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SCIENCE AND TECHNOLOGY, THE BASE FOR INITIATING A STRATEGIC ACQUISITION PROGRAM

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Abstract:
Initiating a major acquisition program is a very sensitive process, not only because of the money involved but also because its role in defense planning. Correlating the mission's needs with the system to be acquired requires a sum of very specific and detailed documents. Identifying different systems that are satisfying the beneficiary requirements is the first step in this process. Behind this activity is an extensive research and expertise that allow defining the technical requirements derived from the missions needs. The role played by the research and technologies organizations has to be very important in this stage.
This papers presents the steps for initiating a major acquisitions program accentuating the importance of science and technology involved and analyses some scenarios in order to emphases the conclusions derived.

Key words: acquisitions, research, mission's needs, operational requirements, complex military systems.

1. Introduction

The military are always analyzing the way they are fulfilling their missions from the operational and the logistic point of view. From time to time, because some equipment becomes old or obsolete, or because new threats come into attention, the military realize the need for an improvement.

This need is materialized into a document called Mission's Needs Document. From this point on is the job of specialized structures to find a way, a well documented and feasible way to satisfy this need.

Throughout this paper I try to give a comprehending view over the process of introducing new technologies into military use.

First chapter will present the current process with emphasis over science and technologies. Some personal ideas regarding some activities will be mentioned as such.

In order to support some the proposal and ideas I will present in short the science and research in NATO, organization / principles / importance.

The final chapter will describe a case study based on a real activity revealing the advantages and of the process in place at this moment.

After trying to underline the principles of S&T and its role in an acquisitions process I will sketch the most important advantages and disadvantages of the NATO and Romania procedures. In conclusion I will present my personal point of view regarding this process.

2.Strategic acquisitions programs in defense planning process

In order to properly understand and analyze the role of S&T in military and, furthermore, to make proposals we should first present the defense planning process.**Fig. 1 Defence planning process**

2.1. Defense planning process

Since the early stages of defense planning process it is important to keep in mind that at some point S&T will be involved.

Unfortunately S&T needs quite generous time to study and develop an idea. It is necessary to correlate the efforts in S&T with the subjects of interest for the military.

The documents that can and should drive the S&T are:

- National Defence Strategy;
- White Paper of Defence;
- Defence Planning Guidance.

Those documents are describing the major military interests and generate the needs for development and acquisitions.

For the S&T they are important not only because they set the military objectives but also because of the timeline comprised. The longer the period referenced the easier is to correlate the S&T activities with the acquisitions / development.

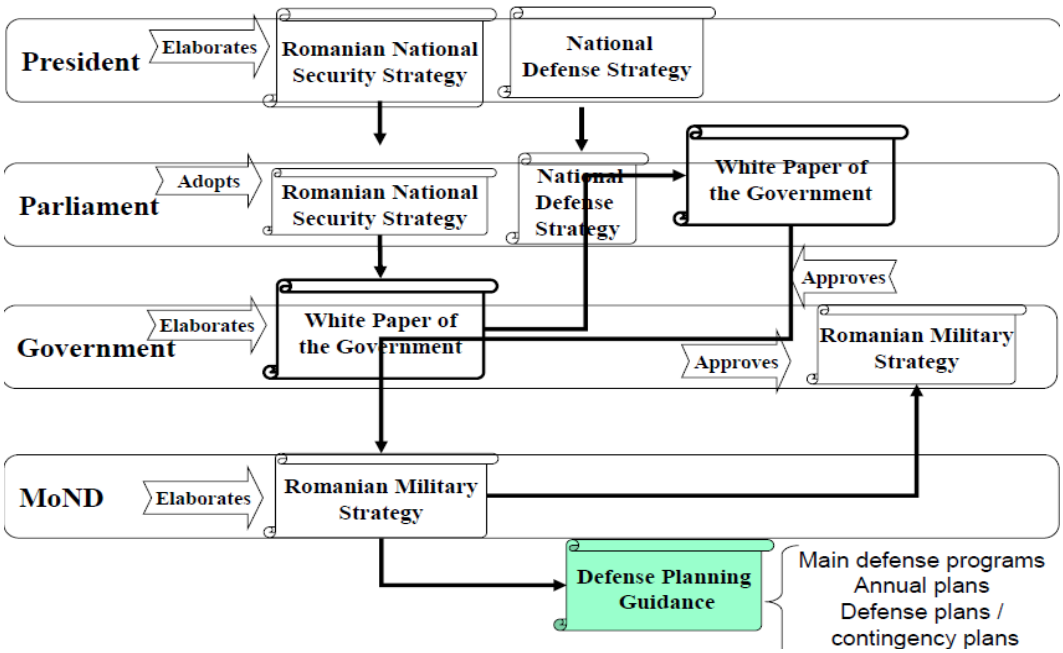

Fig. 1 Defence planning process

The defence planning guidance in place, it is time to develop the defence major programs. Using the Planning Programming Budgeting and Evaluating System - PPBES it is assured that the gaps between planning and existing are kept under control.

It is important to maintain an integrated approach throughout the entire planning process in such a way that the acquisitions' programs and PPBES follow the goals set in the Romanian Military Strategy.[5]

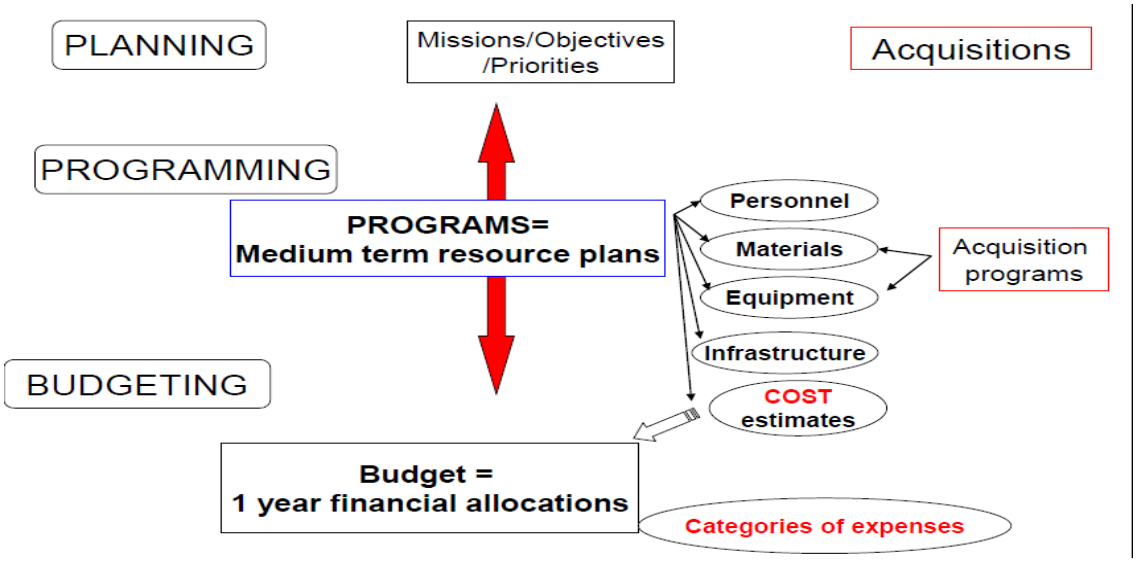

Fig. 2 PPBES and the acquisitions

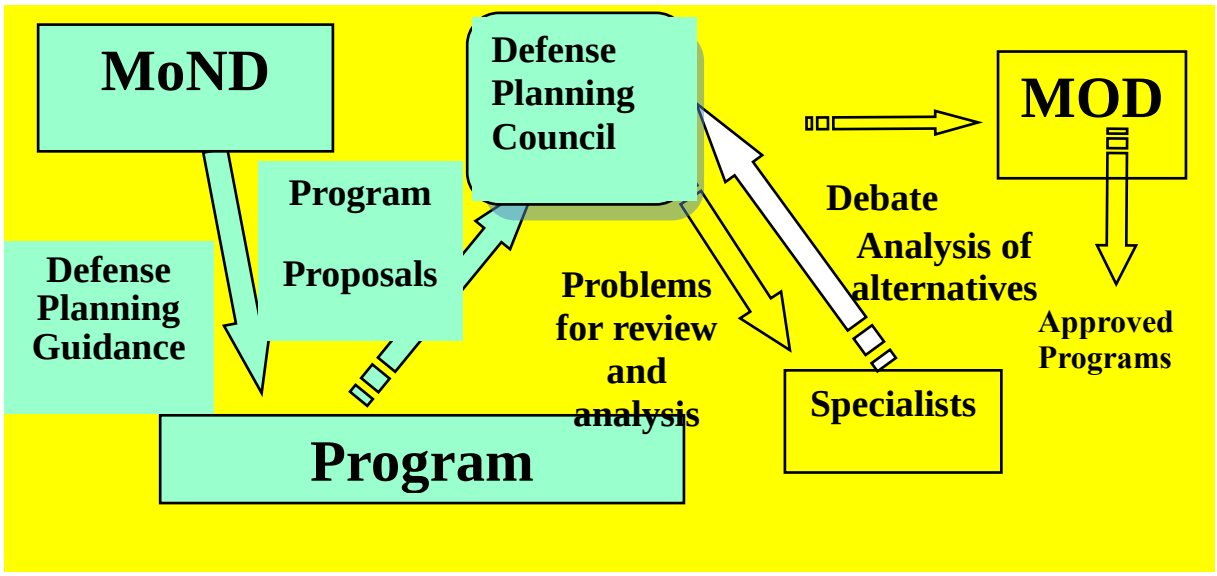

Fig. 3 Program Development And Review Process [1]

2.2. S&T in defense planning

S&T is present in defense planning not only to support acquisitions but also as domain of interest.

The main subject of this paper does not offer a detailed view over the entire S&T process but merely its role in acquisition.

Filling the gap revealed in the planning phase is about money and the acquisitions play an important role. Replacing the obsolete systems or modernizing existing one is made through development and acquisitions.

In order to initiate a development or acquisitions program it is mandatory to have strong knowledge in the field of interest. This knowledge is acquired through research activities.

Considering the time needed for conducting a research program ones must initiate military research programs and to sustain them since early stages of capabilities planning.

In the next chapters I will detail the role as S&T and the role of S&T structures during initiating an acquisitions program.

3. Initiating a strategic acquisitions program

According to the processes described in the previous chapters we can easily indentify the activities and document that generate a need for acquisition.

3.1. Describing the process

In the Fig. 4 Initiating an acquisition program I have tried to identify the main documents (presented in boxes), the processes / activities (left column) and the authorities responsible (right column).

Concept study is the first and the most important S&T document present in the acquisitions process.

Concept study provides the knowledge of the subject matter experts on a given subject. This knowledge is packed in a way that will be useful to decision factors.

Each activity / process is described accurately in *I 1000.2 - Instruction regarding defence acquisitions management - Instrucţiunea 1000.2 privind managementul achiziţiilor pentru apărare*, Ministerul Apărării Naţionale, 1998 [4] and *I 1000.3 - Instruction regarding the interaction between planning, programming, evaluation and budgeting system, requirements elaboration system and defence acquisitions management system* [5].

Acquisitions process is a very sensitive one because of the money involved but also because of the results, the final goal of it. Acquisitions of strategic systems is also time consuming so any mistake in the planning phase can generate misfits of the final product.

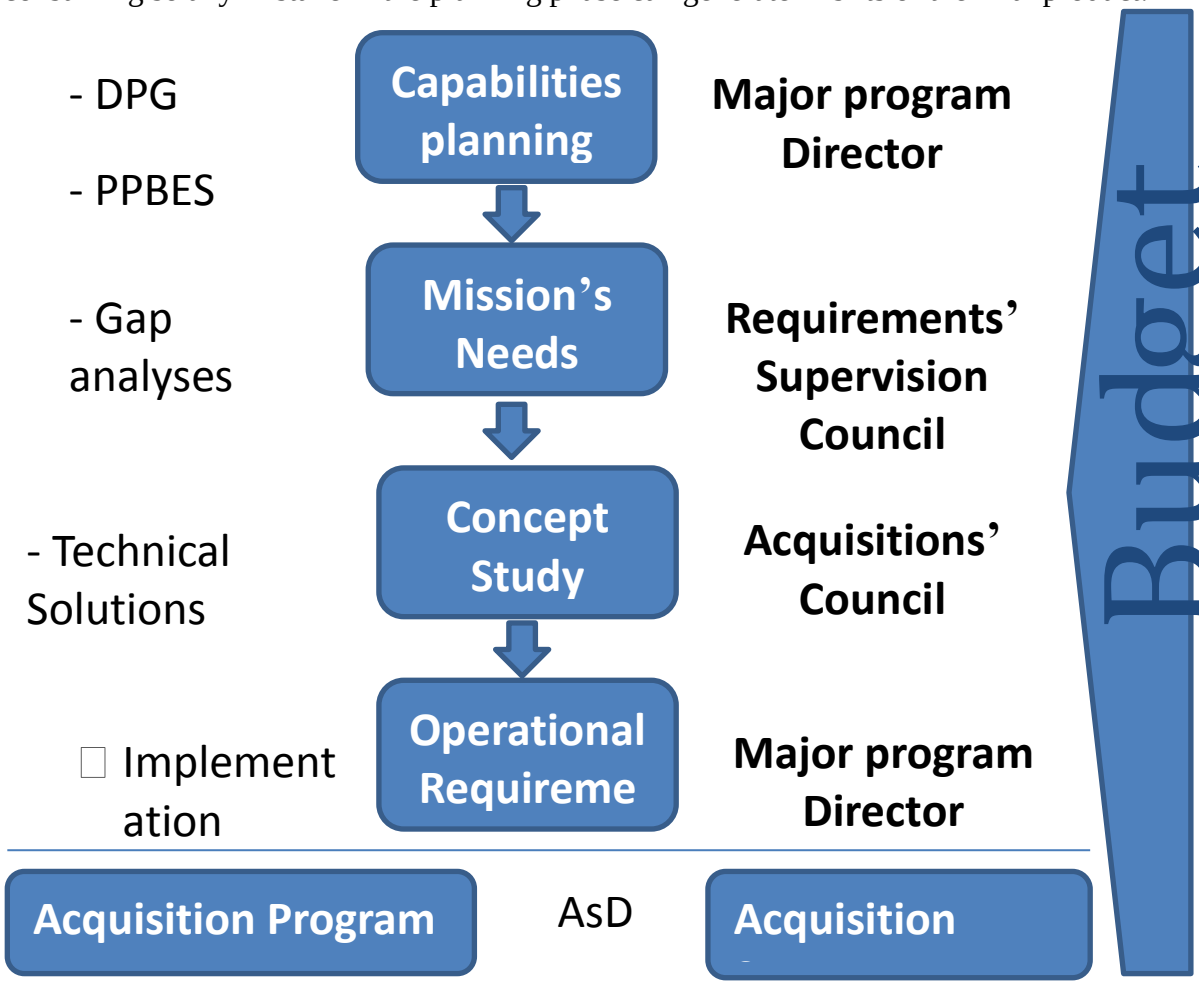

Fig. 4 Initiating an acquisition program

3.2. Mandatory documents

Mission's need document follows one or more capabilities required in the planning documents. It presents the capability, forces and equipment required to respond to a certain risk or threat. If the existent systems do not satisfy the necessity it is introduced the need to develop or acquire a new system to respond to the demand.

Mission's need document is elaborated by a Major Program Director and is approved by the Requirements' Supervision Council.

Concept Study makes the link between an operational need and the system which can facilitate the fulfillment of that need. In the next chapter I will make a short presentation of the content of the concept study.

Operational requirements document takes the technical solution identified in the concept study and prepares the initiation of an acquisition program.

Operational requirements document is elaborated by a Major Program Director and is approved by the Requirements' Supervision Council.

Acquisitions' program base and **acquisitions' strategy** are the documents that initiate the acquisition program. They are elaborated by the endowment / acquisition program director and approved by the Acquisitions' Council.

4. Detailing the Concept Study

The concept study links the mission's needs with the operational requirements. It offers insides of the system that may fulfill the mission's needs.

4.1. Content

The content of the Concept study is meant to analyze the mission's needs and offer at least three technical solutions of implementation.

After the presentation of the objectives of the concept studies one proceeds to detailing the analyzing of the concept and the solutions of implementation throughout several chapters.

- **Mission analyzing**

This chapter presents the mission as it is documented in the mission's need document trying to correlate the mission with different technical solution that may solve the problem (the need).

- **Preliminary requirements allocation**

After analyzing the mission it is important to interpret the mission's needs in such a way that we formulate technical requirements. The technical requirements are the first step in making the transition from a operational / military approach to a technical one.

- **National and international technology level**

After identification of some technical requirements it is the moment to look, at national at international level, for systems or technologies that may be satisfying such requirements.

- **Implementation solutions / embodiments**

This particular chapter is the most important in the whole study. Previous chapters presented the information needed for identifying the solutions / embodiments.

One of the first solutions analyzed is a non-material one. This kind of solution tries to identify means of fulfilling the need using existing, in use systems with minor modifications. This solution may find new procedures or new ways of using a system in order to get the right results.

During the analyses conducted in the previous chapter it is possible to find out a system, somewhat of the shelf system, already developed and homologated in another NATO military, that fulfills the needs.

Other solutions may consist of considering components of such systems interconnected in a specific way or with different developments. In some rare cases it is possible to conclude that we need to develop a system from scratch as the existing systems do not meet the requirements.

Each solution is presented with an estimated cost of acquisition and over life cycle.

- **Comparative analysis**

Each major characteristic / requirement gets a percent of satisfaction in such a way that we can measure each solution. The cost acquisition and life cycle it is an important criterion at this stage.

The result of this analysis reveals the optimum solution to implement.

The next chapters are mostly oriented on common characteristics of the chosen solutions: The **interoperability with similar NATO systems**, **personnel protection**, **training needed**, **infrastructure requirements**, **environmental impact** and so on. If such characteristics are different according to the solutions considered they are analyzed in the previous chapters and may impact the choice of the optimum solution.

4.2. Annexes

The concept study is accompanied by a number of annexes meant to summarize and to clarify the concepts presented:

- Outline for the decisions makers – it presents in one or two pages the optimum solution found and some other elements important for the decision makers.
- Concept Study Synthesis - detailed below chapter -
- Acquisition program base – Draft – offers a proposal for the document that will be elaborated by Armaments Department; this document contains the justification for initiating an acquisition program.
- Acquisition strategy – Draft – offers a proposal for the document that will be elaborated by Armaments Department; this document contains some acquisition solutions / strategy suitable for that specific product.
- Main Testing Plan – describes the proposed steps in testing and evaluating the system / product according to *I 1000.4 – Instruction regarding products' testing, evaluation and homologation processes* - *Instrucţiunea 1000.4 privind procesele de testare, evaluare şi omologare a produselor*, Ministerul Apărării Naţionale, 2006 [6]
- System specification – details the characteristics / requirements at system level.

4.3. Concept Study Synthesis

The Concept Study Synthesis - CSS is one particular important document because it is discussed and validated by the Requirements' Supervision Council.

As the name implies CSS presents the main ideas of the Concept Study in a few chapters oriented on the comparative analysis of the embodiments:

5. Content of the Concept Study
6. National and international technology level – main ideas
7. Comparative analysis of the embodiments – short description of the solutions advantages/disadvantages, costs
8. Optimum solution detailed

After the validation of the CSS the Concept Study is analyzed in Acquisitions' Council in order to be approved.

5. Science and technology in NATO

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Science and technology is represented in NATO by two bodies with different roles and representation. Conference of the National Armaments Directors – CNAD offers a collaborative medium to facilitate discussions and cooperation between Armaments' Departments from NATO's members. The Science and Technology Organization – STO creates a collaborative working place for national science and technologies experts.

5.1. CNAD

Defence Investment Division through the Conference of the National Armaments Directors - CNAD is the NATO body that coordinates acquisitions in NATO.

The main groups under CNAD are presented in the table bellow Table 1 The Conference of National Armaments Directors [2]. Each main group is responsible for a specific technical area considered of importance at NATO level. CNAD is coordinated by North Atlantic Council – NAD and is coordinating with Science and Technology Board.

- The Conference of National Armaments Directors (AC/259)
  - Group of National Directors on Codification (AC/135)
  - NATO Naval Armaments Group (NNAG) (AC/141)
  - NATO Air Force Armaments Group (NAFAG) (AC/224)
    - The Joint Capability Group Intelligence, Surveillance and Reconnaissance (JCGISR)
  - NATO Army Armaments Group (NAAG) (AC/225)
  - Alliance Future Surveillance and Control Project Group (AFSC PG)
  - Ballistic Missile Defence (BMD)
  - CNAD Ammunition Safety Group (AC/326)
  - Life Cycle Management Group (AC/327)
  - NATO Industrial Advisory Group (NIAG)
  - C-IED Activities
  - Industry Relations
- NATO Naval Forces Sensor and Weapons Accuracy Check Sites (FORACS)
- Air and Missile Defence Committee (AMDC) (AC/336)
- Aviation Committee (AVC) (AC/92) *site is under construction*
- Munitions Safety Information Analysis Center (MSIAC)

Table 1 The Conference of National Armaments Directors [2]

5.2. STO

The Science and Technology Organization - STO is a NATO subsidiary body having the same legal status than the NATO itself, and created within the framework of the North Atlantic Treaty signed in Washington in 1949. It has been established with a view to meeting to the best advantage the collective needs of NATO, NATO Nations and partner Nations in the fields of Science and Technology. The STO is operated under the authority of the North Atlantic Council which has delegated the operations of the STO to a Board of Directors (the Science & Technology Board – STB) comprising the NATO Nations S&T managers. The STB is chaired by the NATO Chief Scientist who is a high level recognized S&T leader of a NATO Nation, being permanently assigned to the NATO headquarters in Brussels and also serving as the senior scientific advisor to the NATO leadership.[3]

5.3. Principles

In NATO, S&T is defined as the selective and rigorous generation and application of state-of-the-art, validated knowledge for defence and security purposes. S&T activities

embrace scientific research, technology development, transition, application and field-testing, experimentation and a range of related scientific activities that include systems engineering, operational research and analysis, synthesis, integration and validation of knowledge derived through the scientific method.

In NATO, S&T is addressed using different business models:

- The Collaborative business model where NATO provides a forum where NATO Nations and partner Nations elect to use their national resources to define, conduct and promote cooperative research and information exchange.
- The In-House delivery business model where S&T activities are conducted in a NATO dedicated executive body, having its own personnel, capabilities and infrastructure.

There are several instances where this could happen: the S&T Organisation, the Science for Peace and Security Program, and/or the NATO agencies.[3]

5.4. Organizational view

S&T Board controls 6 panels and a group:

1. AVT – applied Vehicle Technology
2. IST – Information System Technology
3. HFM – Human Factors & Medicine
4. SA – Systems Analysis Studies
5. SCI – Systems Concepts & integration
6. SET – Sensors Electronics Technology
7. MSG – Modelling & Simulation Group

Each panel / group is comprised by national's representatives of the NATO's countries or Partners for Peace interested in the field of the panel. One nation may have up to three members: one from military research, one from academia – usually military - and one from national industry.

Panel's members propose / accept / monitors the activities at the level 3. Level 3 is the actual research that involves specialists from each country that agreed to get involve in that specific activity. Working groups may be: Exploratory Teams – in charge with proving the utility of an idea; Task Groups – conducting up to 3 years applied research; Symposia / Specialists Meetings / Workshops – media for presenting research results; Lecture Series – an academic activity meant to inform generally the students about the work and results in a specific task group.

5.5. Romanian involvement

Romania is represented in all 7 panels and groups by specialists / subject matter experts in the field of that panel or group. The participation may vary according to the momentary national interest in that specific field.

In order to stay in contact with latest S&T progress and to develop its own research programs, Romania encourages participation in the Level 3 activities from military research / civilian research / academia / industry.

As our nation is a member of NATO, and there are large efforts in place to correlate our military with other NATO members, generally our S&T objectives coincide with STO's.

6. Case study

In the table below I will present the timeline of a research project started first in a STO panel with Romanian involvement and having implications on national level in an acquisition program.

No	Structure involved	Year	Comments
1.	Foreign Military - FN	T0	FN research laboratory - FNRL is mandated to find a way to define a common interface for a specific kind of equipment
2.	FNRL	T0	FNRL works at a national standard to define the common interface mentioned before
3.	FNRL	Jan T0+1	FNRL's specialist find that it is necessary to develop the interface with respect to other militaries in NATO so FNRL's representatives in STO propose a common research area in this domain
4.	STO	May T0+1	The panel agrees to sustain work in this field. Different NATO countries and Romania (Armaments Department – Military Equipment and Technology Research Agency – METRA) promise to be involved
5.	METRA	July T0+1	METRA's specialist is presenting the research theme to the potential beneficiary – RLF and to the potential industry interested in developing this interface
6.	STO working group	September T0+1	The first meeting of the group takes place with the participation on METRA's. The group enjoys a better involvement then estimated because of the interest at national level in different countries to develop such an interface
7.	METRA	October 2014	METRA's specialist reiterates the meeting on this subject but there is not identified an interested party neither on the side of the military nor on the side of industry
8.	METRA	2015	Due to lack of resources both human and money METRA has to interrupt participation to the STO group
9.	STO working group	2015-2016	The working group is continuing its development of the interface and a standard to define it. Romania does not has access to this work
10.	RLF	September 2016	A Mission's Need Document regarding the technology of the interface is presented and approved in Requirements' Supervision Council
11.	Acquisition's Council	September 2016	Mandate METRA to elaborate the concept study till December 2016

Table 2 Case Study Timeline

The timeline presented before underlines the possibility of losing touch with state of the art technology. In this particular case it was only a year gap between loosing the resources to conduct research in a specific domain and the appearance of the need for those technologies.

The example also reveals the importance of keeping in touch with the activities in STO as they are driven by NATO policies that also influence our military policy.

7. Improving S&T involvement in acquisitions

As a simple logical exercise we can compare three possible courses of action COA regarding the involvement of S&T in acquisitions:

COA 1. Maintaining present process

COA 2. Involvement of the S&T since Defence Planning Guidance approval

COA 3. Generating national research projects under Defence Planning Guidance and in coordination with STO activities

In this simplified exercise I applied **decision making under certainty - global utility method.**

In order to compare the three COA's I took into consideration four criteria valued in Table 3 COA's analysis:

8. **Human resources involvement** – means the degree of involvement of specialized personnel into acquisitions – in this case I have considered the coefficient of importance 0.1 taking into consideration that the personnel is employed by the military
9. **Time to generate specialists** – the specialization of research personnel is generally high because of the knowledge involved and it affects the time needed for specialization – coefficient of importance 0.2
10. **Quality of the outcome** – Concept Study is the base for all other documents that initiate an acquisition program so the quality must be as high as possible considering the money and the time involved - coefficient of importance 0.5
11. **Budget** – Budget is always important but in this case the numbers are quite low - coefficient of importance 0.2

COA	**Human resouces involvement**	**Time to generate specialists**	**Quality of the outcome**	**Budget allocated**
1	low	high	Poor	low
2	medium	medium	Average	medium
3	high	low	Very Good	high
Ki	0.1	0.2	0.5	0.2
Nature of criteria	Min	Min	High	Min

Table 3 COA's analysis

Each criteria having only three states I noted the best case scenario with 1, the average with 0.5 and the worst 0.

COA	**Human resouces involvement**	**Time to generate specialists**	**Quality of the outcome**	**Budget allocated**	**Total**
1	1	0	0	1	0.3
2	0.5	0.5	0.5	0.5	0.5
3	0	1	1	0	0.7
Ki	0.1	0.2	0.5	0.2	
NC	Min	Min	High	Min	

Table 4 Global utility method results

The results presented in Table 4 Global utility method results reveal that the optimum course of action is COA 3 generating national research projects under Defence Planning Guidance and in coordination with STO activities

Using other decision making theories and adding different criteria and more precise values may affect the final numbers but I don't expect other optimum solution.

8. Conclusion

The processes presented regarding the initiation of an acquisition program clearly reveal the need and the importance of a strong science and technology activity.

The main advantage of our current organization, our process diagram is the management the human resources involved in research. The main research activities are conducted independent of the acquisition process so there is no major impact on the research activities when it is necessary to involve research specialist in acquisitions.

The main disadvantage is that if it is no correlation between main research activities and planning of new military capabilities it is a great risk that, at the moment of formulating a Mission's Need Document, the S&T cannot offer an really documented point of view in due time.

Furthermore participating with specialist in STO activities offers a risk management tool for present process but in the same time is a waste of human resources if national research is not correlated with STO.

Decision making theory only confirms the expected result that correlating the national military research with defence planning guidance and the STO activities will improve the process.

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