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Transforming Air Forces

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CHALLENGES OF AIR FORCE TRANSFORMATION

New security challenges and advances in technology—sensors, communications and information technologies in particular—impact the way militaries around the world are organized and equipped to perform their roles. Our expectation is that, rather than leading to one-step reorganization and restructuring of the military, these factors will bring permanent adaptation, designated recently as *transformation*.

To reflect the impact of these developments on air forces and related organizations, the Editorial Board of *Information & Security: An International Journal* (I&S), jointly with the AFCEA-Varna Chapter and the Headquarters of the Bulgarian Air Force, initiated the preparation of this special I&S issue.

Air Force transformation was the overarching theme of the AFCEA conference on "The Bulgarian Air Force – Missions and Roles in the Context of National and Collective Security," organized by the AFCEA-Varna Chapter [1] and conducted under the auspices of the Bulgarian Minister of Defense in Plovdiv, Bulgaria. Part of the articles in this volume is based on selected presentations made at this conference.

New roles, missions and tasks of the Air Force, expected to be performed in variety of conditions, form the reference point of transformation. Air Forces are preparing to deal with ill-defined asymmetric threats, under uncertain scenarios in multi-agency and multinational setting. In addition, very often Air Forces are expected to assist civilian authorities in law enforcement, search and rescue, and environmental tasks.

To do that effectively, Air Forces shall be able to act in a network-centric manner, where net-centricity is achieved through very high degree of connectivity, near real-time situational awareness, distribution of decision-making authority, and a range of flexible capabilities. Such features are in the process of institutionalization through development of novel doctrine and tactics, adequate organization, and insertion of advanced technologies.

In addition, technological opportunities allow for lower number of personnel, however with more diverse skills and better trained. Therefore, transformation places a special emphasis on continuous education, e-learning, and qualitative improvements in individual, crew, and staff training.

The focus of this issue, however, is on the technological modernization of the Bulgarian Air Force. The first part looks at the overarching challenges of transforming the Bulgarian Air Force and the respective requirements, priorities, plans and programs for acquisition of new weapon systems, equipment, command and control, communications, radars, and navigation systems, presented by Lieutenant General Simeon Simeonov, Commander of the Air Force. This part includes also assessment of the challenges faced by the Bulgarian Air Force from the perspective of NATO, as well as description of current U.K practices in procurement for the air force that may facilitate innovative thinking in the search for higher efficiency in spending limited investment budgets.

Not surprisingly, the focus of attention is on the expected acquisition of new multirole fighters. The second part of the issue provides detailed requirements and examples how this acquisition can (and should) be approached. It starts with elaboration on the role of airpower and the possible definition of air force Mission Capability Packages that would provide for wide spectrum of out-of-area operations and operations on the territory—and airspace—of the country. The final two articles treat exclusively the problem of procuring multipurpose fighters, primarily from operational analysis perspective. As usual, this volume contains useful information on online and other resources of interest to the discourse on air force transformation.

In order to succeed, Air Force transformation needs a clear vision, supported by adequate concepts, doctrine, policies, and technology acquisition. The reader will not find answers to all related questions in this issue. We believe, though, that this I&S volume will provide novel ideas, analysis of experience, and description of advanced technological opportunities, that will be found useful not only in conceptualizing transformation of air forces but also in more tangible ways as regards planning, program and project management, and implementation of advance operational analysis techniques.

Information & Security

[1] Additional information on the activities of the AFCEA-Varna Chapter the reader may find at www.afcea.bg.

Air Force Transformation Challenges

- Bulgarian Air Force – Challenges and Prospects
- A NATO Perspective on Challenges and Prospects for the Bulgarian Air Force
- Challenges for the Bulgarian Air Force – A Royal Air Force Perspective
- Modernization of the Bulgarian Air Force and Interoperability with Allied Forces

BULGARIAN AIR FORCE – CHALLENGES AND PROSPECTS [1]

Major-General Simeon SIMEONOV
Commander of the Bulgarian Air Force

Abstract: This introductory article focuses on three main aspects. First, the Air Force missions and tasks in the context of the national and collective security systems are thoroughly explained. Then the author acknowledges and elaborates on the challenges in acquiring the capabilities necessary to accomplish the missions and tasks. The third part looks at the prospects for development of the Air Force in accordance with Plan 2015.

Keywords: Air Force Transformation, Security Challenges, Air Force Missions, Force Goals.

The dialogue between experts stands in the base of the public consensus and the process of evolving air power in compliance with the rich national traditions and the new realities related to national security.

At the end of the XXth and the beginning of XXIst century, under the pressure of globalization, increasing instability in the form of asymmetric threats and scientific-technical revolution, the world has entered a new phase of development – from post-industrial society into the information era. The world changes its political geography, demography and environment, integrating its multinational economy, eliminating time-space restrictions and uniting security systems under a single flag. Figuratively, the world passes from an environment with a few global threats, with the utmost threat of nuclear self-annihilation, to an environment without such global threats, but with much broader spectrum threats, risks, and challenges.

The parameters of the security environment have changed totally for the past fifteen years. It includes dynamic and hardly foreseen risks and threats, the most serious of which are international terrorism in all its forms, proliferation of weapons of mass destruction, regional conflicts, failed or failing states, organized crime and especially

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illegal trafficking of people, weapons and drugs, natural disasters, accidents and catastrophes, information threats, and social conflicts.

Key factors for the future strategic environment are globalization, increasing complexity of asymmetric war, impact of constantly changing demography and ecology, weak and failing states, radical ideologies, and unresolved conflicts. The security environment generates greater necessity for military response to the global threats. So, to meet adequately the challenges of the dynamic and multidimensional security environment, NATO undertook a deep transformation of its structures and forces and the member states' collective and national security systems.

After the Prague Summit of 2002, the collective and national security systems made a significant progress in their transformation in order to meet the threats and risks in the beginning of XXIst century. The main characteristic of the changes in both systems is the rising support to peace and security outside the traditional zone of responsibility: for NATO – outside the Euroatlantic zone, for Bulgaria – establishing a package of military capabilities for participation in joint or coalition operations outside the country's territory. This article puts emphasis on three main aspects:

- *Air Force missions and tasks* in the context of the national and collective security systems;
- *Challenges* in acquiring the necessary military capabilities for accomplishment of missions and tasks;
- *Prospects* for the development of the Bulgarian Air Force in compliance with the long-term plan for development of the Bulgarian Armed Forces, known as Plan 2015.

A decisive step towards the deep transformation of the national security system in the context of the collective security system was the *Strategic Defense Review*, conducted in 2003–2004. As a result, the National Assembly approved the long-term Force Development Vision, which serves as a basis for the development of the Plan for Organizational Building and Modernization of the Armed Forces till 2015 (Plan 2015), which determined the new missions, tasks, and parameters for the transformation of the Bulgarian military and the Bulgarian Air Force, in particular, and its approval by the Council of Ministers.

We perceive the transformation as a constant process of continuous, deep, and purposeful changes of the Air Force (examined as a system), motivated by the necessity for their adaptation to the new parameters of the strategic environment and establishing integrated capabilities for participation in a wide range of operations. In this sense, the transformation is a response to the challenges of the dynamic and multidimensional security environment.

The main objectives of Air Force transformation aim at:

- Increasing the capabilities for using information technologies to achieve information superiority and to function in a network-centric environment;
- Shortening the decision cycle and increasing the effectiveness of decisions;
- Increasing the opportunities for conducting non-traditional (other than war) operations;
- Establishing a new structure of forces based on planning, oriented toward the development of requisite capabilities;
- Increasing the expeditionary capabilities of forces;
- Enhancing command and control;
- Integrating and enhancing the operational compatibility with the NATO forces;
- Fully utilizing the human potential;
- Achieving synergism by joint application of capabilities;
- Wide-ranging civil-military cooperation for integration of all force instruments (civil and military) and in a comprehensive approach to crisis management.

For achieving the transformation goals, we shall focus our efforts to the priorities and use effectively the resources, which we possess.

The results then will be measured by the increase of our capabilities to accomplish missions and tasks, participation in complex and joint operations, where forces shall quickly adapt to the changing operational conditions – from intensive combat actions to military activities for stabilization, post-conflict restoration and peace keeping.

As a result of the technological advances and developments, the Air Force shall acquire the following *operational capabilities*:

- Combat capability;
- Maneuvers and mobility;
- Strike capabilities, long-range engagement of air, ground, and sea-based targets;
- Expeditionary capabilities;
- Capability to act in a network environment;
- Adaptation to the entire range of potential operations;
- Integrated logistics support.

The advanced technological developments will provide operational superiority of the Air Force during operations.

In the context of the national security strategy, the *main AF mission* is—jointly with the other services of the armed forces—to guarantee air superiority, security, and independence of the country. This mission is accomplished in the collective security and defense system (NATO) through development of operational capabilities to accomplish the following *main missions and tasks*:

Mission "Defense" (in the context of Article 5 of The Washington Treaty)

- Participation in the defense of the national territory;
- Participation of the air component in collective defense operations beyond the national territory.

Mission "Support of the International Peace and Security" (out of context of Article 5 of The Washington Treaty)

- Participation in combined crisis response operations beyond the national territory.
- Participation in combined and joint operations to guarantee peace and security.
- Participation in international military cooperation and in multinational and bilateral formations.
- Participation in arms control and countermeasures against the proliferation of weapons of mass destruction and in international humanitarian operations.

Mission "Contribution to the National Peace and Security in Peacetime"

- Participation in the surveillance, control, and defense of the air space and, together with the other types of armed forces, of the national territory and sea space.
- Ground-base air defense of strategic sites.
- Participation in the fight against terrorism, organized crime and trafficking in drugs, people and arms.
- Protection and support of the population in time of disasters and catastrophes.
- Search and rescue operations.
- Support of the normal functioning of state agencies and institutions.
- Participation in preparing the infrastructure for response in case of crisis and environmental protection – provision of support to military contingents as a host-country and environmental protection.

During combat and crisis response operations, according to its operational characteristics and capabilities, the Air Forces perform *specific tasks* for:

- Gaining and preserving air superiority in the operational zone.
- Providing air defense of troops and sites on national territory.
- Isolation of the operational area.
- Close air support to the Land Forces, the Navy, and the special formations of the Ministry of the Interior.
- Special actions for support of other services and branches of the armed forces (air reconnaissance and observation; electronic warfare; air transport; airborne landing; combat search and rescue; air control and targeting; air-medical evacuation; support to Special Operations Forces).

To accomplish the defense missions and tasks, the Air Force establishes and supports effective, combat, multifunctional, modular, mobile and interoperable formations with the following *operational capabilities*:

- *Command and Control System*, capable to operate in a network environment and to provide superiority in the decision-making process.
- *The Airspace Surveillance and Control System* is built as "a system of systems" with the following component systems: surveillance and recognition system, fighter coverage system, air defense coverage system, active resource management system and logistics support system.
- *Air Reconnaissance Forces* – surveillance, patrolling, protection, and defense of the national territory and naval spaces in real time.
- *Expeditionary Forces* for participation in joint multinational operations, with capabilities for joint deployment, maneuver and support, precision targeting and information superiority.
- *Immediate Response Forces* on the territory of the country for countering terrorism, protection of the people in cases of disasters, accidents and catastrophes and participation in relief operations.
- *Protection Forces* of the territory of the country or of an allied country in the collective defense system in all conditions.
- *Integral Logistics Forces* – protection, education, training, and mobilization of units for Air Force operational deployment.

The Air Force faces a number of *challenges and risks* in the process of acquiring the necessary operational capabilities.

First, these are the challenges related to the deployable forces and the NATO command forces (Air Policing). The risks connected with these capabilities are *low* to *av-*

erage. They come from the inability to abide by the agreements concerning the Armed Forces, the realization of projects for modernization and acquisition of new equipment and armaments due to the lack of sufficient resources for their implementation.

Second, these are the challenges faced in the process of development of the necessary capabilities of the surveillance and control system. The risks regarding the inability to abide by the agreements are *low* to *high* due to the restricted number of combat aircraft and air defense complexes, slow processes of regaining of the airworthiness and modernization of the necessary aviation facilities, as well as a slow process of development of a NATO-compatible control, surveillance, and identification system. The additional risks come from the ambiguity related to the acquisition of new multi-role fighters, 3D radars and modernization of the existing air defense complexes.

Third, these are the challenges connected with the development of capabilities for air reconnaissance, surveillance, patrolling, and protection of the state border, national territory and naval spaces in real time. The risks from the inability to abide by the agreements are *low* to *average*. In case of inability to acquire aircraft for air patrolling and reconnaissance (this project is not included in Plan 2015), the risks become *high*.

Fourth, additional risks in the process of acquiring the necessary operational capabilities appear due to the systematic inability to abide by annual financial plans for material provision in the part for the Air Force (especially concerning overhauls of aircraft, provision of spare parts and aggregates) and the lack of financial resources – exceeding the existing budget (planned and programmed).

The Air Force transformation and development strategy is included in Plan 2015. In the context of Plan 2015, the Air Force's organizational building and modernization is subdivided into *three stages*:

- *First stage* – from January 2005 till December 2007
  At that stage, the Air Command and Control system and the Air Force training system are to be reorganized and modernized, achieving readiness to provide a selected few of the declared Forces for the needs of NATO in line with the approved Force Goals. At the end of this phase the Air Force will be fully manned by contract personnel.
- *Second stage* – from January 2008 till December 2010
  During the Second stage, a reorganization of the AF formations is envisaged in line with the schedule for modernization, rearmament, and transformation of the manpower. The rest of the Air Force Deployable forces shall be rendered into readiness.

- *Third stage* – from January 2011 till December 2015
  This stage is characterized by modernization and rearmament of the Air Force and utilization of surplus weapons and equipment. The Air Force Command and Control shall join a new NATO Air Force Command and Control system (ACCS). The National Air Defense will be fully integrated into a NATO Integrated Air Defense System (NATINADS).

As a result of the accomplishment of Plan 2015, the Air Force will be *organizationally structured* as follows:

- Air Force Staff – Sofia;
- Aviation Operational Center with ASOC (Air Sovereignty Operations Center) – Sofia;
- Aviation base for multi-role fighters with two squadrons and a single unit for air policing and reconnaissance located at two airports – Graf Ignatievo and Bezmer. The Bezmer Airport is supported as a front base;
- An airbase with two helicopters squadrons (combat and transport) – Krumovo;
- An airbase with one aviation squadron for transport aircraft – Vrazdebna;
- GBAD brigade for air defense of land forces and nine sites;
- Radar regiment with 16 mobile radar units (with six radar stations contributing to the NATO Recognized Air Picture).
- Military University of the Air Force with training airbase—one aviation squadron with training aircraft—Dolna Mitropolia;
- Combat and logistics support units.

In accordance with the new Force Goals, the Air Force establishes Deployable and In-Place Forces.

The *Deployable Forces* are formations with high and low level of readiness, capable to fulfill the whole spectrum of NATO missions on the territory of the Alliance or beyond it, in the context Article 5 of The Washington Treaty or other crises response military or non-military operations. These forces include as follows:

- Expeditionary aviation unit of combat helicopters – four Mi-24 in role “raid on ground targets”;
- Expeditionary aviation unit of transport and special helicopters – three Mi-17 (ready till the end of 2006). It is envisaged that until the end of 2007 the existing helicopters will be replaced by “Cougar”, two of which will be transport ones and one will be for MEDEVAC;

- Module for communications and information support of the deployed aviation units;
- Module for nuclear, chemical, and biological reconnaissance;
- Four pairs of front aviation direction determining aircraft;
- Engineering module for support of de-embarkation at airports;
- Module for oil, lubricants, and fuel – middle class.

The *In-Place Forces* are formations with high and low level of readiness, capable to fulfill tasks in the defense of territorial integrity (independent of and/or within the Collective Defense System), national air sovereignty defense operations within the NATO Integrated Air Defense System, assuring contribution to the national security in peacetime, and countermeasures against potential asymmetric threats. They establish capabilities providing replacement and rotation of the formations from the deployable forces or of these, which are assigned to the European Union forces.

The *NATO Command Forces* in NATINADS include in their structure a pair (after 2007 – a group) of fighter airplanes and the Air Sovereignty Operations Center (ASOC) from the Air Operational Center (AOC), operationally subordinated to the Combined Air Operations Center (CAOC-7) in Larissa.

According to the EU operations manual, the Air Force can offer a combined helicopter group (two attack and two transport helicopters) for participation in EU-led operations.

The *Immediate Response Forces* contribute to the accomplishment of the mission "Contribution to the National Security in Peacetime."

The *Air Force Command and Control System* includes two levels:

- Operational – Bulgarian Air Force HQ with AOC;
- Tactical – airbases' staff, brigades, units and subunits with base (brigade) operational centers, support management posts from the MATSA and command posts (operational centers) of the subunits.

The C2 system of the Air Force is supported by the communications, information, navigation system (CINS) and Radiolocation surveillance and recognition system.

Education and *Special Training* of the AF cadre will be implemented in the Air Force Academy (cadets – in the university faculties, sergeants – in the professional college, and contract soldiers in the education and qualification centers).

The training of the young pilots shall be accomplished in the approved training center for pilots (including foreign aviation specialists) in line with the standards of NATO and ICAO. The training center is part of the Air Force Academy.

Further training of the personnel and staffs shall be conducted in the AF units in compliance with the annual training plans.

The enhancement of qualification of personnel shall be implemented through professional courses and post graduate-level specialization course.

Further education of the officers is carried out in the "G.S. Rakovski" Defense and Staff College or other international military colleges and academies.

The Armed Forces Goals and criteria accepted by the NATO members in compliance with the national programs and traditions provide the basis for force training.

The *AF Logistics Support* is provided through the system for unified logistics of the Bulgarian Army. Logistics priorities are:

- Logistic support during training and participation in the full range of missions and tasks on the territory of the country or abroad;
- Provision of effective and accident-free service and exploitation of weapons and equipment;
- Medical provision of personnel;
- Infrastructure modernization in line with NATO and ICAO standards.

In compliance with the organizational and functional structure of the Air Force, the following weapon systems and equipment shall be fully operational by the end of 2015:

- Multi-role tactical fighters – 20;
- Combat helicopters – 12;
- Transport aircraft – 10;
- Transport helicopters – 18;
- Training aircraft – 18;
- Air patrolling and reconnaissance aircraft – 4;
- GBAD units – 14;
- 3D radar complexes – 16.

We appreciate the importance of the technical advances and innovation for the Air Force development and operation, but within the range of resource capacity of the country. Also, we think that the technological advances should be accompanied by intellectual development, bringing changes in the organization, doctrine, and in the people's way of thinking. Only then the full potential of the Air Force operational capabilities could be achieved.

We are led by the understanding that the Bulgarian Air Force, together with the other services and NATO forces, has to be *joint force* capable of performing the full spectrum of missions and military operations of the Alliance.

Notes:

[1] Briefing by the Commander of the Bulgarian Air Force HQ at the international conference organized by AFCEA-Varna, 14-15 March 2006, Park-Hotel "S.Peterburg" – Plovdiv.

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A NATO PERSPECTIVE ON CHALLENGES AND PROSPECTS FOR THE BULGARIAN AIR FORCE [1]

Henk EMMENS

Abstract: This article addresses the NATO perspective on the challenges and prospects for the Bulgarian Air Force. The general discussion is put in the context of one of NATO's main themes at the moment, Transformation.

Keywords: Transformation, NATO's Defence Planning Process, NATO Response Force (NRF), Air Force Modernisation.

Strategic Background

The current work on transformation largely stems from the Prague Summit in November 2002, commonly referred to as "*The Transformation Summit*." However, what is meant by "*Transformation*" in NATO?

To answer that question, we need to go back to the London Summit in 1990 where Alliance Transformation in its widest sense was initiated. The fundamental decision was taken to reorient from an Alliance of confrontation to one of cooperation with the then Soviet Union and the countries of Central and Eastern Europe. This was a 180 degree turn from the policy of the previous forty years, but with the understanding that collective defence remains the core of the Alliance. It resulted in two rounds of enlargement, bringing ten new members in total to the Alliance, a major transformation in itself.

The Washington Summit in 1999 was the next key landmark, with the approval of the Strategic Concept,[2] defining the Alliance's fundamental security tasks in terms of both collective defence and new activities in the fields of crisis management, partnership, and enlargement.

The concept articulated the overarching requirement for NATO forces to be able to operate in a constantly changing security environment that transgressed the traditional Article 5 environment of the Cold War years.

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The Military Committee definition of transformation is found in the document describing NATO's Command Structure—MC 324—and is as follows: "Transformation is the pursuit of a continuous process of developing and integrating new and innovative concepts, doctrine and capabilities, in order to improve the effectiveness and interoperability of NATO and Partner forces."[3]

The Prague Summit of 2002 was already mentioned above as the *Transformation Summit*. It had three main headlines.[4]

- *New Members.* NATO extended invitations to seven countries to begin accession talks to join the Alliance. This round of enlargement was arguably the climax of a transformation process in NATO, which began at the London summit in 1990.
- *New Relationships.* The Summit acknowledged that the security challenges of today are multi-faceted and cannot be handled by any single institution. In the wake of 9/11 the North Atlantic Council decided that Partnership for Peace mechanisms should be reviewed in order to maximise their potential in the context of the fight against terrorism.
- *New Capabilities.* The summit launched the following initiatives: the Prague Capabilities Commitment, the new NATO Command Structure, and last but not least, the NATO Response Force.

With regard to the NATO Response Force (NRF), the Heads of State and Government signed up to a "new type of Force" that will be: "a technologically advanced, flexible, deployable, interoperable and sustainable force, including land, sea and air elements, ready to react quickly wherever needed, as decided by Council."

Since then, the NRF concept has matured as NATO's 21st century operational tool. But it also serves a second very important purpose: it is a tool for the transformation of NATO's and NATO Nations forces and capabilities. This issue will be discussed again later.

NATO Force Planning in a Nutshell

This section provides a brief introduction to the mechanism in NATO, under which the Alliance collectively challenges and influences the nations in their medium to long-term defence planning: NATO's Defence Planning Process.

The NATO's Defence Planning Process and more specifically the Force Planning Discipline, has been shaping the Alliance capabilities and influencing National plans, and will continue to do so. First, I will provide a glimpse into the process itself before elaborating on the challenges and prospects for the Bulgarian Air Force from a NATO perspective.

Simply put, the aim of NATO's force planning is to fill the NATO Force Structure by ensuring the availability of national forces and capabilities for the full range of Alliance missions. This is done by setting targets for implementation and assessing the degree to which these planning targets are being met.

The process begins with the identification of the Minimum Military Requirements, in terms of the capabilities needed to meet NATO's Level of Ambition in the predicted security environment. This is done mainly through a sophisticated *Operational Research* tool called Defence Requirements Review, or the DRR.[5] Then, from the identified requirements NATO develops and assigns Force Goals that form collectively-agreed targets for individual nations. Finally, Nations take part in the Defence Review Cycle, in which NATO collectively assesses the national implementation of the Force Goals and the implications of that for the overall Force Structure: will NATO be able to meet the Minimum Military Requirements as set out in the first element of the process.

NATO Force Goals to Bulgaria for the Period 2006-2014

In this section, I focus on the present NATO Force Goals and the challenges and prospects they pose to the Bulgarian Air Force for the medium to long-term period.

Even before NATO accession, the Bulgarian Armed Forces embarked on a transformational phase. The development of its Strategic Defence Review [6] in April 2003 is a case in point. To recall, one of its main goals is to correspond to the new conceptual views of NATO. The Bulgarian Long Term Vision for the Armed Forces 2015 underpins, and is guiding, the transformation of the armed forces by focusing on deployability, usability, interoperability and modernisation of the Armed Forces as a whole. This clearly shows that transformation is already in the heart and mind of the Bulgarian military.

The allocation of Force Goals to Bulgaria has been related to country's force structure and does take into account the principles of fair burden sharing and reasonable challenge.

Based upon the national responses of each nation, NATO conducts an assessment that includes evaluation of how national defence plans support NATO's operational requirements for the short to medium-term period. Now I will again focus on the Air Force.

The Bulgarian Air Force clearly aims to create a structure that is sustainable and more responsive to the new security challenges, in line with NATO's overall needs. The current plans call for modernisation of the Bulgarian Air Force fleet across the spectrum of roles and missions by 2015. If implemented, this will dramatically improve

the Bulgarian Air Forces' ability to contribute effectively to the Alliance needs. There will be a significant reduction in force numbers, but this will be compensated by re-investing in the modernisation of the remaining systems, along with the acquisition of new capabilities for multi-role fighter aircraft and helicopters. These are very ambitious plans that really need to be underpinned by adequate resources. Air Superiority is of vital importance to the overall success of a joint campaign but can only be achieved in a multinational environment if the Air Force units are well equipped and well trained under NATO standards. Similarly, the availability of In-Theatre aviation support in the Joint Operations Area, as all ongoing NATO operations have clearly demonstrated, is also of utmost importance. The near term acquisition of Cougar helicopters for the Bulgarian Air Force fits exactly in NATO's requirements in this particular area.

Irrespective of their type and role, NATO's Air Force units have to make use of common procedures and interoperable equipment, ensuring timely, safe and effective operations. As basic as these components of a capability may sound, their importance cannot be overemphasised. Furthermore, any Air Force Unit can only perform well if it is well supported from a logistics perspective (spare parts, fuel, ammunition) with the required conditions to ensure its survivability. The logistics perspective is even more relevant when taking into account that potential operations will most probably be executed Out of Area and from bases with limited or no host nation support. This effectively means two things. Firstly, that Nations have to make their forces really deployable and, secondly, that nations share a part of the burden to make those bare bases usable. Therefore, they should include in their plans the implementation of a number of Service Support functions for their contingents. It is not surprising that the provision of transportable, flexible, efficient and interoperable Communications and Information Systems (CIS) is mentioned as an essential element and an example of those requirements.

One of the eleven prioritised Major Modernisation Projects already adopted by the Bulgarian Government aims at the acquisition of a modern multi-role combat aircraft. This will undoubtedly increase the visibility of the Bulgarian Air Force and its ability to operate within the Alliance and with the Alliance Air Forces. Several important characteristics and generic capabilities of this particular project have to be highlighted. It is highly desirable that a combat aircraft offered to NATO has a beyond visual range and all weather capability. Furthermore, Nations need to contribute with flexible, multi-role combat aircraft, capable of sustained operations with multinational formations, under adverse environmental conditions, with increased accuracy of weapon systems and with adequate stocks of modern ammunitions. Finally, new aircraft should have an air-to-air refuelling capability in order to be capable of long deployments and long range sustained operations.

It is not within NATO's purview to point at specific platforms. This is a national decision, in which national interests and requirements will be balanced against other factors, NATO's requirements being just one of these. If NATO were to be asked for support in that process, it would always emphasise the necessity to meet NATO standards and criteria. NATO will not ask *every* nation to take a certain share in *all* the capability requirements NATO has, as the smaller nations certainly will not be able to implement all those requests. It is also not in the interest of NATO as a whole to see a nation overstretching its abilities and developing a capability in such a way that will *not* be relevant for NATO's operational demands. To be more specific: the national ambition must be tailored to the available resources. If a nation wants to acquire fighter aircraft, it should be in the position to bear the consequences. This includes: allowing for their pilots to fly the minimum required number of hours per year and allowing for a logistics organisation to produce and sustain those flying hours. And, given the fact that we are talking about *NATO* operations, it might also want to consider a multinational approach. The European Expeditionary Air Wing is just an example of how this can work.

The NRF as a Challenge and Opportunity for Bulgaria

This section turns the discussion back to the theme of transformation by expanding a bit upon the NRF as "the manifestation of the transformation of NATO and NATO Nations forces and capabilities" and the relevance of NRF to Bulgaria.

The NRF is a coherent, joint, trained, and certified force package, held at high readiness that will be tailored for an assigned mission. It is not a standing force but on a rotational stand-by. Forces participating in the NRF will be drawn from the entire NATO Force Structure, as well as from other forces offered by Alliance Nations, on the basis that *they meet the capability and readiness criteria* as set by the Operational Commander.

The envisaged missions assigned to the NRF, which have been endorsed by the Nations, cover a wide spectrum. To successfully conduct these NRF missions, there must be cohesion between national and collective training efforts and certification processes to maximise operational effectiveness. NRF roles and missions give the nations a focus for their deployable forces.

The NRF is filled by national force contributions through Force Generation against a Combined Joint Statement of Requirement, or CJSOR. This provides Nations with an indication of the type and scale of forces and the capabilities required.

The Air Component of the NRF comprises helicopters, UAV's and fixed wing aircraft, with appropriate command and control, support facilities, theatre missile defence, air defence and infrastructure for a number of deployed operating bases. This

only underlines my previous remarks on the importance of and the need for Alliance Nations to also share the burden in Combat Support and Combat Service Support areas.

Detailed Permanent and Evolutionary Criteria on NRF Standards have been developed. Work is underway with the NATO Strategic Commands to establish a yearly review and development cycle for Evolutionary Capability Criteria. These criteria will then also be taken into account in the development of capabilities through the Defence Planning Process described earlier.

Not all forces and capabilities assigned to the different NRF rotations will be able to comply with all the criteria from the very beginning of the rotation of the force. But as more and more forces are passing through the NRF training and certification process, they will progressively meet those criteria and spread them within the nations' forces.

As stated earlier, it is clear that the NRF will act as a main driver for Alliance transformation. Participating in the NRF will pose challenges for all nations and also for Bulgaria. But what is important to be stressed here is that it is a worthwhile effort, as it will also provide for prospects and opportunities. By being a regular contributor to NRF rotations, the Bulgarian Armed Forces and the Bulgarian Air Force will learn and evolve. It will motivate the players, the soldiers and airmen, and thereby contribute to their motivation. But it will equally motivate the national leadership to implement the ambitious national plans and underpin them with the necessary resources and thereby improving the relevance of the Bulgarian Armed Forces.

Conclusion

The Bulgarian Armed Forces in general and the Bulgarian Air Force in particular face multiple challenges in their national defence reform programme. However, Bulgaria is not the only nation facing the challenges of combining the necessary downsizing of the force structures with reorganising and modernising of the remaining parts, while at the same time ensuring that "the shop will not be closed" during the transition process: the country has to continue contributing to ongoing operations. This is not only an organisational and financial challenge but it will also put pressure on the personnel and will demand a lot of their flexibility. On the other hand, there is a range of prospects and opportunities!

Throughout history nations have always pursued innovation in increasing their military effectiveness. It is the acceleration of technological change combined with the associated operational and organisational transformation that altered the character of war over the last two hundred years and led to the so called revolution in military affairs. Such an analogy could almost apply to the Bulgarian Armed Forces. But the

other part of the analogy is that history also shows that most nations succeeded in this process.

Notes:

[1] This is a Briefing of Air Commodore Henk Emmens, Royal Netherlands Air Force, Deputy Assistant Director Plans & Policy Division, to the AFCEA Bulgarian Air Force Conference held on 14 March 2006.

[2] The Alliance's Strategic Concept, approved by the Heads of State and Government participating in the meeting of the North Atlantic Council in Washington D.C. on 23rd and 24th April 1999, in *The Reader's Guide to the NATO Summit in Washington - 23-25 April 1999* (Brussels, 1999), pp. 47-60, <www.nato.int/docu/rdr-gde/rdrgde-e.pdf>. The 1999 Strategic Concept superseded the 1991 concept – *The Alliance's New Strategic Concept*, agreed by the Heads of State and Government participating in the meeting of the North Atlantic Council in Rome on 7th-8th Nov. 1991, <www.nato.int/docu/comm/49-95/c911107a.htm>.

[3] NATO Military Committee, "NATO Military Command Structure", MC 324/1, dated 07 May 2004.

[4] See <http://www.nato.int/docu/comm/2002/0211-prague/index.htm> (21 May 2007).

[5] See <http://www.nc3a.nato.int/organization/or.html> (12 June 2007).

[6] <http://www.md.government.bg/bg/strateg.html#> (12 June 2007).

Air Commodore **HENK EMMENS** was born on 23rd of May 1951. He joined the Air Force as a conscript in 1970. Then he signed a short-term volunteer contract in 1972 and was promoted to 2nd Lieutenant. From 1972 till 1980, he was posted to AB Leeuwarden where he performed several jobs in the field of Survive-To-Operate (passive defence, active defence, training and active air defence/SHORAD). In 1975, Henk Emmens became regular officer. From 1980 to 1986, he was posted to RNLAF Logistics and Training Command. He was promoted to Captain in 1980. Jobs consisted of STO-affairs, basic military training affairs and operations. From 1986 until 1988 he was posted to AB Soesterberg as Head of Ground Operations Office. In 1986 he was promoted to Major. From 1988 till 1990 he followed the Advanced Staff Course at the RNLAF Staff College. In 1989 he was posted to HQ RNLAF where he performed several jobs in the Planning department of the Air Force. In 1991, he Became Head of SAM/Ground Defence Policy and Requirements Section and was promoted to Lieutenant Colonel. Then, in 1992, he became Head of Air Force Planning Section.

In 1994, Henk Emmens was posted to MOD/Defence Staff as Head of (interservice) Projects and Parliamentary Affairs and promoted to Colonel. On 1st of November 1995 he was appointed Chief International Planning Affairs, dealing with NATO and WEU policy matters, NATO Defence Planning, Internal (and external) adaptation of NATO. Then, in October 1997, he was appointed as Chief of Cabinet of CHOD NL. Later, in June 1998, he became Deputy Chief of Defence Staff for International Plans and Cooperation and was promoted to Air Commodore.

From May 2001 until August 2003, Air Commodore Henk Emmens was posted to SHAPE as Deputy Assistant Chief of Staff Intelligence Division. On 2nd of September 2003, he was posted to IMS as Deputy Assistant Director, Plans & Policy Division. Air Commodore Emmens is married to Truus Bakker; they have four sons.

CHALLENGES FOR THE BULGARIAN AIR FORCE – A ROYAL AIR FORCE PERSPECTIVE

Gavin MACKAY

Abstract: Addressing the challenges facing the Bulgarian Air Force, this article examines the way defence planning is conducted in the United Kingdom. Ways to save money from the defence budget are suggested. The author offers valuable guidance on intelligent procurement and advice on how to achieve control of a country's defence procurement procedure.

Keywords: Defence Planning Procedure, Strategic Assessment, Capabilities Development, Cooperative Defence Projects, Intelligent Procurement.

Introduction

Many Armed Forces around the world have difficult decisions to make about what their force structure should be, *what* they buy, *who* they buy it from, and how to get agreement with other areas of their government about these issues. Many have lists of requirements that greatly exceed their budget. The Royal Air Force also has to face such problems.

As a mirror to the challenges facing the Bulgarian Air Force, this article will look at how defence planning is conducted in the UK. Some of the ways to save money from the defence budget will be examined and some thoughts on intelligent procurement will be offered.

The main theme is the national value to be gained from developing and retaining control of country's defence procurement procedure, so that a force structure that is geared to the particular national needs and aspirations is achieved – and is affordable; not just at the beginning, but throughout its Service life.

UK Defence Planning Procedure

The UK's defence planning is a top-down *joint* process conducted from first principles. It works from the broadest views towards the more specific. Most of it is done at

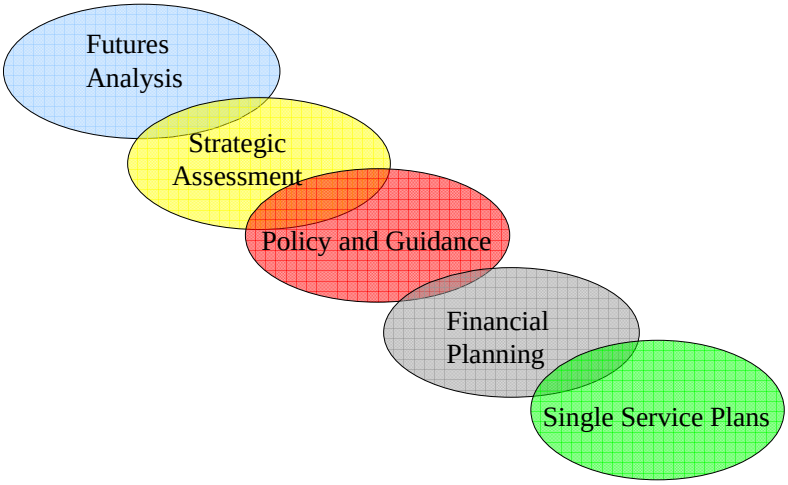

Figure 1: The Planning Process.

Ministry of Defence level, and only at the very end does it arrive at the single Services.

The planning process uses five stages (see Figure 1). It starts with the widest view of the future global environment and moves through trends that are relevant for defence, towards more detailed work on requirements. And it is only at the end that justifications for specific capabilities are provided.

This article will look at each of these phases.

Futures Analysis

The first stage of the decision process is to gather information about the wider environment and analyse it (see Figure 2). Inputs are taken from a wide range of governmental and non-governmental bodies and the focus is on the three levers of diplomacy – Politics, Economics and Military force. Obviously, we are most interested in the last of these, but we need to understand the other two and how we interact with them.

They also need to be considered against the likely social, legal, physical and technological developments in the UK, which will influence attitudes to the use of military force. These *internal* factors will be balanced by the next part of the equation, the strategic context and the *external* themes it gives us.

Strategic Assessment

The strategic context includes all the external pressures that may compel a nation or group of nations to take action. There are some global issues that impact all European

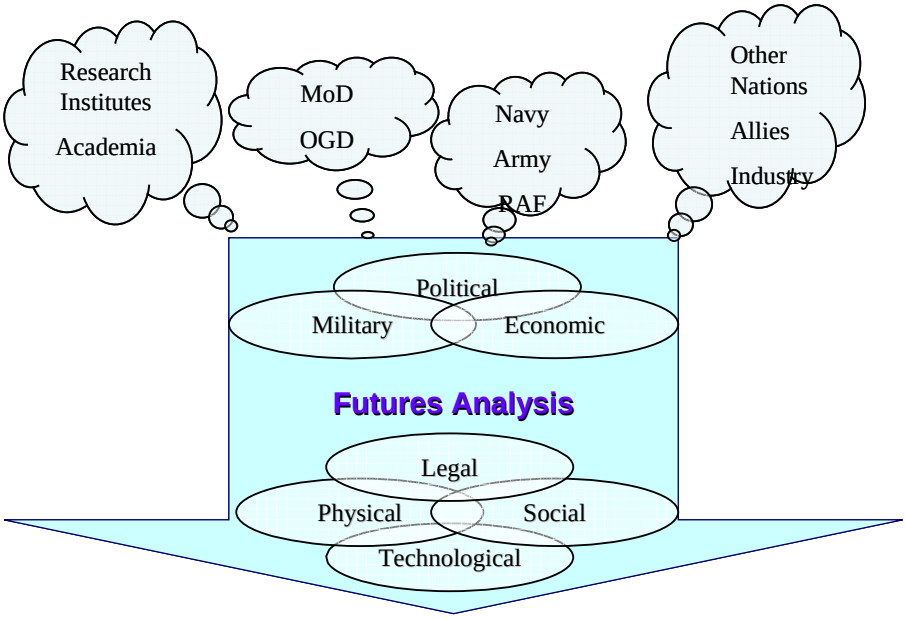

Figure 2: Futures Analysis.

countries:

- International Terrorism;
- Proliferation of Weapons of Mass Destruction;
- Failed and Failing States/ Intransigent Regimes;
- Energy Security;
- Climate Change and Resource Pressures;
- International Relations;
- International Legal Framework;
- Personnel;
- Technology;
- Coalition Operations;
- The Private Sector.

Confronting these issues offers difficult choices.

Overlaying the global strategic context on the wider analysis of the future gives us a basis for a strategic assessment as it affects defence. This needs to tell us *how* the world is changing around us and *what* defensive capabilities we need. We need to

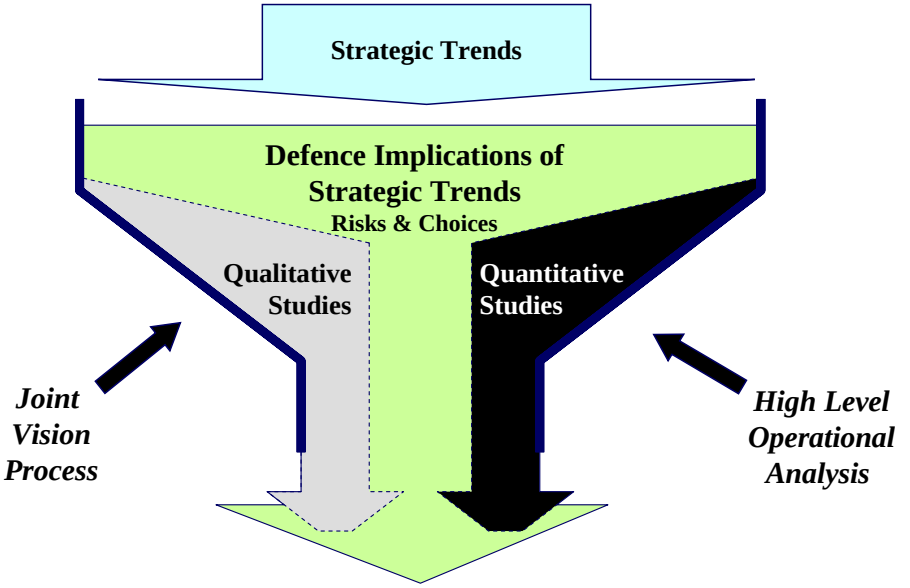

Figure 3: Strategic Assessment.

understand more about the risks and the choices, and this can be approached from two different directions (refer to Figure 3). Using *quantitative* analysis, we use war gaming techniques to model a range of outcomes from a particular set of circumstances. This will tell us how well we are doing at the higher level and whether we have enough capability.

Similarly, we can describe a selection of future capabilities and make decisions on their relative merits using our judgement. This is *qualitative* analysis.

All of these feed into our analysis of risks and choices and inform our strategic assessment.

Policy Development

We now have to make some decisions and set policy. Given the options that we have discussed, what are the defence goals that we should attempt to meet? The Defence Policy Staff set the boundaries for British defence. Defence planning assumptions are illustrated on the left hand side of the diagram in Figure 4.

Defence Planning Assumptions (DPAs)

The UK's Defence Planning Assumptions are grouped under four main headings as illustrated in Figure 5: (1) standing strategic tasks, (2) standing home commitments, (3) standing overseas commitments, and (4) contingent operations overseas. These

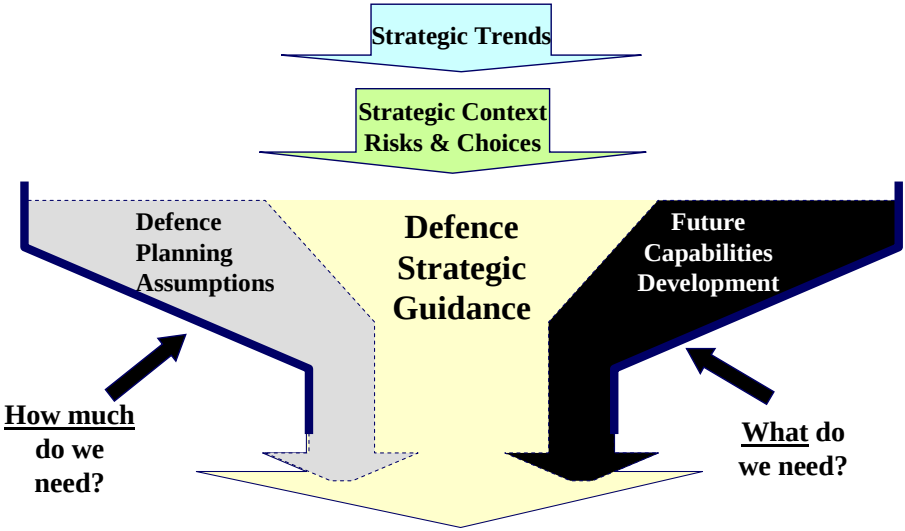

Figure 4: Strategic Policy.

capture the entire spectrum of current and foreseeable military tasks.

The force structure that is needed to support these tasks is built around a framework of ten sections, ensuring that all aspects are fully considered (refer to Figure 5). Let us consider three of them. *Concurrency* is the ability to conduct more than one task at a time; *Recuperation* is the time taken for a force to recover from a task and be ready to mount the next one; and *Harmony* is the ability to sustain forces through a cycle of

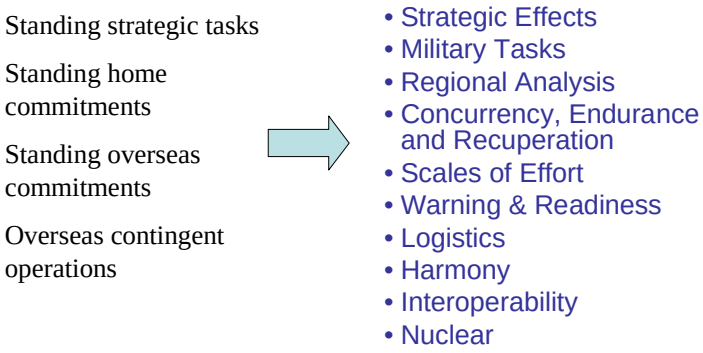

Figure 5: Defence Planning Assumptions.

deployments. Inevitably, some particular specialisations bear more than the average burden when recurring deployments take place. For the RAF, such groups include tactical communications and supply and the purpose of harmony studies is to identify these groups and find ways to relieve the pressure on them.

Strategic Policy

We now have the defence tasks derived from the risks and choices. The next step is to determine what equipment capability is needed to meet these tasks.

One defence planning assumption might be that British forces could be required to operate anywhere in the world. This would mean that future *equipment* has to be capable of operating in high and low temperatures; in mud, sand or snow. We would also need the means to get UK forces to these places – so we need a transport and logistic system that can support them. On the other hand, another assumption might be that offensive operations will *always* be done in coalition with other nations' forces. This would imply that forces from another country might provide one or more specific capabilities – which would mean a saving for us.

Resource and Financial Planning

Having decided what capabilities will be needed, decisions have also to be made on how they are to be achieved, how the costs are to be met and in what order. Ministers and the Heads of the Armed Forces provide the *Defence Strategic Guidance*. This must be practical and affordable, it must address known areas of weakness and it must identify future challenges and opportunities. It guides senior executives and budget holders, planning and resources staffs, and it forms the basis of the equipment plan.

Departmental Plan

The final stage is to develop a plan for each of the Services, showing them what equipment they are getting and for what purpose.

There are two parts (see Figure 6); the equipment programme, a long term (10 year) vision for the continuing re-equipment of all UK forces with new platforms and weapons, and the short term (4 year) plan, measures covering running costs, and contingencies not covered by the long term plan.

This is the part of the planning process that has to bear the brunt of defence cost reviews. The departmental plan is reviewed regularly and it is managed to meet the available budget. Some items are postponed; some brought forward, some cancelled. And there is a feedback process to the strategic policy level to make sure that policy ambitions do not get too far ahead of what we can afford.

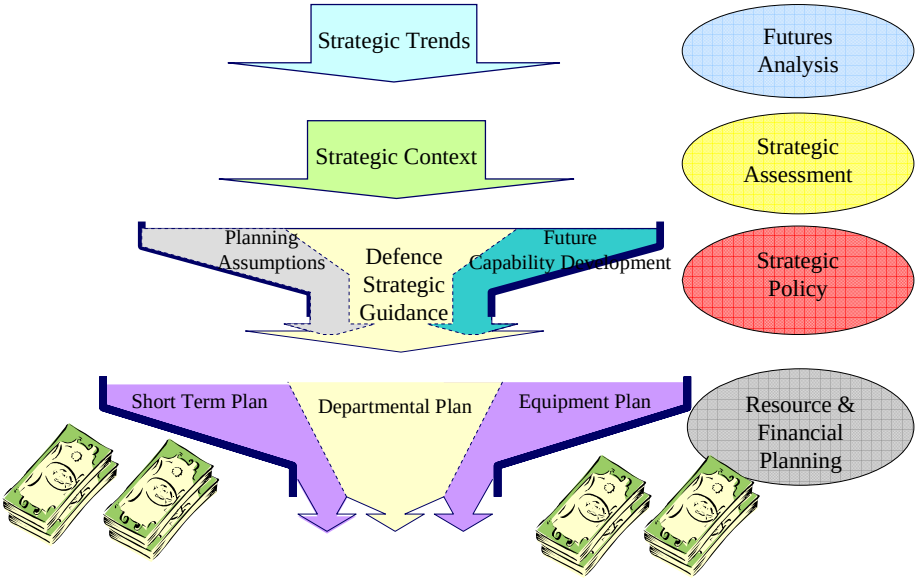

Figure 6: Departmental Planning.

Having assembled all the elements of the equipment plan, which is very much a *joint* process within the Ministry of Defence, the single Services' plans are clear. They can now see what equipment they will receive, when it will arrive, and they can decide

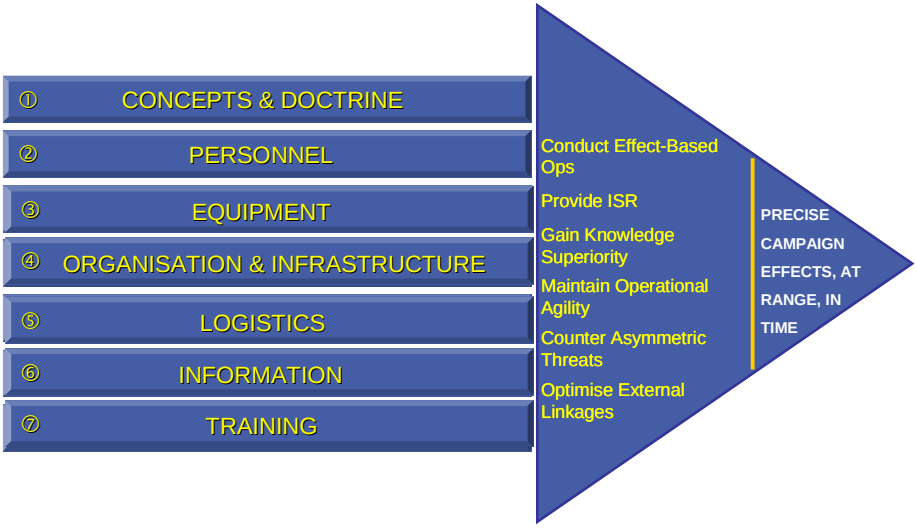

Figure 7: Developing Air Power for Tomorrow: Lines of Development.

what work they need to do to put it into service (just as is the case now with the Typhoon fighter).

All these decision processes, when put together, provide the background for the realisation of the Royal Air Force vision, which is what the diagram shown in Figure 7 illustrates. Every element has its place and its own staff somewhere in the Air Force machine, working to develop the bigger picture.

Getting Better Value for Money

This section looks at some of the measures that the UK has taken to get better value for money from its defence budget. With costs rising faster than budgets, we have had to make substantial changes to our business practices, and what the author means is *business*. We have looked at how industry determines best value for money. The most important part of this concept is being able to evaluate whole life costs.

Whole Life Costs and Cost of Ownership

No one today has the luxury of an unlimited defence budget. If budgets are to be realistic, then costs must be evaluated and constrained—not only at the planning stage but throughout life—and, for equipment, that includes the aggregated cost of research, development, design, testing, production, in-service support, modification and disposal. For personnel, it includes the costs of recruitment, training, pay, allowances, pensions, and support.

Definitions

A couple of definitions will be given first.

Whole Life Costing is the continuous process of forecasting, recording and managing costs throughout life of equipment with the specific aim of optimising its whole-life costs and military output.

Cost of Ownership (COO) is the annual estimate of resources consumed directly in procurement, operation, training, support and maintenance of military equipment at all stages of its life.

So, adding up every year's cost of ownership over the whole time the equipment is in service is the whole life cost.

Cost of Ownership

In compiling a Cost of Ownership Statement, all relevant costs associated with that project have to be gathered (see Figure 8).

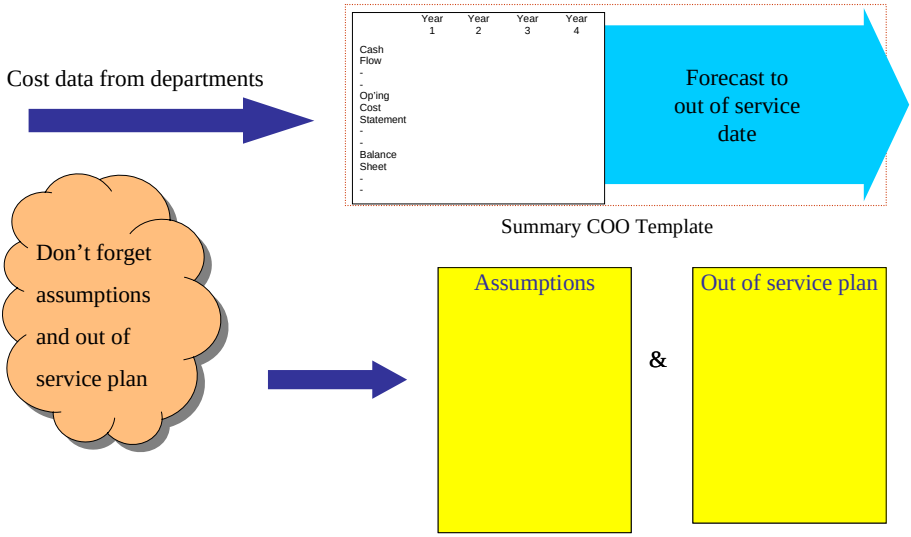

Figure 8: Compiling Cost of Ownership.

Each organisation, or "stakeholder", has to identify how much of its planned annual expenditure relates to that particular equipment.

The *Through Life Management Plan* provides a series of agreed assumptions that allows each stakeholder to model costs in the same way across the remaining life of the equipment. The Cost of Ownership system then draws together all the inputs to provide a view of the full cost of the equipment – throughout its planned life.

Why do we put so much emphasis on estimating Whole Life Costs at the planning stage? Well, we have learned the hard way that it is absolutely necessary. A piece of equipment that seems very cheap to buy initially, may turn out to be hugely expensive in the long term if, for example, it needs a lot of maintenance, or consumes a lot of spares, or needs a large number of personnel to operate it.

The diagram presented in Figure 9 shows a typical COO profile. Costs are initially low in the early years – the Concept, Assessment and Demonstration parts of the project, but they start to increase as the project moves through Manufacture and into Service. Costs are at their highest during the In-Service phase, and they start to decline as the out of service date approaches and the number of assets reduces.

Data is captured against six cost categories. These are:

- Other Costs – a bucket to capture costs not covered by the other categories.

- General Services Received – represents contract costs with industry for supporting the equipment.
- Stock and Fuel Consumption – costs of actually running and supporting the equipment.
- Manpower – the cost of MOD/ Service manpower procuring, operating, supporting and maintaining the equipment.
- Depreciation – the annual consumption of the equipment asset. It is important to note that COO is based on resources consumed rather than cash; thus the initial procurement cost is reflected through depreciation over the useful life of the asset, i.e. total procurement cost divided by the life of the asset provides the annual depreciation or consumption of that asset.
- Cost of Capital – a notional charge within the MOD accounts. It seeks to promote correct behaviour within the MOD by making a charge on the value of assets that we hold thereby encouraging the MOD to keep its asset base to a minimum (an incentive to get the maximum return for each pound spent on assets).

Figure 10 demonstrates perhaps even more clearly the year on year cumulative effect of through life costs.

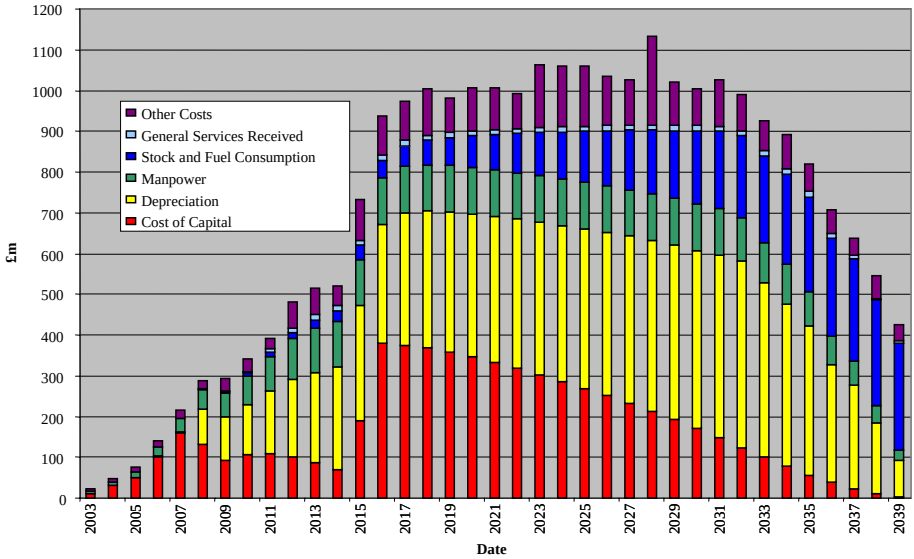

Figure 9: Annual Cost of Ownership Profile.

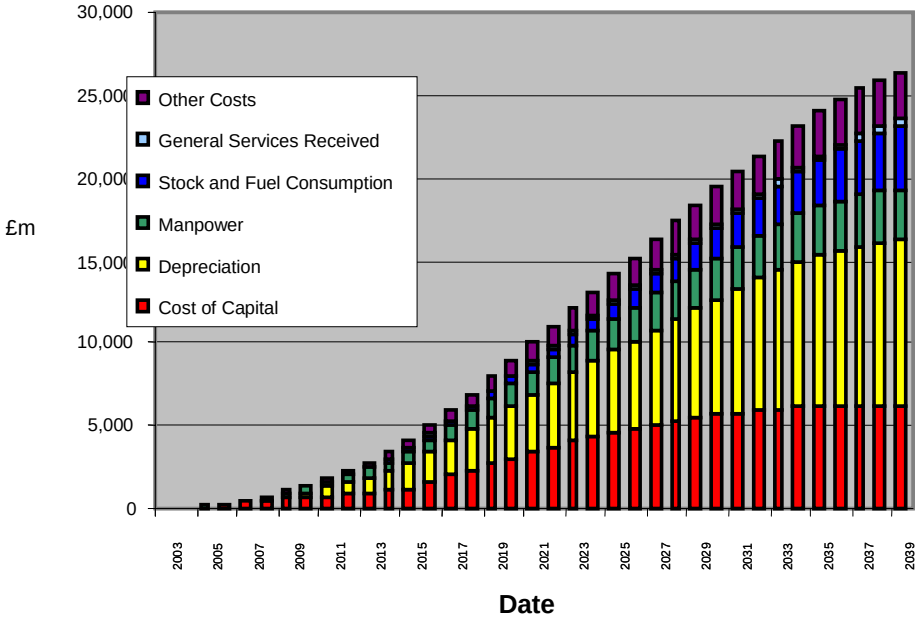

Figure 10: Year on Year Cumulative Cost of Ownership.

Co-operative Defence Projects

This subsection will look at international defence projects. Co-operative defence projects have many benefits.

Advantages

In these projects costs and skills are shared, making more advanced projects possible. We get economies of scale during production, provided that everyone wants much the same version of the product. International business contacts are made and refreshed, and—in the ideal case—technology transfer flows freely.

And one project often leads to another. For example, the UK, Germany and Italy went on from building Tornadoes to the highly successful Typhoon fighter. And British and American cooperation on the Harrier is continuing with the JSF. However, there are some disadvantages that are not always obvious at the beginning of a multi-national project.

Disadvantages

One major factor that can delay multi-national projects can be the fragile nature of the funding stream – if all the partner governments do not stay absolutely committed to production at the planned time.

Almost all of the advantages of co-operative programmes can be lost if the agreed equipment standards are not sustained. Some programmes never really start with common standards; with others the standards of the partners drift apart.

It is not smart practice to procure equipment that is likely to go out of service with one partner much before the other, unless agreement is reached about sustaining it in later life. While depreciation on older equipment reduces, other costs increase, especially when it becomes necessary to modify or change something in the system.

Consider software. Experts involved in project development and software modifications have a habit of disappearing when a project goes out of the parent nation's equipment programme. Modification in later life then becomes either impossible because no-one is prepared to release the source code, or because the cost of retaining a specialist workforce becomes prohibitive.

Thus, cost of ownership can start to rise in the later life of a project if appropriate safeguards are not provided.

Force Structure

The RAF also continues to refine its force structure. Using the experience of real operations and the output from operational analysis of imaginary scenarios, we can evaluate alternative structures before putting them into practice. For example, RAF's move to effects-based warfare, which means that one sophisticated aircraft with smart weapons can produce the same desired effect as a whole squadron only a few years ago, has allowed the RAF to reduce the numbers of squadrons and sizes of units. This has meant reduced support and reduced costs, while sustaining—and even increasing—RAF's capability in some areas.

We are moving from a structure with two major commands to one only, and we are reducing overall numbers of air force personnel, by working more efficiently, and by employing civilian contractors where it makes sense. This allows savings in recruiting targets, training budgets, wages, pensions, housing and support, releasing money to be spent on more sophisticated equipment.

This is also being applied to the RAF defence estate – all the stations and properties that the RAF occupies. The smaller size of many of our units gives us the opportunity to co-locate more of them at each station. The reductions of the UK base planned (already much reduced from what UK had during the Cold War) emphasise on grouping together specialist forces geared to expeditionary warfare. This allows much closer integration, and easier and better training. Houses at bases closed under this scheme can be sold on the civilian market, and airfields can pass to local authorities that wish to open regional airports.

Contractor Involvement

Civilian Roles

In the UK, we have significantly reduced whole life costs by involving the manufacturer more closely with the in-service maintenance of the product. Thus almost all major aircraft maintenance work on RAF bases is now performed by either manufacturer's or contract civilian staff, saving the cost of expensive Service personnel and allowing the manufacturer to more closely match his staff to the task. However, the author does appreciate that in Bulgaria the relative costs of Service Personnel and contractors may be different to their experience.

Also, much of UK armed forces' logistic support is contracted out to organisations that routinely provide the same sort of support in civilian life; for example, a well known global food supplier is on contract to supply basic foodstuffs to UK forces wherever they are in the world, saving the MoD most of the effort involved in organising its transportation. We have the same arrangement for the delivery of high priority freight.

Working with Civilians

It is obviously good practice to inject competition into defence projects, to achieve the best value for money. Not only should competitive tendering be the norm, but tenders should be scrutinised to make sure that they are realistically and fairly priced. It is common practice now to insist that where costs are estimated, an agreed level of profit should be specified so that subsequent audit can identify actual costs and relate them to overall project costs. This will prevent the contractor trying to take excessive profits.

Other techniques, such as defining the criteria for milestone payments, can also be adjusted. In this case, other components of the contract not on the critical path become part of the milestone itself; this practice is known as chevron payment. This is intended to encourage contractors to look at the project as a whole, not as a series of milestones. If necessary these ideas can be extended further, for example with 'Earned Value Management' to provide detailed control of both the programme and payments; ultimately incentivising the contractor to meet his targets in both cost and time.

Leaning

Hangar. In conjunction with previous measures, the Defence Logistics Organisation has adopted a concept referred to as 'Leaning' or the reduction of waste and spare capacity. This relies on defining clearly at every stage what degree of activity is essential to meet the output requirement – and discarding anything else. By working closely with manufacturers, we have removed a very significant proportion of 'fat'

Figure 11: Leaning – Eliminating Waste.

surrounding engineering activities. These before and after shots (see Figure 11) taken at two major RAF stations show the same activities in the same hangars. The savings are evident.

Innovative Funding

Many British defence programmes are now funded in what are referred to as 'innovative' ways. The C-17 aircraft we need for expeditionary warfare are very expensive to buy, but we were able to negotiate a lease with Boeing in the same way as an airline might do. Our future air-to-air refuelling capability will be provided by a civilian consortium through a Private Finance Initiative. Our staff college buildings and facilities are funded and operated privately with MoD being directly involved only in the running of the courses. Our contractors carry out all other activities to agreed standards. The four other programmes being provided under contract are only the tip of the iceberg, but they all allow the MoD to focus on *operating* rather than procuring and maintaining.

Leasing

The UK has been in the lead in procuring equipment by leasing a capability, and I will briefly show the advantages.

In the early stages, capital outlay is greatly reduced. Instead of paying for expensive research and development programmes, you get to use proven equipment. The risks attached to the project are almost completely transferred to the supplier, relieving the

Ministry of Defence of having to make provision for problems that may not arise, or—worse—having to cope with a problem for which there was no provision.

The overall capability is often acquired faster because more resources are in play. The contractor can plan the use of his facilities most effectively. He may divert other equipment and manage supply more easily. Combined with the purchase of appropriate weapons, you can rapidly acquire a complete capability. Training and support can be included in the contract, allowing a rapid build-up of forces. Capital funds can be directed towards the infrastructure necessary to accommodate the project. The problems of obsolescence and disposal at the end of project life go away, because the project is over when the contract runs out, so there is always a clear end state visible, rather than a lingering flirtation with obsolescence. The programme has auditable costs that allow a proper appreciation of value against capability. And finally, capabilities that are provided under contract are relatively immune to defence cuts, because the funding has been agreed. Thus pressure to make cuts can be resisted by pointing to the implications for particular programmes or capability areas. This is not so easy when all activity is managed by the MoD.

How Can UK Experience Help Bulgaria?

The author is aware that much work has been already done in Bulgaria on defence reform to align needs and budgets, and to enable a full and effective contribution to NATO. Some of the measures that the United Kingdom will have to implement are already in Bulgaria's programme. I offered a view of the way the UK plans to get the most from its defence budget, together with a few observations on procurement. The Royal Air Force and the UK Government are very keen to continue the discussions of defence matters, and there will be topics in the future not discussed here, such as alternative models for headquarters staffing, or the concept of identifying capability areas for equipment procurement.

Lastly, our forces are only as good as their training. We look forward to training and operating with the Bulgarian Armed Forces at a mutually agreeable time, and we remain ready to assist the Bulgarian colleagues in identifying their needs. Basis proficiency can certainly be developed during home-based training, but the benefits rapidly tail off as we become over familiar with scenarios and locations. All forces benefit from exposure to unfamiliar circumstances. Leaders are stimulated to make better informed decisions, and the operators develop a confidence in their own ability that can never be achieved from repetitive exercises. This means training abroad on allies' facilities where possible: and NATO recognises and encourages this through exchange training visits.

Defence Equipment Assistance

I discussed some of the background work that needs to go into defence equipment procurement to ensure a lasting and effective capability that meets the needs and budget of the nation. We are all aware that when this work is done some difficult decisions have to be made to align aspirations with funding. So what happens when generous offers are received that appear to solve at least some problems by providing capability at very little cost?

Advantages

The advantages are obvious to everyone; aircraft programmes suddenly appear possible instead of unaffordable, training and weapons may be provided, as may advisers and other facilities. This may indeed be an answer to capability and budget problems. But there is a downside.

Disadvantages

Firstly, by foregoing the analysis that leads to a sound defence programme and its budget, government is deprived of the tools it needs to control its defence. The provider, by making the programme fit the available budget, muddies knowledge about real costs of ownership. The real experience behind defence that stimulates debate, builds confidence and looks to the future, is lost in inexact figures designed to be acceptable. Neither is there any way of determining what capability is actually present where trials are already complete, and where weapons are included in the deal. The advantage moves firmly towards the provider who holds all the cards. In these circumstances there are questions to be asked about what capability is actually present, what it can be used for and for how long is it useful?

Given that such programmes come at low initial cost, overall costs are most likely to rise with time, operational effectiveness may well remain static rather than increasing with time, and fifteen years down the road nothing much has changed except that a follow-on deal is now being offered, with more of the same. Such deals are frequently attractively packaged, but the costs are in imported knowledge, something less than state of the art equipment and long term stagnation in national defence thinking.

Born and brought up in the north of Scotland, Air Vice-Marshal **GAVIN MACKAY** enjoyed a brief flirtation with the Royal Navy at BRNC Dartmouth before studying Civil Engineering at Glasgow University. He was commissioned into the Royal Air Force during his final year, and passed out from Cranwell in 1971. Creamed off from advanced flying training, he instructed on the Jet Provost before converting to the Hunter and subsequently the Harrier, serving in the fighter ground attack and reconnaissance roles in Germany, Belize and the UK. Returning from the Falklands after the war, and having been awarded the AFC, he attended Royal Naval Staff College before joining the Central Tactics and Trials Organization as the Harrier specialist. He subsequently commanded the Central Flying School's Examining Wing, leading advisory teams worldwide and flying, instructing and examining on numerous types of aircraft; from micro-lights to MiGs. He was awarded the OBE following this tour.

From 1987 to 1990, he served in the Ministry of Defence (MOD) in Concepts Studies and Operational Requirements, before commanding RAF Gutersloh and the RAF Germany Harrier Force from 1991 to 1993, during which time he also became limited combat ready on the Puma helicopter. Following a further short tour in the MOD as Deputy Director Air Offensive, he attended the Royal College of Defence Studies in 1994. He then moved back to Germany in a NATO appointment as ACOS Operations, HQ Allied Air Forces Central Europe, before returning to the Central Flying School as Commandant, once again accompanying CFS teams and the Red Arrows on tours abroad. From early 1999, he led the Joint Force 2000 Implementation Team, charged with bringing together the RN and RAF Harrier Forces. He was Air Officer Commanding and Commandant of the Royal Air Force College for two years from July 2000, and was appointed as a Companion of the Bath in 2002.

He took up his appointment as Senior Military Adviser in the Defence Export Services Organisation (DESO) in September 2002, leading a staff of experienced Navy, Army and Air Force officers providing tri-Service operational and technical advice on British military equipment and services.

MODERNIZATION OF THE BULGARIAN AIR FORCE AND INTEROPERABILITY WITH ALLIED FORCES [1]

Major-General Simeon SIMEONOV
Commander of the Bulgarian Air Force

Abstract: This article provides a brief introduction to the achievements of the Bulgarian Air Force. The author elaborates on the requirements, principles, and approaches for institutional development of the Air Force. The activities related to the implementation of the Bulgarian Air Force modernization projects and NATO interoperability are thoroughly presented.

Keywords: Air Force Transformation, Organizational Development, Technology Insertion.

The conclusions made as a result of the Strategic Defense Review, the missions and tasks of national defense predetermine the requirements towards the Air Force and the necessary resource framework for their realization. The operational capabilities encompass potential for accomplishing the Air Force main mission – to support the security and defense policy of the Republic of Bulgaria. Building and improving these capabilities depend on the following basic *requirements*:

- Information support;
- Command and control;
- Combat readiness;
- Deployment;
- Mission execution;
- Sustainability;
- Logistics support.

The new missions, tasks, and capability needs require transformation of the Air Force institutional structure and functional distribution, as well as building modern and effective units through realization of the following *principles*: joint effort; dependability; modular structure; functionality; and expeditionary nature.

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The basic approach to institutional building is the establishment of a comparatively small in numbers but capable Air Force, which would provide adequate contribution both to national defense and to the security of the Alliance. These would be achieved through:

- Command and Control system development;
- Gradual but continuous enlargement of the Air Force combat capability during the process of transformation till 2015;
- Development of projects and programs for acquiring new aviation equipment and modernization of part of the present aviation, radar, and ground based air defense (GBAD) equipment;
- Enhancing the level of sustainability;
- Development of the logistics support system.

The endorsed by the National Assembly of the "Long-term Vision for Development of the Armed Forces" envisages three periods for acquisition of new capabilities and transformation of the Bulgarian Air Force:

- First period – 2005-2007;
- Second period – 2008-2010;
- Third period – 2011-2015.

In the context of these three periods, it is envisaged that the Bulgarian Air Force will conduct initiatives for transformation of its structures, life extension and modernization of existing equipment and rearmament with modern weapons and technology in order to achieve new capabilities.

The main initiatives for these periods are described below.

Reorganization of the Air Force Command and Control structure is scheduled for the *first period*; preparatory actions regarding the establishment of the Air Force Academy have already been undertaken. Projects for regeneration of the MiG-29 aircraft and modernization of the helicopters Mi-17 and Mi-24 are under way. The projects regarding rearmament with new types of aircraft for operational airlift and new types of tactical transport helicopters as well as combat search and rescue (SAR) have already been launched.

The *second period* includes reorganization of the main aviation and GBAD units, as well as the Air Force training system. The Air Force command and control system will be improved together with achievement of Air Defense system interoperability in accordance with the NATO Integrated Air Defense System (NATINADS). The process of modernization of a part of the aviation and SAM equipment continues in par-

allel to the acquisition of new transport airplanes and helicopters. Projects for acquisition of a new multi-role fighter and 3D radars are about to begin.

The *third period* includes reorganization of the radar units and completion of the modernization, as well as discharge of surplus weapons and equipment. The Air Force Command and Control System is scheduled to become part of the new NATO Air Force Command and Control system (ACCS). The Air Force rearmament with new aircraft and radars will continue in this period. Certain quotas for personnel, technology, and arms are to be agreed.

The leadership of the Bulgarian Air Force definitely agrees that the most significant element and reason for the entire transformation of the Bulgarian Air Force is to accomplish the plans for modernization as related to approved levels of personnel numbers, insertion of advanced technologies and quantities of weapon systems. Modernization as a vital element of the transformation process requires allocation of considerable resources from the annual defense budgets.

Main *national funds* providing resources for modernization are:

- The National Defense budget;
- The long-term loans, guaranteed by the state.

Main *foreign funds* providing resources are:

- Funds from bilateral cooperation agreements;
- Participation in NATO programs (NSIP);
- Pre-accession instruments and EU funds.

The process of transformation and modernization require the inclusion of the national research and development potential with the objective to prepare and support the modernization projects. The *basic principle* for Air Force modernization is the rational use of the capacity of the national defense industry regarding international integration and cooperation as well as the establishment of strategic relations with foreign companies, in countries members of the European Union and NATO.

The main priority projects for modernization and rearmament of the Bulgarian Armed Forces have been determined by a decree of the Council of Ministers of the Republic of Bulgaria 46 dated May 27th, 2004.

The implementation procedures of these projects are organized in line with the Law on Public Tenders, the conditions and regulations for assigning special public contracts in the Instruction on Public Tenders, as well as the requirements and criteria for candidate assessment as approved by the Ministers of Economy, Finance, and Defense.

Bulgarian Air Force HQ have planned, prepared and approved *twenty-five projects* for modernization and rearmament that are to be accomplished by 2015. The most important projects are as follows:

1. *"Recovery and Modernization of Mi-17s and Mi-24s"* with the main objective of overhaul, extension of their life span, avionics modernization, interoperability in line with NATO and ICAO standards, communications and navigation equipment, and IFF system. The envisaged project results will enhance the operational capabilities and the accomplishment of respective force goals.

   Regarding this project, a public tendering procedure for selection of a candidate was conducted and a contract with "Elbit Systems Ltd." was signed in December 2005. The contract started on January 1st, 2006.

2. *"Procurement of New Utility Helicopters"* with the intention of phased substitution of the existing transport helicopters and special helicopters for SAR operations, equipped with modern electronic suits and weapons in line with the NATO standards. The main objective of the project is to provide the whole range of equipment for freight, materials, troop-divisions transport, accomplishing tasks for combat SAR in peacetime, MEDEVAC, etc. The final results planned by the Bulgarian Air Force HQ include carrying out the agreements with NATO and the European Union. Within this project, the Ministry of Defense conducted procedures for selection of a candidate under the Law on the Public Tenders and, at the beginning of 2005, signed a contract with "Eurocopter-EADS." The contract was validated on January 1st, 2006.

3. The project *"Procurement of New Multi-Role Fighters"* will support the implementation of a wide range of tasks assigned to the Bulgarian Air Force, such as participation in allied operations and substitution of the obsolete fighters of Soviet design that are currently in use. We are in the process of preparation for launching the procedure.

4. The project *"Procurement of New Transport Airplanes"* provides for the implementation of the whole range of tasks regarding airlift, completion of sea patrol, SAR, MEDEVAC, and others. Concerning that project, a procedure for selection of a candidate has been conducted and a contract arranged with "Alenia Aeronautica," Italy; the signing of the contract is forthcoming.

5. The project for *"Regeneration of MiG-29s"* accomplishes the main operational requirements for the protection and defense of the airspace until new multipurpose fighters are acquired. With regard to that project, a selection

procedure under the public tendering regulations has been conducted and a contract with the first selected candidate RSK MiG, Russia, has been prepared, the signing of which is to be concluded soon.

The above-mentioned projects are included in the list with eleven priority investment projects for modernization of the Bulgarian Armed Forces, approved with the decree of the Council of Ministers of the Republic of Bulgaria.

6. *"Recovery & Modernization of the L-39s,"* including computer processing and information visualization, will allow the transition from L-39 ZA Training Combat aircraft to PC-9M (Pilatus) training aircraft and further to the future multipurpose fighters to be a smooth process in the overall modernization of the Bulgarian Air Force.

7. The project *"Procurement of New Trainers"* will meet the necessary requirements for propelled training aircraft for the needs of the young pilots from the Bulgarian Air Force.

8. The implementation of the project *"Development of Air Surveillance, Air Traffic Control, and Air Defense Systems"* will provide the complete range of missions and tasks for protection of the National Air Sovereignty in the allied defense system and full integration in NATINADS in line with the force goals. The project includes improvement of the system for air surveillance through introduction of 3D radars, capability for aircraft identification in accordance with the NATO STANAG 4193, improvement of the military air traffic control system and enhancement of the air defense system.

9. The main goal of the project *"Modernization of GBAD SA-3"* is enhancing the maneuverability and firing capabilities as well as the exploitation of the characteristics of SA-3, inclusion of the NATO identification "friend or foe" system, information visualization and provision of centralized control of SAM units in order to achieve interoperability with the NATO air defense standards and inclusion of the SA-3 units into NATINADS.

10. The project *"Modernization of Bezmer and Dolna Mitropolia Air Bases"* will provide communications, information and navigation interoperability of the airfields with aircraft equipped according to NATO and ICAO standards. The implementation of this project is underway.

11. The project *"Modernization of CINS Battalions"* aims at achieving interoperability of communications, information, and navigation aviation services and will provide the Chief Staff of the Air Force with opportunities for effective command and control of Air Force units.

12. The implementation of the project *"Establishment of CINS Modules in Accordance with the Accepted Force Goals"* will facilitate the link with the NATO communications and information systems and inclusion of part of the CINS into the integrated information system as well as accomplishment of respective force goals through provision of equipment and software for:
    - Protected UHF channels for voice and air-ground data conveyance;
    - Protected communications channels for voice and data conveyance;
    - Tactical Air Control Party;
    - CINS for deployed aviation units;
    - CINS modules for aviation units according to their alert status.

The main goal of the projects:

13. *"Establishment of Bare Base and APOD Support Module"* and
14. *"NBC Reconnaissance Module"*
    is to provide the Bulgarian Air Force units assigned to allied NATO operations with technologies for nuclear and chemical reconnaissance, interoperable with NATO NBC units.
15. The project *"Developing a Support-Jamming Pod"* will increase the value of the aircraft, accomplishing tasks in a complex and hostile electromagnetic environment.

For each project, the Bulgarian Air Force HQ develops technical specifications, plan for realization, technical and economical analysis and proposals for direct offset. After being approved by the Defense Acquisition Council and the Defense Council, the Minister of Defense launches an open procedure for a public tender under the regulations for special public tenders.

In conclusion, I would like to emphasize that the Bulgarian Air Force is in a process of transformation of its doctrines, conceptual and regulatory documents, organizational and functional structure, personnel, weapons and technology, training and education, logistics support, military infrastructure and combat readiness, in order to be adequate to the dynamically changing defense environment and to establish modern Air Force, interoperable with allied air forces and capable to accomplish the whole range of missions and tasks in the frameworks of collective and national security.

Notes:

[1] This paper is based on a presentation by the Commander of the Bulgarian Air Force to the international conference organized by AFCEA-Varna, 14-15 March 2006, Park-Hotel "S.Peterburg" – Plovdiv.

SIMEON SIMEONOV – Information about the author is available on p. 18 of this volume.

Analytical Support of Air Force Transformation

- Examining Air Power as a Component of State Power
- 2020 Air Force Mission Capabilities Packages from Operational Analysis Perspective
- A Framework Methodology to Support the Selection of a Multipurpose Fighter
- Analysis of Alternatives: An Efficient Tool in Managing Force Modernization Projects

EXAMINING AIR POWER AS A COMPONENT OF STATE POWER

Dimitar NEDIALKOV

Abstract: The article presents a model of air power and describes its major components. Based on a brief historical overview and assessment of current security and technological trends, the author concludes that airpower continues to be an important ingredient of military potential and state power – a conclusion that is just as valid for small countries, as it is for leading global powers.

Keywords: Security Policy Making, Air Doctrine, Combat Potential, Airpower Model.

Introduction

A fundamental task facing the political and military leaders in making security policy is to determine critical situations and design and implement effective solutions to deal with such situations. Nowadays, the development of a methodology to this end largely rests on model building and the widespread use of computers. However, any approach to the creation of such methodology faces the challenge of identifying the key problems of the day and determining their place in global processes. Today, a major expert task is to articulate a set of concepts and to apply adequate terminology in a rational and correct fashion: a process at the base of each problem solving exercise. Different methods can be applied to this end. One possibility is to see how problems are viewed in the business world and borrow existing concepts, adapting them to a degree that is adequate to the problems and requirements of the present day. Typical problems in this sense may be issues related to national security and state military might. These are large-scale issues which comprise quantitative and qualitative elements and are exceptionally hard to resolve. Similar issues of a mixed and indetermi-

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nate character are among the fundamental ones of the present day, in our transition towards the information age.

Medium and large-scale problems are of particular interest to scientists and researchers. It can be claimed that air power and air potential are among these. Their solution calls for the creation of a hierarchical system of concepts the study of which is relevant not only now, but also in the foreseeable future.

The development of science and technology goes along with national and state potential, and contributes to its development. It is precisely this potential that defines a nation's place in the contemporary world and its ability to attain set political, economic, and military aims. This is particularly valid for the contemporary period when the leading nations, or the so called 'Great Powers,' are entering the new information age. However, regardless of the age which a particular nation occupies and in which it lives, the pace of its development is determined by its ability to marshal the potential at its disposal in the right direction. We may define the degree of realization of national potential for the attainment of set aims in politics, the economy, and in the strategic area as *national power*. Naturally, this degree has different levels. They determine national vitality, and a nation's ability to survive in difficult periods, and to continue towards prosperity.

Once we define national power as the degree of realization of national potential, we may view it as a result or end state of a process which takes place within a complex system (whether in the national state or within a coalition of states), functioning within a set environment with which it constantly interacts.

New realities impose a broader view on national power as a whole and over its composite parts and elements. The fact that it is the result of the workings of an open system, one of whose entry points is *air power*, is germane to its study. Once we have concluded that national power may be viewed as a system, it is then necessary to define the environment – that set of finite elements that have an impact on the system. Such elements, which are essential for its existence, are the sources, which create the end result or give rise to a final and manifest concept needing only definition. Basic source of national power is the nation state as a system. Conditionally, we may divide the sources of national power into tangible and intangible ones (refer to Figure 1). *Tangible* sources include geography, economic potential, infrastructure, technological development, human resources, the armed forces, etc. *Intangible* sources may include, *inter alia*, culture, ideology, national will and morale, the ability of government and its responsibility in governance, the skill of national diplomacy in attaining its aims, and significant past successes and failures of a political and military nature.[1]

Depending on the objectives set by political and military leaders, national power may be military and non-military. This distinction derives from the sources of national

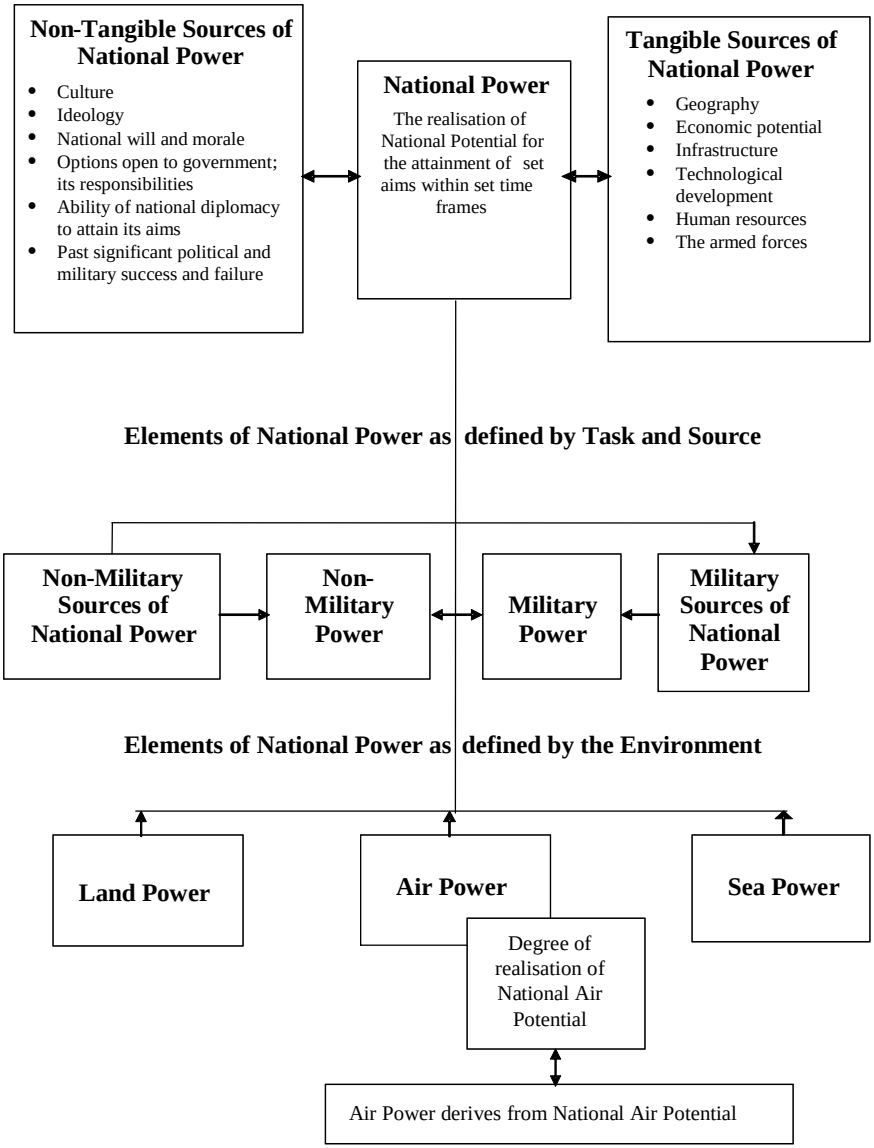

Figure 1: The Elements of National Power.

power and the logic of interaction between them. The conditionality in this case is deepened by the process of the most developed nations entering the information age, where the links within the system of national power under review are considerably stronger and where the boundaries between its individual parts are even harder to de-

termine. However, a distinction is still needed due to the fact that few nations have already reached such a stage of development. The strife of leading nations to retain a *status quo* that puts them in the position of world leaders able to shape the modern world according to their interest is natural. This is also a major reason for the emergence of sharp political and economic crises calling for frequent use of armed force for the enforcement of one or another decision.

Non-military power derives from non-military sources, which feed the part of the system linked mainly to the national political and economic potential. Military power derives from military sources. Both types of sources may be tangible or intangible and determine the methods and type of resource used to achieve set political goals on one hand and military ones, on the other.

In the context of the issue considered here, concepts of national and state military power are of particular interest. Military power is invariably part of national power and is expressed through the attainment of national aims or the defense of national interest by military means, which are also its basic source. State military power could be defined as the sum total of the action of all tangible and intangible sources of power within the state, or within a set class, or a coalition of states, which depending on the specific tasks ahead have to generate such power and mobilize available resources for the attainment of war aims or the resolution of matters other than war. Military power depends on the economic, social, scientific and technological, and morale and political means at disposal by the state. It is directly embodied in the state's armed forces and their ability to fulfill the tasks set by the political leadership. In turn, the armed forces are divided into Services, which depend mainly on the environment within which they are expected to act.[2] These are the Land Forces, the Air Forces, and the Navy. The ability of each Service to fulfill its narrow tasks depends upon its combat power. Combat power may be defined as that part of military power, which is generated by the action of a system of tangible and intangible sources that determine the state of the armed forces and their ability to fulfill combat tasks. It is realized through direct impact upon the adversary and is proportional to the number, morale, and training level of the force, the quantity and quality of combat equipment, and the ability of its C4I system. *Combat potential* is at the base of military power. It expresses the state and ability of forces and means directly involved in combat and directly engaged in the accomplishment of set combat tasks. The basic *components* of *combat power* are (see Figure 2):

- The forces and means directly participating in combat: personnel and equipment comprising basic combat potential;
- The forces and means supporting combat: special technical and logistics backup comprising the potential for combat support;

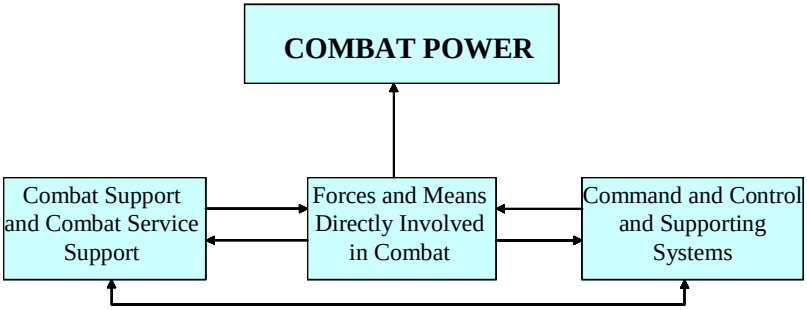

Figure 2: The Components of Combat Power

- The forces and means for command, comprising command and control potential.

Before embarking upon the definition of air power as a subsystem of national power as a whole, and of military power in particular, it is necessary to state that, depending on the environment, national power may be defined as the nation's potential to use land, sea and air in the realization of set goals related to its prosperity and existence.

Hitherto, *air power* theory has been exclusively developed by Western European and American theoreticians and experts. The attempts to formulate and explain air power date back to the infancy of aviation. Concepts related to naval power provided starting points. Early air power theoreticians borrowed ideas and postulates from naval warfare fairly uncritically. This worked only occasionally.

What is the nexus between naval power and air power? At the turn of the 20th Century, it was the striving to seek superiority or mastery in a largely uncontrollable environment. In addition, both naval and air power depended upon—and served—the needs of land operations. This gradually led to the triune configuration of national power, enabling nations to pursue objectives not only on land, but also on the seas, and in the air.

What were the properties of the new environment that challenged politicians and soldiers in search of superiority? The first and essential one is its universality. The earliest flying machines suggested to strategists that the new leap of human ingenuity had a future: with development, it would render any point on Earth accessible, moreover at a speed unknown to land and sea vehicles. Speed gave the new environment its second advantage: greater mobility, granting intrinsic privileges to owners of flying machines. The third advantage stems from the ability to move in three dimensions, thus gaining a large measure of invulnerability. Zeppelin's dirigibles and airplanes abruptly ended a British geographical immunity bestowed by 36 kilometers (21

miles) of Channel. This immunity had held well since the Norman Conquest in 1066, yet henceforth no nation was beyond invasion by air.

The first military leader, who not only saw the significance of nascent air power but also began active work to elevate it as a primary pillar of national power, was German General Staff Head, General-Feldmarschall von Moltke. Before the First World War, he formulated and applied a program for the promotion of this new weaponry and for the creation of properly functioning Army and Navy air units.[3]

In the Great War, Generals Trenchard and Billy Mitchell were the first to breach the Klausewitz postulates on warfare (which Foche followed). British soldiers had principal differences with Klausewitz's paradigms: they had attained and maintained a 150 year superiority not by setpiece wars but by maneuver, limited war, attrition and threat. Major General Trenchard and Brigadier Mitchell proved that rather than being tied to close support of the infantry, aerial forces ought to cooperate with them, and yet pursue independent objectives.[4]

Reviewing Tripolitanian, Balkan, and Great War experience, General Douhet attempted the first definition of air power in his 1921 book, *Command of the Air*.[5] He and subsequent theorists regarded air power merely as a tool for mastery, even after the advent of missiles. For instance, writing in the August 1955, Major Alexander de Seversky defined air power as a function of speed, height, range, mobility and the ability to project armed power with pinpoint accuracy in time and place at maximum speed.[6]

To this very moment, theoreticians tend to regard air power as a component of national military power. In this sense, its definitions tend to recycle general concepts of armed power and combat potential. Treating the air force as a prime command, they address its armed power, combat potential, state, and ability to attain set objectives within a discrete timeframe.

Why is the topic of air power currently important?

- It has existed, exists, and will exist in the future;
- It has always presented planners with a broad range of options, does so now, and will continue to do so in the future;
- It calls for significant capital investment involving high levels of risk;
- It is highly dependent on national scientific and technological potential;
- It is an exceptionally convoluted and complex matter where rigorous decision making and implementation require a whole range of disparate resources;
- It is central to national security.

The methodology for addressing similar issues does not call for a precise definition of success.[7] (Some system analysis communities even claim that such problems do not repay any over-detailed preparatory formulation.) However, national security matters such as air power and its role in armed conflict are overridingly important. Therefore, it is important prior to studying air power to define it (and options for its development) with the greatest possible precision. Efforts to formulate air power and imbue the concept with content date back to its very emergence.

To this day, as has been already mentioned, air power has been viewed in most cases as part of national military power. In this sense, to a certain extent, it coincides with the concepts of military power and combat potential, in this particular case dealing with combat power and combat potential specific to the air force as a major service and with its state and ability to fulfill set tasks and obtain set results. There is ground to believe that the result of the action of the means for overall use of airspace, including those for defending national interests, within a set period and using the environment and those means rationally do indeed comprise state air power. This power is determined by the nation's ability to utilize the military and economic potential of the airspace towards its goals. In this sense, air power may also be defined as the degree to which national air potential is harnessed, and more precisely the degree to which the elements of national air potential are harnessed.

Air power may reasonably well be regarded as a consequence of the functioning of a system composed of intertwined and interdependent components and elements. They all exist in a unity with the environment of the air. It is in this environment where the system exists as an integral whole.

The significance of the individual components does not depend on specific historical circumstances. Rather, the content of the system depends largely upon current and future circumstances. Considering the main objectives set here, reviewing the military aspects of air power is particularly important, bearing in mind the significance of air forces in current and future military conflicts.

The structure of the system that generates air power is clearly hierarchical. It includes *basic components* directly linked to the fulfillment of set economic or military tasks and *elements*, which, to one degree or another, influence these tasks. The number of components and elements in the proposed system vary. Their amount and degree of development depend on a number of factors and have a purely national character. Such factors could be the degree of economic development, the priorities the nation has set, guiding principles in its national defense doctrine, the political environment, and geography among others. Thus, most nations maintain three-service armed forces while just four (Saudi Arabia, Israel, Russia, and Vietnam) have four services with air defense in the role of the fourth service. Nevertheless, the principles of defining the

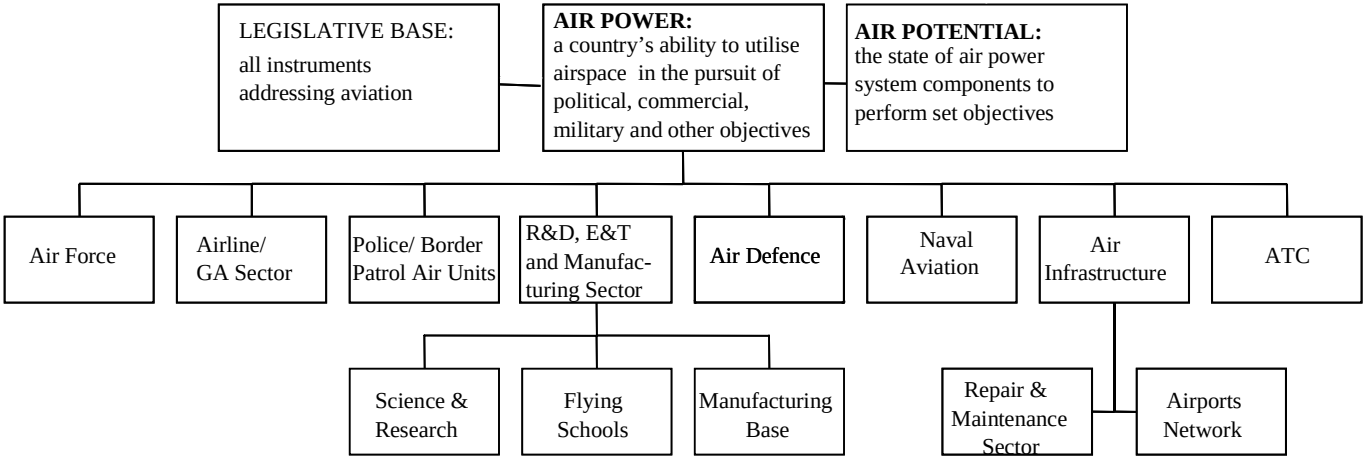

Figure 3: The Major Components of Air Power.

basic components are valid for the air power of any nation, which possesses aircraft and conditions for their use.

The following basic components of the air power generation system could be listed (see Figure 3):

- The nation's air force (including air defense forces, except the four aforementioned nations, where air defense forces are viewed as a separate component);
- State-owned and private airlines and aviation companies;
- The navy's aviation;
- Aviation arms of the police and the border police;
- State-run and volunteer aero clubs and defense support organizations;
- Air traffic control systems;
- The entire infrastructure supporting regular/normal flying;
- Research, education and training, and production facilities.

Sound air legislation is particularly important for the system's normal functioning. This cannot be counted as a component, yet directly influences the nature of processes at hand and the manner in which tasks are performed, particularly in peacetime. Each of the above mentioned major components may be regarded as a subsystem of elements. Thus, air forces represent a service within the armed forces. One of their elements, aviation, may also be viewed as a subsystem, which is composed of various types of aviation services. However, over-detailing of the system is not the aim here, since any over-complication would obscure the tasks set in the introduction.

Some of the elements in the structure of components that generate air power play special role in shaping and pacing its development. This explains why the author believes that the structure of these components deserves particular attention and their composition can be used as an entry point to the system of air power. Under consideration are two components: the entire infrastructure specialized in support to normal flying and research, education and training, and production facilities. The former essentially includes maintenance facilities and the network of airports. The latter component essentially consists of three elements: a developed research base; an aircraft manufacturing base, design facilities and teams of designers; and a system of schools devoted to training air personnel. Despite the fact that these elements are described in general terms as parts of two components and that in most countries their presence may be symbolic or altogether lacking, their significance in the development of aeronautics and aviation is enormous.

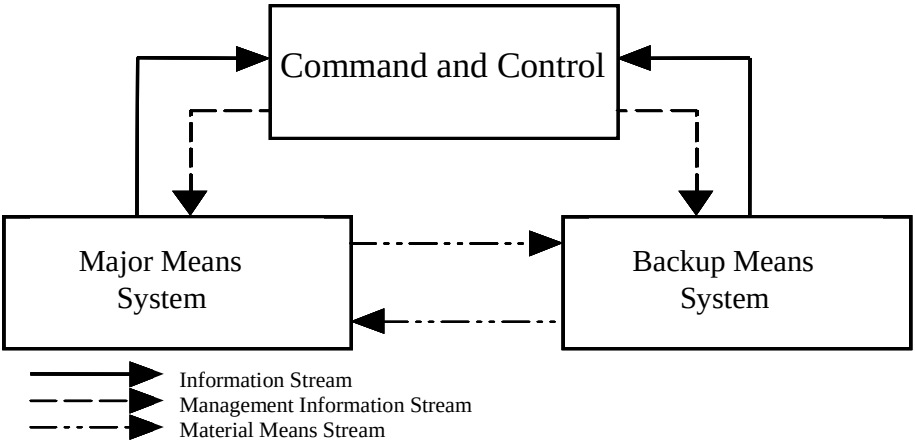

Figure 4: Basic Systems of Air Power.

In turn, these components may be subdivided into three basic subsystems (Figure 4):

- The major means subsystem comprising components directly involved in performing set tasks using aircraft;
- The backup means subsystem comprising all components, which ensure normal flying;
- The command and control subsystem comprising components involved in command activities.

Such a distinction is necessary in order to facilitate the creation of a method for quantifying air power – the practical purpose and meaning of the system proposed in Figure 3. National air potential forms the basis of air power. It determines the quality of the system. Air potential expresses the state and capabilities of air power components or those of the forces and means directly participating in meeting set tasks. It is not always necessary for the state to exercise its full potential. The extent of its application depends on many factors, foremost among them being the nature of the task in hand.

Air potential may be viewed as a source, which feeds the system that generates air power, or else as a system composed of several basic elements which determine it (Figure 5). They are grouped on the basis of possible modernization of components and essential elements in the system which generates air power. They might be viewed as the entry point to the system of air potential, whose exit point is the degree of its relevance as the ultimate assessment indicator of the state of the components of air power. The following elements of air potential could be outlined:

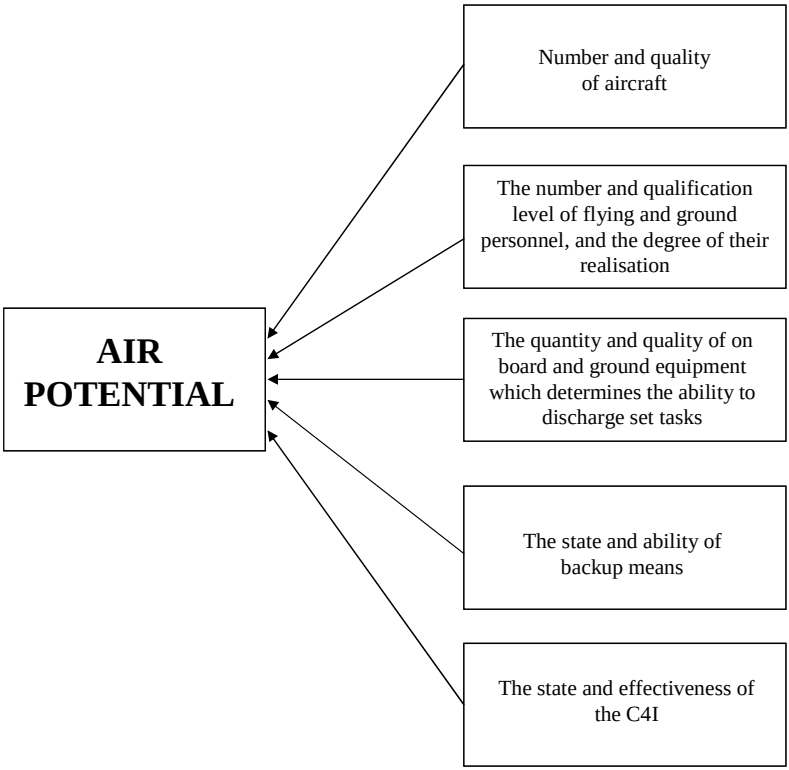

Figure 5: The Elements of Air Potential.

- The number and quality of aircraft;
- The number and qualification level of flying and ground personnel, and the degree of their realization;
- The quantity and quality of on-board and ground equipment, which determines the ability to perform set tasks;
- The state and capabilities of supporting means;
- The state and effectiveness of the command system.

The degree of relevance of air potential over a set time frame also determines the degree of air power. This is conditional, depending upon the actualization of the ele-

ments of air potential. Cases are known in practice where for one reason or another one or more components generating air power or elements of air potential have been missing or have been underdeveloped. Yet this did not mean that air power has been absent or that a certain part of its potential has become irrelevant. Naturally, it has to be clear that in such cases the level of air power at disposal of a nation and a state is seriously degraded. Apart from its own real capabilities, it is also subject to decision by the political or military leadership on the functions it assigns to air power in the overall system of military or national power.

It is clear that the proposed system for generating air power is part of the system generating military and national power. Its results may be measured by the degree of relevance of the air potential to the tasks assigned. Broadly, these tasks may be performed in peacetime, during crises, and in wartime. Despite the fact that the set of peacetime tasks that could be performed by the system of components which generates air power is very big, it is well possible to classify them as follows:

- Dissuading potential aggressors;
- Providing aid in time of disasters and crises;
- Helping realize all national and state priorities in economy, science and research;
- Patrolling and controlling national airspace;
- Maintaining a constant level of training and readiness for possible transition from peacetime to war.

The role of the Air Force in peacetime as a component of the system that generates air power is specific. As an armed service, the Air Force is able to demonstrate visible and tangible potential and readiness for its use. Political leaderships often apply such approach in order to dissuade and deter potential adversaries. Demonstrative actions in many cases allow to attain political aims without recourse to arms: merely through the effect of potential power or superiority, or demonstrating the threat of an armed clash.

Thus, the presence of air potential is always an instrument of national policy, and a reliable backup to peacetime diplomacy. This is helped by the very nature of the air force and its inherent properties: the constant high state of combat readiness; mobility and the ability to concentrate forces within the chosen theater of action rapidly. In this sense, the lack of and adequate level of air potential of Bulgaria, and the current process of minimizing the potential of components within the system, which generates air power, deprives the political elite from positions on the international arena. This is especially true today, when this system can play a decisive role in crisis management by performing basic tasks linked to:

- Measures for each phase of crisis escalation;
- Finding and destroying the likely enemy's diversionary and reconnaissance units, including terrorist groups;
- Participating in special operations (aerial reconnaissance, transferring special operations units, etc.).

At the same time, air power along with the other elements of national power increases the nation's ability to resist possible armed attack in a significantly faster and more adequate manner. Thus, it attains ever-greater significance in national security as the degree of armed threat rises. The material manifestation of this aspect of air power is characterized by the genuine ability of the state and nation to rebuff aggression, which must not be taken to mean that air power depends solely upon the combat power of the air force. Above all, air power must be interpreted as the ability of the state to utilize all resources and possibilities at its disposal in the use of airspace, including its use for the purposes of defense. Seen from this angle, the concept of air power may to some extent be defined as a basic indicator of national economic power, since it is an ever-present part of it. In today's conditions, economic power predetermines the levels both of military power, and of air power as an element of the former, and thus has both an economic and a military aspect.

The circumstances, which make us include military aspects into the concept of state air power, are mostly of an international character. Precisely these circumstances form the degree of threat to the state and beget the need for defense. In this sense, in military conflict of varying degrees of intensity and scale, air power expresses itself in the ability to:

- Control airspace over the home territory;
- Secure the actions of other components of military power;
- Control enemy airspace;
- Conduct constant surveillance (aerial, signals and radar) and gather information on the enemy using the advantages of the third dimension;
- Conduct transport operations.

The relative importance of army, air force, and navy has always depended on political and strategic factors, geography, international alliances, etc. The army has played first fiddle in some periods; in others, primacy has rested with the air force or navy. The place and role of each service in peace and war depends on the technical level of adversaries, their potential, and their geography.

Experience shows that each of the services makes a definite and always significant contribution to victory. Over the last century (since the arrival of air power) there

have been no pure infantry, naval or air wars; neither do military experts foresee any in future. One thing remains unaltered: only the army can secure the results of a campaign or a war. Its sheer physical presence on the ground consolidates the conquests of hot conflict.

Conditions for attaining the objectives arise only if organized, well-armed and well-trained armed forces are available. Each service has a specific purpose and modes of interplay with the others. Appropriate utilization of this specificity determines the success of an operation, campaign, or war. Thus, the pursuit of balance between the services (and within each of them) is a major issue in modern military science. National interests guide this search closely as do, *inter alia*, tasks set by political and military leaders, developments in the region and beyond, national potential, and geography. Finding this balance is also the key to another challenge: striking a balance between the components of air power.

Those who devise air power must carefully blend its components in the most advantageous way, and must maintain this blend thereafter. This is only possible after thorough scientific analysis of all influences on civil and military aviation. Balancing thus involves military science and addresses historical and technical developments. The issue of balancing invites examination of historical and military science aspects.

Military doctrine, national security postulates, and national constitutions have to provide for balanced development of air power. They must determine the role and place of air power and the air force within the hierarchy of national power, and national armed power. They must fix its relative weight in the system, its tasks in peace and war, and the composition and purpose of various force commands and civic volunteer formations.

In view of the basic requirements to air power (to perform tasks using its peacetime strength while taking account of geography, and to maneuver using available resources), another major procedure is to determine human and material strength. Here, planners must bear in mind that force renewal in today's swift wars is highly problematic, and generally considered impractical. Thus, balancing and creating air power is mainly a matter of peacetime planning.

Balancing the components of air power is an ongoing process. It evolves according to historical circumstances. Major factors determining such evolution include politics (changing balances, military blocs, and changes of régime), economic realities and changes in national economic and military potential, developments in indigenous and world science, and changes in the tasks assigned to air power. Tasks set by politicians and the level of national economic development are prime among these factors.

The study leads to these conclusions:

- Air power is among the major indicators of national economic and military prowess. It expresses a country's genuine ability to utilize the air in the pursuit of its interests. Thus, it is undoubtedly a primary element of the national security system, and a measure of national prosperity and potency.

- *The benefits of possessing air power* and air potential stem from the air as an environment (high speed, long range, three dimensional maneuverability), and from the promise of further development as science progresses. The air allows high mobility, flexibility and universality, and offers politicians and military leaders rapid and effective solutions to complex problems. This ranks air power as a prime element of national power. The primacy of air power and its growing importance define it as an issue that would repay its study as a system.

- *The number of components* and the degree of their development express priorities and objectives nations set themselves. They are explicit in national security doctrines and implicit in geography, and the state of tangible and intangible sources of national power. This state varies with time. It also relates to links between system components. In this sense, air power is a complex open system whose entry point features components and subsystems, and whose major source is air potential.

- *Air power has a multi-role nature* in both peace and war. Each of its tasks draws on a different set of components, thus calling for proper balance. Such balance can be determined using set principles and criteria. Experience shows that imbalance in constructing and developing components results in limited ability to perform tasks, and degraded ability to tackle subsidiary tasks. In this sense balancing components, and refining them to maintain this balance, is a challenge to national business, intellectual, and political leaders.

- *The utilization of air power* depends on the proper interaction of heterogeneous components. Thus, utilizing air power does not imply merely summing these components' potentials, but rather invoking an altogether higher unity and potency. Attaining proper balance in the structure of air power depends to a decisive degree on complex scientific management during its construction and maintenance. This in turn may call for adequate funding. Obtaining it ought not to be a problem, since air power is always a matter of adequate sufficiency in a national context.

- *Armed conflicts are direct stimulus* for the development of air power and air potential. They have played a unremitting shaping role ever since air power's emergence. Experience from assigning roles to air power's components can read across to military science, and to the formulation of national priorities as

a whole. Armed conflict is an extreme state that most rapidly tests the veracity of peacetime assumptions. What is necessary is a thorough study of the influence of air power on the course and outcome of armed conflict (particularly of air power's major wartime component, the air force). Because of their properties, air forces also manifest themselves as prime instruments of national policy in a variety of circumstances.

Notes:

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2020 AIR FORCE MISSION CAPABILITIES PACKAGES FROM OPERATIONAL ANALYSIS PERSPECTIVE [1]

Velizar SHALAMANOV

Abstract: This article deals with the development of Air Force mission capabilities packages. To this end, it addresses the challenge of operational analysis of the complex relationships among end users, services, missions and tasks of the Air Force, capabilities, resources, units, etc. The author emphasizes the importance of creating respective service-oriented governmental architecture. The need for definition of Universal Task List (UTL) for the whole security sector and distribution of capabilities among security sector organizations is also outlined. A systematic operational analysis for capabilities/ force structure planning and mission capabilities packages (MCP) planning for certain operations/services is thoroughly presented.

Keywords: Force planning, air force capabilities, task list, air force technologies, operations research, balanced scorecard, QPR.

Introduction: Mission and Universal Tasks of Bulgarian Air Force

The Bulgarian Air Force (AF) has clear mission to provide Air Sovereignty (air policing, air defense, control of the airspace) and air support to Land Forces and the Navy, as well as to play crucial role with airlift capabilities, reconnaissance, search and rescue, evacuation, fire-fighting, and other support activities. Training and certification is another important mission.

Certainly, there are some invariant missions such as radar coverage with IFF capability to provide common recognized air picture. Command and control with adequate Air Operations Center / Air Sovereignty Operations Center (AOC / ASOC) is critical to the integration of air power. Communications, including at present predominantly data links (for example, Link 16), are essential for any other mission as well as for the integration of the AF with other services and allies in a network-enabled force. The need for a coalition-wide planning is crucial for a country that is NATO and also EU member.

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For future force development the end user becomes more and more important, that is we have a shift from enemy centric planning to capabilities centric approach and finally to user-oriented planning model. The analysis of the services provided to the end user leads to the Universal Task List (UTL) for the AF, from which required capabilities could be drafted. This creates a complex network of a user, services, UTL, capabilities, resources, units, etc. The operational analysis of such a complex system is the challenge addressed in this paper.

Certainly, some of the above mentioned AF missions and respective capabilities could be assigned to other institutions, but this is something to be decided after a serious operational analysis of the specific case of Bulgaria. There is a clear and present need to develop a *service-oriented governmental architecture in the field of aviation*.[2] After that it will be possible to define alternatives for the organizational support of these services and to select the best option. It is more or less evident that in a small country like Bulgaria it is difficult to expect the government to have many air-related service operators. Different services could be used by different agencies and other users, but operator could be one body (or several bodies with certain specialization – horizontally or vertically, but without overlap and duplication).

The main themes in this article are:

- The importance of the service-oriented governmental architecture in the aviation field;
- The need for security sector large UTL definition and distribution of capabilities;
- The crucial role of IFF and data link for network enabled forces;
- The need for a systematic operational analysis for capabilities/ force structure planning and mission capabilities packages (MCP) planning for certain operations/ services;
- The role of the Center of Excellence in Operational Analysis (CoE-OA) and the supported by the Center Joint Training Simulation and Analysis Center (JTSAC) for Computer Assisted Exercises (CAX) to provide Concept Development and Experimentation (CDE) followed by Implementation Planning, Management and Measurement (IPMM) using Balanced Scorecards (BSC).

Services Provided and Capabilities Supported by the Air Force

The definition of capabilities and services provided by the AF is essential part of the planning process. This is an iterative process comprising several steps:

- Initial definition services, required UTL and capabilities needed for these AF UTL;

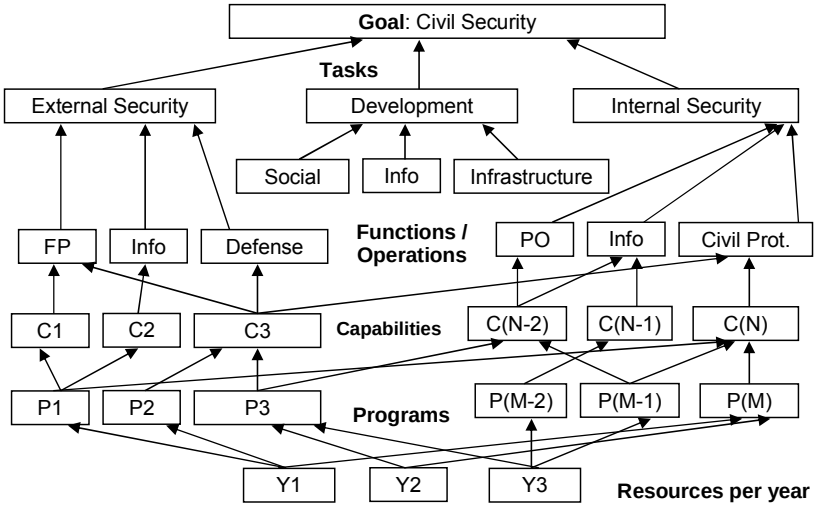

Figure 1: AF Capabilities as Element of the Security Sector Capabilities.

- Integration and balancing with the capabilities and services of other institutions;
- Development of a Mission Capabilities Packages planning system for specific operations/ services.

When considered at Alliance level, the process of operational analysis has to include coordination and balancing on international level as well.

Another specific aspect is related to the possibility of one mission being carried out with different set of capabilities and a certain capability to be built trough different programs (with different type of equipment, personnel, training, logistics, doctrine, etc.). At the end, all programs are funded practically from one budget for security and defense.

The real challenge is to optimize the set of programs in such way that with minimum budget to provide the best combination of capabilities in different institutions (including AF) and related services that through different operations/ functions contribute to the main goal of security – protection and freedom of the citizens (the ultimate end-user).

Figure 1 illustrates the procedure used to generate a set of analysis/ optimization modules for decision-making support aiming to find the best possible way to distrib-

ute a limited amount of money to different programs in order to obtain the best mixture of capabilities in different institutions for the most effective joint/ coalition operations. This approach is being further developed in the CoE-OA, but in a more efficient way this task could be solved if Bulgaria requests transfer of capabilities planning/ change management models from the NATO C3 Agency and tries to participate more actively from the very beginning in the research plans of the newly established European Defense Agency.

The definition of distribution of services and capabilities among different institutions relates mainly to procurement and maintenance of equipment, training of personnel and provision of certain level of readiness. This is essentially definition of a service-oriented governmental architecture. The next challenging task is planning and operational use of mission capabilities packages for real operations – providing real services.

Alternatives for Mission Capabilities Packages

There are some critical capabilities—invariant to any service—provided by the AF as, for example:

- Collection of common recognized air picture (including IFF);
- Adequate command and control (C2);
- Modern data links and other type of communications (Comms);
- Decision-making support tools (DSS).

These are network-enabled capabilities (NEC) for the AF on national level and in coalition environment.

Other important capabilities, which directly produce service for the end user, are:

- Air defense and air superiority;
- Air support/ strike;
- Transport – operational/ tactical airlift;
- Reconnaissance;
- Search and rescue;
- Emergency management support;
- Training.

It is important to decide on the list of possible MCP and variations for their services. As a next step for every MCP, the pool of equipment and personnel has to be identified (developed/ trained). There are different options and the clear definition of these

options as well as the criteria for assessment and selection are important elements in the decision-making process.

So, there are alternatives for the pools of capabilities from which we could develop alternatives for MCP in preparation of specific operation.[3]

When developing the alternatives for the pools of capabilities for generation of certain MCP, we have to keep in mind the range of MCP we plan to build for typical operations, as well as how many MCP will be deployed simultaneously.

It is realistic to consider as a first option the possibility to maintain pools of capabilities for all eleven MCP listed above. These pools will be the main organizational formations of the AF, for example:

- Multi-role fighter unit;
- SAM unit;
- Combat helicopters unit;
- Reconnaissance unit (UAV or other);
- Transport airplanes unit;
- Transport helicopters unit;
- Radar unit;
- C2 unit;
- Communications unit;
- Logistics unit;
- Training unit.

Every MCP will need capabilities from different pools integrated and focused on the result/ effect – following the effect-based operations concept. Every MCP will certainly need C4ISR (including IFF) capability to integrate all other capabilities for combat result/ effect as well as logistics to sustain itself. In most of the cases MCP are for expeditionary missions so they will need reach-back and air lift.

Some of the above mentioned units providing the pool of forces for MCP could be integrated (for example, helicopter units). Some of these pools could be used to plan MCP for other services/ institutions – if for example all helicopters are in the AF, from these helicopters MCP for the Ministry of Interior or the Ministry of Emergency Management could be formed.

Some of the MCP for a certain operation will probably require capabilities that are provided by pools of capabilities developed in other institutions– for example, communications, radars, transport vehicles/ aircrafts, etc.

In the CoE-OA, tools are under development to analyze the needed MCP for future missions, but the real use of these software packages will require close cooperation with military experts. Algorithms are available for generation of alternatives for MCP according to defined mission (combat effect/ result) from available pools of capabilities in different units. The service-oriented architectural approach forms the basis for definition of alternatives for MCP (operations planning) and before that – capabilities pools (force planning).

Assessment and Selection of MCP

When we consider a specific operation, the set of MCP has to be defined and configured from the existing building blocks. For example, a set of MCP that are needed for Kabul airport control in Afghanistan or to support the Bulgarian participation in Iraq, Kosovo, or Bosnia, could be defined having in mind the services to be provided there and the availability of capabilities in different units (including level of interoperability and readiness, sustainability in the context of the real operation).

As an example, for all expeditionary operations we need MCP for operational airlift, as well as MCP for local air transport/ tactical airlift, evacuation, and SAR. In addition, in any expeditionary operation there is a need for air reconnaissance and, in certain cases, close air support. Obviously, field Air Operations Center is needed for any deployed air capability as well as local radar coverage and certainly IFF capability for all aircrafts.

For every specific case, there are many alternatives for the MCP composition from existing pools of items, so there is a need for decision-making support in forming different MCP, assessing them and selecting the best alternative. Selecting one alternative as a result of comparative assessment is rather easier than trying to generate optimal MCP, or to pretend that there is one and only option for the required MCP. In the CoE-OA, there is expertise in using the software Expert Choice/ Multi–Choice 2 for generation of alternatives, assessment, and selection. As a separate first step, the overall architecture of the AF or possible typical MCP could be developed using System Architect.[4]

Sometimes, it is impossible to optimize the force architecture as a whole without considering all MCP together and in the context of possible planning scenarios. For example, MCP for Air Defense (AD) and MCP for Air Support (AS) as well as other possibilities could be generated from different elements – AD from mix of specialized AD fighters and surface-to-air missile (SAM) complexes, AS from strike fighters and helicopters as well as missiles, but both AD and AS MCP could be formed from multi-role fighters with more flexibility and with lower cost of overall life-cycle support.

Operational analysis based on generation and assessment of alternatives with selection of the optimal one is a key instrument for force planning, capabilities planning, and MCP planning in a complex.

The link between MCP planning and force structure (pools of capabilities) planning is very sensitive in the real time/ resource/ information-uncertainty frame. For example, a planner could decide to keep and modernize in certain way older equipment until more resources/ information is acquired for a new procurement. It is even possible to plan modernization in such a way that provides for security of investment in certain critical capabilities as communications, data links, IFF, etc.

Let us consider three options for MCP-AD: Bulgaria could keep MiG-29 for another 15 years, upgrading them with data link and IFF; could acquire second-hand F-16 with the same data link/ IFF capability for the next 15 years; and could procure new Grippen for the next 30 years. In the first two cases, Bulgaria will save money and will be prepared after 15 years with more resources and information to acquire a modern multi-role fighter for the next 40 years. In the first case, the initial price is lower than in the second case, but the transition from MiG-29 to a new multi-role fighter after 15 yeas will be more difficult and the exploitation cost will be higher. In the third case, the price is in the middle, but the risk of uncertainty is higher. All options could be assessed according to selected criteria and focused on certain goal, which will provide a solid ground for a decision to be taken. This could be achieved only through comprehensive operational analysis process. Such a process could not be separated from the developments in our NATO neighbors; further, it needs to account for the current and planned US military presence in Southeast Europe.[5]

Result-Oriented Implementation Management

In order to have effective management of the development of pools of capabilities as well as formation/ generation of MCP for certain operations, there is a need for a management system oriented towards a balanced system of indicators/ scorecards (BSC).[6]

Implementation management has to be realistic from resource point of view, priority of needed MCP for operations we are committed to, and according to the timetable of achieving required level of readiness.

It means that there is a need for combination of several parallel processes in one transformation process, in addition to which real deployment for operations is essential. The management of this combination of processes is a complex task because they are of different nature and normally with multi-source funding (national funds, public-private partnership or private financing initiatives, foreign military financing,

NATO/ EU funding) and reporting to different institutions (not only to those who fund the projects, but to stakeholders in the society).

For example, the processes are at least of three different types:

- Management of an organizational unit (capability pool or production unit);
- Management of a project – procurement/ modernization or utilization process;
- Management of current operation of deployed forces.

The sources of funding are from national defense budget, international programs (NATO, EU), bilateral foreign military funding, loans, national infrastructure project funding (for example air and maritime security, including IFF) and have different rules of spending.

In the CoE-OA there is a tool based on Microsoft Project and QPR ScoreCard [7] to support such complex change management processes of different type of sub-processes with different lines of funding and reporting.

Role of the Center of Excellence in Operational Analysis

The CoE-OA is a specialized academic body with core competences in the area of operations research and computer assisted exercises (based on modeling and simulation) that works with experts from military staff and administration to develop options, analyze these options, assess them, and recommend solutions to various problems in the fields of operational planning, capabilities planning, acquisition management, etc. In the environment described above, the CoE-OA is able to define in an interactive and iterative way a concrete structure for the scheme presented in Figure 1 and later to define options for pools of capabilities, structure of key MCP as well as plan for development and maintenance of these pools and MCP.

The most simplistic approach is to have a phase space for the AF with a step of one year (year budget) or three years (budget forecast) with assessment of static maintenance expenditures (including resources for operations) and dynamic expenditures (change/ investment – including training of personnel and organizational restructuring that is related to utilization of extra equipment as well) from phase to phase.

Let us consider an example based on the data given in Table 1 with the following capability pools/ units with certain number of items and cost of procurement and operational deployment:

Table 1: Generation of MCP from Capabilities Pools (CP) with Assessment of Cost for Maintenance of CP and Use of MCP for Certain Operation.

Operation	***MCP 1***	***MCP 2***	***MCP 3***	***MCP 4***	***MCP 5***	***Need***	***Cost***	***proc***	***ops***
CP 1	1	1	5	1	1	6	60	10	0,5
CP 2	1	1	6	1	1	7	7	1	0,2
CP 3			6			6	120	20	1
CP 4	3	4			2	6	60	10	1
CP 5		4		6		6	90	15	1
CP 6	1	1	3	1	1	4	8	2	1
CP 7	1	1	3	1	1	4	8	2	0,5
Cost	5,2	10,2	14,2	8,2	4,2	**28,4**	**353**		

- CP1 – radar unit (1 item is 10 M for procurement and 0.5 M for 6 months operation with deployment/ redeployment);
- CP2 – communications unit (1 item is 1 M for procurement and 0.2 M for 6 months operation with deployment/ redeployment);
- CP3 – fighter unit (1 item is 20 M for procurement and 1 M for 6 months operation with deployment/ redeployment);
- CP4 – air transport unit (1 item is 10 M for procurement and 1 M for 6 months operation with deployment/ redeployment);
- CP5 – air support unit (1 item is 15 M for procurement and 1 M for 6 months operation with deployment/ redeployment);
- CP6 – logistics unit (1 item is 2 M for procurement and 1 M for 6 months operation with deployment/ redeployment);
- CP7 – C2 unit (1 item is 2 M for procurement and 0.5 M for 6 months operation with deployment/ redeployment).

Total cost for *procurement* will be 353 Million.

In Table 1, we consider the following MCP with the presumption that only one MCP will be deployed at a time and certain reserve to define the number of needed items in every unit:

- MCP1 – operational air lift;
- MCP2 – tactical air lift;
- MCP3 – air sovereignty;

Phase Diagram of AF Development to 2020

Years budget	2007 -2009 130 M	2010 -2012 150 M	2013 -2015 170 M	2015 -2020 190 M
CP Procure Sustain	CPi -30% 40 M 50 M	CPi -50%	CPi -70%	CPi -70%
MCP readiness	MCPk -60% 10 M	MCPk - 100%	MCPj -70%	MCPj - 100%
MCP deployed	MCPs 30 M	MCPk	MCPr	MCPj

Figure 2: Change Management Table.

- MCP4 – air support;
- MCP5 – SAR/ emergency support.

Total cost for *critical deployment* in this case will be 28.4 Million.

The change management table shown in Figure 2 defines only one route – real operational analysis has to be based on a network diagram with many different options for every time period and transition arrows with certain cost. Practically, all these states in the diagram are concrete realization of the BSC to measure the effectiveness of AF transformation and the goal of planning is to define the optimal trajectory of the transformation as well as to manage it in the best possible way.

For the diagram, there are some critical steps to be taken:

1. Definition of goals for the next 10-15 years;
2. Definition of future capabilities;
3. Development of planning scenarios and level of ambition;
4. Concept development;
5. Planning/ costing of experimentation, including exercises;
6. Lessons learned;
7. Planning/ costing of implementation of concepts;
8. Planning/ costing of education, training and certification;

9. Planning/ costing for real deployment with subsequent lessons learned, improving of concept implementation and feedback to education/ training.

In such a network of phase situations we could identify the best end state in 10-15 years period and the best trajectory to reach it according to a set of criteria, including available resources.

In the course of such a planning process, criteria for success are identified that could lead to a balanced scorecard for transformation effectiveness.

Conclusions and Recommendations

A clear definition is needed for the main AF services, the respective UTL and the key required capabilities in order to define pools of capabilities and mechanism what is the possible optimal way to form MCP for a certain operation according to planning scenarios.[8]

Some other security-related services (for example, provided by the Ministry of Interior or the Ministry of Emergency Management, even by the other branches in the Ministry of Defense) require the same or similar capabilities available in the pools of capabilities of the AF. This calls for integrated capabilities planning for pools as well as integrated MCP planning for certain operations across the services and ministries.

The best way to develop methodology and supporting software is to test these concepts through series of exercises (preferably CAX) with the participation of many institutions in order to identify all the criteria and options/ alternatives for optimal/ rational decision-making.[9]

The main idea of this article is to stress the need of cooperation in the development of capabilities model of the AF in balance with other services and institutions outside MoD in order to optimize the pools of capabilities supported by the AF and the process of MCP planning for specific operations on national and NATO or EU level.

The main conclusion specific for the AF is that an IFF/ Data Link solution has critical importance and has to be flexible enough to integrate every element of the AF Architecture in the process of change of platforms/ weapons in the NEC force. The proposed solution is based on a tailored package for different air platforms and radar sites and maintenance of commonly supported integration architecture.

An additional conclusion is related to the integrated planning of transport/ SAR/ emergency support/ crisis management support capabilities at large with the other institutions in the security sector. It is most important currently in the area of transport airplanes/ transport helicopters and their specific capabilities as well as common field AOC for joint/ combined operations. What the CoE-OA proposes in this sense is

based on integrated capabilities/ MCP planning system and flexible field C2 modules to establish mobile AOC for different operations.

The general process of MCP planning through support of Concept Development and Experimentation using CAX in the area of civil-military cooperation in crisis management is supported by the NATO SfP981149 Project for capacity building in the CoE-OA. The key tools used in the CoE-OA are System Architect/ OpNet for architecture development, SCIP/ Powersim for scenario planning and simulation in decision-making support, a set of analysis/ optimization models and MS-Project/ QPR ScoreCard for management of the process, together with an environment for CAX to support analysis and decision-making with experts in the loop.

Finally, it has to be recognized that effective AF MCP planning is impossible outside the collective capabilities planning in NATO and EU as well as without close cooperation with our neighbors, especially Romania as a new NATO/ EU [10] member and also considering the future membership of Macedonia and Albania. The Bulgarian NATO/ EU commitment to Black Sea Cooperation [11] and especially the role for integration of Georgia has to be kept in mind during the planning process.

In this context, the CoE-OA and the Joint Training, Simulation and Analysis Center (JTSAC), developed by the Institute for Parallel Processing, Bulgarian Academy of Sciences, in cooperation with other institutes to support the transformation of the security sector are examples for the approach we propose to the AF as well as to other services from the national security sector. Such an approach will facilitate the transformation to an integrated security sector with cooperation between services, industry, and academia.[12]

Now, when main platforms—transport/ training airplanes and helicopters—are procured as well as airfield modernization has been finished at high enough cost with forecast for large funding not so favorable in the future, the challenge to the AF is the development of service-oriented architecture and the establishment of MCP/ force structure planning and management system in the context of the whole security sector and even of NATO/ EU as well as of a regional scope.

Notes:

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A FRAMEWORK METHODOLOGY TO SUPPORT THE SELECTION OF A MULTIPURPOSE FIGHTER

Todor TAGAREV, Gueorgui STANKOV, Lozan BIZOV, and Atanas NATCHEV

Abstract: The procurement of multipurpose fighter planes is one of the major procurement, or modernization projects, announced by Bulgaria's Ministry of Defense in 2002, but a procurement case has not been initiated so far. This article calls for a transparent decision-making process within a rational framework, based on both qualitative and quantitative analysis, that would allow to select "the best" multipurpose fighter for the Bulgarian Air Force. After outlining the main assumptions, the authors examine the issue of identifying and structuring the criteria for selection of a multipurpose fighter, describe the main steps of a rational, quantitatively-based, transparent decision-making process and analyze the major decision support requirements, as well as methods and tools that may be used in providing analytical support to both the selection process and the follow-on contract and project management.

Keywords: Defense procurement, defense acquisition management, decision support, DSS, AHP, transparency, contract management, risk management.

Introduction

Since the beginning of Bulgaria's defense reform in 1999, the Air Force enjoys a position of higher priority in the plans for modernization of the Bulgarian Armed Forces. Considerable part of the defense investments since the 1997 decision of the country to seek membership in NATO dealt with primary interoperability issues, i.e., command and control, strategic and tactical communications, air surveillance and exchange of related information, and host nation support requirements.[1] Another portion of the investments addressed immediate requirements of the increasing contribution of the Bulgarian Armed Forces to peace operations in the Balkans and, later, in the international operations in Afghanistan and Iraq.

In the first five years of reform only the Air Force received new platforms and started sizeable programs to upgrade legacy equipment. First, the Ministry of Defense pro-

cured six Bell-206 helicopters (primarily for training) and one Bell-430.[2] The procurement of Pilatus aircraft followed – the Air Force received six PC-9M aircraft for training and one PC-12 for VIP transport. A contract for the delivery of twelve helicopters AS 532AL "Cougar" for the Air Force (plus six AS 565 MB "Panther" for the Navy), estimated at approximately USD 300 million, was signed in 2004 and three of the "Cougars" have been delivered. In 2005, the MOD signed a contract for procurement of five transport aircraft C-27J Spartan, estimated at 91 million Euro, with an option for three additional airplanes, and the first one of these is expected in August 2007. Contracts were signed for overhaul and upgrades of a squadron of MiG-29 fighters and for Mi-24 and Mi-17 helicopters.[3] In addition, the Ministry of Defense invested in upgrading airfields, as well as in the performance and the interoperability of the air defense system (which in Bulgaria is part of the Air Force) through modernization of air surveillance radars, IFF, and building of a new Air Sovereignty Operations Center.

Nevertheless, all these investments pale in comparison to the expected procurement of a squadron of multipurpose fighter planes.[4] This procurement is of considerable importance not only because of the cost involved; it relates to the prestige of the military, and the Air Force in particular, potentially provides for an air defense role of Bulgaria in parts of South East Europe, and enjoys heightened societal interest. Moreover, any procurement decision will be accompanied by a very intensive struggle among the services for a share of the limited defense investment budget.

Therefore, the high cost involved and the interest towards the potential procurement of multipurpose fighters for the Bulgarian Air Force among political and military elites, experts in and outside the Government, businesses and society, as well as international businesses and lobbies, calls for a fairly transparent decision-making process within a rational, commonly understood and agreed decision-making framework. This paper presents a possible outline for such decision-making framework and overview of the support that the operational analysis community may provide to the selection, as well as to contract and project management decisions.

Key Assumptions

Any transparent decision-making process requires clear identification and, often, deliberation on key assumptions. In the national experience, assumptions are rarely stated publicly and, thus, cannot be challenged. Our analysis outlines four key assumptions for this particular procurement.

First, Bulgaria will not set its own requirements for *development* of a future aircraft (and certainly will not develop its own aircraft). The country will select among available fighters. Furthermore, and given predicted costs of fighters under development,

the country will select among fighters that are *currently available* on the market.[5] Possibly, the Ministry of Defense will set some unique, but minor requirements towards the platforms and/or maintenance equipment. One example would be the provision of full documentation package in the Bulgarian language. However, such requirements are not expected to be among the important considerations in the selection process.

Secondly, most probably Bulgaria will conduct its own tender, without cooperating with other countries planning to procure multipurpose fighters in the near future. The combination of procurement projects of two or more countries is still a possibility, although fairly distant one at this stage. Nevertheless, compatibility of analysis and approaches to selection and project management is an important consideration in order to assure common understanding of requirements and proposals, as well as to provide opportunities for future cooperation with other countries in operating and maintaining the same type of aircraft and, thus, to lower operations and maintenance costs.

Thirdly, the sheer cost of this project raises strong expectations that this and other similar defense procurements will be used to generate investments in the country and to create other economic benefits through the mechanism of offsets. Recently, Bulgaria's Prime Minister Mr. Sergey Stanishev welcomed the changes in the offset regulations [6] and presented the offset programs as a tool "to bring additional investments in the Bulgarian economy, that will lead to higher levels of economic growth, technology transfer and creation of new jobs."[7]

The formulation of the fourth and last among the key assumptions is based on analysis of the experience and reasonable forecasts of the defense budget. The procurement of multipurpose fighters may be signed only using a loan that is guaranteed by the Bulgarian state. The practice is that the prospective supplier joins forces with a powerful financial institution that is willing to provide the loan. Then, this loan will be paid off from the defense budget over a number of years.

Criteria for Selection

There are dozens, possibly hundreds indicators by which we can judge whether and to what extent a particular aircraft suits the needs of the Bulgarian Air Force, or rather – Bulgaria's security and defense policy. A subset of the respective requirements should be set as *criteria* in advance to the initiation of the selection procedure. For convenience, this paper presents the possible criteria clustered in three main groups, related to *performance*, *cost*, and *economic impact*. Additional criteria are included in one of these three groups even though strictly speaking they may not perfectly fit the chosen name for the group.

Performance Criteria

Aircraft speed, altitude, range, agility, weapon load and stand-off capabilities, sensors and electronic suites, protection, day/night and weather-related capabilities, take-off and landing requirements, etc., are key considerations in the selection of an aircraft.[8] The respective criteria should be clearly related to foreseen missions and, respectively, set primarily in operational terms.

System requirements may also be included in this group of criteria, especially when they are related to interoperability and compatibility with existing infrastructure. Particular technical specifications cannot be set as "criteria," unless they are solidly justified, e.g. if the aircraft needs to fit in existing hardened shelters.[9]

One particular sub-group of criteria is based on necessary, and expected, availability and the respective reliability and maintainability requirements. These relate, in part, to the system of maintenance for the aircraft, which as discussed bellow, impacts aircraft life cycle costs.

Cost

Much too often decision makers focus their attention on the upfront cost, i.e. the cost to procure the aircraft *per se*. Of primary importance in the formulation of cost criteria, however, is to account for "full cost" both in terms of package, necessary to operate and maintain the aircraft, and costs throughout its life cycle.

Since Bulgaria's defense establishment has very limited experience with the notion of "full cost," and in order to provide "interoperability" in the communication with potential contractors and possible future partners in procurement and/or maintenance of the aircraft, it is strongly recommended to use commonly accepted cost breakdown structures and life cycle cost models.[10]

Given the forth among the key assumption above, in the formulation of cost-related criteria Bulgarian defense officials need to account for the full cost to refund the loan, i.e. interest rates, etc., but also for perceptions on what is a good balance between immediate and future financial obligations to be covered by the defense budget.

Economic Impact

Since January 2007 Bulgaria requires offset obligations for at least 110 percent of the contract cost. The new *Regulations for Granting Special Public Contracts* in effect predefine the selection criteria, related to the economic impact of the procurement of multipurpose fighters. The Regulations further fix the ration between direct and indirect offsets and authorize the Ministry of Economy and Energy to deal with the offset aspects of the procurement. Thus, only the volume of the offset obligations may be

seen as a criterion among all others for selection of a supplier; the Ministry of Economy and Energy deals with all indirect offset arrangement, and the Ministry of Defense – with the direct offsets.

Implicitly or explicitly, the Ministry of Defense may include requirements towards bidders that would guarantee a degree of independence of the country in maintaining and operating the aircraft. Some of these may take the form of offset requirements.

In this group or separately, decision makers may decide to account for a number of additional factors, such as expected negative environmental impact of the new weapon system, the necessity to build a new base, to expand or to close down an existing one, and the respective communal impact, etc.

One special group of criteria may relate to the arrangement for management of the procurement contract and the whole project, such as:

- Rate and time of delivery
- Risk management conditions, etc.

Decision-making Process

Decision making is a process of choosing among alternative courses of action for the purpose of attaining a goal or goals.[11] Turban and co-authors identify four distinct phases of the decision-making process: (1) intelligence, (2) design, (3) choice, and (4) implementation.[12]

In regard to acquisition decision making and focusing on the selection of a supplier, Elisabeth Wright further subdivides eight phases in the development of acquisition strategy:[13]

1. Identification and commitment of the right resources
2. Collection of background information and data
3. Synthesis of information
4. Identification of optional strategies
5. Further development of best optional strategies
6. Identification and integration of "best choice" strategies
7. Evaluation of best choices
8. Final risk assessment and risk mitigation.

The intelligence phase covers identification and definition of the problem at hand; setting organizational objectives; data collection (with account of data collection costs, accuracy, objectivity, and potential information overload); problem classification and statement; problem decomposition.[14] Communication among decision mak-

ers and decisions on process ownership are important, albeit often neglected requirements towards this phase.

In the design phase, functional area specialists and analysts together define variables, relationships, criteria, and create adequate models. Then they propose principles of choice, identify alternative courses of action, consider how to deal with risk, develop/generate alternatives, identify alternative solutions, predict and measure potential outcomes.

The choice involves solving the model and conducting sensitivity analysis. The phase culminates in selection of "best" or good alternative or alternatives.

During the implementation phase a number of feedback loops are used to refine models in order to better manage risk during the implementation of the contract and the whole project.

Although usually a Minister or a designated Deputy Minister makes the final decision, group decision making is prevalent in the process.

Analysts in Decision Support Roles

The operational analysis community is able to provide decision support in almost all phases and aspects of the decision making process. This section of the essay gives a glimpse on important decision support requirements and possible analytical roles, methods and tools.

First and foremost, analysts are able to assist defense officials in bounding and structuring the problem of selecting a multipurpose fighter.

Secondly, rigorous analysis is indispensable in translating poorly structured concepts and requirements of security and defense policy into performance requirements for the fighter.[15] The creation of a typical goal structure (selection criteria) should account for fighter missions and tasks to be performed over a set of diverse scenarios, fighter capabilities and characteristics, and to provide a suitable metrics while working with different timeframes.

Key is the role of analysts in dealing with multiple criteria with hierarchical structure and complex relationships in order to compare a number of alternatives. Typical tasks involve normalization of criteria, assigning quantitative measures for qualitative attributes, usually through the use of utility functions, checking for consistency, processing expert estimates, etc.

In addition, typically analysts are involved in devising cost structure models and, in particular, life cycle cost models, as well as analyzing statistics compiled over the years and related to diverse platforms.

Another key analysis task based on assessment of potential performance and costs is to rank alternatives according to cost-benefit criteria.[16] Recently, Bulgaria's Ministry of Finance introduced rigorous requirements towards the management of all public investment projects, including requirements for provision of convincing cost-benefit assessment *prior* to the allocation of requested finances.[17]

For projects of this magnitude, scientists are often tasked to develop and/or adapt decision support systems (DSS) in order to facilitate the work of the selection team, save time, alleviate mistakes, visualize alternatives and results, etc. From mathematical standpoint decision support involves the use, and DSS typically implement techniques for multi-criteria decision-making such as Analytical Hierarchic Process (AHP), Multi-attribute utility theory, Concordance analysis, Regime Method, Evamix Method, ELECTRE, Weighted summation, Ideal point method, etc.[18] Examples of implementations of DSS systems are Expert Choice, Force Matrix Model,[19] etc.

Further to the selection of the "best" aircraft, analysts may support the Integrated Project Management Team in planning and overall project management. In addition to general purpose project management methodologies, such as PERT/CPM,[20] the key challenge here is to manage requirements throughout the selection, contracting and the delivery processes. DOORS is an example of a requirements management DSS that is adequate to such complex projects.[21]

In conclusion, the selection of a multipurpose fighter for Bulgaria's Air Force is a complex, semi-structured problem, which involves very high expectations and costs. Recently, the regulatory framework in the country placed much higher requirements for transparency in decision making and cost-efficiency of public investments, including defense investments. We reason in this essay that to meet these requirements is far from trivial. On the contrary, it demands elaborated decision-making frameworks and use of solid analytical capacity. The essay provides a sketch for the decision framework and the respective methodology and informs decision makers on decision support requirements and key roles of the analytical community in the process of fighter selection.

Acknowledgement

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Notes:

[1] Volume 6 of Information & Security, <http://www.isn.ethz.ch/pubs/ph/details.cfm?lng=en&id=773>, addressed the priorities of modernization. See for example the article Todor Tagarev, "Prerequisites and Approaches to Force Modernization in a Transition Period," *Information & Security: An International Journal* 6 (2001): 30-52.

[2] See <www.airforce-bg.com/helicopters.html> (27 May 2007).

[3] Most of these, however, failed.

[4] See *Armed Forces Modernization Plan 2002 – 2015* (Sofia: Ministry of Defense, 2004), <http://www.mod.bg/en/modern.html#>; and *Summary of the Basic Projects for Modernization of the Bulgarian Armed Forces* (Sofia: Ministry of Defense, September 2004). Project # 3 in the list of the 11 main modernization projects is "Acquisition of a new Multi-role Fighter."

[5] Which means that by the time it is fully operational, the Bulgarian fighter force will be ten to thirty years behind its more technologically advanced allies and possible "peer competitors."

[6] With its Ordnance # 1 for 2007, the Council of Ministers enforced new *Regulations for Granting Special Public Contracts*, published in State Gazette 7 (January 2007). For any defense contract amounting to over 10 million BGN, a foreign contractor is obliged to sign offset deals for no less than 110 percent of the cost of the defense procurement, and 70 percent of these shall be "indirect offsets."

[7] Sergey Stanishev, Prime Minister of the Republic of Bulgaria, Speech to the International Conference "Offset in Bulgaria: Current Challenges and Perspectives" (Sofia, 19-20 February 2007), unofficial translation by the authors. The speech is available in Bulgarian at <www.natoinfo.bg/SpeechesAndDiscussions/Stanishev_offset.htm> (12 April 2007).

[8] For a structured and detailed presentation of performance requirements see the article by Venelin Georgiev, "Analysis of Alternatives: An Efficient Tool in Managing Force Modernization Projects" in this volume of *Information & Security*.

[9] Such requirement may not be included among the selection criteria, but then the cost for building such shelters (if still necessary) should be included among the costs of the respective alternative.

[10] A number of NATO RTO studies provide a good starting point. See *Cost Structure and Life Cycle Costs for Military Systems*, RTO Technical Report TR-058 (Paris: RTA, September 2003), <www.rto.nato.int/panel.asp?panel=SAS&topic=pubs#>, and Marcel Smit, Arthur Griffiths, et al., *Methods and Models for Life Cycle Costing*, Pre-released RTO Technical Report (Paris; RTA, January 2007).

[11] Efraim Turban, Jay A. Aronson, and Ting-Peng Liang, *Decision Support Systems and Intelligent Systems*, 7th ed. (Upper Saddle River, NJ: Pearson Prentice Hall, 2005), 40.

[12] Turban, Aronson, and Liang, *Decision Support Systems and Intelligent Systems*.

[13] Elisabeth Wright, "Twenty First Century Defense Acquisition: Challenges and Opportunities," *Connections: The Quarterly Journal* 5, no. 1 (Spring-Summer 2006): 71-80, <https://consortium.pims.org/twenty-first-century-defence-acquisition-challenges-and-opportunities>.

[14] Recognizing that even poorly structured problems may have highly structured sub-problems. This study may serve as an example.

[15] See as an example the article by Velizar Shalamanov, "2020 Air Force Mission Capabilities Packages from Operational Analysis Perspective" in this volume.

[16] On cost-benefit analysis with emphasis on public spending see, for example, Anthony E. Boardman, David H. Greenberg, Aidan R. Vining, and David L. Weimer, *Cost Benefit Analysis: Concepts and Practice*, 3rd ed. (Upper Saddle River, NJ: Pearson Prentice Hall, 2006); Diana Fuguitt and Shanton J. Wilcox, *Cost-Benefit Analysis for Public Sector Decision Makers* (Westport, Connecticut: Quorum Books, 1999).

[17] *Guidance on Analyzing Investment Projects According to Cost and Benefits* (Sofia: Ministry of Finance, 2006).

[18] See, for example, Frederick S. Hillier and Gerald J. Lieberman, *Introduction of Operations Research*, 8th ed. (Boston, MA: McGraw Hill, 2005); and Turban, Aronson, and Liang, *Decision Support Systems and Intelligent Systems*.

[19] Developed by Lockheed Martin Aeronautics Company. An article by Robert K. Murphy and G. Richard Cathers in the forthcoming volume of *Information & Security* will present this model.

[20] Hillier and Lieberman, *Introduction of Operations Research*, CD-ROM Supplement, Chapter 22.

[21] Telelogic's DOORS® is designed to facilitate communication and collaboration to provide for requirements compliance and verification.

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ANALYSIS OF ALTERNATIVES: AN EFFICIENT TOOL IN MANAGING FORCE MODERNIZATION PROJECTS

Venelin GEORGIEV

Abstract: Analysis of alternatives is a systematic method to deal with the problem of selecting a reliable variant and a common approach to the efficient allocation of limited resources among the competing candidate alternatives. In this method, the alternatives for meeting the existing needs are studied by assessment of the quantitative effects and costs for each of the considered alternatives. This becomes the objective that is approached by means of mathematical, economic, statistics, and other scientific methods. The analysis of alternatives is a process that includes definition of goals, main parameters, assumptions and constraints for the analysis; preparation of a list of considered alternatives; collection of data into a database and evaluation of the effects and cost for each alternative; performing sensitivity analysis; and reporting the final results from the analysis. The practical realization of the analysis of alternatives is related to the elaboration of a plan for the analysis, whose content is presented in this article.

Keywords: Analysis of Alternatives, Primary and Secondary Analysis, Measures of Effectiveness and Measures of Performance, Sensitivity Analysis, "Cost-Effectiveness" Analysis.

In conditions of market economy and budget limitations in the area of defense and security, the Armed Forces do not have sufficient financial resources to acquire the armaments necessary to meet the requirements of new missions, goals, and tasks. The existing limitations entail decision making for selection of a rational approach to acquire the required operational capabilities and to determine the actual projects for modernization to be funded with limited financial resources. There is a real necessity for a variant/ tool that enables the decision makers to choose from various considered alternatives the one with the highest efficiency, the realization of which involves rational and acceptable risk and expenditures. One such method is the Analysis of Alternatives (AoA) approach that could be defined as a systematic method for studying the problems of selection of alternatives and a common approach to the effective al-

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location of the limited resources among the competing needs. In this method, the alternatives for meeting existing needs are studied by assessing the quantitative effects and costs for each of the considered alternatives. This becomes the objective that is tackled by means of mathematical, economic, statistical, and other scientific methods which compare and rank the different alternatives. In the AoA approach the effects and costs for the alternatives are estimated for their entire life cycle.

The practical realization of the AoA approach requires theoretical knowledge summarized in this article. The theoretical background of AoA is supported in the article by an example of the application of the method within the area of research for selection of the most suitable multi-role fighter for the Air Forces. This example serves only as an illustration of a possible practical implementation of the AoA approach as a decision support tool and the results from this example are only illustrative. Furthermore, results presented in the article are not final due to the fact that the analysis has not been yet completed.

It is possible to use the AoA approach in other decision-making processes for performing portfolio selection of projects, for which there exist more than one possible and reliable alternative that satisfy defined needs and requirements.

In case there is only one alternative, which satisfies project requirements, comparison of the effects and life cycle costs is impossible and practically excludes the necessity of performing AoA.

From a practical point of view, for the realization of all projects for modernization of the Armed Forces, including the project for procurement of a new multi-role fighter for the Air Force, there are more than one possible and reliable alternatives and this fact entails the necessity to implement AoA for each of the projects.

AoA is one of the possible methods that support the Armed Forces management and the decision-making process, in particular. One of its main advantages is the possibility to represent in an understandable manner the mission requirements, the possible decisions, and the expected effects and financial terms of the different alternative decisions. Another advantage of the AoA is the possibility to compare different alternatives for realization of the projects on an equal basis. AoA makes it possible to assess the alternatives and goals in terms of costs, effects, and existing risk and when it is necessary they can be examined more precisely using sensitivity analysis.

The process of application of the AoA approach to the example of choosing a new multi-role fighter for the Bulgarian Air Forces consists of seven phases.

The *first phase* includes definition of goals and main parameters for the implementation of the AoA approach. Precise, clear and, if possible, quantitative definition of the AoA goals is being performed in order to achieve adequate realization of the project

requirements. This is an important step in the implementation of the AoA approach due to the fact that without a clear vision for the issue what has to be examined, it will not be possible to reach the desired final results. Improperly defined goals can mislead the users of the AoA results and make them think that a particular decision has already been made; and that AoA is not performed for finding the most rational and economically justified decision, which satisfies the existing needs and requirements.

The AoA's goal for the example considered in this article could be defined as analysis of alternatives for acquiring required operational capabilities (ROC) for performing Air Force missions and tasks through procurement of multi-purpose aircraft or modernization of the current fleet, which possess the necessary capabilities for the implementation of the new missions and tasks, such as air superiority, air interdiction, close air support, kill boxing, reconnaissance, etc.

The analysis of alternatives approach includes the following common parameters.

Scope of Analysis

The main factors that influence the scope of the analysis are the defined needs and requirements that have to be met, the period of time for evaluation and the efforts and expenditures necessary for AoA realization. Whether the analysis will be primary or secondary depends on the nature of the needs. Primary analysis is performed when an alternative (proposal) for satisfying the existing needs with smaller amount of resources is examined. That means, when existing needs were satisfied in a particular way but at the same time there is a better alternative serving the same purpose. Secondary analysis is performed when new needs/ requirements have to be met or when the existing tools cannot satisfy the identified new needs any longer (refer to Figure 1).[1]

For the purposes of the analysis of alternatives approach, the main characteristics of the project considered in this article makes it possible to classify the analysis as secondary – it is required to satisfy new needs of the Air Force.

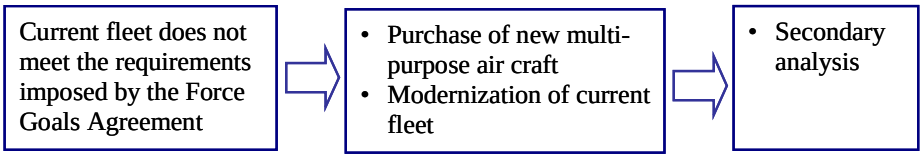

Figure 1: Secondary Analysis of Alternatives.

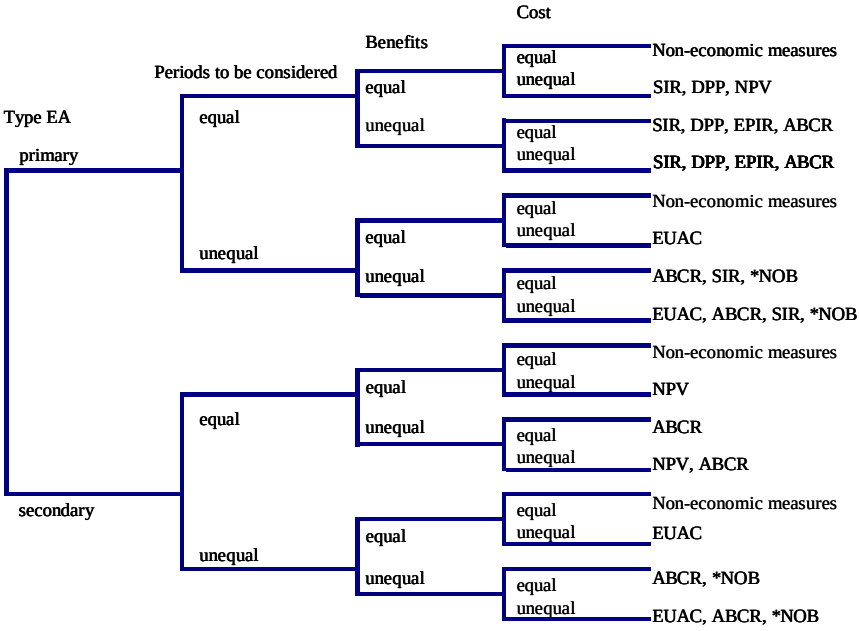

Figure 2: A Possible Chart for Choosing Methods for AoA Implementation.

Method for Comparison of the Existing Alternatives

There are different methods to compare competing alternatives; however, the most frequently applied ones are NPV, DPP, SIR, etc. The main factors that determine the method to be used for the particular project and its analysis are the amount of financial resources available, the effects/ benefits obtained by means of the examined alternatives and the duration of the period of analysis. There are various types of specific charts that can be used for the purpose of determining the method for comparison in the AoA approach. An example of such a type of chart is shown in Figure 2.[2]

Due to the fact that the size of the expected spending and the effects are different for the different alternatives considered in the example here, but the duration of the period for analysis is the same for each of the alternatives, the methods suitable for comparison of the examined alternatives are NPV or ABCR (refer to Figure 3).

Main Time Characteristics for the Analysis

The year of discounting the spending for the examined alternatives has been assumed as a starting point for the AoA's time period. This period includes several key points, such as mission's life, base year, lead-time, etc. Mission's life is a period over which the asset is needed. Base year is the year to which costs and benefits for the alterna-

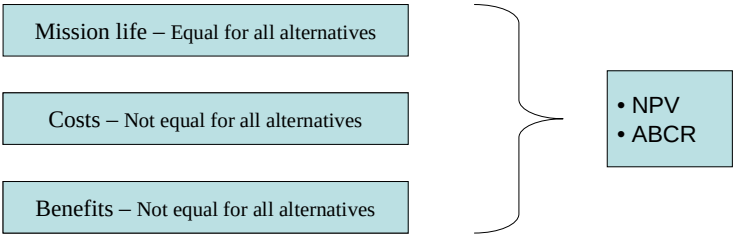

Figure 3: Choosing a Useful Method for Comparison of the Considered Alternatives.

tives will be discounted. Start year is the year in which initial investments for the considered alternatives are made. Lead-time is the time between the beginnings of start year to the beginning of the economic life of an asset for each of the examined alternatives.

Measures of Effectiveness (MoE) and Measures of Performance (MoP)

Measures of Effectiveness (MoE) represent the customers' view, usually assuming a qualitative nature. They describe the customers' expectations of a product, project or system. MoE can be represented in the form of a hierarchical diagram (see Figure 4).[3] Each horizontal level in the hierarchy represents 100 % of the effectiveness or performance. Weights can be attached to each design requirement. Evaluation of alternative designs can be made through the use of a method such as the weighted objective decision matrix or similar methods. The use of MoE enables the experts who perform the analysis to make the right decision and to propose the best alternative for solving the problem in consideration.

For the purposes of the analysis of alternatives for the example considered in this article, the following measures could be used as measures of effectiveness – survivability, vulnerability, cost, weapon system features, armament flexibility, exploitation, and upgrade.

The measures of performance express the producers' opinion for the project products. They represent the technical specifications of these products.[4] As a rule, the measures

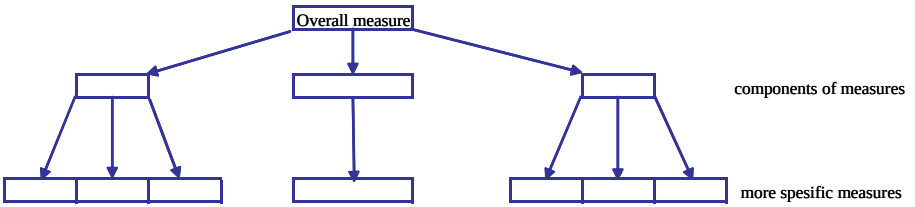

Figure 4: The MoE's Hierarchy Diagram.

Specification		
1	Maximum speed	2000 - 2300 km/h
2	Maximum altitude	15000 - 18000 m.
3	Range	2000 - 2500 km.
4	G-max	9Gs
5	Combat radius	500 km.
6	Combat endurance	>2 h.
7	Weight - empty	15 - 20 tons
8	Payload	3 - 5 tons
9	Maximum wing loading	up to 4 tons
10	Thrust - weight ratio	0.95 - 1.2
11	Reverse thrust of power plant	yes
12	Active power thrust vector control	yes
13	Max Vertical velocity	300 - 350 m/s
14	Supersonic cruising speed	yes
15	Takeoff and landing distance	750 - 1000 m.
16	Navigation/weapon delivery system	yes
17	Weapons loads	up to 8 pylons
18	Systems for self-defense	yes
19	Inoperability with land and air based systems	yes
20	Ability to transfer data in real time at a distance more than 150 km	yes
21	Container for air reconnaissance	yes
22	Container for electronic warfare and reconnaissance	yes
23	Aerial refueling	yes
24	Catapult system at Vo and Ho	yes
25	Exploitation system	yes

Figure 5: Specification for the Desired Fighter.

of performance are quantitative characteristics and their purpose is to demonstrate what the producers have done to reach the requirements of the customers by producing the desired products (see Figure 5).

For MoP in the analysis presented here, applying the method of expert assessment leads to the estimation of the significance of the characteristics needed to perform the required missions and tasks shown in Figure 5. The results from this assessment are as presented in Table 1.[5]

At probability P =0.1 and degree of freedom $n-1$=25-1=24, the tabulated value of the Pearson's criteria is 61.1. Comparing the analytical and tabulated values of the Pearson's criteria shows: $V = 63 > 61.1 = \chi^2$. This comparison gives high confidence to conclude that with a probability of no less than 90%, we can assume that there is a strong correlation between the opinions of the experts and thus we could use the results for the AoA. Based on the results from the expert assessment, charts for the significance of the MoP are drawn using different methods (Figures 6 and 7).

Table 1: Statistical Results.

Ranking Total: $\sum_{i=1}^{n} X_i = \frac{1}{2} n(n+1) = \frac{1}{2} 25.26 = 325$	Corrector: $U_j = \frac{1}{12} \sum_{i=1}^{n} u_{ij} (u_{ij}^2 - 1) = 25.5$
Parameter a: $a = \frac{1}{2} m(n+1) = 130$	Parameter S_d: $S_d = \sum_{i=1}^{n} \left(\sum_{j=1}^{m} X_{ij} - a \right)^2 = 34059$
Coefficient of concordance: $W = \frac{S_d}{\frac{1}{12} m^2 n(n-1) - m \sum U_j} = 0.2625$	Analytical value of Pearson's criteria: $V = \frac{S_d}{\frac{1}{12} mn(n+1) - \frac{1}{n-1} \sum U_j}$

The *second phase* of the AoA's approach includes making a complete list of alternative decisions to solve the problem under consideration. This list includes all rational and reliable alternatives and even those alternatives that for some reason cannot be realized at this moment. It is noteworthy that an incomplete list of alternatives can be a reason to question the validity of the AoA approach. The alternatives that are not

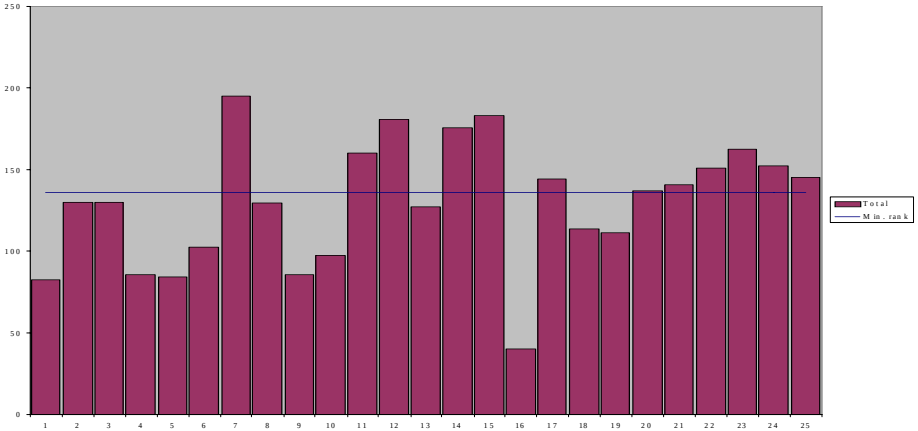

Figure 6: Histogram of the MoP.

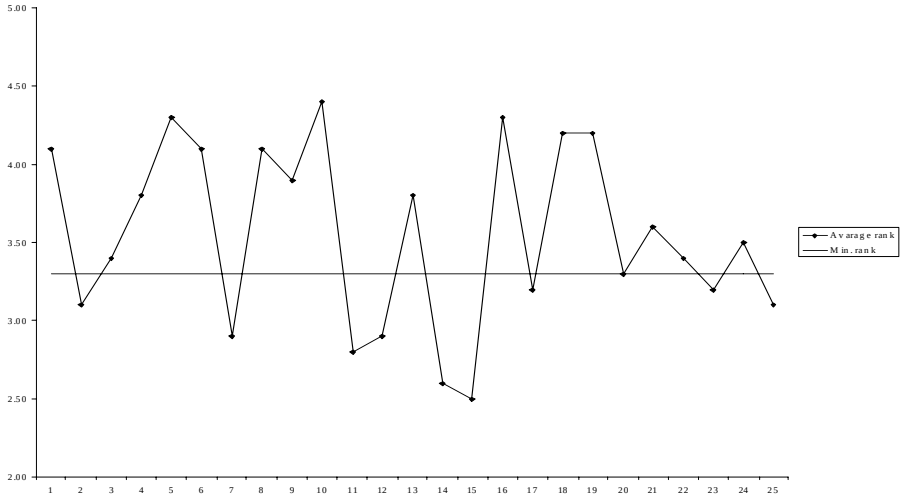

Figure 7: Applying the Method of Semantic Differential.

rational and reliable enough at the moment of analysis should be discussed and documented within the AoA approach, but it is not necessary to include them in the future work on cost and effects estimation. As a rule, one alternative is rational and reliable when it completely satisfies the stated requirements and its realization is possible at the period of analysis.

Possible alternatives for realization of the projects for modernization could be defined as producing, purchasing or leasing new types of armaments, purchasing or leasing "second-hand" armaments and modernization of the existing types of armaments. In practice, the realization of the projects for modernization of the Armed Forces is possible by combination of different approaches, which was mentioned above. For the project considered as an example in this article, the list of possible alternatives includes modernization of the existing types of fighters, MiG-21 or MiG-29, as well as purchase of new or "second hand" fighters, for example F-16, F-18, and Gripen. The first two alternatives from the list (modernization of the existing types of fighters) are not rational and reliable enough and they should be only documented as part of the analysis. The other alternatives have to proceed to the next steps of the AoA, as it is shown in Figure 8.

The *third phase* of the AoA's approach includes the definition of assumptions and constraints. In general, the analysis of alternatives is performed in conditions of lack of complete information, which imposes assumptions and constraints to be defined. The goal is to reduce the extent of uncertainty in the analysis. Sometimes, the assumptions and constraints for the AoA are defined before choosing the examined al-

	Specification	Requirements	Alt_1 F-18 E/F	Alt_2 F-16 C/D	Alt_3 GRIPEN
1	Navigation/weapon delivery system	yes	yes	yes	yes
2	Maximum speed	2000 - 2300 km/h	1900	2142	2126
3	Combat radius	500 km.	722	1252	800
4	G-max	9Gs	9	9	9
5	Maximum wing loading	Min. 4 tons	7,7	7,2	6,5
6	Thrust - weight ratio	0.95 - 1.2	-	1,1	-
7	Combat endurance	>2 h.	2,5	-	-
8	Inoperability with land and air based systems	yes	-	-	-
9	Systems for self-defense	yes	yes	yes	yes
10	Max Vertical velocity	300 - 350 m/s	-	294	80
11	Payload	3 - 5 tons	-	-	-
12	Maximum altitude	15000 - 18000 m.	15,2	15,3	19
13	Range	2000 - 2500 km.	3700	4215	3300
14	Ability to transfer data in real time at a distance more than 150 km	yes	-	-	-
15	Container for air reconnaissance	yes	yes	-	-
16	Weapons loads	Min. 8 pylons	9	9	8
17	Exploitation system	yes	yes	yes	yes
18	Container for electronic warfare and reconnaissance	yes	yes	-	-
19	Catapult system at Vo and Ho	yes	yes	yes	yes
20	Reverse thrust of power plant	yes	yes	-	yes
21	Aerial refueling	yes	yes	yes	yes
22	Supersonic cruising speed	yes	yes	-	yes
23	Active power thrust vector control	yes	yes	-	yes
24	Takeoff and landing distance	750 - 1000 m.	430/620	450/650	400/600
25	Weight - empty	15 - 20 tons	16,65	11,84	9,7

Figure 8: List of Alternatives for the AoA used in the Article as an Example.

ternatives. The assumptions and constraints should determine the environment for the analysis in a way that ensures correct understanding for their influence on the final results from the AoA. This is extremely important for the people who will make the final decision.

For the example in this article, assumptions and constraints could be defined in the following areas – span of their life-cycle cost and effects, technical and tactical characteristics, cost for utilization and maintenance, etc.

The *fourth stage* of the AoA approach includes gathering data for the effects and cost of the examined alternatives, storing them into a database and executing the computations. The sources used for gathering data and the results from the computations should be correctly documented as they determine how precise the obtained results are. This phase of the AoA approach is the most critical part of the analysis. It needs sufficient time and has a major impact on the accuracy of the final results.

There are three main types of cost estimates:

- Detailed estimates – within 5 % of actual costs;
- Good estimates – accuracy is about 10 % of actual costs;
- Order of magnitude estimates – estimates differ from actual data by as much as 50 %.

The people performing the analysis should take into account all cost factors and expected effects from each of the examined alternatives in their association. They can

use different methods for life cycle cost analysis:

- Engineering cost method used when there is detailed and accurate capital and operational cost data. It involves direct cost estimation of a particular cost element;
- Analogous cost method used when there is a high level of detail drawn on historical data from other asset of analogous size, technology, and operational characteristics;
- Parametric cost method used when an actual or historical cost data is limited around known parameters.

Each alternative is examined separately. Computations on the effects and cost for the alternatives may be performed using existing models, but it is also possible to make the computations using models developed by the people performing the analysis.

During the *fifth stage* of the AoA approach, comparison and ranking of the examined alternatives by means of cost-benefits analysis is completed. In the literature, this stage of the AoA is known as "the heart of the analysis." But, at the same time, the implementation of this stage could be the easiest part of the analysis if the previous four stages have been carried out precisely and completely. At this stage, three main criteria could be used for comparison and ranking of the examined alternatives:

- "Min" cost if the effects from the alternatives are equal;
- "Max" effects if the costs for the alternatives are equal;
- "Max" ratio effects/ cost if both are not equal for the alternatives.

These three criteria determine three types of links between costs and benefits of the examined alternatives – unequal cost and equal effects; equal cost and unequal effects; unequal cost and unequal effects.

When all considered alternatives have equal costs and equal effects, they are ranked using non-economic criteria. The possible cases of comparison of alternatives are shown in Figure 9.[6]

Comparison of Alternatives		
Costs	*Benefits*	*Basis for Recommendation*
Equal	Unequal	Most benefits
Unequal	Equal	Least cost
Unequal	Unequal	Highest benefits to cost ratio
Equal	Equal	Other factors

Figure 9: Possible Cases for Comparison of Alternatives.

The *sixth stage* of the AoA approach includes performing sensitivity analysis. This specific type of analysis is made when the level of risk for the AoA is too high or when there is no considered alternative, which is obviously better than the others. The sensitivity analysis answers "what-if" questions and helps in finding results and final conclusions, which vary in broad intervals if some of the considered factors for the AoA such as cost, assumptions, constraints, or MoP have changed their parameters. The sensitivity analysis is performed mandatory for projects, whose results from the AoA do not show the best alternative for meeting the customer requirements. If a change in the value of some of the considered factors is a reason for change in the ranking of the considered alternatives, it means that the AoA is sensitive to this factor. The factors that demonstrate significant influence on the extent of the cost and effects for the alternatives form suitable basis for performing sensitivity analysis. An appropriate way to find these factors is to evaluate the influence of their change in percentage on the cost and effects for the alternatives. From practical point of view, all factors that are related to spending of size bigger than 20 % from the total spending for the alternative have to be considered in the sensitivity analysis.

The sensitivity analysis is usually performed not for all alternatives but only for those ranked first and second and the investigated changes of the factors are in the same direction – an increase or a decrease. Performing sensitivity analysis and including the results from this analysis in the report for the AoA application provide the necessary information to the decision makers about the influence of existing uncertainties and risks on the final choice.

The *seventh stage* of the AoA consists of reporting of the results from the analysis and making recommendations to the decision makers. This is essential phase of the AoA approach – the best alternative has to be shown and recommendations for its implementation have to be formulated. The recommendations to the decision makers are extremely important because, sometimes, the ranking of the alternatives does not show clearly which alternative satisfies the requirements in the best possible way.

For almost all AoA for the Armed Forces modernization projects, the best alternative could be that with the lowest level of spending estimated for the period of analysis. This conclusion is correct due to the assumption that all examined alternatives are rational and reliable and they satisfy the stated requirements.

The final results from the application of the analysis of alternatives approach should be presented to the decision makers in the most convenient way for use and understanding. The report includes the goals of the AoA, the assumptions and constraints, the list of examined alternatives, the summarized database for life cycle costs and effects, the appropriate charts, and the results from sensitivity analysis. The report

should end with conclusions and recommendations. And as an example, the content of the AoA report may consist of:

- Summary of the AoA application, including goals, alternatives, their ranking, conclusions, and recommendations. Here is the place of the assumptions and constraints made in the beginning of the analysis.
- Detailed analysis of the life cycle cost and effects for the considered alternatives. Here, within a table, are shown detailed effects and cost for each of the examined alternatives for each year of the period of analysis.
- Charts that illustrate the results from the analysis.
- The results from the sensitivity analysis including the examined factors and the arguments for their choice. Here, the results obtained after changing the parameters of the factors are presented.

The practical realization of the AoA approach is related to the development of appropriate plan and its implementation. The plan should contain a description of the approach for AoA implementation, the main tasks, and who is responsible for solving these tasks. Only as a suggestion, the content of the AoA implementation plan may include the following elements:

- *Introduction* that explains the origin of the problem in consideration, the goal and the scope of the analysis. The introduction includes description of the necessity to perform AoA. The level of detail for the AoA approach that is appropriate for the particular situation is defined.
- *AoA main rules*, which include the scenarios and threats leading to the definition of the requirements, assumptions and constraints for the analysis. The considered scenarios are extracted from the defense planning scenarios and they are enriched with specific details. The environmental factors, which influence the examined scenarios and tasks, such as climate and terrain, are important for the analysis and they are part of the AoA main rules. The AoA constraints are described as factors that limit the possible options for the AoA team. On the other hand, when they are correctly defined and if they truly represent the system characteristics, the constraints increase the probability of reaching the final goals of the analysis. Understandably, even the most precise analysis is realistic only within the constraints and if these constraints change, the AoA will lose accuracy and effectiveness. The assumptions are factors presumed to be true statements during the AoA planning process. The assumptions account for the uncertainty in analysis and this explains why they influence the level of risk in the AoA.
- *The examined alternatives*, which are presented describing their content, probability, expected benefits, operational and support concepts. The consid-

ered alternatives are documented in the AoA implementation plan and their number could be changed during the AoA implementation. It is a normal practice to limit the number of rational and reliable alternatives in the beginning of the AoA. In the course of the AoA application, after receiving some new information, the AoA team could add new alternatives to be considered in the analysis. The number of considered alternatives could be controlled by avoiding similar alternatives and eliminating some of the alternatives using, for example, reasons such as unacceptable level of risk and life cycle cost.

- *AoA implementation technology*. The estimation of the expected benefits and life cycle costs for the examined alternatives presupposes knowledge of specific details from the area of operational and supporting concepts. The operational concepts describe in detail the conditions for use of each alternative in peacetime, during crisis and wartime. The supporting concepts describe the planned activities related to the realization of the considered alternatives in such areas as personal training, utilization and maintenance of the facilities and infrastructure, etc. The matrix for assessment of the examined alternatives is described in the AoA implementation plan, which in the majority of the cases is constructed and presented as a hierarchical system of mission tasks, MoE, and MoP. The mission tasks describe the necessity of required new capabilities. The MoE could be viewed as a more detailed matrix that enables the quantitative assessment of tasks and missions' implementation. One or more MoE have to be defined for each mission task, which describe the effectiveness of each of the considered alternatives in performing a task. On the other hand, each MoE should support one or more mission tasks. As a rule, the MoP are quantitative characteristics and they are used when it is necessary to estimate the MoE. The AoA implementation plan presents the selected analytical approach for analysis of the effectiveness of the considered alternatives as a hierarchical system of mission tasks, MoE, MoP, scenarios, and treats. The chosen analytical approach defines the level of detail for the effectiveness analysis of the examined alternatives. This level depends on the number of considered scenarios, threats, and alternatives. The approach for life-cycle cost assessment of the considered alternatives is also detailed in the AoA implementation plan. The cost analysis is performed in parallel with the effectiveness analysis. In the cost analysis, the life-cycle cost for each of the examined alternatives is evaluated separately. When the costs for the alternatives are estimated in a long time period, the cost analysis is performed using discounting methods. It is important to emphasize that the life-cycle cost analysis is one of the most important parts of the AoA approach and it requires the knowledge and expertise of very well prepared experts. The results from the cost analysis are used together with the results from the effectiveness

analysis for comparison of the examined alternatives, laying the foundation for comparison along different criteria. The final analytical part of the AoA implementation plan is related to planning of the comparison of the considered alternatives using "cost-benefit" criteria. In the majority of the analysis, the examined alternatives have different effects and life-cycle costs, a fact that poses the question how to determine whether marginal increase of effectiveness justifies the associated marginal cost. From practical point of view, it is impossible to find the perfect conditions when the effects and cost for the examined alternatives are absolutely equal due to the complex nature of the alternatives.

- Finally, the AoA implementation plan includes a description of *the procedure for management of the AoA implementation*. In general, a dedicated team with a designated leader performs the AoA implementation. The team consists of cautiously selected experts from different areas of the analysis. The AoA implementation team includes different working groups (WG), for instance WG for scenarios and threats; WG for definition of alternatives; WG for definition of operational and support concepts; WG for effectiveness analysis; WG for life-cycle cost analysis, etc. For the largest part of the AoA, the central role is played by the WG for effectiveness analysis and this group combines and relates the work of the other groups.

The plan for AoA implementation proposed in this article is not mandatory for each AoA; it provides and example to acquisition management experts. Obviously, each AoA has unique features which explains why the implementation plan for each particular AoA is unique, too.

As a conclusion, we could emphasize that the AoA is one of the most valuable tools that managers could and should use in conditions of market economy to manage the projects of their organizations. Using the AoA in practice requires knowledge of the respective theory, which will ensure that the results desired by the managers will be reached.

Acknowledgement

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Notes:

[1] Government Asset Management Committee, *Life Cycle Costing Guideline* (Sydney, New South Wales: Government Asset Management Committee, 2001).

[2] *Life Cycle Costing*.

[3] *Measures of Effectiveness (MOE) and Measures of Performance*, Design Methods Fact Sheet (University of Queensland, 2001).

[4] *Measures of Effectiveness and Measures of Performance*.

[5] E. Bojanov and I. Vuchkov, *Statistical Methods for Modeling and Optimization of Multi-Factor Objects* (1999).

[6] *Life Cycle Costing*.

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U.S. Department of Defense Office of Force Transformation

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The Bundeswehr Transformation Center

www.zentrum-transformation.bundeswehr.de/portal/a/ztransfbw

The Bundeswehr Transformation center supports the Federal Ministry of Defense in tasks related to the central management of the transformation process, to the major task of Bundeswehr planning, to planning, preparation, execution and follow-up of missions, exercises and experiments as well as to operations research and modeling and simulation. Moreover, the Bundeswehr Transformation centre supports politico-military planning and decision-making processes of the Ministry of Defense.

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U.S. Department of Defense Website for Transformation

www.defenselink.mil/transformation/

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Air War College Transformation Links

www.au.af.mil/au/awc/awcgate/awc-chng.htm

National Defense University Transformation Links

http://merln.ndu.edu/index.cfm?secID=118&pageID=3&type=section

What is Force Transformation?

www.oft.osd.mil/what_is_transformation.cfm

The way in which Vice Admiral (ret.) Arthur K. Cebrowski, Director of Office of Force Transformation, defined force transformation.

CONFERENCES AND ON-LINE PUBLICATIONS

Transformation Trends

http://www.oft.osd.mil/library/library.cfm?libcol=9

This is an initiative by the Office of Force Transformation, U.S. Department of Defense, to keep decision makers involved and interested in transformation abreast of the latest developments across the department, the military services, commercial industry, and technology worlds. It is intended as a service to promote knowledge on variety of topics, related to transformation.

The following is a sample of topics, appearing in *Transformation Trends*:

- US Military Transformation: Decision Rules
- Transformation's Trajectory
- Sea Basing Issues
- Wolf Pac Distributed Operations Paper
- Cebrowski Interview with Ubiquity
- Mobilus Initiative: Airships as a New Aerospace Industry Segment
- Why Transform?

- Transformation and the Changing Character of War?
- Transforming Warfare
- Transforming Transformation
- Fantasy to Prophesy: The Need for a New Lighter-Than-Air Aerospace Capability
- Implementation of Network Centric Warfare
- Understanding Transformation.

U.S. Air Force Transformation Flight Plan 2004

www.oft.osd.mil/library/library_files/document_385_2004_USAF_Transformation_Flight_Plan.pdf

The Flight Plan is the Air Force's transformation roadmap submission to the Office of Force Transformation as required by the Secretary of Defense's Transformation Planning Guidance. It is a reporting document that shows how ongoing and planned Air Force transformation efforts are addressing this guidance. It is intended to reflect decisions, information, and initiatives already made and/or approved by the Air Force capability-based planning, programming, and budgeting process.

Air Force Transformation: The Edge

www.af.mil/library/transformation/edge.pdf

The Edge is a brief introduction to the many transformational initiatives underway within the United States Air Force and further detailed in the U.S. Air Force Transformation Flight Plan.

Transforming the Royal Air Force

www.raf.mod.uk/rafcms/mediafiles/628864A8_EC65_BEBF_C4C64EC02534493A.pdf

US Fighter Modernization Plans: Near-Term Choices

www.csbaonline.org/4Publications/PubLibrary/R.20070620.US_Fighter_Moderni/R.20070620.US_Fighter_Moderni.pdf

This report by Steven Kosiak and Barry Watts (Center for Strategic and Budgetary Assessments, 2007) explores the near-term modernization choices now facing the U.S. Department of Defense in fixed-wing air power.

Air Force Transformation: Past, Present, and Future

www.airpower.au.af.mil/airchronicles/apj/apj01/fal01/phifal01.html

This is an article by Maj Gen David A. Deptula, published in Aerospace Power Journal, Fall 2001. General Deptula is director, Air Force Quadrennial Defense Review, Headquarters USAF. He was the principal planner for the coalition's offensive air campaign during Operation Desert Storm and director of the Expeditionary Aerospace Force implementation. This article, drawn from General Deptula's testimony to the House Armed Services Committee, discusses Air Force transformation, delineating not only the definition of the term, but also its ramifications for the military services' structural and operational enhancement.

Airpower, Jointness, and Transformation

www.airpower.au.af.mil/airchronicles/apj/apj03/win03/fought.html

This is an article by Dr. Stephen O. Fought and Col O. Scott Key, USAF, published in Air & Space Power Journal, Winter 2003. The article reflects the discussions and writings of the AWC professors and students participating in an Air War College Seminar – Seminar Six's Warfighting course. This seminar, class of 2003, studied, debated, and developed personal convictions about the argument that in the second century of manned flight, airpower may well be the transforming piece of the jointness puzzle – the instrument through which ground and naval forces could be integrated. Grounded in the history of the evolution of airpower theory, this seminar developed a new definition for a "transformational system" to focus on the future of war fighting and force structure.

International Conference on Transformation, Modernization and Building Expeditionary Capabilities of the Bulgarian Air Force, 2-3 October 2007, Park Hotel Sankt Petersburg, Plovdiv, Bulgaria

www.afcea.bg/conferences.php

AFCEA Chapter Varna in cooperation with the Bulgarian Air Force will host an International Conference & Exhibition in Plovdiv on 2nd and 3rd of October 2007, on the eve of the Official Day of the Bulgarian Air Force. The conference agenda will cover the following main themes:

- The new missions, roles, and required operational capabilities of the Bulgarian Air Force;
- Modernization plans and programs of the Bulgarian Air Force;
- Technologies for advanced air, air defense, and space capabilities;

- Building expeditionary capabilities of the Bulgarian Air Force.

Confirmed speakers: Lt. Gen. Jo Godderij, Director, NATO International Military Staff; Vice Admiral Emil Lyutscanov, BuN, First Deputy Chief of Bulgarian General Staff; Lt. Gen. Simeon Simeonov, Bu AF, Commander of the Bulgarian Air Force; Lt. Gen. Laurentiu Maftei (ret), Air Defence Counselor to the Chief of the Romanian Air Force.

The conference will feature an exhibition of Air Force equipment and technologies.

First International Conference UMSSOFT 2007 – Using Models and Simulations in Support Of Force Transformation

www.procon.bg/umssoft/

UMSSOFT 2007 was hosted by Bulgaria's Ministry of Defense at the "G.S. Rakovski" Defense and Staff College. It provided opportunities for:

- Sharing experience from the implementation of methods, tools and latest research results in support of force planning and management, operations planning, and training in the new security environment
- Facilitation of the development of a common "knowledge infrastructure" of related concepts, methodologies, methods, and tools
- Promotion of the implementation of objective, rational decision-making frameworks
- Identification of key implementation challenges and priority research areas.

A selection of the papers presented at the conference will appear in the next issues of Information & Security: An International Journal.

CLOSING CAPABILITY GAPS

Strategic Airlift Capability

Strategic airlift is among the top capability requirements, as decided at the NATO Summit in Prague, and reiterated at the two follow-up summits in Istanbul and Riga.

In order to close this gap, 15 NATO member countries—Bulgaria, the Czech Republic, Denmark, Estonia, Hungary, Italy, Latvia, Lithuania, the Netherlands, Norway, Poland, Romania, the Slovak Republic, Slovenia and the United States—and Partner country Sweden initiated the purchase of *C-17 Globemaster* transport aircraft.

The capability will initially comprise three C-17s, flown and maintained in a multinational arrangement.[1]

The initial operating capability is planned for the latter half of 2007, with the full complement of aircraft and full operating capability in 2009. This is one of two complementary initiatives aimed at providing NATO with strategic airlift capabilities. The other is the Strategic Airlift Interim Solution (SALIS), under which a multinational consortium of 16 countries, led by Germany, is chartering Antonov An-124-100 transport aircraft.[2] Possibly, this pool will expand through future acquisition of Airbus A-400M (when available).

Protecting Helicopters against Rocket Attacks

One of the ten priority areas of NATO's Conference of National Armaments Directors (CNAD) program on *Defense Against Terrorism* addresses the vulnerability of helicopters to rocket-propelled grenades (RPG). Within the CNAD program, Bulgaria is the lead country in the development of helicopter protection technology, with Greece and Poland also involved.

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[1] See "C17 airlift capability for NATO displayed," 27 November 2006, <www.nato.int/docu/update/2006/11-november/e1127a.htm>; and "SALIS' Sibling: NATO's C-17 Pool Inaugurates In-House Heavy Lift," 18 December 2006, <www.defenseindustrydaily.com/salis-sibling-natos-c17-pool-inaugurates-inhouse-heavy-lift-02630>.

[2] "C17 airlift capability for NATO displayed."

In a collaborative effort, the Bulgarian Ministry of Defense and the Bulgarian Academy of Sciences test a technology, described as "passive." It is designed to be strapped onto helicopters and to prevent rocket-propelled grenades from exploding. Tests, conducted in 2006, are considered "promising." More testing is scheduled to assess whether the technology is viable for use by NATO forces.[3] Poland is currently conducting a parallel program of testing.

For other examples of ballistic protection technologies the reader may refer to <www.airforce-technology.com/contractors/modifications/roshield>. For comprehensive treatment of other helicopter protection issues see Jordan D. Yankov, "Helicopter Survival: Fly or Die?" <www.globalsecurity.org/military/library/report/1991/YJD.htm>.

[3] See "New technology to protect helicopters," <www.nato.int/docu/update/2006/10-october/e1010a.htm>; and "NATO: Bulgaria May Have RPG Protection Solution for Helicopters," <www.defenseindustrydaily.com/nato-bulgaria-may-have-rpg-protection-solution-for-helicopters-02732>.

AFCEA BULGARIAN CHAPTER VARNA

On May 12th, 2000, in Varna on the Bulgarian Black Sea coast a new Chapter of the Armed Forces Communications and Electronics Association (AFCEA) was founded. The Chapter was granted Charter of Incorporation by AFCEA International on July 24th, 2000. This second Bulgarian Chapter of AFCEA pursues the objectives and abides to the principles of AFCEA International. It thus, contributes to the success of the Bulgarian military reform, as well as to the strengthening of the country's national security.

Chapter Varna has been spreading its activities throughout the Bulgarian Black Sea coastal areas. In so doing, it is mutually supporting and complementing the Bulgarian Chapter Sofia, in contributing to a wider dissemination of the ideas and activities of AFCEA throughout Bulgaria, South-East Europe and the whole of the Black Sea region. This is very much seen as a positive contribution towards peace and stability in the region.

The Chapter's Board consists of active and retired naval officers from the Bulgarian Navy HQ, from the Naval Academy, as well as representatives of the business community in Bulgaria.

Since its inception more than four years ago, AFCEA Varna Chapter has proven its value as a centre for defence and security matters, for business contacts and for personal development. It regularly holds meetings, lectures and conferences on these and other related issues, attended by many government, military, NGO and industry leaders.

Chapter Varna now has more than 45 individual members, including the Bulgarian Military Representative to NATO, the Bulgarian President's Secretary on National Defence Affairs, military diplomats from the US, UK and the Netherlands, senior military officers, as well as former senior Ministry of Defence officials. Additionally there are four corporate sponsors, namely Thales Nederland B.V., Unimasters Logistics Group Ltd, Varna, the Institute of Air Transport, Sofia, and WESTEL Ltd., Sofia.

In 2003 and 2004, the Chapter received important recognition for its consistent efforts for promoting the ideas and principles of AFCEA in Bulgaria by receiving Albert J. Myer "Special Recognition" and "Special Achievement" Awards of AFCEA

International. One individual Chapter member was elected to serve on the Board of Directors of AFCEA International and became a member of the European Advisory Council of the Association, while another Chapter member was nominated as 2003 Distinguished Young AFCEAN (DYA) and the Regional DYA for the Mediterranean & Black Sea region.

The major event organised by AFCEA Varna is its International Conference. The Chapter has so far organised conferences on the following topics:

- The Bulgarian Navy Transformation – New Missions and New Technologies
- TECHNET EUROPE 2006
- Challenges and Developments in Black Sea Security – the Naval Dimension
- The Bulgarian Air Force – Challenges and Prospects
- The Bulgarian Navy – Transformation and Modernisation in the Context of Black Sea Security
- The Bulgarian Land Forces – New Missions, Tasks and Required Operational Capabilities
- The Bulgarian Air Force – Missions and Roles in the Context of National and Collective Security
- Challenges for Bulgaria's Navy and Maritime Sovereignty
- The Bulgarian Navy – New Missions, Roles and Capabilities
- The Bulgarian Navy – Global Trends and Local Aspects.

Two future conferences organized by the Chapter are:

- Transformation, Modernisation and Building Expeditionary Capabilities of the Bulgarian Air Force
- The Bulgarian Land Forces Transformation – Building Required Operational Capabilities.

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Number endnotes consecutively; these numbers must correspond to those in the text. Endnote should follow *The Chicago Manual of Style*. Examples:

Book: 1. Carl von Clausewitz, *On War*, Anatol Rapoport, editor (London: Penguin Books, 1968), 164-67.

Article: 2. William Owens, "The Emerging System of Systems," *Military Review* 75, 3 (May-June 1995), 15-19.

Chapter: 3. David Alberts, "The Future of Command and Control with DBK," in *Dominant Battlespace Knowledge*, ed. Stuart E. Johnson and Martin C. Libicki (Washington: National Defense University, 1996), 67-88.

Subsequent shortened citations should read as follows:

1. Clausewitz, *On War*, 31.
2. Owens, "System of Systems," 17.
3. Alberts, "Future of C2," in *DBK*, 73.

NOTE: It is understood that submitted articles have not been previously published and are not currently under review for publication elsewhere.

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