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DEFENCE INDUSTRY-PROPOSALS FOR IMPROVEMENT

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Abstract:
The subject of this analysis is to find the most proper way to manage the defense industry capabilities for a small/medium country. Defense industry can be defined as a group of companies which design, develop and produce military equipment and support for it. The first questions that arise are the following: "What is defense industry?", "Where is its place?", "How must be managed: like a hole or individual?" and "Which is the most proper way to be: state owned, private or public private partnership?". In order to answer to these questions will be presented a short history of defense industry, some current situation from different countries and future directions for national defense industry.

Key words: defense, industry, equipment, morenization

1. Introduction

The subject of this analysis is to find the most proper way to manage the defense industry capabilities for a small/medium country. Defense industry can be defined as a group of companies which design, develop and produce military equipment and support for it. The first questions that arise are the following: "What is defense industry?", "Where is its place?", "How must be managed: like a hole or individual?" and "Which is the most proper way to be: state owned, private or public private partnership?". In order to answer to these questions will be presented a short history of defense industry, some current situation from different countries and future directions for national defense industry.

2. Historical perspective of defense industry

Even the production of weapons starts from the beginning of human history by manufacturing swords, shields, bows and arrows, spears, catapults, ships, gunpowder (China), first elements of artillery during Middle Age, the industrial revolution and the ability to produce in large number new, more efficient and powerful modern weapon lead to a great advantages for that countries during wars.

We can consider that modern defense industry starts during second half of the 19'Th century in Western Europe (in countries like United Kingdom, Germany (Prussia), France) and in United States as a consequence of industrial revolution.

During American Civil War 1861-1865 the Northern part of the United States based on technologically advance and superior industrial capabilities over the South gave a great advantage to the Union Army against Confederacy Army. Two important examples can be mentioned: using of breech-loading riffles by the North against muskets used by South and the beginning of the industrial production of Gatling gun – an early machine gun. Huge number of casualties by both sides (between 800.000 and 1.000.000 dead) is a consequence of this modernization. Another important aspect that must be mentioned is the first battle

between ironclads: the CSS Virginia and the USS Monitor. The lack of industrial capabilities able to produce these ships by the South led them to try to procure it from Britain. The appearance of ironclads (first time in 1859 – Gloire, French Navy) led to disappear of the wooden fleet and the beginning of the manufacturing new type of warships.

The most notable example in Europe can be considered Prussia which was one of the first countries that began to implement technological innovations (especially new developments in artillery and rifles) using its own industrial capabilities. All these capabilities and innovations implementation help them to defeat Austria in 1866 and France in 1870-1871 wars.

Starting with twentieth century and World War I the implementation of the large number of technological innovations in manufacturing weapons gave a huge advantage to the nations. Using of field telephone, radio communication, aircraft and sound detection to locate enemy batteries led to a revolution in artillery. Armored vehicle, tanks, submarine, fixed-wing aircraft used for observation and ground attack, observation balloon with crew equipped with parachute and aircraft carriers were used for the first time during this war. Chemical warfare was another innovation used during this war.

Innovation of weapons and used this innovation by Germany nearly defeating the allies in World War I. Initially the United States had a small army, but, after entering the war, it drafted 2.8 million men, and, by summer 1918, was sending 10,000 fresh soldiers to France every day - a huge resource allocation.

Technology had a significant effect during World War II. It also had the greatest effect on the technology and devices that are used today (e.g. radar, ballistic missile, sonar, night vision, nuclear technology, jet engine). Some of these technologies were developed during 1920s and 1930s, much was developed in response to lessons learned during the war, while others were developed as the war ended. World War II was the first war where military operations were focused to obtain intelligence on the enemy's technology and targeted the research efforts of the enemy.

It can be stated that the war was a clash between one of the most technically advanced country in the world, Germany, from economic, scientific, research and industrial capabilities perspective and a global superpower, with political and economic control of a quarter of the world's population, industry and resources, British Empire, in 1938. From the war resources perspective the entry of the United States into the war in late 1941 add a huge quantity of financial, human and industrial resources. For example in 1939 annual aircraft production for the US military was less than 3,000 planes and by the end of the war US factories had produced 300,000 planes. In 1944 US had produced two-thirds of the Allied military equipment. In the same time USSR evacuated the majority of its European territory (2,500 factories, 17 million people and great quantities of resources) to the east.

According to William S. Knudsen, "We won because we smothered the enemy in an avalanche of production, the like of which he had never seen, nor dreamed possible."

As a result it may say that defense industry's most important characteristics can be considered to be ***technological innovations*** & ***resources*** provided capabilities.

3. Current status of defense industry

3.1 International statistics

In order to have a proper instrument of comparisons and analysis of the current status of the defense industry the most appropriate approach can be some statistics data from this industry. Data regarding world's largest arms exporters and a list of major weapon manufacturers could be the most appropriate for this analysis. Stockholm

International Peace Research Institute (**SIPRI**) is an international institute based in Sweden, dedicated to research into conflict, armaments, arms control and disarmament. The following data used in this analysis will be provided by this institute.

World's largest arms exporters are presented in the bellow table:

2012–2016 Rank	Supplier	Arms Exporters billion USD
1	United States	47,169
2	Russia	33,186
3	China	9,132
4	France	8,564
5	Germany	7,946
6	United Kingdom	6,586
7	Spain	3,958
8	Italy	3,823
9	Ukraine	3,677
10	Israel	3,233

Table 1

Helpful for this paper is a deeper analyze of one of the last countries from this table. It can be noticed that between the largest economically developed countries Israel and Ukraine presence, a small country and east European one.

Second situation listed in Table 2 is the list of major weapon manufacturers. But before this, a major weapon definition is necessary;

Major weapons defined by SIPRI are the following: aircraft; air defence systems; anti-submarine warfare weapons; armoured vehicles; artillery; engines (for military aircraft, for combat ships , for most armoured vehicles); missiles; sensors (active (radar) and passive (e.g. electro-optical) surveillance systems, all fire-control radars, and anti-submarine warfare and anti-ship sonar systems for ships and helicopters); satellites; ships, and other (all turrets for armoured vehicles fitted with a gun of at least 12.7 mm calibre or with guided anti-tank missiles, all turrets for ships fitted with a gun of at least 57-mm calibre, and all turrets for ships fitted with multiple guns with a combined calibre of at least 57 mm, and air refueling systems as used on tanker aircraft).

The Arms Transfers Database used by SIPRI does not cover other military equipment such as small arms and light weapons (SALW), trucks, artillery under 100-mm calibre, ammunition, support equipment and components (other than those mentioned above), repair and support services or technology transfers.

As a consequence we can consider that the most comprehensive defence industry's definition is the combination of the two above mentioned paragraph.

The list of major weapon manufacturers:

Rank	Company	Country	Arms sales (US$ m.)	Total sales (US$ m.)	Arms sales as a % of total sales	Total profit (US$ m.)	Total employment
1	Lockheed Martin	U. S.	36,440	46,132	79	3,605	126,000
2	Boeing	U. S.	27,960	96,114	29	5,176	161,400
3	BAE Systems	U.K.	25,510	27,355	93	1,456	82,500
4	Raytheon	U. S.	21,780	23,247	94	2,067	61,000
5	Northrop Grumman	U. S.	20,060	19,683	86	1,990	65,000

6	General Dynamics	U. S.	19,240	31,469	61	2,965	99,900
7	Airbus	E. U.	12,860	71,476	18	2,992	136,570
8	U. T. C.	U. S.	9,500	61,047	16	4,356	197,200
9	Leonardo S.p.A.	Italy	9,300	14,412	65	584	47,160
10	L3 Technologies	U. S.	8,770	10,466	84	282	38,000

Table no. 2

An important aspect of the second statistics showing companies is the analysis of these companies from the type perspective, products delivered and industry:

1. **Lockheed Martin** is an American global *aerospace*, defense, security and advanced technologies company. **Type** – **PUBLIC COMPANY**
2. **Boeing Company** is an American multinational corporation that designs, manufactures, and sells *airplanes, rotorcraft, rockets, and satellites* worldwide. **Type - PUBLIC COMPANY**
3. **BAE Systems plc** is a British multinational defence, security, and *aerospace* company. **Type** – **PUBLIC LIMITED COMPANY**
4. **Raytheon Company** is a major U.S. defense contractor and industrial corporation with core manufacturing concentrations in weapons and military and commercial electronics. It was previously involved in corporate and special-mission *aircraft* until early 2007. Raytheon is the world's largest producer of *guided missiles.* **Type – PUBLIC COMPANY**
5. **Northrop Grumman Corporation** is an American global *aerospace* and defense technology company. **Type – PUBLIC COMPANY**
6. **General Dynamics Corporation** is an American *aerospace* and defense multinational corporation. **Type** – **PUBLIC COMPANY**
7. **Airbus SE** is a European multinational corporation that designs, manufactures and sells civil and *military aeronautical products* worldwide. **Type - SOCIETAS EUROPAEA, SE**
8. **United Technologies Corporation** (**UTC**) is an American multinational conglomerate that researches, develops, and manufactures products in numerous areas, including *aircraft engines*, *aerospace systems*, and industrial products, among others. **Type** – **PUBLIC COMPANY**
9. **Leonardo S.p.A.**, formerly **Leonardo-Finmeccanica** and **Finmeccanica**, is an Italian global high-tech company and one of the key players in *aerospace*, defence and security. ***The company is partially owned by the Italian government through the Ministry of Economy and Finance, which holds 30.2% of the company's shares and is its largest shareholder***. **Type** – **PUBLIC COMPANY**
10. **L3 Technologies**, formerly **L-3 Communications Holdings**, is an American company that supplies command and control, communications, intelligence, surveillance and reconnaissance (C3ISR) systems and products, *avionics*, ocean products, training devices and services, instrumentation, *aerospace*, and navigation products. **Type - PUBLIC COMPANY**

From type perspective of all of these companies some clarification are needed:

A **public company** is a corporation whose ownership is dispersed among the general public in many shares of stock which are freely traded on a stock exchange or in over the counter markets. A **public limited company** (**plc**) is a type of public company under the United Kingdom company law. A **societas Europaea, SE (**European society or

company) is a public company registered in accordance with the corporate law of the European Union (EU).

It can be easily noticed that all these large companies have two major commonalities: all of them are **public, (**except Leonardo SpA which is partially owned by the Italian government and is its largest shareholder) and all of them are focused on defense **aerospace** industry.

3.2 Italian defence industry – Leonardo S.p.A

Leonardo SpA is the best choice of a study case to be analyzed being a non U.S. company (world biggest economy) and one of the smallest companies in this Top 10 list of major weapon manufacturers (47.000 employees).

The company is organized into seven divisions (Helicopters, Aircraft, Aerostructures, Airborne & Space Systems, Land & Naval Defence Electronics, Defence Systems, Security & Information Systems). These divisions perform research, design, development, production, customer/logistic support for:

- Helicopters (e.g.: AW139, AW169 and AW189 models, AW609 TiltRotor);
- Aircraft (trainers: M-345, M-346; tactical transport and special missions: C-27J, ATR 42/72 MP; international collaborations: Eurofighter Typhoon and F-35; manufacturer of nacelles for Airbus, Boeing, Embraer, Sukhoi Superjet 100, ARJ regional aircraft and the Dassault Falcon business jets);
- Aerostructures (the processing of large structural components in composite materials for Boeing 787, 777 and 767; Airbus A380, A320 and A321; ATR 42 and 72);
- Airborne & Space Systems (integrated mission systems, airborne radars and sensors, electronic warfare systems, on-board avionics, aerial target systems and simulation systems);
- Land & Naval Defence Electronics (air defence systems, radar systems, optronic systems, communication systems);
- Defence Systems (the design, production and integration of heavy and light torpedoes, anti-torpedo countermeasure systems for submarines and surface ships, sonar systems for underwater surveillance; small, medium and large caliber (12.7 to 127mm) naval guns; land artillery ranging from small caliber (7.62 and 12.7 mm) to the larger ones (105 and 120mm))
- Security & Information Systems (supports fast, efficient and safe air and sea traffic).

Leonardo is also the parent company and corporate centre for the subsidiaries and joint ventures, Telespazio (Leonardo 67%, Thales Group 33%; 2.500 employees), Thales Alenia Space (Leonardo 67%, Thales Group 33%Europe's largest satellite manufacturer, 8000 employees), MBDA (Airbus and BAE systems: 37,5% and Leonardo 25%, 10.000 employees, European developer and manufacturer of missiles) and ATR (aircraft manufacturer; Airbus 50%,Leonardo 50%; 1.300 employees,).

3.3 Israel defense industry

From countries' perspectives, in this analysis, Israel's presence in Top 10 World's largest arms exporters can be considered surprisingly due to its size. A dedicated analysis of its defense industry can be useful for the purpose of this paper. Israeli most important major weapon manufacturers according to the SIPRI Top 100 arms-producing and military services companies in the world (excluding China), 2016; SIPRI Arms Industry Database, retrieved December 2017, includes three companies:

Rank (2016)	Company (2016)	Arms Sales (2016) millions USD	Total Sales (2016) millions USD	Arms sales as a % of total sales (2016)	Total profit (2016)	Total employment (2016)
27	Elbit Systems	3100	3260	95	--	--
32	Israel Aerospace Industries	2610	3577	73	--	--
41	Rafael	2120	2166	98	119	7500

Table no. 3

27. **Elbit Systems Ltd**. is an Israel-based international defense electronics company which operates in the areas of *aerospace*, land and naval systems, command, control, communications, computers, intelligence surveillance and reconnaissance (C4ISR), unmanned aircraft systems (UAS), advanced electro-optics, electro-optic space systems, electronic warfare suites, signal intelligence (SIGINT) systems, data links and communications systems and radios. The company also focuses on the **upgrading of existing military** platforms, developing new technologies for defense, homeland security and commercial aviation applications and providing a range of support services, including **training and simulation systems**. In 2016, Elbit Systems had approximately ***12,500 employees***, the majority of whom are engaged in engineering, research and development, and other technical areas. **TYPE – PUBLIC COMPANY**
32. **Israel Aerospace Industries** or **IAI** is Israel's prime *aerospace* and aviation manufacturer, producing aerial and astronautic systems for both military and civilian usage. It has ***16,000 employees*** as of 2013. IAI is wholly owned by the government of Israel. IAI designs and builds civil aircraft, **drones**, fighter aircraft, missile, **avionics**, and space-based systems. Although IAI's main focus is aviation and high-tech electronics, it also manufactures military systems for ground and naval forces. **TYPE - GOVERNMENT-OWNED CORPORATION**
41. **Rafael Advanced Defense Systems Ltd.** is an Israeli defense technology company that develops and produces military *aerospace*, missiles, artillery, defense electronics, and naval systems. It has ***7,500 employees*** as of 2016. **TYPE - GOVERNMENT-OWNED CORPORATION.**

Again it can be noticed that all three companies act in defense aerospace industry but in this case the type is changed: two of them are government owned corporation and one is a public corporation. A **government-owned corporation** is a state-owned enterprise (SOE), a business enterprise where the state has significant control through full, majority, or significant minority ownership.

2.4 National defense industry

Before 1989, Romania was among the top ten arms exporters in the world, with exports from roughly one billion USD per year. This value fell to about USD 43 million in 2006, reaches EUR 141 millions in 2009 and EUR 200 millions in 2016 (last East European country, behind Ukraine, Bulgaria (one billion EUR), Serbia or Croatia). Also the number of employees fell from 220.000 in 1990 to 20.000 in 2009.

For a better understanding of the current situation of national defense industry is useful to look at it from the beneficiaries' perspective:

a) Land Forces: National Company Romarm with its sibsidiaries: Bucharest Mechanical Factory; Sadu Mechanical Plant; Pirochim Victoria; Plopeni Mechanical Plant; Carfil; Arsenal Resita; Mija Mechanical Plant; Fagaras Powders Plant; UPS Dragomiresti; Metrom; Tohan; Cugir Mechanical Plant;

Electromecanica Ploiesti; Cugir Arms Factory; Moreni Mechanical Plant. These companies'products are: armored vehicles, artillery weapons and amunition; components and parts, rockets and missiles, small arms and ammunition. Number of employees: 7.300 in 2012. **TYPE - GOVERNMENT-OWNED CORPORATION**

b) Naval Forces: Daewoo Mangalia Heavy Industries - a joint venture between Daewoo Shipbuilding & Marine Engineering and the 2 Mai Shipyard in Mangalia. Since it was founded the company built over 127 new ships and repaired around 300 ships. The company is also specialized in war ships repair. Even it started in 1997 with a production value of 20 millions USD the turnover in 2016 was 549 millions EURO. Number of employees: 2.389, in 2016. Owned by Daewoo Shipbuilding & Marine Engineering 51% and Ministry of Economy 49%.
c) Air Forces: Romaero; Aerostar; Avioane Craiova; IAR Brasov (Ghimbav); Turbomecanica; Aeroteh; Aerofina; Simultec; Condor; Metav.

Romaero is an aerospace company that integrates two major activities: aerostructure manufacturing and maintenance and repair for civil and military transport aircraft: Number of employees: 863, turnover: 18 million euro in 2016. **TYPE - GOVERNMENT-OWNED CORPORATION** (Ministry of Economy 54%, SIF "Muntenia" 25%, Proprietatea Fund S.A. 20%, others 1%).

Aerostar is an aerospace company specialized in integration, manufacturing, upgrade and maintenance for aviation and ground defence systems; it is also a supplier of aerostructures, sub-assemblies and equipment for civil aviation and provides maintenance and conversion for civil aviation. Number of employees: 1878, turnover: 80 million EURO, in 2016. **Type – PUBLIC COMPANY** (IAROM Bucuresti 71%; SIF "Moldova"14% and others).

Avioane Craiova S.A. is an aeronautical company which designed (in co-operation with the National Institute for Aerospace - **INCAS**) and manufactured an advanced jet trainer aircraft, IAR-99 SOIM; it provides Maintenance and Overhaul for Military aircraft and structural subassemblies for civil aircraft. Number of employees: 318. **TYPE - GOVERNMENT-OWNED CORPORATION** (Ministry of Economy 81%, others 19%).

IAR S.A. Brașov is a Romanian aerospace manufacturer founded in 1925. In 2000, IAR created, with Eurocopter Group, Eurocopter Romania, holding a 49% stake in it. It provides upgrades, revisions, and overhauls on helicopters and light aircraft. It produced and delivered over 360 Alouette III and Puma helicopters under Aerospatiale license (nowadays Airbus Helicopters, a member of the Airbus Group), 830 gliders and motor-gliders and 136 light aircraft in its own conception. IAR S.A. develops upgrading programs, performs periodic inspections, overhauls, flight and ground tests for IAR 316 B Alouette III and IAR 330 PUMA. Number of employees is around 1,200 specialists including more than 170 engineers, turnover 40 million EURO, in 2017. **TYPE - GOVERNMENT-OWNED CORPORATION** (Ministry of Economy 65%, Minister of Labor and Social Justice 7%, SIF "Transilvania" 5%, others 23%).

TURBOMECANICA is a Romanian aerospace manufacturer providing engine repairs and overhauls and aero turbine engine and aircraft components. Number of employees: 447: Turnover: 18 million euro. **Type – PUBLIC COMPANY (**Viehmann Radu - 26%)

AEROTEH is a Romanian aerospace manufacturer providing hydraulic and pneumatic equipment used in control and navigation systems of aircraft and aviation

engines. Number of employees: 109. **Type** – **PUBLIC COMPANY** (Dumitru Bănuț - 58,75%)

Aerofina is a private enterprise manufacturing, upgrading and repairing of airborne, terrestrial and naval equipment. Number of employees: 70. **Type** – **PUBLIC COMPANY**

Simultec is an international Training & Simulation company. Number of employees: 35. **Type** – **PUBLIC COMPANY**

3. Conclusion and Proposals

The SWOT analysis highlights the following strengths:

- Workforce prepared
- Existence of a high degree of discipline
- The existence of the system of quality assurance and certification of the company's units by the military body and other external certification bodies
- Industrial production for competitive civil use.

Weaknesses are due to the high prices in relation to the level of technical novelty, the decrease of the military technique orders for the forces of the Ministry of Defense and the reduced funds for the promotion of own products.

The defense industry comprises a bigger national company CN ROMARM SA, a number of medium or small companies in the aeronautical industry, and one big economic agent in the naval industry.

It can be easily noticed that our aerospace defense industry is spread in too much companies. All these companies are providing maintenance services for different type of aircraft and have a small number of employees. The R&D almost is missing. New products have not been launched since decades.

Some possible solution for all these issue could be:

- A new organization of all aeronautical companies in a single management group for avoiding parallel activity, for specialized production and for better resource management. This group could be a government owned (Israeli's model) or partially owned by the government (Leonardo). Even statistics reveal that the best results are reached with a private management this could be the final target of reorganization.
- A dedicated percent for new acquisition (20-30%) allocate to national defense industry, yearly. If products cannot be provide that percent could be allocated to R&D in order to fulfill the requirements.
- A new regulation regarding acquisition specifying that all the consumable, equipment revisions/overhaul and necessary ammunition must be locally manufactured.
- Focusing aeronautical industry in the upgrading of existing military platforms (using local suppliers as much as possible), training and simulation systems, design and build civil aircraft components, drones, missile, avionics, and UAV. Common projects with/or supplying parts for big aeronautical manufacturers must be one main goal.
- Using national research institutes (INCAS, COMOTI) in a more close connection with industry (training aircraft, helicopters and engine manufacturers) can lead to better and practical results.

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