The 15th International Scientific Conference
"DEFENSE RESOURCES MANAGEMENT IN THE 21st CENTURY"
Braşov, November 12th-13th 2020

THE MANAGEMENT OF RESEARCH AND DEVELOPMENT PROGRAMS IN THE MINISTRY OF NATIONAL DEFENSE

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Abstract:
Research and development are targeted to development new products, new solutions and creates knowledge. Security environment, policies and strategies were analysed in the paper, in order to identify factors that affect military R&D. The last four years of R&D Sectoral Plan were analysed in a comprehensive study, analysing also key players and mechanisms for financing the Romanian military R&D.

Key words: Research and development, military planning, major programmes, budget, end-user

1. Introduction

There are a multitude of definitions for Research & Development (R&D), one of them being presented in the Cambridge Dictionary [11]:

Research & Development is *"a **part** of an organisation that **works** to **improve** its existing products and **develop** new ones"*.

A much more elaborate definition is presented in Encyclopaedia of Quality of Life and Well-Being Research [12]:

"Research and development (R&D) is a broad category describing the entity of basic research, applied research, and development activities. In general research and development means systematic activities in order to increase knowledge and use of this knowledge when developing new products, processes, or services. Nowadays innovation activities are strongly tight into the concept of research and development. In the broadest meaning, ***research and development consists of every activity from the basic research to the (successful) marketing of a product or (effective) launching of a new process (R&D&I)***".

New product design and development is often a crucial factor in the survival of a company. In a global industrial landscape that is changing fast, firms must continually revise their design and range of products. This is necessary as well due to the fierce competition and the evolving preferences of consumers. Without an R&D program, a firm must rely on strategic alliances, acquisitions, and networks to tap into the innovations of others.

In general, research and development activities are conducted by specialized units or centers belonging to a company or can be out-sourced to a contract research organization, universities, or state agencies. [13]

2. Environment analyses

At global level, the security environment is continuously transforming, which is reflected in high interdependencies of international relations and the difficulty of delineating between classic risks and threats and the asymmetric and hybrid ones [2].

Presently, by its commitment to Euro-Atlantic values, Romania has the most powerful security guaranties in the entire history. The main guarantor of Romania's security is the North-

Atlantic alliance, whose policies and capabilities are based on solidarity principles and US commitments in Europe.

Beyond these international "security assurance policies", one of the main objectives of national security policies is the maintenance and the development of high potential for research, expertise and technical and technological consultancy in the military area, as well as the development of testing and evaluation capabilities of the Ministry of the National Defence [2].

2.1 Doctrine papers related to R&D

2.1.1 Wales summit declaration, issued by the Heads of State and Government participating in the meeting of the North Atlantic Council in Wales, 4-5.09.2014 [4].

This document stated, in para 14, that allies who currently spend less than 20% of their annual defence spending on major new equipment, including related Research & Development, will aim, within a decade, to increase their annual investments to 20% or more of total defence expenditures.

2.1.2 The governing programme for 2020-2024 [3] stated a lot of important measures related to R&D, in a dedicated Chapter. Some of these are:

- maximizing resources for domestic defense production, from the mandatory annual budget allocation of 2% of GDP, as well as the appropriate use of funds for research and development in the field of technologies that can be used for dual purposes (and in the civil sector, eg. cybersecurity);
- the increase the value and efficiency of research and innovation funding and reach the target of 2% of GDP by 2024 (1% public funding + 1% private funding) by ensuring a balanced budget distribution to support both applied and fundamental research;
- the harmonization, updating and simplification of legislation on public research organizations according to the principles of "better regulation" and avoidance of excessive bureaucratization;
- stimulating decision-making processes regarding research management, on a scientific basis;
- attracting annually 100-150 Romanian researchers from the diaspora and / or researchers from abroad, through RDI projects with duration of 5 years.

2.1.3 White book of the Defence – 2021 [2]

The Defence White Paper underpins the military strategy and the Defence Planning Directive and is designed in a new strategic paradigm, with the goal of strengthening the defence and deterrence posture based on five key elements: high technology; highly educated and well-trained human resources; a strong domestic defence industry; developing an institutional culture focused on knowledge and innovation; resilience.

This White book states that the basis of the research-development and innovation activity will be represented both by ensuring at least 2% of the defense budget for this domain, and by allocating at least 20% of the defense budget for endowment and modernization.

By developing and capitalizing the national scientific and technological potential, R&D&I, for military purposes, it will be provided the necessary scientific and technological support to fulfil the missions of the Romanian Army, with an efficient management of allocated resources.

The main objectives of research and development and innovation for military purposes are:

- increased performance and efficiency, by:
  - achieving operational capabilities' objectives and priorities;

- development of military scientific and technological competency;
- strengthening the links between R&D entities from the MoND and industry;

- allocation of own resources for:
  - increasing the budgetary allocations for scientific research until reaching the threshold of 2% of the MoND budget;
  - R&D infrastructure development, including by accessing EU funds
  - development of human resources involved in R&D and improvement of young specialist entries in the R&D system.
- increased use of R&D results, by collaborating with companies from national security industry;
- involvement of private sector in military projects, financed by own budget.

2.1.4 National Defence Strategy for 2020-2024 - „Together for a safe and prosperous Romania in a world marked by new challenges", that states some threats, risk and vulnerabilities [1].

The lack of real multi-annual budgetary planning was identified as a vulnerability related to the capacity of state institution to evaluate and mitigate the impact of risks and threats, regarding to critical infrastructure, armed forces' capacity for modernisation and development etc.

One of the correlation between lines of action and the national security objectives stated in the National Defence Strategy is continuing the Romanian Armed Forces' process of transformation, modernisation and endowment/ procurement, by allocating at least 2% of the GDP to the defence budget annually, for at least 10 years, a process started in 2017.

2.1.5 National Strategy for Research, Development, and Innovation 2021 - 2027

This new strategy has not been published yet, so it is not available.

2.1.6. Strategy of the Ministry of National Defense in the Research-Development and Innovation field 2021 -2027 (project) [7]

The general objective of the strategy is the optimal use of the scientific and technological potential of the structures in the Ministry of National Defense that carry out R&D activities, as well as developing the relationship with national and international R&D institutions, both public and private.

The main objectives, for 2021-2027, defined on the project of the strategy consist in:

- Development of defense capabilities used by the Ministry of National Defense to achieve its strategic objectives;
- The armament systems that are part of the Romanian Army must be a priority for the entire scientific community in the Ministry of National Defense;
- Integration with the civil environment.

Accordingly with the strategy, the priority research areas are:

1. Information technology
2. Modern communications and electronic warfare
3. Autonomy and artificial intelligence
4. Weapons, ammunition and missile systems
5. Protection, health and human performance
6. Energy, environment and climate change
7. Eco-nano-technologies and advanced materials
8. Military sciences

9. Information for Defense

2.2 Research, Development and Innovation in Romania

2.2.1 The national R&D establishment

The national R&D network consist of all public and private establishments and institutions that perform R&D according with their registered domain of activity.

The national R&D network includes the following categories of establishments and institutions:

A. Public organizations:

a) R&D institutes, centres or stations organized as public institutions;

b) R&D institutions or research centres organized within national societies, national companies and autonomous bodies under central or local administration (including military research organizations);

c) international R&D centres, established under international agreements;

d) other public organizations, which provide R&D in their activities.

B. Private organizations:

a) R&D entities, organized as companies;

b) companies or their departments which provide R&D in their activities;

c) private accredited higher education institutions or their departments.

2.2.2. Civilian authorities

Ministry of Research, Innovation and Digitalization (MRID) is the top-level governmental authority that organizes and leads the national scientific research, technological development and innovation system [14]. Its responsibilities are derived from laws and regulation and it is responsible for elaborating the public policies for R&D.

As state authority for research and development, MRID provides, on one hand, design, implementation, monitoring and evaluation in scientific research, technological development and innovation, and on the other hand, coordinates the development, implementation, monitoring and evaluation of policies for expanding national and international heritage of research, technology and innovation, sustainable economic development, access to research results and technologies developed domestic and international, customer satisfaction and quality of life.

Intermediary Organism for Research is subordinated to MRID and acts as Management Authority for Operational Programme Competitiveness (POC 2014-2020, even we are in 2021).

Executive Unit for Financing Higher Education, Research, Development and Innovation (UEFISCDI) acts as administrator of National Plan for Research, Development and Innovation and as Management Authority for some programmes in this national plan. UEFISCDI was created in 2010 with the mission to centralise the funding and coordination activities of higher education, research, technology development and innovation. This centralisation reflects a change in the Romanian RDI system, i.e. separation of the RDI policy-making and performance evaluation functions, retained by the Ministry of National Education, from the implementation functions, delegated to UEFISCDI and some consultative councils. [15]

2.2.3 Military authorities

The highest military authority involved in managing R&D activities is **Armament General Directorate (DGArm)**, directly subordinated to minister of defence [16,17].

Among other responsibilities, **DGArm** provide the management of armaments systems and major equipment acquisition programmes, as well as the management of R&D activities, related to major programmes [8, 16].

The main links between Armament General Directorate, RDI organizations from Ro MoND and other military stakeholders are presented in figure 1

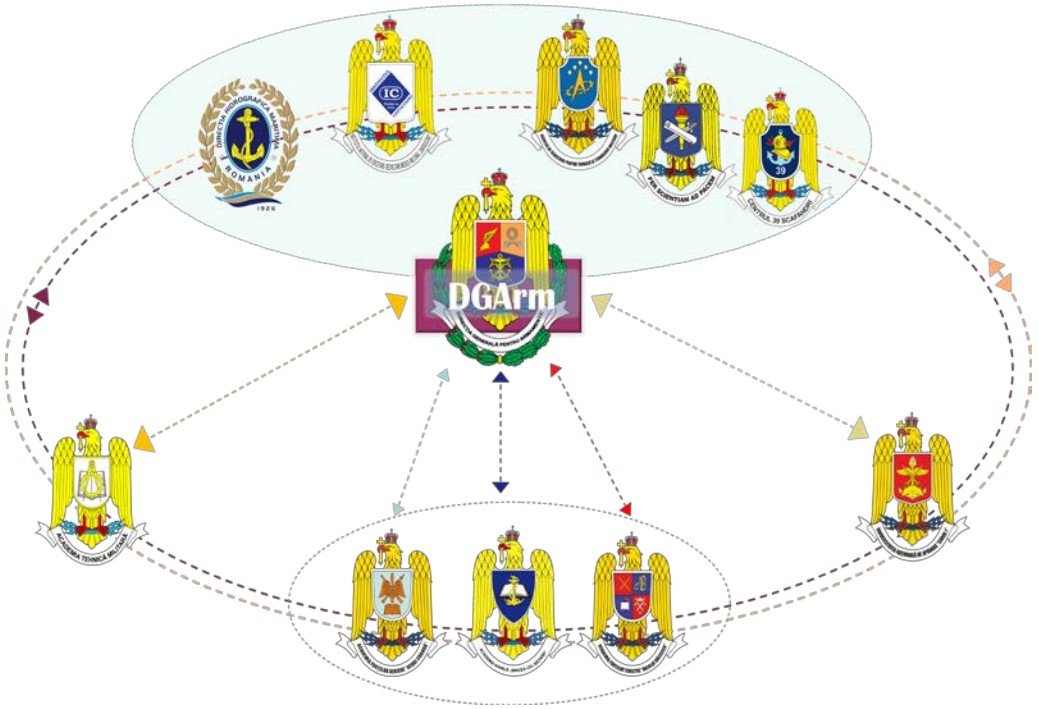

Fig. 1 R&D organizations from Ro MoND

Management Directorate for Endowment Programmes is subordinated to Armament General Directorate and its responsibilities related to R&D consists in the coordination of all R&D activities performed in the Ministry of National Defence, but also the coordination of all testing and evaluation, audits and analyses activities, related to endowment with new military systems and equipment [18].

Military Equipment and Technologies Research Agency (METRA) is subordinated also to Armament General Directorate and its primary mission is to perform basic oriented and applied research, technological development activities, for continuous input of technical progress to military, design of new military technology with higher performances and modernization of fielded technology, at low resource investments [19].

METRA consist in or subordinates 5 scientific research centres, which are organized on departments and laboratories with distinct profile, according to specific research areas:

- Information Systems and Communications Test & Evaluation Scientific Research Center
- Scientific Research Center for CBRN Defense and Ecology
- Scientific Research Center for Navy
- Flight Research and Tests Center

- Test, Evaluation and Scientific Research for Weapon Systems Center

2.2.4 R&D Plans to fulfil military R&D goals

There are three main ways for achieving R&D goals for military purposes, the endowment with new and modern military equipment or technologies:

a. **MoND R&D Sectoral Plan** for military equipment and technologies, funded entirely by MoND based on Governmental Decision no. 1266/2004.

b. **National Plan for Research, Development and Innovation**, funded by Ministry of Research and Innovation based on Governmental Decision no. 583/2015.

c. **Internal R&D Plan** of each research organization within the MoND.

3. R&D in the Romanian military field – case study

The current status analyses are based on the data available for the last 4 years.

Despite all policies and strategies, the R&D expenditures are far away that the presumed ones and are presented in table 1.

Table 1. GDPs vs MoND budgets vs R&D budgets (in the MoND) (K RON)

Year	GDP	Total MoND budget	MoND, %	R&D Budget	R&D %
2018	815,195,000	18,185,459	1.99	1,765.5	0.01
2019	907,900,000	20,309,841	2.00	2,096.5	0.01
2020	1,017,500,000	22,198,333	2.00	15,156.2	0.068
2021	1,110,200,000 (estimated)	22,746,269 (estimated)	2.00	76,103.9	0.335

It could be only one explanation that, despite all the commitments, R&D funds are far less that the desired one. The new security environment and endowment status with old military equipment forced the MoND to focus on acquisition.

It is easier to buy on the shelf military equipment and train the personnel to work with it than waiting for a R&D solution and hoping that Romanian defence industry will produce it to a rate and to the desired quality as expected from the R&D project.

In normal situation, even it has taken longer periods until completed, an endowment programme through R&D is to be desirable, because the end user will have full control of the military requirements, but also the results can be finely tuned during the development phase, in terms of capabilities delivered.

In nowadays situation, when there is great need of modern equipment in short time, the acquisition of on the shelf equipment solve the needs of the army. A big disadvantage of this approach is that the end user cannot control entirely the technical requirements of the military equipment.

Because the funds allocation in the Ministry of National Defence is based on major programmes (MjPs), the current analysis is based on R&D Sectoral Plan (RDSP) for military equipment and technologies, funded entirely by MoND.

As Armament General Directorate, as the highest military authority which coordinates the R&D in the minister, is funded from Central Administration MjP, all the financial resources necessary to perform R&D in the military are traditionally allocated from this MjP.

The process of providing military equipment through R&D starts with a requirement (either in terms of mission needs, or in terms of research needs) of an end-user, analysed by R&D organizations within MoND, which translate the needs in terms of resources (workpower, budget, time) necessary to complete the projects.

Usually the end-user for the R&D projects are the services (Army, Air Force, Navy, Logistic Command), but also General Staff and Military Intelligence Directorate. These end-users are also the structures that run a MjP in Romanian military planning, based on force structure.

The allocation of funds on RDSP for the last four years is presented in table 2 and figure 2.

Table 2. R&D budgets for RDSP, 2018-2021 (K RON, without medical assistance)

Year	R&D Budget	CA	Army	Air Force	Navy	Strategic command	Logistic	Intel
2018	1,765.5	125.7	721	339.6	155.2	271.3	68.1	84.6
2019	2,096.5	165.6	419	873.7	147.2	228.5	102.5	160
2020	3,066.2	187.7	1,048.5	1,097	373.5	185.5	79.5	94.5
2021	23,819.9	3,852	5195	5,586	4,066.9	4,246.5	594.2	279.3
Total	**30,748.1**	**4,331**	**7,383.5**	**7,896.3**	**4,742.8**	**4,931.8**	**844.3**	**618.4**

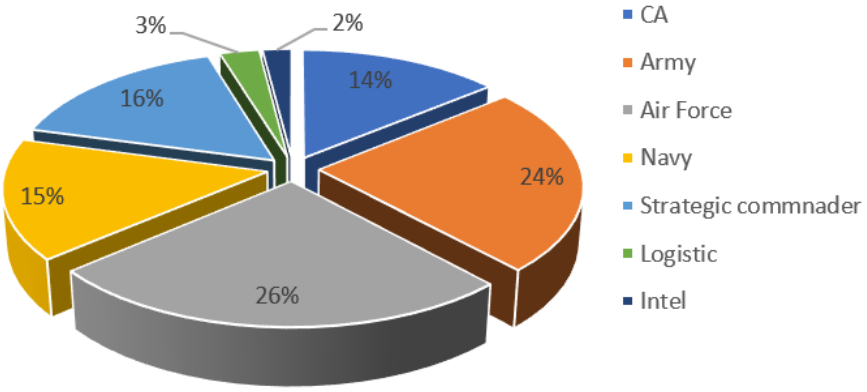

Fig. 2 Budget allocation for RDSP, 2018-2021 (without medical assistance)

In addition, starting with 2020, the "medical assistance" program was budgeted separately. The funds were allocated especially for "Cantacuzino" National Medical Military Institute for Research and Development.

These found represent an important part of the RDSP budget, 12,090 K RON (2020), respectively 52,284 K RON (2021).

The allocation of funds on RDSP for the last two years (including "medical assistance") is presented in table 3 and figure 3.

Table 3. R&D budgets for RDSP, 2020-2021 (K RON, including medical assistance)

Year	R&D Budget	CA	Medical	Army	Air Force	Navy	Strategic command	Logistic	Intel
2020	15,156.20	187.7	12,090	1,048.50	1,097	373.5	185.5	79.5	94.5
2021	76,103.90	3,852	52,284	5195	5,586	4,066.90	4,246.50	594.2	279.3
Total	91,260.10	4,039.70	64,374.00	6,243.50	6,683.00	4,440.40	4,432.00	673.70	373.80

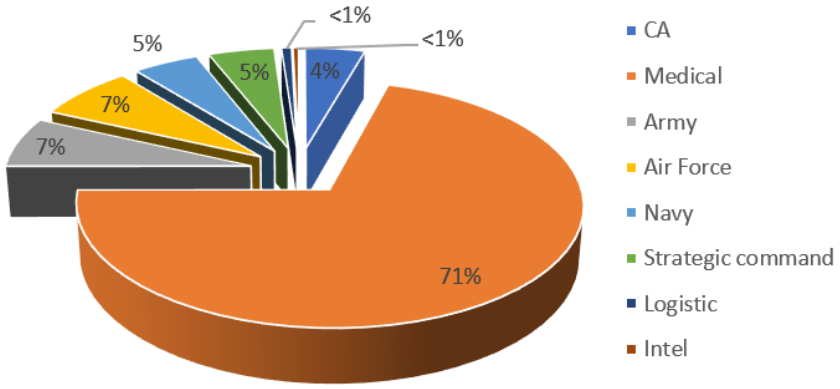

Fig. 3 Budget allocation for RDSP, 2020-2021 (with medical assistance)

For the first time in 2021, investment funds were allocated. These founds (11,636 K RON) represent 22.3 % of the budget allocated for this year.

For a thorough understanding of the allocating funds process for R&D, I will consider each end-user situation.

The R&D budgets (for RDSP) in the analysed period are presented in figure 4.

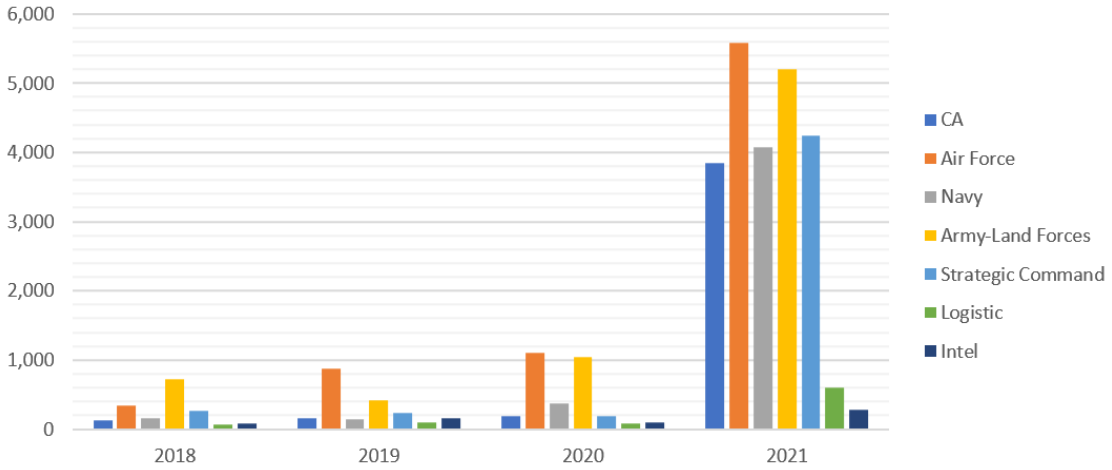

Fig. 4 Annual budget allocation for RDSP, 2018-2021 (without medical assistance), K RON

Each end-user can allocate additional financial resources to the R&D budget. As a result of increasing needs for R&D projects coming from various end-users, they started recently to add some funds from their MjPs to the common pool of RDSP. A statement of allocated financial resources vs. expenditure for 2021 is presented in fig. 5. Also, the number of R&D Project, from RDSP 2018-221, for each end-user are showed in the figure 6.

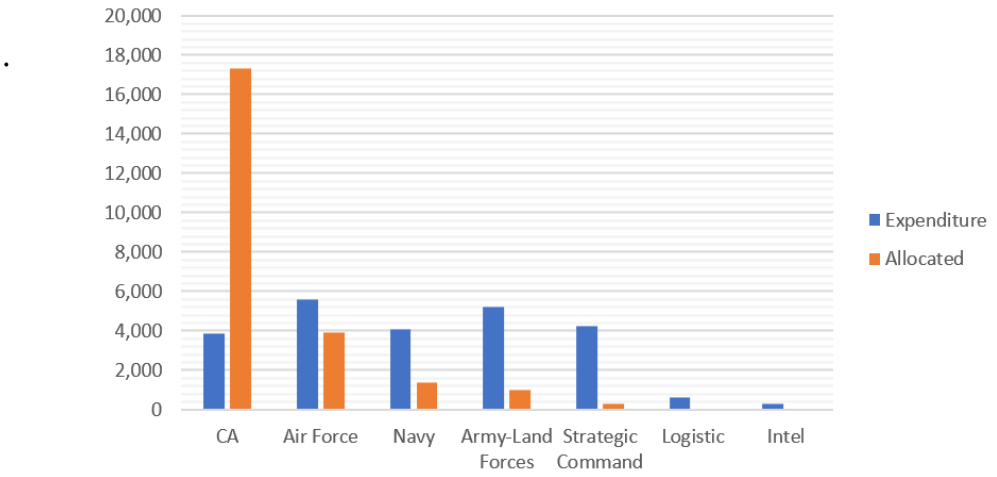

Fig. 5. End-user's own allocations and expenditures for RDSP, 2021

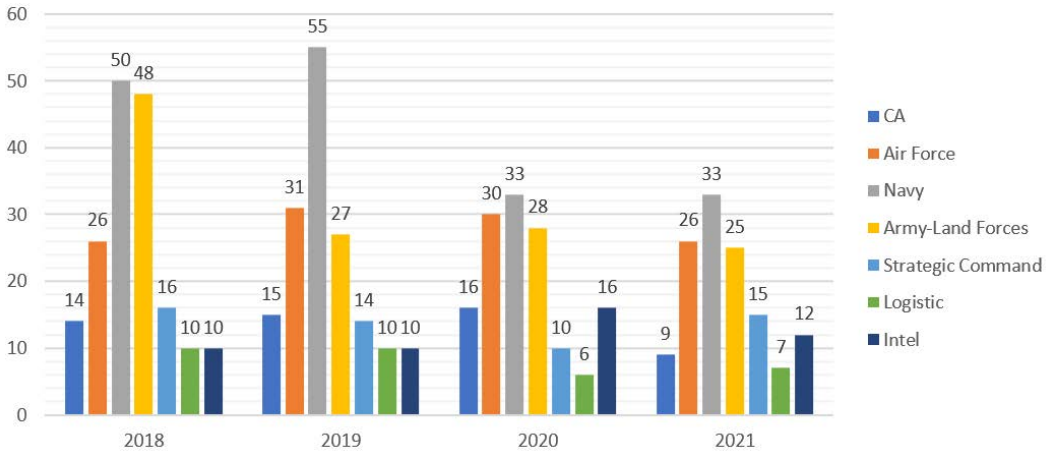

Fig. 6. Number of R&D Project (from RDSP), 2018-2021

These figures proved that when there is interest for specific R&D projects, MjP managers can identify the necessary funds. Even if the number of projects is relatively the same (for each end-user per year), when the number of projects increase, based on end-user needs, MjP can supplement the R&D budget with funds dedicated for specific projects.

Figure 4 shows a significant increase in the budget in 2021 compared to previous years. Even the number of projects has remained relatively the same, a significantly larger budget allocated in 2021 demonstrate that the allocation is not driven by the number of projects, but rather by their importance.

4. Conclusions

Policies and doctrines, both international and national, have only limited and general provisions about R&D. There are strategic document where the progress involves R&D, but their implementation consider mostly the actual economic situation and not the approved strategies.

Current domestic security environment does not support the R&D as a major programme for Romanian MoND, the actual budgetary structures being based on existing structures (services or commands) and not on needs and/or capabilities.

The lack of real multi-annual budgetary planning was identified as a vulnerability related to armed forces' capacity for modernisation and development.

The actual financing mechanism for R&D is not a sustainable one. There are too many actors involved in the process, with different responsibilities and different roles, thus the accountability of the R&D process being diluted:

a. The services are issuing the needs and sometimes contribute to the overall budget for R&D, but only with small amounts, if a specific interest occurs. Exceptions from this situation are Air Force and Navy MjPs, which contribute almost yearly to RDSP.

b. Armament General Directorate is managing the distribution of the end-users needs toward the proper military R&D organization, and also the rest of the processes (projects proposals, project management, project ending, audits, homologations and so on).

c. Central Administration MjP is the main financing authority, but is placing in the R&D common pool only what is left from other subprogrammes, because it is not an end-user for the R&D results. The R&D results are not interesting for CA MjP, further implementation of the R&D projects being responsibility of end-users.

d. R&D organizations propose the way projects should be fulfilled, but the approval is mandatory for Armaments General Directorate, and not for the end-users or CA MjP.

Funds allocation should come from the end-users entirely as a result of negotiation between the end-user and the R&D organization, thus making the end-users more accountable for project outputs and their later implementation in the military. The actual organization, where end-user issue a need and someone else is responsible for project audit lead to a lack of responsibility, both for project results and results implementation.

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