subject to special common rules. These ones are concerning their qualifications, obtained along with the specific training that is most reliable to real conditions.

Many articles are dealing with ineligible influence of the virtual reality, such as field of view, the level of perceptions or display influence. We have to admit that the technical equipment and information technologies development is progressing really rapidly – in quantum leaps. We cannot omit mentioning the vast positive acquisition during the training via virtual reality simulation, emphasizing the following: reaching faster and measurable results, increasing effectiveness of the training at the rate of low investments, individual pace of training, possibility of intervention during the training, as well as high level of safety and many others. These positive features are, not only in my opinion, far above the simulation inadequacies. Supposing that, there will be no resources stagnation from the perspective of several years, we will be able to speak about establishment of the Simulation Federation. That would consist of individual types of simulation interconnection (constructive, virtual simulation and Instrumented Maneuver Training) As a desired result, there would be the creation of a hugevirtual setting, where both, flight (ATCs, pilots, aircraft maintenance), and ground personnel with other support units, would interoperate at common tasks and goals completion. As the final result of the above mentioned federation we can depict meeting the conditions of high level of interoperability and compatibility.

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INVENTORY MANAGEMENT REVISED

Analysis of behavioral aspects of decision making within Sales & Operations Planning process

Peter JUREČKA

Abstract: The purpose of this article is to extend the standard text-book static inventory optimization model for the process view by analyzing the antagonistic incentives of different planning stakeholders that may lead to inefficiencies in inventory management. Two models are outlined to investigate the impacts of such potentially contradictory behavior – optimization model based on duality known from the classic microeconomic theory of consumer representing more theoretical simulation and Value Based Management model following recent trends in business management.

Keywords: inventory management, economic modeling, process optimization, sales and operations planning, S&OP.

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1 INTRODUCTION

Topic of inventory management is present with different detail at every level of company's planning, independent whether examining manufacturing or service providing private entity or public sector organization. Topics of strategic management of resources, financial optimization of working capital, volatility in sales demand or flexibility in operations has a common denominator - inventories.

Most of the text-book inventory optimization models have been dealing with the trade-off between two types of costs – i) Ordering/Set-up costs often called also as Preparation costs and ii) Inventory Carrying costs. The outcome of the optimization of total costs of inventories is the calculation of optimal order size known as Economic Order Quantity (EOQ)[1].

What has been missing is more complex view that would include at least also the iii) Costs of not having the inventory when needed, i.e. cost of missed sales due product shortage on one side and the iv) Costs of surplus inventory on the other.

While the first two categories are rather objective with costs defined by the structure of companies assets for i) or by the position of market costs for related services for ii), categories iii) and iv) are rather subjective and highly dependant on the quality and set-up of internal planning process.

In the upcoming chapters, the focus will be on the latter two categories and their denomination considering the roles and power of different business functions within planning process. In Chapters 2 and 3, antagonism in incentives within Sales and Operations Planning (S&OP) process is explained via using the microeconomic modeling. In Chapter 4, Value Based Management approach is applied to outline the consequences of various process set-ups on value creation of the firm.

2 ANTAGONISM IN SALES & OPERATIONS PLANNING

The most typical example of company's planning process with possibly highest impact on inventory levels is the process of Sales and Operations Planning (S&OP).

In general, S&OP is taking three key inputs; the business plan, the anticipated demand and the available resources that are used to create and maintain two fundamental plans for managing the business in the medium and long term. First is the sales plan, which is the agreed volume of expected future sales and second is the production plan, which is the agreed volume of production required to support the sales plan.

Based on the brief description of S&OP process, it is clear that the two main parties involved in this process are the Sales and Supply chain (Operations)[2]. Although the general goal of the

[1] Two main parts of preparation costs includes i) Processing of Purchase Orders, i.e. costs of purchasing, goods receiving, incoming inspection and accounts payable and ii) Manufacturing Set-up Costs including all the costs of managing the works order, e.g. preparing the specification, raising and tracking the order or the costs of setting up the machine and initial inspection.
Inventory Carrying costs results from the fact that the item is in stock and includes: cost of capital, deterioration, obsolesce, theft, insurance and storage costs etc.
For more information see e.g. Brealey, Meyers, Allen (2010), p. 758 – 759 for model with certainty or Kislingerova (2007), p. 474 – 483 for the model with uncertainty.

[2] By Sales or Supply chain contrary to sales or supply chain would be for the distinctive purposes meant the sales/supply chain department or function in the company. From the perspective of input, Marketing with its definition of business strategy and Finance/Controlling with financial valuation of quantitative plans play also very important role. However, in the end it's mainly the Sales and Supply chain/Operations that should align sales plans with

company is usually quite straightforward, aiming mostly on the sustainable profit growth and thus creating value exceeding capital costs for its stakeholders, specific targets of different parties involved in S&OP process might differ, even though they do not conflict or ideally they support the general target.

The level and structure of inventories[3] is the indirect outcome of S&OP process as it is the result of the production and distribution planning and sales. In general, inventory level and structure should be kept so, that the company is able:

a) to react effectively on the demand fluctuations on the market,

b) at the lowest possible costs.

However, these two requirements have partially antagonistic effect on the total costs of inventories.

Looking closer at the motivation of Sales, the sales representatives and managers are in most cases focused on the increase of sales performance. The main contribution to the profit increase from Sales is thus reached through growth on the side of revenues. From the view of product availability, the two main prerequisites of reaching their goals are:

a) to have sufficient amounts of product available (i.e. volume related flexibility),

b) early enough before the anticipated sales (i.e. timing related flexibility).

This would ensure the total desired sales flexibility representing sufficient product availability so that Sales is able to react on the demand volatility for company's product.

On the other hand, the core function of Supply chain is to "supply the Sales" and eventually the customers at the lowest possible costs under the assumption of maintaining certain agreed level of flexibility for Sales, defined usually in a certain form of Service Level Agreement. Supply chain is thus primarily trying to contribute to profit creation through lowering the costs, instead of increasing the revenues.

As can be seen, different motivation of Sales and Supply chain influences the level of inventories, and thus eventually the costs in the opposite direction. The request for "flexibility buffer/safety stocks" from the Sales point of view leads to the increase in the amounts and time of products on stock, which opposites the costs minimization efforts of Supply chain.

To sum up, the efficiency of S&OP process can be viewed from two perspectives:

- the ability of Supply chain to meet the requirements of Sales regarding the amount and time availability of product; or in other words, the satisfaction of Sales from having at disposal sufficient amounts of product soon enough on stock (named Product Availability – "PA")
- Costs of inventories related to this product availability – "CoI".

Both of these views meet under the topic of inventory management that deals mainly with two issues: "What is the appropriate level/mix of inventories?" and "How long in advance should be the product available on stock before the planned sales?"

Both PA and CoI are generated by certain amount of inventories at stock for certain period of time. Therefore, for the modeling purposes the following two variables needs to be defined::

- average level of inventories (measured in quantitative units of measure, named "Q_i"), capturing the "volume aspect" of inventory management,
- average period, for which the inventories are at stock (measured in time unit of measure, named "T_i"), capturing the "time aspect" of inventory management.

The higher is each of the variables, the higher are the CoI, as well as PA.

3 OPTIMIZATION MODEL – MICROECONOMIC MODELING

Looking at the problem of antagonism in S&OP process through "microeconomic lenses", it is possible to recognize many common features of decision makers involved within this process with rational consumer from the classic microeconomic theory. Applying microeconomic findings on business processes can explain the different motivation of involved parties and thus find the possible gaps in efficient setting and functioning of S&OP process.

Looking for the link to microeconomic Theory of consumer, we can say, that Sales are "consuming" certain levels of $Q_i(S)$ and $T_i(S)$[4], which form the

production capabilities. The Supply chain here is represented mainly by Demand planners, Forecast managers, Supply chain managers etc. depending on the organizational structure of each individual company.

[3] For the purposes of this text, under the term inventories, one should understand the finished goods (not assuming two other main inventory groups, raw materials and work-in-progress, as the S&OP process relates mainly to the part of supply chain from production to customers and not from suppliers to production)

[4] In this work, wherever (S) or (SC) are used to identify, whether variable refers especially to Sales (S) or

specific level of PA. The utility for Sales increases with the increase of PA and the "PA bundle"[5] is denoted by the vector:

$$PA_m = (Q_i(S)_m, T_i(S)_m),$$

where $Q_i(S)_m$ and $T_i(S)_m$, m = 1,2,3…n, represents the specific quantity and time of inventories[6] on stock. Moreover, the values of $Q_i(S)$ and $T_i(S)$ are not only not-negative, but are also restricted within specific limits:

$$0 < Q_iMin < Q_i(S) < Q_iMax$$
$$0 < T_iMin < T_i(S) < T_iMax$$

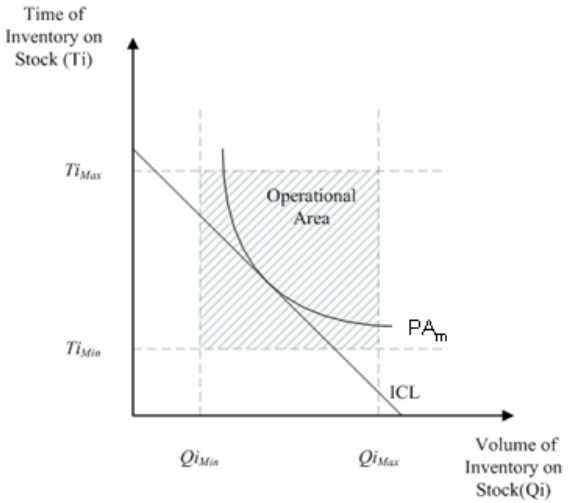

Fig. 1 Operational Area

The rationale for this assumption is as follows: there is certain minimum level of $Q_i(S)$ and $T_i(S)$ (called Q_{iMin} and T_{iMin}), that represents an unbiased minimal level of inventories accepted/agreed by both Sales and Supply Chain, under which the normal functioning of the business is impossible. Contrary to this, we can assume also certain maximum level of $Q_i(S)$ and $T_i(S)$ (called Q_{iMax} and T_{iMax}), above which keeping any additional inventories would have no possible benefit for business. Therefore, we can determine the "Operational area" for inventory optimization within the area defined by these two points $[Q_{iMin}; T_{iMin}]$ x $[Q_{iMax}; T_{iMax}]$, as illustrated on the Figure 1. Sales ranks the bundles in the feasible set in order of preference and choose the one with the higher ranking.

Further on, each level of PA brings certain level of utility to Sales, which can be expressed as:

$$u_S(PA) = u_S^0$$

where u_S^0 is some given number. Establishing the notion of Sales utility function (u_S) and with regards to the assumptions of preference ordering described above, we can redefine the problem of finding the most desired level of PA as the one of constrained maximization of a strictly quasiconcave function[7].

Each combination of Q_i and T_i not only brings certain level of utility for Sales, but also bear inventory related costs. The higher the Q_i and T_i, the higher amount of company's capital is bounded in form of inventories, and thus higher its costs.

All combinations of Q_i and T_i that comes to the consideration from the perspective of Supply chain form the "Feasible set". Each point within the set represents a specific level of Costs of Inventories (CoI), whose minimization belongs to primal targets of Supply chain. Supply chain tries to manage the cost of inventories through effective production and distribution planning in order not to exceed the certain maximum target level of CoI, named CoI_{Max}. The total level of CoI_{Max} is usually determined through various Key Performance Indicators (KPIs) in relation to other variables, such as level of sales, e.g. it's common business praxis that company adopts the target that the Average Inventory to Sales ratio should not exceed certain percentage. From budgeted or forecasted yearly level of sales, the level of average yearly inventories is calculated, and out of it using expected/defined prices p(Qi) and p(Ti) also the CoI_{Max}.

Formally, this feasible set showing the total Cost of Inventories (CoI) can be calculated as follows:

$$p_{(Qi)}Q_i + p_{(Ti)}T_i = CoI \le CoI_{\max},$$

where $P(Q_i)$ stands for average unit price of the unit of Inventory related to Quantity and $P(T_i)$ represents the price of the unit of inventory related to time[8].

As can be seen on the following figure, the Feasible set is a triangular area determined by the level of CoI_{Max} from "the top" and Operational area $[Q_iMin; T_iMin]$ x $[Q_iMax; T_iMax]$ described above from "the bottom".

Supply Chain (SC), e.g. Qi(S)* means the optimal level of Inventory volumes from the perspective of Sales.

[5] Consumption bundle in the Theory of consumer

[6] "m" stands for Stock Keeping Unit/ Article

[7] For more information about the features of utility function see e.g. Gravelle, Rees (2004), p. 16-18.

[8] $P_{(Qi)}$ is the compound measure most commonly represented by combination of the prices of transportation, warehousing and handling per square or cubic meter or palette based on the nature of the inventory. $P_{(Ti)}$ represents the compound measure too, capturing the time aspect of the inventory, (e.g. for how long is the product stored), including speed of transportation (air freight vs. ground shipping), price for the unit of time the goods are stored, etc.

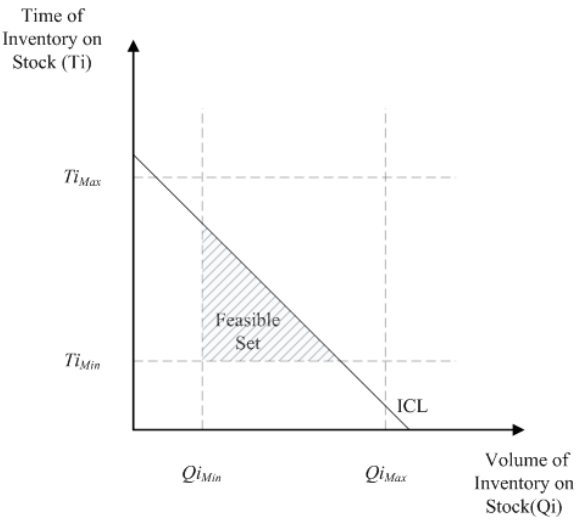

Fig. 2 Feasible set

The upper boundary of the Feasible set, named Inventory Cost Line (ICL) can be defined by the simple modification of CoI definition as:

$$Ti = CoI_{\max} / p_{(Ti)} - p_{(Qi)} Qi / p_{(Ti)}$$

and its slope thus as:

$$\left.\frac{dT_i}{dQ_i}\right|_{CoI\ const.} = -\frac{p_{(Qi)}}{p_{(Ti)}}$$

Taken into consideration the assumptions mentioned above, the problem of choosing the most preferred mix of Q_i and T_i can be formalized as:

$$\max u\,(Q_i, T_i);$$
$$s.t.\ p_{(Qi)} Q_i + p_{(Ti)} T_i = CoI \le CoI_{Max};$$
$$(Q_i, T_i) \in [\mathrm{Q_{i\,Min}}, \mathrm{Q_{i\,Max}}]\ \mathrm{x}\ [\mathrm{T_{i\,Min}}, \mathrm{T_{i\,Max}}]$$

Based on these assumptions, the Sales preferences about the optimal levels of PA are represented by Sales utility function u(S) with indifference curves such as on the Figure 3.

As both Q_i and T_i are positively related to PA and thus have positive marginal utility for Sales, the combinations of Q_i and T_i lying on higher indifference curves will be preferred to those on lower ones. This, together with assumption of Non-satation of preferences will result in using the maximal level of CoI by maximizing u(S). The combination of Q_i and T_i on the ICL will be chosen.

In the Figure 3, the optimal combination of Qi* and Ti* is a tangency solution, where the highest attainable indifference curve is tangent to ICL. In this point, slope of indifference curve is equal to the slope of ICL[9]:

$$\left.\frac{dT_i}{dQ_i}\right|_{u\ const.} = \left.\frac{dT_i}{dQ_i}\right|_{CoI\ const.}$$

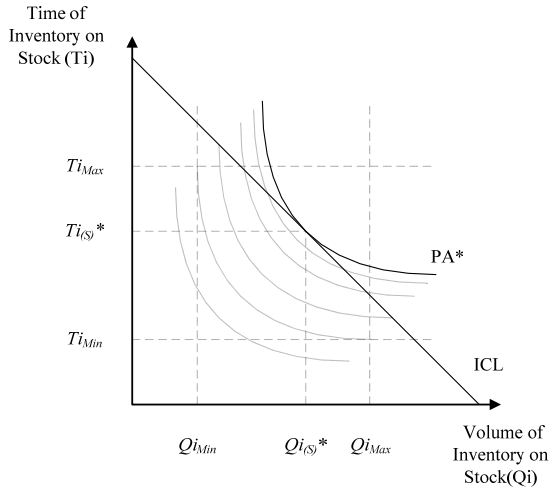

Fig. 3 Optimal solution – Sales

So far, we have been dealing with finding the optimal mix of Q_i and T_i under assumption that Sales is the main decision making authority regarding the choice of the level of PA. In other words, we assumed that Sales drives the S&OP process. In theory it would mean that Sales take the maximum level of CoI (CoI_{Max}) as given, and move alongside Inventory cost line trying to find the common point on the highest indifference curve, i.e. the highest level of PA.

The situation when commercial functions like the Sales or Marketing are driving forces of the S&OP process will be more applicable for the companies selling highly profitable products, where the financial impact of the loss of sales outweighs the risk of higher inventory costs, therefore there is higher pressure on product availability.

Different approach to the solution of this optimization problem would be applied, if the main driving part of S&OP process would not be Sales, but Supply chain. This will be most probably the case for the "cost driven industries" with relatively small gross profit margins. Supply chain than take the preference ordering of Sales as given, and it is

[9] Using the assumptions of strictly quasi-concavity of utility function and the characteristic features of feasible set (convex, non-empty, closed and bounded), we can derive that the optimization problem has a unique solution and there are no other non global local solutions (For more information see e.g. Gravelle, Rees (2004); Appendixes A-D)

looking for the cheapest way, how to achieve certain level of PA. In other words, by finding the optimal solution, it would move alongside the given indifference curve looking for such level of PA – as the combination of Qi and Ti – that is lying at the lowest possible Inventory cost line.

In this case we are dealing with dual optimization problem to that described above. Formally, we can write it as:

$$\min\left(p_{(Qi)}Q_i + p_{(Ti)}T_i\right);$$
$$1)\ u_S(SCF) \geq u_S,$$
$$2)\ (Q_i, T_i) \in [(Q_{i\,Min}Q_{i\,Max}), (T_{i\,Min}, T_{i\,Max})] \in R^2$$

Analogically to the situation when Sales was driving the S&OP, solving of these equations would lead to similar results, i.e. that in optimum, the ratio between marginal utility of Qi and Ti for equals to the ratio of $p(Q_i)$ and $p(T_i)$:

$$\left.\frac{dT_i^*}{dQ_i^*}\right|_{CoI\ const.} = -\frac{p_{(Qi^*)}}{p_{(Ti^*)}} = \left.\frac{dT_i^*}{dQ_i^*}\right|_{u(SCF)=u(SCF^*)}$$

From the outcomes of the previous chapters it might seem, that it does not make any difference regarding the optimal level of PA and CoI, whether the main decision making power in S&OP is Sales or Supply chain. However, this difference will become visible:

a) when we examine the impact of changes of prices $p(Q_i)$ and $p(T_i)$ on optimal choice of Q_i and T_i and (i.e. when the slope of ICL would change)
b) when we look at the setting of constrains for optimizations (when the whole ICL would shift as a result of different CoI).

It is obvious that the setting of S&OP process and the split of decision making power between Sales and Supply chain can have substantial impact on the costs of inventories which might represent significant portion of company's total costs. This is valid especially in the case of selling organizations where big amount of capital is tied in form of finished, but not yet sold products. In praxis, such optimization is not possible for example because of difficult attribution of cost down to the level of individual stock keeping unit.

Also, in most of the companies where incentives are not aligned and each function is primarily focusing on its own targets, the prevailing business function will shape the whole inventory management approach, i.e. in strongly Sales oriented organizations, the PA and related CoI will be in extreme case determined by Q_iMax and T_iMax and in strongly cost oriented companies with low profit margins, the PA and CoI will be much closer towards levels defined by Q_iMin and T_iMin.

The examples above also show the application of classic microeconomic optimization models to real business environment.

4 OPTIMIZATION MODEL – VALUE BASED MANAGEMENT

As mentioned in previous chapter, there are certain constrains for practical application of theoretical optimization models as described above. One of the alternative ways of how to approach the optimal set-up of business planning process is to analyze how its quality contributes to generation of value for company's shareholders. Identifying and focus on the main drivers of value creation is one of the main targets of the concept of Value Based Management.

The thinking behind Value Based Management (VBM) is quite straightforward. As the value of a company is determined by its discounted future cash flows, company is creating additional value only when returns from invested capital exceed its costs.

The following figure shows the typical Value driver tree decomposing EBIT after Cost of Capital (EaCC) into individual parts.

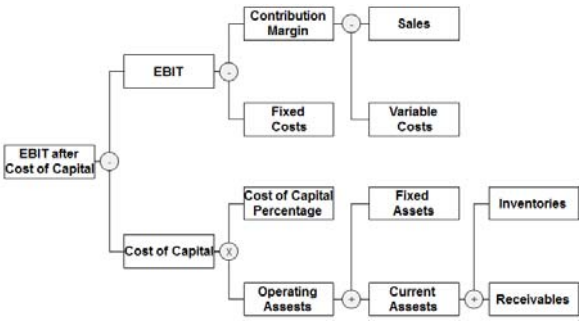

Fig. 4 Value driver tree in general

In order to demonstrate how can the set-up of planning process from the perspective of empowerment of individual decision makers influences EaCC, we have to examine how it influences the individual value drivers, or even more precisely, how it impacts the KPIs that are assigned to these drivers. Specific value drivers closely linked to planning performance can be identified and their impact on overall bottom line performance of the firm measured.

In general, right inventory structure resulting from properly set S&OP process impacts the EaCC twofold - either indirectly via supporting sales through proper response on sales demand volatility

by having the right product at disposal at the right time, or directly via the costs of inventories[10].

The following figure shows the value drivers that are essential for supply chain management related to planning quality[11], supplemented with examples of some most frequently used KPIs.

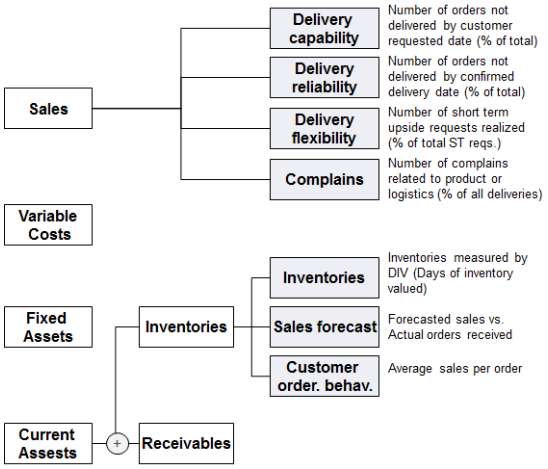

Fig. 5 Value driver tree – Supply Chain KPIs

As can be seen, reaching high levels of supply chain capability, reliability and flexibility, with its direct link on logistics related customer complains are the key prerequisite for delivering sales. Unless Supply chain keeps persistent high performance levels, Sales and Marketing will always be reluctant to showing transparently their most realistic sales forecast and will always be biased either towards earlier production or to overestimation of operations planning in order to secure their sales flexibility.

If there is not enough transparency in planning that would steer alignment of planning processes and reconciliations between plans of Sales and Operations, it hits back negatively the overall efficiency of operations and consequently also financial performance.

Also in case of aligned incentives, i.e. through sharing the common targets of forecast accuracy or average inventory levels by both Sales and Supply Chain, there is a need for a decision basis on whether the additional unit of product should be made available to support potential sales on one hand or burden the capital costs in case if not being sold on another. This is especially valid for the Make-to-Stock operational set-up, where the production is triggered by anticipated or forecasted demand, not by actual confirmed orders.

Generally, product should be made available if the potential value gained from its sales is higher than costs in case that it would not be sold, i.e. if:

$$p(GP_m) - (1-p)(COGS_m) > 0,$$

where:

p…… likelihood that product will be sold
$(1-p)$…. likelihood that product will not be sold
GP_m….. Gross Profit of product m
$COGS_m$ Cost of Goods Sold for product m
P_m…..... Sales Price of product m ($=GP_m+COGS_m$)

After numerical adjustment we get:

$$P > COGS_m/(COGS_m-GP_m)$$
$$P > COGS_m/P_m$$
$$P > COGS_m \text{ margin}$$

This easy example can serve as “rule of thumb” method on the decision regarding additional requirement of sales on upside production. In case the probability that the additional product is higher than the Cost of goods margin, it is on average profitable to produce additional volumes of this product.

The finding also supports the argument that the more profitable is the products (i.e. having higher GP margin thus lower COGS margin), the lower the likelihood of potential sales is required to justify additional production.

This effect is even more obvious if the product can be resold later, i.e. for the case of seasonal products with more that one season of shelf life. Than the costs related to not selling the product will be limited only to the costs of capital bounded in form of inventories for the time till the product is sold. The adjusted formula for such case would be as follows:

$$p(GP_m) - (1-p)(COGS_m)xCC > 0,$$

where CC stands for Costs of Capital bounded in form of inventories.

[10] Apart from the impact on Sales and Inventories, ineffective set-up of S&OP process might also have negative implications for example on some variable costs, e.g. through usage of air-freights as a firefighting reaction of product shortages in some cases, but this analysis is out of scope of this article.

[11] There are also multiple other value drivers related to supply chain with effect mainly on fixed costs or variable costs (e.g. logistic costs or lead times), but these are nor directly impacted by quality of business planning, therefore are out of scope of this article. Although one could probably argue that in case of firefighting reaction on the problems related to wrongful planning might be for example necessity of usage airline shipment in stead of vessels and thus directly impacting logistic costs, but this should be taken more as an exceptional case and therefore is not considered further.

5 CONCLUSIONS

Standard text-book inventory optimization models often omit the process part of inventory management, i.e. the behavioral factors and set-up of the internal planning process that in the end has major impact on the inventory levels.

The article outlined the two alternative approaches towards further analysis of this topic. Duality known from microeconomic Theory of consumer was applied to demonstrate different approaches towards same problem of finding the optimal inventory mix from Sales and Operations perspective.

More practical approach can be offered by application of Value Based Management principles through analysis of how the inventories impact the value that company is generating.

Both of the approaches can be applied to support the discussions about one of the most common trade-offs within Sales and Operations Planning of the firm – balancing additional benefits from more sales flexibility with costs of additional inventories.

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RESEARCH FILTERING ALGORITM WITH DELAY EFFECT FOR MEASURMENT SYSTEM

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Abstract: An object with the delay effect in the signal tansmission was researched. The efficiency of the developed modified Kalman filter with time delay was demonstrated by the simulation of the test model error of the inertial navigation system (INS).

Keywords: Filter Kalman, delay effect, INS.

1 INTRODUCTION

Aerocraft control is carried out on the basis of the received information from navigation equipment system. Normally, the navigation equipment is inter-connected into navigation complex. On the basis of principle, the navigation complex on board the aerocraft consist of inertial navigation system - INS, Radar, satellite system GPS/ ГЛОНАСС, navigation station and other kinds of numerous position systems.

To consider systems and navigation system applied in defined ship's parameters procedure. The method to increase exactness of navigation complex is by algorithm. Navigation complex settled to research is most exact, it consists of INS, source of peripheral navigation information (GPS/ГЛОНАСС), level indication - observed capacity and Kalman filter.

Built algorithm is able to allow increasing exactness of selected navigation complex. Improved model of Kalman filter has pointed out, there, it allows to be calculated delay element - not depended on evaluation object.

2 THE FILTER KALMAN WITH DELAY EFFECT

The realization of the algorithms for estimating in the computer's center is supposed that it is needed to be expressed into the discrete form.

The mathematical models of the dynamic object with a delay are written in the discrete form. If the model is continuous, it is necessary to transfer into the discrete one.

The class of only time delay is reason of the transform the information. The time delay τ is defined by following expression:

$$\tau = dT_0;\ d = 1, 2... \quad (1)$$

T_0- Discrete period

The discrete differential equation, written about the dynamic object with only time delay is expressesed in the following form:

$$z_k = Bu_{k-d}\ z_{k-d} \quad (2)$$

Here: z_K - Output of the object; u_{k-d} - Input of the object; k- Index of the discrete takt;

In the practice applications, there are objects with their dynamic characteristic delay. Therefore, we consider only the class of the object. The delay is written by the different ways.

- The discrete model with the input delay could be written in the following form:

$$x_{k+1} = \Phi x_k + B u_{k-d} \quad (3)$$

$$z_k = Hx_k \quad (4)$$

Where:

x_k - State vector of the object;

Φ - Matrix of the system;

H - Matrix of the measurements;

- The discrete model with the output delay could be written in the following form:

$$x_{k+1} = \Phi x_k + Bu_k \quad (5)$$

$$z_{k+d} = Hx_k \quad (6)$$

- The delay could be consisted in the system's matrix. In case, we express the delay through d - units in the input and output of the model.

- The discrete model with the input delay could be written in the following form:

$$y_{k+1} = \Phi_1 y_k + B_1 u_k \quad (7)$$

$$z_{k-d} = H_1 y_k \quad (8)$$

Here:

y_k - State vector of the object with d units delay:

$$y_k = [\, u_{k-d}, u_{k-d-1}, ..., u_{k-1} \,]^T$$

$$\Phi_1 = \begin{bmatrix} 0\,1\,0\,...\,0 \\ 0\,0\,1\,...\,0 \\ ..... \\ 0\,0\,0\,...\,1 \\ 0\,0\,0\,...\,0 \end{bmatrix};\ B_1 = \begin{bmatrix} 0 \\ 0 \\ ... \\ 0 \\ 1 \end{bmatrix};$$

$$H_1^T = \begin{bmatrix} 1 \\ 0 \\ ... \\ 0 \\ 0 \end{bmatrix};$$

we form a new state vector from the sub vectors x_k and y_k .

The expand system of the equations has the following form:

$$\begin{bmatrix} x_{k+1} \\ y_{k+1} \end{bmatrix} = \begin{bmatrix} \Phi & BH_1 \\ 0 & \Phi_1 \end{bmatrix} \cdot \begin{bmatrix} x_k \\ y_k \end{bmatrix} + \begin{bmatrix} 0 \\ B_1 \end{bmatrix} \cdot u_k \qquad (9)$$

$$z_k = \begin{bmatrix} H & 0 \end{bmatrix} \cdot \begin{bmatrix} x_k \\ y_k \end{bmatrix}$$

Rewriten the Eq. (8) and (9) in the new equation system:

$$x^*_{k+1} = \Phi^* x^*_k + w_k \qquad (10)$$
$$z^*_k = H^* x^*_k + \nu_k$$

Where:

$$x^*_k = \begin{bmatrix} x_k \\ y_k \end{bmatrix} \; ; \; \Phi^* = \begin{bmatrix} \Phi & BH_1 \\ 0 & \Phi_1 \end{bmatrix}; \qquad (11)$$

$$w_{k=} \begin{bmatrix} 0 \\ B_1 \end{bmatrix} \cdot u_k \; ; H^* = [H \; 0];$$

w_k - vector of the input noise. There is a discrete random serial.

ν_k - vector of the measured noise.

Let us the object with a delay is written in the following form [1]:

$$\begin{bmatrix} x_k \\ y_k \end{bmatrix} = \begin{bmatrix} \Phi_{k,k-1} & \Gamma_{k,k-1} \\ 0 & D_{k,k-1} \end{bmatrix} \cdot \begin{bmatrix} x_{k-1} \\ y_{k-1} \end{bmatrix} + \begin{bmatrix} 0 \\ G_{k,k-1} \end{bmatrix} \cdot w_{k-1} \qquad (12)$$

$$u_k = \begin{bmatrix} H & 0 \end{bmatrix} \cdot \begin{bmatrix} x_k \\ y_k \end{bmatrix} + \nu_k \qquad (13)$$

Here:

x_k - State vector of the object; $x_k \in R^n$,

y_k- State vector, whose elements with the delay, $y_k \in R^m$,

w_k , ν_k - vectors of the white random noise; $M[w_j \nu_k^T]=0$;

In practice applications the problems for estimating the elements $y_k \in R^m$ with delay is not inspected. The estimation task is carried out with the reduction method. The method supposes that for estimating the n - vector of the states, it is necessary to use the mathematical model, made for full (n+m)-state vector.

We rewrite the equation for estimating the full state vector in the block - matrix form:

$$\begin{bmatrix} \hat{x}_k \\ \hat{y}_k \end{bmatrix} = \begin{bmatrix} \Phi_{k,k-1} & \Gamma_{k,k-1} \\ 0 & D_{k,k-1} \end{bmatrix} \cdot \begin{bmatrix} \hat{x}_{k-1} \\ \hat{y}_{k-1} \end{bmatrix} + \begin{bmatrix} K_k \\ U_k \end{bmatrix} \cdot u_k \qquad (14)$$

$$u_k = z_k - \begin{bmatrix} \Phi & \Gamma \\ 0 & D \end{bmatrix} \cdot \begin{bmatrix} \hat{x}_{k-1} \\ \hat{y}_{k-1} \end{bmatrix} \qquad (15)$$

For every sub vector $\hat{x}_k$, $\hat{y}_k$ we receive:

$$\hat{x}_k = \hat{\Phi}_{k,k-1} \hat{x}_{k-1} + \Gamma_{k,k-1} \hat{y}_{k-1} + K_k (z_k - H_k \Phi_{k,k-1} \hat{x}_{k-1} - H_k \Gamma_{k,k-1} \hat{y}_{k-1}); \qquad (16)$$

$$\hat{y}_k = D_{k,k-1} \hat{y}_{k-1} + U_k (z_k - H_k \Phi_{k,k-1} \hat{x}_{k-1} - H_k \Gamma_{k,k-1} \hat{y}_{k-1}); \qquad (17)$$

According to suppose (assume) of the tats, $\hat{y}_k = 0;$ therefore:

$$\hat{x}_k = \hat{\Phi}_{k,k-1} \hat{x}_{k-1} + K_k (z_k - H_k \Phi_{k,k-1} \hat{x}_{k-1}); \qquad (18)$$

Taking the influence of the delay of elements when defining the amplified matrix K_k of the reduced algorithm for estimation, first of all we define the previous covariance matrix of the estimate error:

$$\begin{bmatrix} P^1_{k/k-1} & P^2_{k/k-1} \\ P^3_{k/k-1} & P^4_{k/k-1} \end{bmatrix} = \begin{bmatrix} \Phi_{k/k-1} & \Gamma_{k/k-1} \\ 0 & D_{k/k-1} \end{bmatrix} \cdot \begin{bmatrix} P^1_{k-1} & P^2_{k-1} \\ P^3_{k-1} & P^4_{k-1} \end{bmatrix} \cdot \begin{bmatrix} \Phi_{k/k-1} & \Gamma_{k/k-1} \\ 0 & D_{k/k-1} \end{bmatrix}^T + \begin{bmatrix} 0 \\ G \end{bmatrix} M[w_{k-1} . w^T_{r-1}][0 \;\; G^T] \qquad (19)$$

For the every block of the predict covariance, we have:

$$P^1_{k/k-1} = \Phi P^1_{k-1} \Phi^T + \Phi P^2_{k-1} \Gamma^T_{k,k-1} + \Gamma P^3_{k-1} \Phi^T + \Gamma P^4_{k-1} \Gamma^T \qquad (20)$$

$$P^2_{k/k-1} = \Phi P^2_{k-1} D^T + \Gamma P^4_{k-1} D^T \quad (21)$$

$$P^3_{k/k-1} = D P^3_{k-1}.\Phi^T + D P^4_{k-1} \Gamma^T \quad (22)$$

$$P^4_{k/k-1} = D P^4_{k-1} D^T + GM[w_{k-1} w^T_{r-1}] G^T \quad (23)$$

The predict covariance matrix of the estimate errors is defined by the known form of filter Kalman using the determined covariance matrix of the estimate errors in the previous step:

$$\begin{bmatrix} P^1_{k-1} & P^2_{k-1} \\ P^3_{k-1} & P^4_{k-1} \end{bmatrix} = \left\{ \begin{bmatrix} I & I \\ I & I \end{bmatrix} - \begin{bmatrix} K_{k-1} \\ U_{k-1} \end{bmatrix} \cdot \right\} \cdot \left\{ \cdot \begin{bmatrix} H_{k-1} & 0 \end{bmatrix} \right\} \quad (24)$$

$$\begin{bmatrix} P^1_{k-1/k-2} & P^2_{k-1/k-2} \\ P^3_{k-1/k-2} & P^4_{k-1/k-2} \end{bmatrix}$$

Taking the symmetry of the covariance matrix of the estimate errors, the equations of the every block-element is rewritten in the following type:

$$P^i_{k-1} = (I - K_{k-1}.H_{k-1}).P^i_{k-1/k-2}; i = 1,2,3,4; \quad (25)$$

In the classical filter Kalman, the amplified matrix is defined by the equation that is written in the following block-matrix form [2]:

$$\begin{bmatrix} K_k \\ U_k \end{bmatrix} = \begin{bmatrix} P^1_{k-1/k-2} & P^2_{k-1/k-2} \\ P^3_{k-1/k-2} & P^4_{k-1/k-2} \end{bmatrix} \cdot \begin{bmatrix} H^T_k \\ 0 \end{bmatrix} \cdot \left\{ \begin{bmatrix} H_{k-1} & 0 \end{bmatrix} \cdot \begin{bmatrix} P^1_{k-1/k-2} & P^2_{k-1/k-2} \\ P^3_{k-1/k-2} & P^4_{k-1/k-2} \end{bmatrix} \cdot \begin{bmatrix} H^T_k \\ 0 \end{bmatrix} + R_k \right\}^{-1} \quad (26)$$

The measured covariance matrix of the noise is defined by experiment way, and in the practice, normally it is constant, K_k = const.

For the every block- matrix of the Eq. (26), we rewrite:

$$K_k = P^1_{k/k-1} H^T_k \left[H_k P^1_{k/k-1} H^T_k + R_k \right]^{-1} \quad (27)$$

$$U_k = P^2_{k/k-1} H^T_k \left[H_k P^2_{k/k-1} H^T_k + R_k \right]^{-1} \quad (28)$$

Therefore, the estimation of the state vector with the taking the un-estimated variable state and taking the elements of delay is carried out by the Eq.: (18), (20) ÷(23), (25), (27) and (28).

When we construct the control system of the object with a delay, we need to control the delay parameter.

When all of the delay elements, contained in the state vector need to be estimated, then we could use different optimal or adaptive algorithms for estimation.

When a part of the delay elements contained in the state vector is need to estimated, then we could use the way, given in the previous paragraph or the classical algorithm for estimation. In the algorithms, the mathematical model of the object consists of only the estimated state variables.

The forming the mathematical model of the object carries out the last way. In the model the influence of the un-estimated variable states on the estimated variable components is considered. The most simple realization of the way is accepted of the un-estimated components from state vector and is examined the influence of the components through the restored (reestablish/renewal/reconstruct) serial ν_k in the equation for estimation of the state vector.

$$\hat{x}_k = \Phi \hat{x}_{k-1} + K_k \nu_k \quad (29)$$

The method is the simplest for realizing in the computer, but its exactness is the worst. The algorithm formed according to the method estimates roughly. Therefore the way is not considered in future.

In the paragraph, we consider a way for estimating the notwithstanding selection of the state variables, taking the influence of the un-estimated components on to the selected estimated variable components in the mathematical model of the studied object.

The notwithstanding selection of the variable state vector for estimation depends on the practice condition of the tats. The necessary condition for selection of the variable state vector is the observation of the variable states according to the measurements. In the later we suppose that the studied variable states are observed. We consider the equation of the object, written for the full state vector:

$$x_k = \Phi x_{k-1} + w_{k-1}$$

Substituting the values of k = 2, 3,...n, we receive:

$$\begin{aligned} &x_2 = \Phi x_1 + w_1;\ x_3 = \Phi x_2 + w_{2=} \\ &= \Phi^2 x_1 + \Phi w_1 + w_2; \ldots \\ &x_n = \Phi^{n-1} x_{n-1} + w_{n-1} = \Phi^{n-1} x_1 + \Phi^{n-2} w_1 + \\ &+ \ldots + w_{n-1} \end{aligned} \quad (30)$$

Let's see, the sub vector: x^*_k is need to be estimated, and x^i_k - element with delay. The variable states needed to estimate and the full state vector that is related by the equation:

$$\begin{bmatrix} x_k^* \\ x_k^i \end{bmatrix} = Cx_k \qquad (31)$$

Where:

$x_k^T = [x_k^1 \ ... \ x_k^l \ ... \ x_k^h \ ... \ x_k^i \ ... \ x_k^h]$;

$C = \begin{bmatrix} 0 \ . \ 0 \ 1 \ 0 \ . \ 0 \\ ..... \\ 0 \ . \ 0 \ 1 \ 0 \ . \ 0 \end{bmatrix}$ - Has n columns;

$x_k^* = [x_k^1 \ ... \ x_k^h]^T$ - Sub vector need to be estimated;

Considering the (31) the equations of object for the first n moments of time are written in the form:

$$\begin{bmatrix} x_1^* \\ x_1^i \end{bmatrix} = Cx_1 \qquad (32)$$

$$\begin{bmatrix} x_2^* \\ x_2^i \end{bmatrix} = C\Phi x_1 + Cw_1 \quad (33)$$

$$\begin{bmatrix} x_n^* \\ x_n^i \end{bmatrix} = C\Phi^{n-1}x_1 + C\Phi^{n-2}w_1 + ... + Cw_{n-1} \quad (34)$$

In the block-matrix form:

$$\begin{bmatrix} x_1^* \\ x_1^i \\ x_2^* \\ x_2^i \\ ... \\ x_n^* \\ x_n^i \end{bmatrix} = Sx_1 + \begin{bmatrix} 0 \\ C.w_1 \\ ... \\ ... \\ ... \\ ... \\ C\Phi^{n-2}w_1 + ... + Cw_1 \end{bmatrix} \qquad (35)$$

Where: $S = \begin{bmatrix} C \\ C\Phi \\ ... \\ C\Phi^{n-1} \end{bmatrix}$

For defining the x_1 it is necessary to define condition: $S^{\#} = (S^TS)^{-1}S^T$ in the case, the number n is equal to the size of the full state vector. Therefore, when estimating some elements (n >1) of the state vector, the number of the rows of the matrix S is bigger then the number of the columns.

We examine a particular case, when the estimated sub-vector is directly measured. Therefore, the matrix C is measured one. It shows us how the full state vector x_k is observed by the measured sub- vector $\begin{bmatrix} x_k^* & x_k^i \end{bmatrix}^T$. The matrix S is observed one, that means, it is not grew worst (set (S) ≠ 0), and the pseudo-invert matrix $S^{\#}$ is existed.

In the practical applications, for decreasing the calculation operations on the computer, it is necessary to select the smallest value n, correlatively. Existing the selecting n, equal to the ratio of the size of the full state vector and the number of the estimated state variables, we receive square matrix S.

The solution of the equation (35) in this case will be in the form:

$$x_1 = S^{-1}\begin{bmatrix} x_1^* \\ x_1^i \\ x_2^* \\ x_2^i \\ ... \\ x_n^* \\ x_n^i \end{bmatrix} - S^{-1}\begin{bmatrix} 0 \\ C.w_1 \\ ... \\ ... \\ ... \\ ... \\ C\Phi^{n-2}w_1 + ... + Cw_1 \end{bmatrix} \qquad (36)$$

In the general case, the equation (36) is rewritten in the following type:

$$x_1 = S^{-\#}\begin{bmatrix} x_1^* \\ x_1^i \\ x_2^* \\ x_2^i \\ ... \\ x_n^* \\ x_n^i \end{bmatrix} - S^{-\#}\begin{bmatrix} 0 \\ Cw_1 \\ ... \\ ... \\ ... \\ ... \\ C\Phi^{n-2}w_1 + ... + Cw_1 \end{bmatrix} \qquad (37)$$

For estimating the interested component of the state vector we rewrite the equation of the object at the moment (n+1):

$$\begin{bmatrix} x_{n+1}^* \\ x_{n+1}^i \end{bmatrix} = C\Phi^n x_1 + C\Phi^{n-1}w_1 + ... + Cw_n \quad (38)$$

Considering the Eq. (37) the Eq.(38) will be rewritten in the form:

$$\begin{bmatrix} x^{*}_{n+1} \\ x^{i}_{n+1} \end{bmatrix} = C\Phi^{n}S^{-\#} \begin{bmatrix} x^{*}_{1} \\ x^{i}_{1} \\ \dots \\ x^{*}_{n} \\ x^{i}_{n} \end{bmatrix} -$$

$$-C\Phi^{n}S^{-\#} \begin{bmatrix} 0 \\ Cw_{1} \\ \dots \\ \dots \\ C\Phi^{n-2}w_{1} + \dots + Cw_{n-1} \end{bmatrix} +$$

$$+C\Phi^{n-1}w_{1} + \dots + Cw_{n}$$

Substituting:

$$W_{n} = C\Phi^{n}S^{-\#} \begin{bmatrix} 0 \\ Cw_{1} \\ \dots \\ \dots \\ C\Phi^{n-2}w_{1} + \dots + Cw_{n-1} \end{bmatrix} -$$

$$-(C\Phi^{n-1}w_{1} + \dots + Cw_{n})$$

The equation (38) will be in the form:

$$\begin{bmatrix} x^{*}_{n+1} \\ x^{i}_{n+1} \end{bmatrix} = C\Phi^{n}S^{-\#} \begin{bmatrix} x^{*}_{1} \\ x^{i}_{1} \\ \dots \\ x^{*}_{n} \\ x^{i}_{n} \end{bmatrix} - W_{n} \qquad (39)$$

W_n - Input noise, equivalent with the noise of the estimated state variables.

The estimation of the state variables at the moment (k+1) is defined by the following equation:

$$\begin{bmatrix} \hat{x}^{*}_{k+1} \\ \hat{x}^{i}_{k+1} \end{bmatrix} = C\Phi^{n}S^{-\#} \begin{bmatrix} \hat{x}^{*}_{1} \\ \hat{x}^{i}_{1} \\ \dots \\ \hat{x}^{*}_{k} \\ \hat{x}^{i}_{k} \end{bmatrix} - K_{k+1}\nu_{k+1} \qquad (40)$$

K_k - Amplified matrix at the moment k,

ν_k - Recovered serial.

Therefore, the consideration of the influence of the un-estimated components on the estimated state variables is carried out directly by the estimation of the state variables at the previous time moments that uses the mathematical model for making the previous estimation.

The influence of the un-estimated components could be considered in the vector of measurements. The measurements are carried out in the defined scheme.

We consider the way of the measurements for another organization of the task.

Let's see the object that is written in the following equation:

$$x_{k} = \Phi x_{k-1} + w_{k-1} \qquad (41)$$

And the direct measurements are written in the form:

$$z_{k} = Hx_{k} + \nu_{k} \qquad (42)$$

There is formed tats to estimate the despite element with delay, that is a part of the state vector component.

We write the measure equations at the different moments of time:

$$z_{1} = Hx_{1} + \nu_{1};\ z_{2} = H\Phi x_{1} + Hw_{1} + \nu_{2};$$
$$z_{n} = H\Phi^{n-1}x_{1} + H\Phi^{n-2}w_{1} + \dots + Hw_{n-1} + \nu_{n} \qquad (43)$$

In the block-matrix form the Eq. system (43) are rewritten in the following:

$$\begin{bmatrix} z_{1} \\ z_{2} \\ \dots \\ z_{n} \end{bmatrix} = \begin{bmatrix} H \\ H\Phi \\ \dots \\ H\Phi^{n-1} \end{bmatrix} x_{1} +$$

$$+ \begin{bmatrix} \nu_{1} \\ H + \nu_{2} \\ \dots \\ H\Phi^{n-2}w_{1} + \dots + Hw_{n-1} + \nu_{n} \end{bmatrix} \qquad (44)$$

Putting a new vector of the measurements:

$$Z_{1} = \begin{bmatrix} H \\ H\Phi \\ \dots \\ H\Phi^{n-1} \end{bmatrix}^{-1} \cdot \begin{bmatrix} z_{1} \\ z_{2} \\ \dots \\ z_{n} \end{bmatrix} \qquad (45)$$

And the noise:

$$V_1 = \begin{bmatrix} H \\ H\Phi \\ \dots \\ H\Phi^{n-1} \end{bmatrix}^{-1} \cdot \begin{bmatrix} \nu_1 \\ H + \nu_2 \\ \dots \\ H\Phi^{n-2}w_1 + \dots + Hw_{n-1} + \nu_n \end{bmatrix} \quad (46)$$

The equation (44) will be rewritten in the form:

$$Z_1 = x_1 + V_1 \quad (47)$$

Or for the despite moment of the time:

$$Z_k = x_k + V_k \quad (48)$$

The equation (48) is one of the formed measurements too. The equation gives the way to measure the full state vector components. The measurements in the equations (48) are called converted one, that means, they are combination of the measurements.

The measured noise in the (48) also is combination of the measured noises, contained by the errors of the used measured equipment and the input noises of the object. The noise is called converted too. The converted noise is received by the converting the all of the acted noises to measured variable state. The level of the converted noise is bigger, then the level of the directly measured noise in the equation (42), therefore, in the later, it is necessary to filter the noises.

For estimating, we write the equation of the object at the (n+1)-th moment:

$$x_{n+1} = \Phi^n x_1 + \Phi^{n-1}w_1 + \dots + w_n = \Phi^n x_1 + w_n^* \quad (49)$$

Here: w_n^* - vector of sum input noise.

In the respectively with equation (49), we define an equation for estimsted element with delay. The element is contained in the vector x_{n+1}:

$$\tau_{n+1}^i = [f_1 \dots f_n].x_1 + w_n^{i*} \quad (50)$$

where:

$[f_1 \dots f_n]$ – i th row of the matrix Φ^n; n - size of the vector x_1;

w_n^{i*} – i th component of the vector of sum input noise w_n^*

For inspite of time moment, the equation (50) will be written in the form:

$$\tau_{k+1}^i = [f_1 \dots f_n].x_1 + w_k^{i*} \quad (51)$$

Separating the component $\tau^i_k \in x_k = [x^1_k, x^2_k, \dots, \tau^i_k, \dots, x^n_k]^T$, we rewrite equation (51) in the following form:

$$\tau_{k+1}^i = f_i\tau_k^i + \sum_{j=1;j\neq i}^{n} f_j x_k^j + w_k^{i*} \quad v \quad (52)$$

We perform all components of the state vector x_k without τ^i_k:

$$x_k^j = Z_k^j - V_k^j; j = 1,2,\dots,i-1,i+1,\dots,n \quad (53)$$

Putting the equations (53) in to (52), we receive:

$$\tau_{k+1}^i = f_i\tau_k^i + \sum_{j=1;j\neq i}^{n} f_j Z_k^j - \sum_{j=1;j\neq i}^{n} f_j V_k^j + w_k^{i*} \quad (54)$$

The equation (54) establishes relationship between the values at present and previous moments of time of the element wit delay. The influence of another element in the state vector on the element with delay is considered by the measurements. In the equation also see that the level of the converted noise is bigger than level of the initial noises. Therefore, it is necessary to filter it before using algorithms for estimation. The procedure for filtering the converted noise could be carried out by using the selected number of the bigger measurements than the size of the state vector. In the case, the observer matrix S is right-triangle and instead of using the invert matrix S^{-1}, we use the pseudo-invert matrix $S^{-\#}$. The process is filtered, but the algorithm of the data process is complex.

The simplest method for filtering the noise is average of the measurements on the in spite of time interval. If the interval of time is bigger, then more exact constant values of the measurements are received. For the variable components of the state vector, the interval for average is selected according to the practice conditions with considering the object dynamic.

Next step of the data process- constructed the measured parameter. We will estimate in the form:

$$\hat{\tau}_{k+1}^i = f_i\hat{\tau}_k^i + f_1 Z_k^1 + \dots + f_n Z_k^n + K_{k+1}\nu_{k+1} \quad (55)$$

Where:

K_{k+1} – Amplified coefficient of the algorithm estimation

$$\nu_{k+1} = Z_{k+1}^i - f_i\hat{\tau}_k^i$$

Therefore, using the n measure at the n moments of time we could receive estimation of the elements $\hat{\tau}^i$ with delay τ.

The amplified coefficient is defined by the difference equation of filter Kalman or despite other algorithms for estimating.

The using scalar algorithms for estimating element with delay should be used when the conditions with low level of noise, that means, the level of input noise and measured noise is much lower than the normal value of the estimated component.

To verify the functionality of the researched algorithm we used the test mathematical model error of the inertial navigation system (INS).

The test model is:

$$x_k = \Phi x_{k-1} + W_{k-1}$$
$$z_k = Hx_k + V_k \quad ,$$

Where

x_k - state vector, included the errors of INS;

z_k – scalar measurment;

$W_k - n$ -vector of the incoming noise,

V_k – measuring noise,

W_k *u* V_k – discrete analogs of the white Gaussian noises, for any *j* and *k*,

$$M[W_k] = 0, \quad M[V_k] = 0, \quad M[V_j W^T{}_k] = 0 ,$$

$$H = [\,1 \;\; 0 \;\; 0\,]$$

$$\Phi = \begin{bmatrix} 1 & -3600 & 0 \\ 10^{-7} & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}, \quad x_k = \begin{bmatrix} \delta V_k \\ \varphi_k \\ \varepsilon_k \end{bmatrix},$$

Where δV_k –INS errors in velocity definition, φ_k – deviation angle of the gyroplatform from the moving thrihedral , ε_k – drift velocity of the gyroplatform.

For simulation we used the test model with numerical values that are relevant to the navigation systems in the civil aviation [2].

The results of the classical Kalman filter with time delay are shown in Fig. 1. Estimation error in this case is=35.07 m/min.

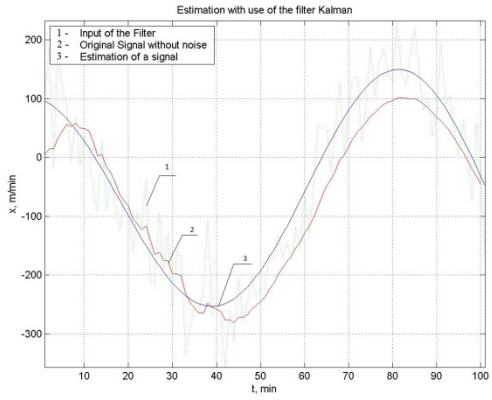

Fig. 1 The results of the simulation of the classical Kalman filter

The simulation results of the modified Kalman filter with the delay effect are shown in Fig 2. Estimation error in this case is=16.1744 m/min.

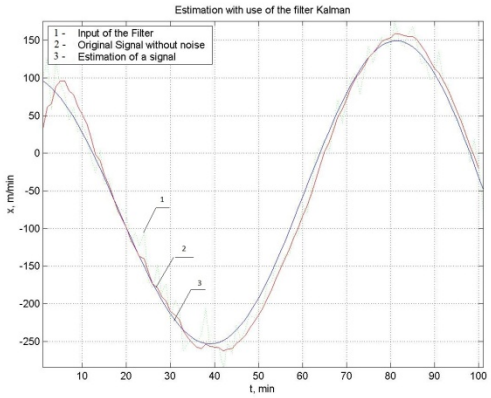

Fig. 2 The simulation results of the classical Kalman filter with the delay effect

3 CONCLUSION

Made algorithm Filter Kalman with delay effect and the improved linear Filter Kalman that permits to estimate with higher exactness than the traditional Filter Kalman by considering the delay effect.

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REVIEW OF MAINTAINABILITY AND MAINTENANCE OPTIMIZATION METHODS FOR AVIATION ENGINEERING SYSTEMS

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Abstract: Reliability is an essential element for aviation systems operators in order to accomplish assigned missions in a continuous challenging world. Increased reliability could be achieved through increased availability and maintainability. This has emphasized the importance of maintenance, especially for the systems designed to operate in less friendly environment. An efficient maintenance process in case of airborne assets could be achieved through optimized preventive maintenance methods, considering also the influences of palliative maintenance actions. This would reduce the logistic footprint, especially when operating in remote and challenging areas of operations. The present paper focuses on surveying the optimization methods of the maintenance policy in the case of the aviation engineering systems, on the grounds that an improper policy would increase above an accepted threshold the risks to mission accomplishment and to human operators.

Keywords: preventive maintenance policy, optimization models, aviation engineering systems.

1 INTRODUCTION

The complexity of the phenomena is a characteristic of today's systems, be it technical or social. The increase of qualitative and quantitative changes around us is an on-going process, contributing to the complexity of phenomena. Part of this process of development, aviation engineering systems are a remarkable complex phenomenon, because of the large amount of parts organized by complex functional links between the components to meet the ends of highly complex missions within not so favourable environments.

In the military field especially, due to the highly probability of malfunctions, this increase in complexity developed new issues, mostly related to the reliability and availability. A failure of these systems during operation could also be an expensive but a dangerous event. Governments would like the aviation systems to be exceedingly reliable, thus ensuring high availability with a minimum of life-cycle costs (LCC). The values of the above mentioned parameters (reliability and availability) depend on the components of the technical systems (their ages, the interaction between each other), the applied maintenance policy and the operating environment. The success of the mission could be assured, from the point of the above considered parameters, when the engineering systems would have performed its functions without critical failures.

As one has noticed, the maintenance is always advisable for complex systems. Maintenance is the set of all technical and organizational actions that run on all equipment in use and are made to maintain or restore functions for which the required technical performances have been designed. Maintenance includes two main processes: preventive maintenance - PM, and corrective maintenance - CM. The objective of PM policies is to reduce the probability of failure or degradation of the complex systems, through simple preventive maintenance and preventive replacement activities. CM comprises a set of activities (minimal repairs and corrective replacements) performed after the failure or at the unexpected degradation of equipment' functions in order to restore its state.

2 MAINTENANCE AND MAINTAINABILITY

The main objectives related to maintenance are: ensuring system' basic functions (availability, efficiency, and reliability); ensuring system life through proper connections between its components (asset management); and ensuring safety for human operators, environment and system itself.

The current maintenance policy used by the Romanian Air Force refers to three levels of maintenance activities: Operational ("O"), Intermediate ("I"), and Depot ("D") level (Fig. 1). The "O" and "I" levels of maintenance could be fulfilled by organic structures of the operators of aviation assets, while the most specialised activities of the "D" level should be performed through outsourced services. On the other hand, in remote theatres of operations and in austere conditions, the first line of maintenance could be performed by the organic structures, while the other levels should be fulfilled by facilities out of the allied logistic pool or outsourced to mobile teams of civil specialised maintainers.

A design parameter of an engineering system is its maintainability, expressed by the probability that a PM or a repair to be performed in a given time, under stated conditions, and with procedures, personnel and resources available. It is a quality of the whole system, which makes it easy to repair.

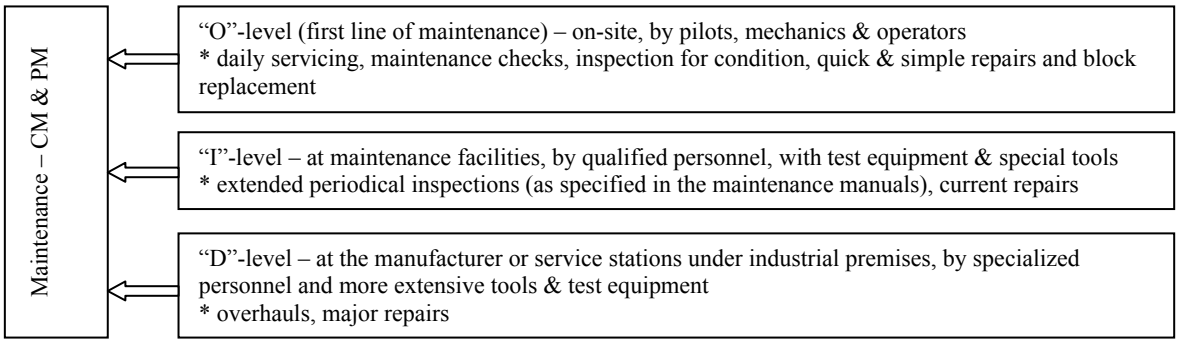

Fig. 1 Current maintenance concept within military organization

Figure no 2 depicts the place of the maintainability in relation to the overall performances of a complex engineering system. The dashed line separates the desired objective from the outcomes of the compromise between system parameters. The conclusion is that there is the need to establish a compromise between reliability and maintainability, in order to achieve the desired availability sought by all operators of the systems.

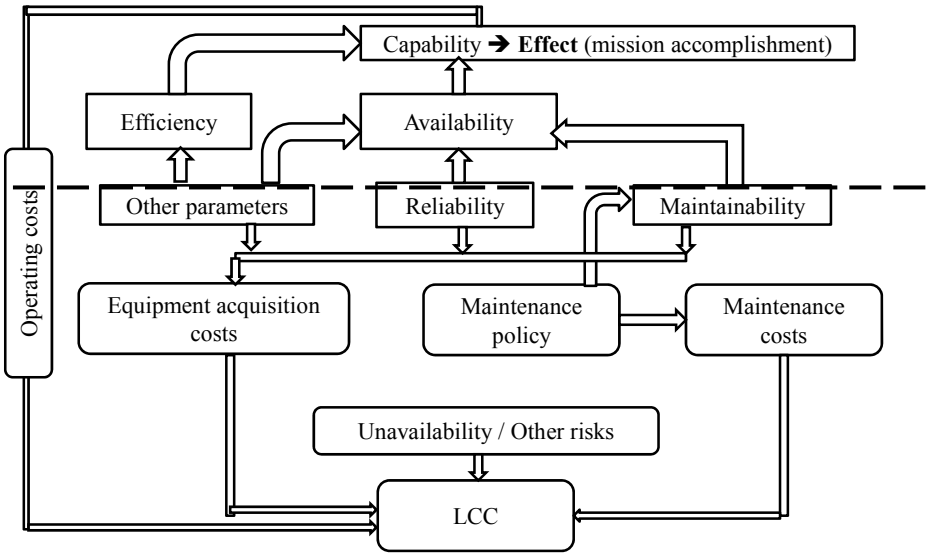

Fig. 2 Relations between maintainability and other parameters of the aviation engineering system

Maintainability objective is projected as a maximum cumulative time of immobilization (unavailability) T_{ci}, for a specified period. This parameter is the sum of required period of times for CM (index *c*), and PM respectively (index *p*):

$$T_{ci} = N_c * M_c + N_p * M_p \quad (1)$$

where: N_c = number of required CM operations;
N_p = number of required PM interventions;
M_c = average time for CM missions;
M_p = average time for PM missions.

N_c is a parameter for reliability specified and known for each case. If the evaluation of the other three parameters gives values that do not meet the projected T_{ci}, one will change the system design or the maintenance policy on the extent of costs envisaged.

The requirements of the maintainability are often pictured using parameters like MTTR (Mean Time To Repair) or other average periods of time for PM and CM. MTTR is defined as the total time of immobilization of the engineering system due to repairs divided to the total number of CM activities (N_c).

$$MTTR = {}^{T_{ci}}/_{N_c} \quad (2)$$

It can be assessed that MTTR is the arithmetic average of the requested time for performing the maintenance interventions. In practice, in order to evaluate the MTTR of a complex engineering system, the manufacturer estimates no less than n = 50 probable failures with their MTTRs.

$$MTTR = \frac{(N_1\lambda_1 R_{p1} + N_2\lambda_2 R_{p2} + \cdots + N_n\lambda_n R_{pn})}{(N_1\lambda_1 + N_2\lambda_2 + \cdots + N_n\lambda_n)} \quad (3)$$

where: N = total number of components;
λ = failure rate of a specified component (the number of failures in a specified time);
Rp = predicted time for corrective repairing of a component (identification, removal of the fault component, replacement, adjusting and controlling the new component).

The maintainability is expressed by the probability to perform, in a time constraint, a repair of a random failure:

$$M(t) = 1 - e^{-\mu t} \quad (4)$$

Considering μ = 1/MTTR, maintainability could be expressed by:

$$M(t) = 1 - e^{-\left(\frac{t}{MTTR}\right)} \quad (5)$$

The high values for M shows the possibility to save money and also to obtain a high reliability (the more important issue in aviation). Fig. 3 shows the effect of three different MTTRs on M at discriminated values for t.

Ensuring adequate logistics can be a difficult task to accomplish due to the high costs of spare parts and specialised maintainers (especially in emerging markets in conditions of economic crisis), the need to ensure interoperability and the requirement to reduce the logistic footprint in the remote theatres of operations. The usage of built-in or ground-borne test equipment can help increase maintainability of airborne assets, but with expensive costs due to the complexity of aviation technical systems. In this case the maintenance policy can decisively influence the LCC, since the designing process of military equipment (the requirement to ensure lower MTTR), continuing with maintenance optimization models during the functioning of the system.

As shown above, maintenance has a huge influence in the LCC, thus in the efficiency of an engineering system. It is generally accepted to define the efficiency of a complex system as its costs efficiency. The following figure shows the dependency between different factors to influence the efficiency of an engineering system, besides the above mentioned maintenance and maintainability.

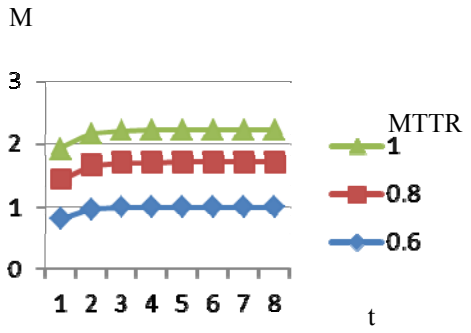

Fig. 3 Maintainability in + relation with MTTR and compulsory time for repairs

3 AN ANALYSIS OF THE CANDIDATE MODELS FOR MAINTENANCE OPTIMIZATION IN AVIATION SYSTEMS

Aviation systems are characterized by a huge complexity, thus directing the optimization of maintenance to take into account an extended set of parameters. The basic maintenance optimization is expressed by the classical cost-benefit analysis (CBA) of each maintenance alternative in order to extract the optimal strategy, taking into account the imposed constraints and the global picture of risks. The benefits of these optimization approaches consist of savings, a lower LCC and an increased capability (Figure 2).

There have been a large number of theoretical approaches to maintenance optimization since 60s, within the operations research literature. The first known models of maintenance optimization were the age and block replacement models. Later on the multi-unit models appeared, together with the approaches to optimize the preventive replacement. Generally, the main tactic adopted to minimize the costs of maintenance was the modelling of the PM initiatives, although CM has also a direct influence on LCC.

Maintenance optimization models include four stages in their theoretical approach:

- the description of the engineering system, its functions and importance;
- the modelling of the deterioration of the system with age and projected consequences on its functions;
- the description of the available information about the system and of the action subject to management;

- the optimization technique to find the right balance between costs and benefits of the measures.

The deterministic models are limited in the way they do not give relevant information about potential risks. On the other hand, the stochastic models use probability equations to represent variability and uncertainty in different cases because the system' state is subsequent to predictable actions (natural variability) and other random elements.

The following table depicts a comparative analysis of some maintenance optimization models with greater impact in specialized literature.

Tab. 1 Review of maintenance optimization models

Crt no	Maintenance optimization models	Reference author(s); year	Short description
1.	Block replacement model	BARLOW *et al.*; 1960	Introduced for optimization of replacement times in PM of one-unit systems. The equipment is replaced at failure and exchanged at a pre-specified time, respectively.
2.	Age replacement model	BARLOW *et al.*; 1960	Introduced for optimization of replacement times in PM of one-unit systems. The equipment is replaced at a failure or when it has reached a predetermined age. The method has benefits for system availability, but is not cost-effective from the replacement decision point of view.
3.	Minimal repair model	BARLOW *et al.*; 1960	The model advocates on performing minimal repairs in order to restore the system. There are limitations regarding the distinction between critical components.
4.	Opportunity replacement model	JORGENSON *et al.*; 1967	In this model there are two classes of components – failure of a component from one class triggers opportunities for preventive replacement of components from the other class.
5.	RBR (rule-based reasoning)	BUCHANAN *et al.*; 1969	RBR optimization comprise a knowledge-base and a set of rules the system use to diagnose or predict a fault. Extracting, validating, and verifying the rule base is essential since one faulty rule may wreck the complete result and make the results unreliable.
6.	PHM (proportional hazard model)	COX; 1972	In this model, the unique effect of a unit increases in a covariate is multiplicative with respect to the hazard rate. The model is limited to the cases where the replacement of the faulty component is considered to bring the system to its original state.
7.	CBR (case-based reasoning)	SCHANK *et al.*; 1977	CBR is based on the idea to apply old knowledge of problem solving to solve new problems, using a cognitive model of learning from experience. When a new failure occurs, it is compared with the existing case library and similar cases are retrieved. In complex systems CBR cycle could become progressively time and resources consuming.
8.	PAR (proportional age reduction)	MALIK; 1979	The maintenance effect is assumed to reduce the age of the system with respect to the rate of occurrence of failures, and the stress acts multiplicatively on the baseline cumulative intensity.
9.	Pareto optimum	KOSKI; 1984	The concept has been introduced as the solution for multi-objective optimization problems. The weighting of the maintenance objectives depends on the consequences of failure, economy, and reliability.
10.	Ant colony optimization	COLORNI *et al.*; 1991	The collective behaviour emerging from the interaction of the different search threads has proved effective in solving combinatorial optimization problems.
11.	Optimal interval for PM/ replacement using an age-based/ diagnostic-based renewal strategy	LEGAT *et al.*; 1996	The method is useful for engineering systems with Weibull life distributions and for a reasonable range of the cost factor (ratio of unit corrective to unit preventive maintenance costs).
12.	Optimal maintenance schedule	VATN *et al.*; 1996	Used for the components of a production system, taking into account safety, health and environment objectives, maintenance costs and costs of lost production.
13.	Age reduction	DEDOPOULOS *et al.*; 1998	It determines the optimal number of PM interventions within a specified time, the extent of these activities by means of the age reduction of the system and the expected profit.
14.	PAS (proportional age setback)	MARTORELL *et al.*; 1999	The model considers that the maintenance activity reduces proportionally the age that the component has immediately before it performs maintenance.

15.	Joint optimization of PM and replacement policies	HSU; 1999	Used for queue-like production system with minimal repair at failures it provides long-run expected profit per unit time for a given maintenance and replacement policy.
16.	PM optimization to multi-state systems	LEVITIN *et al.*; 1999	The architecture of algorithms is developed to identify the optimal sequence of maintenance actions to provide system functioning with the desired level of reliability during its time by minimum maintenance costs.
17.	Risk-based maintenance optimization using a Bayesian approach	APELAND *et al.*; 2000	Used to present probabilistic frameworks for the maintenance optimization, with the help of Bayesian approaches to risk and risk analysis.
18.	Optimal number and period of time for periodic PM	PARK *et al.*; 2000	Used to minimize the costs of PM of the systems subject to slow degradation. Each PM relieves stress temporarily and hence slows the rate of system degradation, while the system keeps its hazard rate monotonically increasing.
19.	Incorporate GAs (genetic algorithms) in planning periodical PM	TSAI *et al.*; 2001	Introduced for systems with deteriorated components. The degraded behaviour of components was modelled with a dynamic reliability equation while the effect of PM to reliability and failure rate of components was formulated based on age reduction model.
20.	PM policy with the critical reliability level	ZHAO; 2003	Developed to avoid the problem posed by degradation systems with imperfect PM effect when using conventional PM policies, the model is based on the law that there is the same number of faults in the interval between PM cycles, with the same degradation ratio.
21.	Determination of PM schedules to optimize one measure of the system performance	BARTHOLOMEW-BIGGS *et al.*; 2006	The method treats the number of PM as a continuous optimization variable, with the global minimization of a non-smooth performance function. The method optimizes, through proper PM timing, a measure of system performance, such as minimizing the mean cost over a lifetime, or maximizing the lifetime per unit-cost.
22.	Optimum frequency to perform PM	DUARTE *et al.*; 2006	The model computes the interval of time between two close PM interventions for each component, minimizing the costs, with the total immobilization periods not exceeding a predetermined value.
23.	Integrate the effect of CM while planning for the PM	SAMROUT *et al.*; 2009	The method does not consider the CM actions as minimal repairs or replacements, like many of the PM optimization before it. The PHM was used as a modelling tool.
24.	Proposed framework to establish PM plans with safety constraints	VATN *et al.*; 2010	The authors envisaged a framework for maintenance optimization which shifted the decision tool in maintenance policies with high safety impact, from the maintenance / logistic department to safety department of the organization.

4 CONCLUSIONS AND FUTURE WORK

The problem of maintenance in aviation systems is very complex because of the multiple interactions between subsystems. In military aviation it is also necessary to consider the risks associated to the mission itself, in extreme weather conditions and an intensive use. In this case it results a higher probability of malfunctions and a lower reliability with direct impact on the processes of maintenance, thus directly affecting the required military capability. One could assess also the additional issues related to the classic criteria of optimizing the life-cycle costs. The objective is to obtain the critical / minimum values for the parameters of reliability and availability according to the above mentioned restrictions. The critical analysis of models for optimization presented should be extended with new elements and the technological progress should be also included in a future framework. Moreover, the use of suitable maintenance optimization models with an adequate informational & computational system would ensure an increased efficiency of aviation engineering system exploitation by any operator.

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THE MANAGEMENT AND MANAGERIAL SKILLS ARE NEEDED FOR THE SLOVAK MANAGER

Daniela HREHOVÁ, Peter KAMENEC

Abstract: To manage a business appropriately is to manage it effectively, respecting and taking advantage of knowledge of management, marketing, law, economic and technical standards, knowledge of technology, foreign languages and other disciplines (psychology, sociology, etc.). (1) The aim: To show that managers need to have management skills to influence effectively the behaviour of others, and ultimately achieve the desired results and determine the level of management skills manager. (2) The discussion: According to the mentioned data, self-reflection of managers at the level of self management skills is not completely balanced in terms of ability to manage. The result is also consistent with other available research results of other authors. Insufficiency can be traced within the decision-making skills as well as within the ability to solve legal, economic and personal or financial and material problems. 3) The conclusion: Additional research is needed in the area to determine how best to recruit and train managers in these skills to move forward.

Keywords: manager, management skills, soft skills, self-reflection, research.

1 INTRODUCTION

Changing economic, political, technological, socio-cultural environment revealed the requirement of adaptability of companies. The only "component" of the company, which has the ability to change are the people. On this principle, Pascal and Athos suggested the "7S" model, who conceived this fact in a more complex way based on a "hard S" (strategy, structure, systems) and "soft S" (management style, associates, integrating all the skills and shared values). Joining the Union the effort to find top managers with hard and soft skills is getting stronger, which particularly concerns East and Central Europe companies (Múčka, 2004).

2 A MANAGER AS THE MANAGING DIRECTOR

The manager is a person whose primary activities are the management functions. It is a man who plans, organizes, manages, maintains and controls human, financial and information resources. The manager is a person who directly supervises one or more people in business and directs them to meet business goals (Hickman, 1995). Managers belong to the category of directive workers in the company. This concept can be understood:

a) in a broader sense, managers are those in various departments in the company who manage the work of these departments and are responsible for the work of others;
b) in the narrow sense, managers are leaders of a company, i.e. top management (Daft, Lane, 2009).

Therefore, in order to carry out their work succesfully, they should have power, influence and authority, which can be achieved in four different ways (Yau, Scully, 1990, pp. 32-33; Whetten, Cameron Woods, 2000):

a) the resources - a manager is responsible for the allocation of resources for members od the group managed;
b) the position – in the control hierarchy a manager occupies the higher position than the subordinate ones;
c) personality – his personal qualities are at a higher level than personal qualities of other group members;
d) qualifications – a manager´s knowledge should be broader than those of other members of the group.

To manage effectively, a manager needs to have:

a) knowledge - economic, financial, technical, business, marketing, law, cultural, etc.;
b) skills - analytical, decision making, humane, communication, imagination, etc.;
c) the key manager qualities, i.e. willingness to be motivated in a proper way (Daft, 2008; Kiltz, 2009).

To be a real asset to the organization a manager must have management skills developed in three categories:

1. Performance management;
2. Managing people;
3. Relationship management (Daft, Lane, 2009; Coltman, Devinney and Midgley, 2011, pp. 205-219).

Majority of people were promoted to managerial roles because they were good professionals and excelled in at least one of the three mentioned categories. The role of the leader comprises more than just determining the strategy (Dvořáková, 2007). This includes clarification of the direction of the company, processes and policies that motivate employees and help them to achieve its business objectives.

3 THE IMPORTANCE OF THE MANAGEMENT SKILLS

The number of books and articles about management skills which came out in the past decade are uncountable. This shows at least two things: the management is still a current topic and there is still a wide range of views and significant disunity - managing as one of the manager's soft skills. The preliminary review identified 14 articles with a research (Gillard, 2009; Searo, 2008, Connell, 2008) or theoretical focus (Zielinksi, 2005; Drucer, 1998, Senker, Beesley, 1986, 2007; Cousins, 2006) on management skills. The papers deal with aspects of management skills. A survey conducted by the Graduate Management Admission Council found that although MBA's were strong in analytical aptitude, quantitative expertise, and information-gathering ability, they were sorely lacking in other critical areas that employers find equally attractive: strategic thinking, management skills, communication, leadership, and adaptability (Klaus, 2008). Book author Peggy Klaus says than research, conducted with Fortune 500 CEOs by the Stanford Research Institute International and Carnegie Mellon Foundation, found that 75 % of long-term job success depends on people skills, while only 25 % on technical knowledge. Another study of headhunters hiring CEOs ranked the ability to communicate and motivate and manage as necessary attributes for positively affecting the bottom line. And when they do provide these soft-skills training, the programs are often exclusively reserved for "high-potential" employees or senior executives. An another qualitative study was conducted with a series of focus group meetings with 54 executives across the USA in order to construct theoretical relationships with which to develop a grounded theory of supply management skills evolution in a changing business environment (Giunipero, Handfield, Eltantawy, 2006). The overwhelming majority (93 %) of the HR managers surveyed said technical skills are easier to teach than soft skills. The most in-demand soft skills cited by the managers are management organizational skills (87 %), verbal communication (81 %), teamwork and collaboration (78 %), problem solving (60 %), tact and diplomacy (59 %), business writing (48 %), and analytical skills (45 %). Also surveyed were IAAP members, who were asked to report the soft skills areas in which they would like to improve. The areas they mentioned the most were analytical, verbal communication, negotiation, management and problem-solving (Research, 2008). In a Job Outlook 2008 survey conducted by the National Association of Colleges & Employers (NACE), the top characteristics looked for in new hires by 276 employer respondents (mostly from the service sector) were all soft skills: communication ability, a strong work ethic, initiative, interpersonal skills, and teamwork (ACS, 2008). An another central finding was that care management requires a range of complex skills. Some pre-Griffiths casework skills are still necessary to practice as a care manager, such interpersonal skills, management skills, negotiation skills and organisational skills. However, new skills are required, such as risk management, the ability to construct a case and use IT, management of other professional input and use of accounting and budgetary systéme (Dustin, 2006). Many of the global surveys of trends in new corporate management note the strong need to increase involvement and other soft skills of managers at all levels of management.

4 METHODOLOGICAL PART

The main purpose: To determine the nature of the personality profile of a manager in terms of management capabilities in the form of self-reflection.

The main problem: What the nature of the personality profile of a manager is in terms of management capabilities.

The main hypothesis: We assume that the nature of the personality profile of a manager in terms of management capabilities is differentiated with respect to the management area while performing various work activities.

The method: To obtain empirical data the research Methodology OP – 1 was used, structured with respect to the intended purpose. Methodology included identification (demographic) data - gender, age, education.

The research methodology was structured according to the level of management skills (15 items). Questions to test the profile of a manager at this level were constructed as a battery (files) items measured using the 7-point scale, where 1=definitely yes, and 7=definitely not. The role of the respondents was to use this range to make their evaluation or self-assessment with regard to the questions included. Obtained empirical data were processed in the program for statistical data processing STATISTICA5.5 Methods used were: descriptive statistics, simple analysis of ONEWAY variance. When processing the primary data and transformed data - averaged scores were used.

The research group consisted of a group of employees at various management positions of various companies, without specifying the selection character (although, results showed that respondents were employees of banks, social services, travel agencies, insurance companies, municipalities and various companies).

Gathering data organization. Empirical data were collected in Kosice in May 2011.

a) Interpretation part

The description of the research sample. The research sample consisted of a total of 190 respondents - managing staff / managers. Character of the structure of the sample can be monitored using identifiers: gender, age, regarding the point formulated in main hypothesis – the ability of managing activities done by a respondent.

Tab. 1 Structure of research sample according to gender and age (v %)

Sex	Age						%
	18-20	21-25	26-30	31-40	41-50	more 60	
M	25,00	0,00	0,00	25,00	25,00	25,00	100,00
W	0,00	20,00	26,67	33,33	20,00	0,00	100,00
Total	5,26	15,79	21,05	31,58	21,05	5,26	100,00

According to the data listed in Tab. 1 a set of research is divided by sex ratio in 80 % of women and 20 % of men. Age categories are represented differently. The largest age group is 31-40 years (31.58 %) less occupied is the group of 26-30 (21.05 %) and 41-50 years (21.05 %). Significantly underrepresented are the categories of 25 years and over 60 years. In the group of men age categories of 18-20 and three categories between 31 and over 60 years - by 25 % are equally represented. Women are most numerous in the category 31-40 years (33.33 %).

b) The analysis of the management capabilities of managers - an overview

Personality profile and image of the guide has been studied at five levels, which together form a superior character and capabilities guide.

Management capabilities are an essential part of the work of managers, constantly updated in a very dynamic and rapidly changing environment. According to the average measured level of self-assessment score ranges from M=2.05 to 2.68.

Spectrum of evaluation at management level is more in the positive range of 7-point scale (score ranges measured in degrees 1,2,3). The best self-assessment is represented by the "ability to communicate" (M=2.05), in the lower position, with the same average score - M=2.21 items that show significant leadership skills of people and rational solutions to the problems "to solve the most serious problems has always maintained in a professional way", "always working as one that people like to follow"and "so far I have managed to lead people to work together to solve the problem" can be traced. Less positive assessed items include the ability "to solve the problems of decision-making capacity, observed in "yet I was physical and financial charakter" (M=2.68), but also "always making the right choice" (M=2.63). Very slight doubt in this respect is confirmed by the scores for other items that have lead to an assessment decision: "... *The report estimates how things develop*," and "*I am very knowledgeable in the use of management practices*" (M for both total = 2.58).

Tab. 2 Average measured score for managing capabilities

Managing capabilities	Average score
I am always able to analyze the situation and solve problems	2,26
I always solve every problem according to other possible aspects	2,16
I have always decided correctly	2,63
When solving the problem successfully estimate how the things are going to develop	2,58
When solving even the main problems I always take it in a professional way	2,21
I am perfectly oriented in using managing methods and technics	2,58
I always perfectly handle the plan strategy of solving problem	2,47
When solving the problem I always have needed information	2,53
I have perfect ability of solving problems of material and financial character	2,68
I am always able to persuade people	2,53
I perfectly know the way how to influence attitude of people	2,53
My abilities to communicate is appreciated every partner, whenever and wherever	2,05
Harmonizing the activities of several people have never been a problem for me	2,47
I always seem to be a person who people like to follow	2,21
Until now I have always managed to lead the people to cooperate with solving the problem	2,21

5 THE VIEWS ON CURRENT STATE OF MANAGEMENT CAPABILITIES OF MANAGERS

Presented results of the analysis indicate overall not a very favourable rate of a self-reflection of managers at the appropriate level. The average score usually moves in the average (middle) spectre of 7-point scale (degree 4). This evaluation at the managerial capabilities is at least significant. Identified and presented results are in an accordance with the assumption expressed in the

main hypothesis and correspond with the results of other surveys. We may mention the survey by the company Target, which pointed out that some Slovak companies use a closed style of management because their leaders are not prepared for criticism and ideas from their colleagues. They are afraid of underappreciation of their position in society and actually they want to have their ideas approved by possibly, all the colleagues at the same level (Karlubíková, April 17, 2009). Foreign managers operating in Slovakia complained about the unwillingness of the slovak managers to take responsibility. Slovaks are reluctant to come into confrontation, fear of confrontation (Orfánus, 2010) and avoid conflicts (Jakubek, 2011, Ernst & Zouny, 2011). Employees are not prepared to risk (Liff, 2007).

It may be clearly stated that the Slovak managers still do not pay sufficient attention to identifying and managing (if possible) the risks in business (Vančo, 2006). Slovak managers compared with colleagues from abroad, risk less, are less empathetic and sometimes they ignore specifics of the local market and management style (Templar, 2006). Slovaks are indeed flexible (Orfánus, 2010), but it is difficult to determine the unique characteristics of their management style. Wojciechowski´s explanation is that this is the consequence of the old regime, which ruled the hierarchical system. The mentality of people affected by what is seen in the lack of initiation, passivity and inability to decide and to rule democratically (Karlubíková, April 16, 2009).

Influenced by the fact that the transition from centrally planned to market economy was accompanied by a deep decline in living standards, increasing unemployment, the breakdown of value structures. This condition is characterized by the fact that changes in thought and action managers are very slow and technocratic management have been exhausted (Kubeš, 2011). Slovak managers can be navigated in three directions: either the so-called. top - top management direction, which is "... in connection to the international and European policy to support the strategic objectives and priorities of the resulting economic reform in Slovakia ..." (Mihalik, 1996) or Western-oriented type of management and applied at all levels of management, or prefer amateur, merchant management style, which is to stabilize the economy, but only the vision of the greatest profit. They should know what is expected of them, they should be involved in decision-making, receive feedback, team-work and continuous education (Olexová, 2007, p. 595). Lacking experience for their work. This means that there is not good connection between education and needs of companies and firms. Then no wonder that, according to a survey from early 2010 the main drivers of the Slovak economy have led the vast majority of expatriots, ie managers from outside (Hnonline, 2010). Even in the neighboring Czech Republic has been surveyed on a quarterly basis approximately 4,000 managers. Tested them in four basic skills. Knowledge, however, rarely exceeded 50%. Testing of Czech managers, although they know something about management and management decisions are not always guided only by intuition, or experience, but their knowledge in the field of management is more than half the recommended long-term knowledge. The average rating so called Directors Index ranges from 41.75 % to 46, 97 % (Kariéra, 2011). Publications Author Alexandre Havard Responsible Leadership (2011) not only set an uncompromising mirror current thinking about leadership in the broadest sense (not only in business), but resulted in specific recommendations for those who are determined to walk the path of leadership. Looking for new models of business management, and business people.

Poland
+ Dynamic environment, a strong entrepreneurial spirit, minimum corruption in business, excellent and appropriate behavior toward customers - Autocratic management, which is based on hierarchy, formality in communication
Slovakia
+ less byrocracy, team work, flexibility, allocation - weak bussines spirit, very formal, avoiding the responsibility
Czech
+ planning, team work, punctuative, great place for foreigners - weak man-to-man relations, lack of humor, lack of flexifibility, formality in communication
Romania
+ hard working, high ambitions, best behaviour towards foreigners - most overpaid managers, unorganised, weak team work, weak planning
Bulgaria
+ good social capabilities, strong will to accept critics, difference between men and women in management - strong corrution, bad planning, bad and the lack of organization, team work and weak customer service

Fig. 1 Positives (+) a negatives (-) of management in chosen countries (Target Can CEE management kompetence, 2010)

6 DISCUSSION AND IMPLICATIONS FOR PRACTICE

An analysis of management capabilities enable managers to create an overall picture in the form of

self-reflection. Therefore, it is naturally possible to envisage some of the distortions that could be corrected by creating a comparative framework - evaluation by staff, colleagues.

Nevertheless, several important recommendations and conclusions can be suggested:

1. At the level of management capabilities the lack of decision-making skills, ability to estimate, overall dynamics of the decision, a lower rate of positive evaluation of knowledge management methods and techniques suggests a need for further intensive development of potential managers in this field;
2. Most cases lacked the apparent ability to solve legal problems, economic and personal or financial and material problems, so it seems desirable to encourage the development of management skills.

These basic, general recommendations can be characterized at the operational level as activities that are directly related to the structural organization of equipment. In this sense, knowledge of self-reflection identified competencies of managers become the basis for deliberate, planned, purposive work of staff the staff involved in order to improve the current potential of personal background. Then:

- Addressing weaknesses at the management level, particularly in the orientation and methods of decision-making and management techniques clearly leads to activities that an organization must provide needed education to managers. Currently, there are many effective forms of education that provides managers with "tailored" information and skilled leadership in professional development at management level. The organization's management in this sense would be held after consultation with experts and further development of the situation with regard to the specific work manager would be set. Formalized forms of broadening of manager qualifications should be suitably complemented with motivation, control and evaluation network supporting self-educational practices and personal initiative managers to monitor their development and build a desirable effect in that ambition. The focus of interest would be to create a situational decision-making framework manager who will reflect the typical, most common situations in which a manager has to decide and handle these situations.
- A set of activities that a manager performs, provides knowledge and skills from several areas. Economic, legal and financial aspects of the job manager are among those that require special attention and necessary initiatives to improve. In this respect, the organization's management must be clearly legible and show efforts to develop manager´s potential. Growth must be part of not only the scientific knowledge, but especially experiential equipment. These procedures should result in more active and responsible managers in terms of solving problems in current conditions causing the problems (economic, legal, material...). Establishing the main causes (lack of information, reluctance, indifference, lack of experience...) is important as well as their diagnosis and targeted "treatment".

7 CONCLUSION

Being a manager is a big job. In order to be an effective manager, you'll want to sharpen and refine your management skills constantly. Managers need to know how to manage, that is, how to handle the various aspects of their job and how to plan, organize, direct a performance, manage information, so as to get the best out of their people and the resources provided to them. However, managerial knowledge is something that a manager must learn – either through self-development or formal training programs.

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SOCIAL AND PSYCHOLOGICAL RISKS ARISED IN POPULATION AND CLEANERS AS A RESULT OF THE CHERNOBYL ACCIDENT

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Abstracts: The analysis of social and psychological risks arise among the population as a result of nuclear accidents was made. Shown that depressed and stress state due to human perception of threat to the health explains the growing number of somatic diseases and can be regarded as adaptive behavior of people in these circumstances. To reduce the risk of mental illnesses requires a number of educational and general preventive measures to reduce the accumulation of radionuclides in the contaminated areas, as well as for constant radiation, medical and genetic monitoring of the population.

Keywords: risk, mental illnesses, radionuclide.

Currently in the European community rather is an issue of energy and nuclear safety. The tragedy at Chernobyl gave impetus to the work of medical and psychological direction. Many from the research findings support the previously established laws for toxic and nuclear disasters. In this connection, we can predict the social and psychological risks that arise from the population as a result of nuclear accidents. This question is especially relevant after the recent accident in Japan at the nuclear power station Fokusima 1, whose effects are comparable with the Chernobyl disaster. In addition, this disaster apeals the urgent need for more thorough review and forecast of both natural and man-made risks and deciding on the economic costs associated with decreased risk (adverse event of natural or man-made ,entailing disastrous consequences.

The salvation of the problem should still be in the direction of higher costs, as the consequences of these accidents is much more expensive, but human life for present and future generations, simply inhumane and unethical to consider in terms of money. Among the risks in the construction of nuclear power plant, Fukushima 1, here there is a neglect of high risk of natural disaster - an earthquake. It was necessary to examine carefully the statistics of the frequency of earthquakes, at least for the past century.

Due to an accident at the Chernobyl nuclear power plant were exposed to radiation as a nuclear power plant workers and the general population, causing risk of adverse effects on their health. Among these populations, exposed to radiation:

1. Employees who are directly involved in an accident, or during the emergency, or during periods of cleaning;
2. The population of the contaminated zones, which was evacuated in 1986;
3. The population of the contaminated zones, which had not been evacuated [1,2].

As a result of environmental contamination by radioactive materials from the affected areas during 1986 was the forced evacuation of more than 100,000 people, and then after 1986 have settled out another 200,000 people from Belarus, the Russian Federation and Ukraine About five million people still live in areas contaminated by the accident .The consequences of the accident were not limited to the territories of Belarus, Russian Federation and Ukraine, as well as other European countries have been exposed as a result of atmospheric transport of radioactive material. These countries are also faced with problems of radiation protection of their people, but to a lesser extent than the three most affected countries [3].

More than 200 000 km ² were contaminated, roughly 70 % - on the territory of Belarus, Russia and Ukraine. Radioactive materials were distributed in the form of aerosols, which are gradually deposited on the surface of the earth. Noble gases dispersed into the atmosphere and do not contribute to contamination of adjacent regions to the station. Contamination was very uneven, it depended on the direction of the wind in the first days after the accident. The most severely affected areas were those in which at that time was a shower of rain. Most of the strontium and plutonium fell within 100 km from the station, as they were held primarily in larger particles. Iodine and cesium have spread over a wider area [4].

In terms of the population exposure in the first weeks after the accident, the most dangerous was the radioactive iodine, which has a relatively short half-life (eight days) and tellurium .Currently (and in the next decade of years) the most dangerous isotopes are of strontium and cesium with a half life of 30 years. The highest concentrations of cesium-137 found in the surface layer of soil, from where it enters intothe plants and fungi. Pollution are also subject the insects and animals that feed on them. Radioactive isotopes of plutonium and americium persist in soil for hundreds and possibly thousands of years, but their number is small [4].Nevertheless, some experts believe that the problems associated with pollution by transuranic elements, require further study. As a result, of the beta decay of Pu-241at contaminated areas goes the formation of americium-241.At present, the contribution of Am-241 in a total alpha activity is of 50 %. Increased activity of soil contaminated with transuranic

isotopes, due to Am-241 will continue until 2060 and his contribution will be 66.8 %.In particular, in 2086 the alpha activity of soil contaminated with plutonium at the territories of the Republic of Belarus will be 2.4 times higher than in the initial post-accident period [2-4].

Incompleteness and inconsistency of official information about the disaster gave rise to a number of independent interpretations. According to WHO, presented in 2005 as a result of the Chernobyl accident, in the long run, may be lost to a total of 4,000 people [5]. Scatter in the official estimates is less, although the number of victims of the Chernobyl accident can be determined only approximately. In addition to the dead plant employees and firemen, they are: sick soldiers and civilians were brought to disaster recovery, and residents of areas affected by radioactive contamination Determining which part of the disease was the result of an accident - a very big challenge for medicine and statistics. It is believed [4] that most of the deaths associated with exposure to radiation, was or will be caused by cancer.

Usually at the mentioning of the health consequences of the Chernobyl disaster one have in mind the appearance of cancer. However, cancers, no matter how serious they are, do not exhaust the medical consequences of nuclear accidents. We should not forget about another aspect - it's frequency of occurrence of certain mental illnesses of patients who were in the area of disaster. In a study of patients with acute radiation sickness developed after the events at Chernobyl, there were:

- increase personal anxiety;
- some signs of internal tension;
- malfunction as a result of the continuing psychological and emotional tension;
- pronounced neurotic conflict;
- pronounced fixation of attention on the health status, chaos and lack of proper systems to analyze events.

The most important factor influencing health status, is not the disease itself but its perception. And by the way we relate to it, and understand human anxiety for survival. This factor and the Chernobyl accident has provided a psychological impact that goes beyond the injury.

The main causes of psychological stress in humans lie in:

- Socio - economic difficulties;
- Biomedical incompetence;
- Ill-conceived actions of the media.

In addition to the factors of psychological stress associated with the accident, it he range of physical diseases, of each of the liquidator is steadily increasing. Depressed mood and stress as a result of the perception of health risks may explain the increase in the number of somatic diseases, and may be an important aspect of pathological behavior, which varies under the influence of the nuclear threat to health. Even a small change in a sick human behavior can lead to awareness of the presence of symptoms and can be viewed as an adaptive behavior in these circumstances.

The slightest tendency to attribute everyday illness or disease with a possible effect of radiation was observed in people - atomic bomb survivors in Hiroshima and Nagasaki [5].

Waiting for the extremely negative consequences of the disaster and perceiving threat to health due to exposure to radiation make people more attentive to their physical sensations, which may be the first signs of disease associated with radiation .A specific focus of attention is characterized by the search due to the existing threat, was observed in humans in situations of deep stress [4].

Taking into account the chronic nature of stress, psychosomatic illness after technological and nuclear disasters can occur for a long time For people affected by severe nuclear accident, even after some years we can expect serious stress effects on health.20 years after the Chernobyl disaster, there are many evidence that relatively low-level ionizing radiation not only leads to stochastic but also to deterministic changes of the central and autonomic nervous systems - radiation encephalopathy [4,5].

In the first six years after the disaster the adults of the contaminated areas had experienced rapid growth in the number of cases of diseases of the nervous system, particularly important after 1990 [2, 5-7]

Tab. 1 Dynamics of central nervous system diseases (to 100,000 adults) in radiation-contaminated territories of Ukraine in 1987-1992

Disease	Years					
	1987	1988	1989	1990	1991	1992
Nervous system	2641	2423	3559	5634	15041	14021
Vegetative-vascular dystonia	1277	131	315	3719	3911	3121

In the study, 80 Ukrainian men - the liquidators in 1986, suffering from encephalopathy, was found structurally functional disability of frontal lobes and left temporal region [8,9].

The liquidators and the population, who was in the radiation area are characterized by structural and functional brain damage involving the frontal and left temporal lobe with cortical-subcortical connections, as well as deep brain structures. Among the pathological changes in the structure of the brain - atrophy and ventricular enlargement, hypertensive type of vascular tone, focal changes of the brain [10].Also observed that the liquidators of male (150 men, 44,5 ± 3 years) showed an increase in expression of the slow forms of activity and a decrease in inter-hemispheric asymmetry reduction in quality performance of all cognitive tests, memory disorders and other disorders of higher mental functions. In people with psychosomatic disorders (400 men, 24-59 years) found irreversible destruction of brain structures: the restructuring of frontal lobes and left temporal region and their cortical-subcortical connections [6,8,9,11].

Typical complaints of them are complaints of severe headache, that are not removed by analgesics loss of memory on current events, general weakness, fatigue, decreased ability to work, sweating, palpitations, pains and aches in bones and joints that interfere with sleep at night ,attacks with disconnect consciousness, seizures, with the heartbeat, feeling chills or fever, blackouts, sleep disturbance, numbness of hands and feet [12]. The neurological status of liquidators characterized by symptoms expressed vegetatively - vascular dysfunction, asthenia, hypochondriac and depressive symptoms, as well as other signs of organic lesions of the nervous system. Reduced mental capacity, namely the reduction of the total functions of attention, short-term memory and operational thinking. These characteristics correspond to the norms of the liquidators for children 10-11 years old and can not be due to exposure to any social factors - they attest to a certain organic brain damage as a consequence suffered in 1986-1987 irradiation [12].

The average age of Ukrainian liquidators (males and females) with encephalopathy, 41,2 ± 0,83 years [6,13], in the general population this figure below. Numerous disappointing data on diseases of the nervous system in the affected areas, as well as liquidators, led to the following conclusions:

- preconceived notions about the stability of the nervous system to radiation exposure are incorrect;
- radiation exposure of relatively small (on the same standards of radiation safety) level, which exists in the affected areas, leads to profound systemic disturbances of the central nervous system [6];
- many residents in the affected areas, as well as liquidators, have the violated functions of the nervous system: features of perception, short-term memory, attention, rapid thinking, sleep
- radiation exposure in some way disrupts the autonomic nervous system;
- mental retardation is seen in 45% of children born to atomic-bomb survivors [14].

Analyzing this situation one can give the following recommendations:

1. Educational and preventive measures are necessary to prevent internal contamination with radionuclides, and to rid the body of inhabitants of the Chernobyl regions of radionuclides originating from contaminated food.
2. Elaboration and continuous improvement measures are necessary that are aimed at reducing the accumulation of cesium-137 in the body of inhabitants of contaminated areas, to relatively safe levels.
3. Organization free of radionuclides day meals in schools and kindergartens, special programs for the rehabilitation and treatment of children with periodic departures from the affected areas.
4. Organization of constant radiation monitoring, as local food, and individual accumulation of radionuclides in the body of inhabitants and, above all, children.
5. To reduce the accumulation of dose load of irradiated critical group in each locality necessary:

- making at least once in three years of mineral fertilizers on all agricultural lands and home gardens;
- to reduce the cesium-137 contamination of mushrooms and berries effective is the introduction of potassium and lignin in forest ecosystems in a radius of 10 km from the villages [6];
- to remove radionuclides from the body it is necessary to provide an individual receiving natural pectin-containing enterosorbents (based on apples, currants, etc.);
- to reduce the intake of radionuclides in the human body with meat, mushrooms, fish and vegetables it is important to respect a number of preventive measures when using these products (maceration products, separation of milk) [3,6];
- to reduce the level of radionuclides in animal products, it is advisable to use enterosorbents (ferrocyanides) during the growth of farm animals;
- in the contaminated areas to establish an annual (for children - quarterly), the individual determination of the actual levels of radionuclides;

- to provide compulsory medical and genetic counseling for marriages residing in contaminated areas (and voluntary - for all citizens who want child-bearing age) on the risk of severe genetic disorders in future progenys [3,6];
- to extend the program for cancer screening and clinical examination of the entire population of the contaminated areas.

6. Necessary in all countries to establish a permanent reserve of potassium iodate and ensure that the iodine prophylaxis in the event of new nuclear power plant accidents.
7. Necessary in all countries to establish the structure and organization independent of the official system of radiation control of foodstuffs.
8. Required independent from the nuclear industry monitoring of the accumulation of radionuclides in humans, especially children, and organization of the active radiation protection.
9. Develop international cooperation in scientific research and nuclear safety with the support of government agencies, the IAEA, the UN and other organizations associated with the nuclear industry.

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MARKETING OPPORTUNITIES FOR EDUCATING THE YOUTH IN NATIONAL DEFENCE: A SYSTEM-BASED APPROACH

Zoltán JOBBÁGY, Judit STUMMER

Abstract: In a discussion during the meeting of the Human Resource Management Working Group of the V4 Countries held in Hungary in spring last year, apart from introducing the Human and Family Support System, educating the youth in national defence was also on the agenda. Members of the delegations praised the Hungarian initiative aimed at broadening the information of young people on national defence, and regarded the just launched *KatonaSuli* (MilitarySchool) program as an example to follow. As of now the program consists only of two courses such as *Katonai alapismeretek* (Basic Military Knowledge) and *Honvedelmi alapismeretek* (National Defence Knowledge). A successful expansion of the program demands marketing mentaliy and a system-based approach. However, before starting the expansion, resources such as personnel, finance, technics, etc. must be provided. These resources must properly be positioned, processes be made transparent, regulations be elaborated, and last but not least, completed training of the personnel involved. As a system the program requires continuous monitoring and oversight control. This must involve adequate data coming from an information architecture that captures, registers, observes, researches information in order to support the decision-making process. Finally, marketing mentality includes market segmentation and definition, and a proper communication of the extended program.

Keywords: Military, school, education, national defence, youth, marketing, research.

1 THE MILITARYSCHOOL PROGRAM

Educating the youth in national defence was on the agenda in a discussion during the meeting of the Human Resource Management Working Group of the V4 countries held in Hungary in spring 2010. Members of the delegations praised the Hungarian initiative and regarded the recently launched *KatonaSuli* (MilitarySchool) program as an example worth to follow.[1]

Experts of the Slovakian General Staff visited the 5th Bocskai István Infantry Brigade anew in November the same year. During their visit they also had the opportunity to take part in a lecture on *Katonai alapismeretek* (Basic Military Knowledge) and gain experience directly in education within the framework of the MilitarySchool program.[2]

In order to better understand the program, it is important to introduce its genesis in Hungary. To get a better grip on typical Hungarian peculiarities, it is also important to deliver first an overview on events characterising the period from the end of the 1990s until now.

Apart from the obvious structural changes of the Hungarian Defence Forces (HDF), the transformation of the security environment, the change in the political system of Hungary, her accession to NATO and the European Union, and the suspension of compulsory military service in peace time resulted that the traditional role of the armed forces within the society has changed significantly.[3]

At the same time when the voluntary-based military force was introduced, novel aspects concerning human policy and links between the society and the military, came also to the fore such as:

- being one of the biggest employer of the country the HDF need trained employees who are comitted to national defence;
- discontinuation of the period in which the younger generation can acquire knowledge on national defence in the framework of compulsory military service;
- the significant reduction of intensity of contacts with the population, especially the youth.[4]

Given the fact that preparing the population of Hungary for national defence is a societal interest also declared by the Constitution, the State must guarantee that citizens may gain the appropriate knowledge of national defense. Parallel to that volunteer recruiters must provide the required numbers for the HDF. It is important that the youth gets information on the peculiarities of military life and the tasks of the armed forces in a considerably young age.

The ability to pass on knowledge on patriotism and national defence resurfaces time and again within the Ministry of Defence (MoD). In the last couple of years there were many promising initiatives to address the youth, but these were done not in a synchronised and systematic way. As a result, none of them could realise the original intent.[5]

Apart from the constantly changing political intents of the parties, the most probable cause was the general or partial lack in utilizing marketing mentality and a system-based approach; popular and an enduring feature of the public sector. There is therefore the risk that the current program to educate the youth in national defence in mid- and higher education insitutions, as introduced during the V4

meeting, can succomb to the same outcome. In order to prevent this, an integrated and systematic approach must be established in which direct military recruitment and indirect military augmentation merge. These two different activities should not intermix, but enforce each other in a meaningful way and leveraged by various marketing tools.[6]

The MilitarySchool program for educating the youth in patriotism and national defence provides an ideal departure for that. However, as of now it contains only two courses. Basic Military Knowledge, which is tought in highschools, and *Honvédelmi alapismeretek* (National Defence Knowledge) tought in colleges and universities.[7]

These are the two pillars of the program that must be extended in order to better attract the attention of the youth towards the HDF. For this, marketing mentality and a system-based approach is needed.

2 RESULTS OF A SURVEY

Research in January 2011 conducted between the teenagers - teachers and students - lecturers brought to light data on the actual state of the program and supports the statement above.

In more specific terms the research wanted to find out the motivation factors that made students decide to take up the course on National Defence Knowledge, the sources they exploit to get knowledge on the HDF, and their level of readiness to apply either for professional or contracted military service. The research also aimed at finding out the reason why schools introduced Basic Military Knowledge, how teachers see the conditions to teach the course, and how they see its content. The selection criteria for the educational institutions was based on their geographic situation and the date of course introduction.

The research was based on basic questionnaires. The results, statements and suggestions of the research come from the questionnaires and information based on document analysis, quantitative data mining and the experienced knowledge of the authors.

However, limitations in terms of size and scope of this article only allow an introduction to the main aspects of the research together with some selected areas. As stated above, marketing mentality and a system-based approach can be displayed or their lack thereof be shown.

2.1 Motivation factors

After analysing nearly 500 questionnaires it became clear that students choose the course on National Defence Knowledge because of its 3 credit-value (50 %), the chance to get information on the HDF (49 %), and the possibility of e-Learning (44 %). In contrast, Basic Military Knowledge as a course was choosen due to the general interest in military topics (69 %) that can also be interpreted as a sort of curiosity. Gaining information on the HDF was not regarded as primary reason (21 %). Further motivation factors were realising future plans (48 %), and a non-negligible option was to improve physical fittness (31 %). High Schools opted for introducing Basic Military Knowledge because they wanted to support education on national defence and satisfy the curiosity of the children for military topics. Important aspects were to help them to promote their future career (67 %), to educate them in comradery (55 %), and to improve their physical fittness (44 %).

2.2 Knowledge of the HDF

It became clear that prior to the course two-thirds (62 %) of the students had only minimum information on the HDF, and one third (32 %) of them had no information at all. The bulk of information came from the Internet (53 %), and from family members and friends (53 %). A similar proportion was found among the teenagers. Before taking up the course on Basic Military Knowledge, only a small group had information on the HDF (9 %). Information came mostly from the Internet (63 %), but also family members and friends played an important role (52 %).

Given the data above, it is of utmost importance that information activities should adjust to the primary information sources of the youth. It is detrimental to have a homepage – yet to be introduced – that addresses and satisfies the need of this younger age group. This way it could provide for interactivity and the chance for community building.

Among those who successfully passed the examinations in National Defence Knowledge, the proportion of students who see the HDF in a positive way is significant (39 %). Given the fact, that those who were surveyed had already completed their course, this lasting positive atitude can be seen as an important achievement. Unfortunately, the defence sector (HDF and MoD) does not show much interest for these young people. It is assessed that as of now, they are not important for the sake of national defence.

Half of those (54 %) who attended the course on Basic Military Knowledge announced that during the course their opinion on the HDF changed significantly, and in a positive way. Stabilising this positive image among the teenagers appears to be an

easier task since the timeframe to influence their attitude lasts between 2-4 years.

2.3 Choosing military career

The research made it also clear that one third of the students (for the entire term 155) tempered with the idea to join the HDF as contracted officer after their studies. Unfortunately, also this case shows the lack of a marketing mentality. By not approaching them, the HDF runs the risk to lose these 155 possible candidates, who all successfully completed the course on National Defence Knowledge. Regarding the future the authors just can hope that the students' opinion on the HDF stays unchanged and sooner or later they appear as employees in the defence sector.

2.4 Evaluation of content

The research proved that with the National Defence Knowledge course roughly two third (64%) of the students gained a comprehensive picture on the HDF. One hird (31%) thought that their knowledge on security policy issues were broadened and gained a knowledge that can be used in everyday life.

Teenagers had similar opinion on the course on Basic Military Knowledge. They gained a comprehensive picture on the way the HDF works (61 %), they also gained knowledge that can be used in everyday life (56 %), and a bit more than one third (35 %) thought that they became more disciplined as a result of attending the course. It is important to mention that nearly one third (30 %) became interested in joining the HDF.

Teachers of Basic Military Knowledge are on the same opinion with the teenagers. They think that the content of the course is suitable to introduce the HDF (58 %) and gives a knowledge that can be used in everyday life (52 %). One third (33 %) of them think that also the teenagers' physical fittness improved, and some might have achieved even better grades in other courses.

2.5 Teaching conditions

Regarding the conditions of lecturing National Defence Knowledge it can be said that the upkeep of e-learning as a system is guaranteed only in the short term. Due to limitations in current capacity, additional resources must be involved in near future (i. e. because of increasing number of students, start of voluntary reserve training, etc.).

The theoretical part of teaching Basic Military Knowledge is guaranteed, but in the field of practical training there are shortfalls in some High Schools. In order to amend the situation they constantly seek co-operation with the MoD and military units. According to one third (32 %) of the teachers the role of the MoD is not yet clarified. They think that the effectiveness of teaching the course could be improved in many ways such as better military logistic support, better equipment, increasing the practical part, exchanging experience with other schools, helping in A-levels examinations, etc.

3 REFLECTING THE RESULTS

Based on the research the authors briefly outline the basic foundation upon which the program, if designed and extended in a proper and systematic way, would both help educate the youth in national defence and provide perspective personnel for the HDF.

However, when speaking about education on national defence one has to take into account that patriotism is a *personal* thing and not a political category. No one would doubt that it is worth trying to form attitudes along basic societal values such as commitment to fatherland and accepting service for the home country. Due to the fact that it is a long process, in theory one should try to start this education at the earliest age possible. This of course is a task that demands the involvement of many players such as the family, educational institutes, the HDF, and various civilian organisations. The MilitarySchool program as a basis for an enduring solution to educating the youth in national defence can be seen as an added value that binds all this together into a system.[8]

To exploit and extend the possibilities the program provides for, it should be regarded as a long-term investment that demands consequent marketing and PR activities. The expansion of the MilitarySchool program would be based on the organisational strategy of the HDF, which is derived from the National Defence Strategy and the respective Government's Program. This would define mission, the way-ahead, and outline basic principles and core values in a coherent way.

Unfortunately, due to the fact that long-term planning on educating the youth in national defence, and the transparency of related tasks are as of yet not granted, crafting and passing such strategy is more than vital. Results of the research introduced above amply show that a strategy addressing the youth cannot be part of a human or a recruitment strategy. It must be a strategy on its own.

Basic pillars as of now are the two courses introduced. However, to increase their efficiency (i. e. establishing a presence in elementary schools, organising events, providing sports and other programs, establishing co-operation on various levels) further programs need to be involved. Some of them should not be new, but could be the revitalisation of already or formerly existing ones.

4 CONCLUSION

The question how the expansion of the MilitarySchool program as a system would eventually look like, arises naturally. In order to deliver an answer to that question the authors emphasise an important thing; the MilitarySchool program *does not* stand for recruitment, and education in national defence *does not* mean military training. Although some might prefer to see the program as a source only for providing personnel in enough numbers to the HDF, it is simply not true.[9]

The extended MilitarySchool program could be seen as a system of those long-term investment projects, including the strategy for the youth to be in concert with other relevant strategies. These can include a human resource management strategy or recruitment strategy addressing various aspects of national defence. In this system the MilitarySchool program as it stands now, is nothing more than a novel and on-line backed educational opportunity. However, when offered and integrated with various extended youth programs into a system the program could not only provide for the theoretical part of teaching Basic Military Knowledge at High Schools, and National Defence Knowledge at colleges and universities, but:

- enable the theoretical education of people outside highschools, colleges and universities (i. e. certain public sector employees, and voluntary reserve personnel),
- make possible that regardless of the age group everybody gets access to information on national defence,
- make possible to support the recruiting activity of the HDF in order to bring in professional, contracted and reserve personnel.

As of now only Basic Military Knowledge and National Defence Knowledge exist. A successful expansion of the program demands a marketing mentality and a system-based approach. However, before starting any sort of such activity related to the expansion of the existing MilitarySchool program, resources such as personnel, finance, technics, etc. must be provided. These resources must properly be positioned, processes be made transparent, regulations elaborated, and last but not least, thorough training of the personnel involved. After establishing the background, proper management of the extended program including annual plans (milestones with indicators) and the means for their continuous monitor and control is essential.[10]

Successful marketing must involve adequate data coming from an information architecture that captures, registers, observes, researches information in order to support the decision-making process.[11] Given the fact that the MoD only partially posesses such an architecture, it would be helpful to establish it as soon as possible. Market segmentation and definition, and proper communication of the extended program is necessary, too.

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