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DEFENCE INNOVATION: NEW MODELS AND PROCUREMENT IMPLICATIONS

The Spanish Case

By

Carlos MARTÍ SEMPERE

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ABSTRACT

This short article describes the innovation and procurement policy of the Spanish Ministry of Defence. It addresses key issues such as the role of innovation in defence; the current organisation, norms, and regulations that implement this policy and the assessment of its repercussion on the Spanish Defence Industrial Base. The expected impact of the European Defence Fund on this policy is also assessed. The article ends up with some brief conclusions.

Keywords: *Defence Industry, Collaboration, Research and Development, European Defence Fund, European Union.*

INTRODUCTION

The defence ecosystem undergoes a constant transformation due to the fast-changing operational needs and technological advances which compels to preserve, or even improve, military capabilities over potential adversaries[1]. Such a transformation demands procurement processes able to innovate, co-evolve and adapt quickly to such changing circumstances.

Innovation involves a wide set of activities within armies and the supporting industry ultimately aimed at increasing the efficiency of military missions. It is a complex task that shall be performed in a rather competitive environment. It entails research, development, test and evaluation activities to find solutions that meet, in a better way, the operational needs. It is mainly a process of compiling and gaining further knowledge based upon scientific methods and it is largely subject to risk and uncertainty, which demand constant adaptation to unexpected results and the iterated exploration of alternatives paths (Sahal, 1985). The stock of knowledge of some innovations is so large that a network of organisations shall join to achieve major outcomes. This is particularly true for integrated systems, which are rather common in defence[2]. Furthermore, this process leads to the obsolescence of firm portfolio, assets, and processes, which triggers painful adjustments[3]. All these features require an appropriate environment to succeed in innovation.

This transformation also affects the Spanish Defence Technical and Industrial Base. This brief article addresses the changes occurred in the last decade, the government policies and regulations regarding innovation and procurement, and assesses its adequacy to this transformation.

DEFENCE PROCUREMENT POLICY IN SPAIN

Spain, like other countries, requires for its defence a set of military capabilities to accomplish the missions assigned to its armed forces. Today, such capabilities largely

[1] Innovation may not necessarily require a research and development phase. Existing technologies applied in a new and different way may improve performance of the operation as for example the use of civilian aircrafts by terrorism to attack the Twin Towers in New York on 11 September 2001.
[2] On the economics of system integration, see for example Dosi *et al.* (2003).
[3] This is the well-known Schumpeterian concept of "creative destruction".

depend on some capital goods provided by the industry. Because the supply of new equipment shall outperform the old generation, some degree of innovation, of higher or lower magnitude, during the procurement process is always required.

Spain has always tried to obtain these sophisticated equipment and systems from national suppliers in order to preserve, as much as possible, its national autonomy. Indeed, defence procurement has been a traditional policy tool to promote the Spanish technological and industrial base especially in fields such as electronics and aerospace.

The standard policy is to finance a national research and development phase when it can be done with a national budget and domestic firms, trying to preserve as much as possible a national supply chain. When this is feasible, co-development projects with two or more nations have been chosen in order to share this effort, which happened for the Eurofighter or the A400M aircrafts. Ultimately, this phase being too costly and non-profitable, and since there is an existing equipment developed by an ally, the acquisition is made trying to sign an offset arrangement to improve the national industrial assets and technological capabilities when it is possible. When the project can be faced nationally, but some parts of the system require technologies outside the scope of the R&D budget, the supply chain of the product is opened to foreign firms.

Innovation is customarily present in defence procurement in Spain. It even appears along supply contracts, not necessarily marked as research and development, containing considerable novelty, such as when software developments are contracted to support some military tasks, e.g. a new logistics system to manage spare parts. Even offsets programmes trigger innovation activities when the national industry opens up new production lines (e.g. the EF-18 flight simulators) or develops assets and maintenance procedures to support the life-cycle of new defence equipment (e.g. the Predator RPAS).

An indicator of the allocation of resources innovation is the outlays of defence R&D. As we can see in the table below, this amount is rather low when compared with the EU and leading nations.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
European Union - 28 countries (2013-2020)	7,701	6,233	4,374	4,628	4,240	4,631	4,636	4,343	n/a	n/a	n/a
Spain	198	118	121	107	82	73	86	61	65	59	n/a

Table 1. Government Budget Appropriations or Outlays on R&D in Defence (€ million). Source: Eurostat

Whereas these values are small[4], Spain largely expends in acquisition programmes where innovation plays a significant role. The most relevant, due to its size and its role regarding key military capabilities, are grouped under the name *Programas Especiales de Armamento* (or PEAs). Around 26 programmes fall in this category which represents investments of € 41,396 bn since 1997[5]. The last incorporations to this list include two national programmes, the VCR 8x8 Dragon and the new frigate F-110, as well as the collaboration in the international programme Future Combat Air System (or FCAS) as fully-fledged member. These programmes are viewed by defence stakeholders as the nurturing source that preserves the firms of the Spanish land, naval, aerospace, and electronic defence industry.

These programmes include a research phase followed by a large number of engineering tasks mostly related to the development of the new system, based mainly on the integration of available technologies, and the preparation of the production phase which absorbs a very large percentage of the innovative effort[6]. Since their outcome mainly addresses military needs, these programmes are fully financed by the government. The scarceness of available funds has made innovation in Spain mainly incremental rather than disruptive, based more on exploiting than exploring new technologies and solutions.

Innovation in the Spanish defence procurement process

The operational means needed to perform the missions of the Spanish Armed Forces are organised through a planning system where the type of equipment and capabilities needed for their missions are stated. This information is collected in a document called the Military Capability Goals that is conceived by the Chief of the Joint Staff. This document

[4] This amount probably understates the allocation of resources to defence innovation in Spain.
[5] Statement of the Secretary of State of Defence to the Spanish Congress on 29 January 2019.
[6] Yet, the *Frascati Manual 2015* considers that the labelling of the latter activities as research and experimental development shall be done with care when they are aimed to manufacturing design, prototyping, tooling-up, pre-production series and troubleshooting.

is reported to the Secretary of State of Defence who, based on the available budget, allocates resources to achieve these capabilities. The whole process is described in the Instruction 67/2011 of 15 September which regulates the process of acquiring material resources. It defines the procurement policy of these means and how they unfold into acquisition programmes organised in phases, which will ultimately require the collaboration of the industry for their implementation.

The assessment of the operational requirements[7] determines if a R&T phase or a design and development phase will be required, or eventually an international collaboration programme shall be launched as the most appropriate procurement method. The Directorate General of Armament and Material (or DGAM) plays a key role in this decision process supported by four sub-directorates. The Plans, Technology and Innovation Sub-directorate is mainly in charge of R&T projects; the Programmes Sub-directorate is in charge of the main development programmes (the aforementioned PEAs); the International Relations Sub-directorate interfaces with the European Defence Fund (EDF), the European Defence Agency and the OCCAR; and the Acquisition of Armament and Material Sub-directorate is in charge of the administrative, economic and contractual management of the remaining non-centralised programmes. Another relevant organisation is the *Instituto Nacional de Técnica Aerospacial* (or INTA), a public research organisation owned by the Ministry of Defence. It groups the main laboratories of defence and also performs some research and development.

There have been attempts to create an independent agency in charge of defence procurement, like the French *Direction Générale de l'Armement* (DGA), but they have never succeeded in Spain. Yet, a relevant achievement was the Order 244/2014 which boosted the DGAM's powers and authorised the State Secretary to approve the provisions needed to centralise the management and contracting of armaments and material programmes formerly managed by the headquarters of the three armies. This delegation enacted Resolution 320/03967/2014 on 20 March 2014, which centralises in the DGAM the PEAs which consume the largest part of the acquisition budget. This decision was argued as a way to improve the management of these programmes, which due to their amount of innovation require powerful management offices able to tackle the

[7] These operational requirements are often derived from existing product specifications available in more advanced nations.

contingencies that constantly happen until the desired product is achieved. In fact, these programmes have often suffered from over-costs and delays due to unexpected tasks needed to deliver a final product within the performance requirements.

Procurement in defence is regulated by the *Ley 24/2011* of 1 August, *de contratos del sector público en los ámbitos de la defensa y de la seguridad* which is the transposition of the EU Directive 2009/81/EC on defence and sensitive security procurement. This law has been complemented with the Resolution 420/38100/2015 that published the Agreement of the Council of Ministers determining the industrial capabilities and knowledge areas that affect the essential interest of national security and defence. The wide definition of such capabilities and areas in this Resolution easily sustained the use of article 346 of the TFUE to limit foreign tenders[8,9].

The official view of the Ministry of Defence regarding technology and innovation is contained in the document *Estrategia de Tecnología e Innovación* published in 2015[10]. The relevant technologies are identified in the annex of the document as a sort of guiding compass. It provides an extensive list of technologies ranging from ammunition to command and control systems spanning the list contained in the aforementioned Resolution. However, it does not furnish priorities, ordering or allocation of funds to raise their matureness, which deprives of guidance the technological niches with potential military demand the industry needs to know to allocate its own resources.

The Ministry of Industry also plays a significant role in the procurement of the PEAs. However, it focuses mainly on advancing funds to support acquisition programmes awarded to prime-contractors and government-owned firms as part of the Spanish Industrial Policy due to the low defence investment budget. While some people argue that this is a way of reducing the allocation of funds for defence, which is not very popular among citizens, it may also be due to the perception that the support to this economic sector provides substantial benefits to the civilian industry through spill-overs, despite

[8] The list is quite extensive and includes among others C4I and ISTAR systems; cyberdefence; navigation aids; critical system embarked in platforms; space, mission and data processing system, simulation and training systems; missiles and complex ammunition and integrated complex systems.
[9] The Ministry has developed a *model of excellence for the management of value added purchases* (based upon norm UNE 15896) that was certified by the Spanish Standard Association in 2018. No information is available regarding its use or effects.
[10] https://www.tecnologiaeinnovacion.defensa.gob.es/Lists/Publicaciones/Attachments/205/ETID%202015.pdf

being only sustained by anecdotal evidence and wishful thinking. This argument is strongly sustained by the industrial associations, such as TEDAE and AESMIDE.

Profiting from civilian spill-overs

Initiatives aimed at adapting civilian innovations to military needs have led to ministerial orders which regulate the *Cooperación en Investigación Científica y Desarrollo en Tecnologías Estratégicas* (also known as COINCIDENTE programme), DEF/862/2017 published in 2017 was the last one. This programme makes a yearly call with a set of topics or themes defined by the Spanish Ministry of Defence[11]. The financing of projects ranges from 20 to 80 percent of the budget depending on its benefits for defence and other factors. Its main problem is the small amount of funds available. Namely, around € 48 million from 1986 to 2017 and only € 1.6 million for the 2020 call, certainly a rather small amount.

An important organisation related to innovation is Spain is the *Centro para el Desarrollo Tecnológico e Industrial* (or CDTI), an autonomous agency aimed at supporting the Spanish Technological and Industrial Base that is under control of the Ministry of Industry, Commerce and Tourism. Whilst this organisation could be quite relevant to expand the defence industry ecosystem by helping it to profit from civilian spill-overs, its role does not seem too significant for the time being. Its *Big Facilities and Dual Programmes Department* grants loans and subsidies (up to one-third of the loan) for projects with potential dual use in the defence or the civilian market. Yet, no mention is made to such kind of projects in the annual report of 2018 which suggests a low relevance of this funding. The CDTI signed in 2019 a collaboration agreement with the Ministry of Defence, the Ministry of Science, Innovation and Universities, and the State Innovation Agency. The agreement, without supporting budget, focuses mainly on information sharing and coordination activities such as joint workshops.

Innovation also occurs in the Spanish defence industry through the absorption of technological advances from the civilian sector. This process assimilates advanced methods and techniques used by the civilian industry in the same market segment – for example ship building, car manufacturing, aircraft production, electronics or

[11] For example, in the 2020 call the following topics have been chosen: detection technologies for active protection systems, lowering of signature, and systems for load reduction and support to the soldier mobility.

management systems –, provided by specialised non-defence firms (Pavitt, 1984). Those related to the fourth industrial revolution mainly based on information and communication technologies are particularly relevant. This absorption is probably faster in firms which operate both in the civilian and in the defence market. Project *Navantia Astillero* 4.0 is a good example of this, financed by the Spanish Ministry of Industry within the frigate F-110 programme based upon intensive use of advanced computer aided design and production tools.

ASSESSMENT OF THE EVOLUTION OF DEFENCE INNOVATION IN SPAIN

As we have seen, over the last years Spain has implemented reforms on defence innovation and procurement that do not strongly emphasize a more open industrial ecosystem able to profit from the technological innovation made by the civilian industry. Even though there is not a perceived need regarding reforms on this question, there is still an undoubtable trend, under the current framework, to improve innovation openness in defence acquisitions due to its higher chances of achieving success and high-quality results[12]. However, there are reasons that limit such openness in Spain, which may probably also happen in other nations.

First, the role of defence as a leading user and the main source of innovation (Von Hippel, 1988) in Spain is to some extent limited. Operational experts are in short supply, expertise in programme offices is often lacking, the capabilities of the armies are often defined by imitating more advanced nations[13], or this task is delegated to the industry. There seems to be room for improvement in this area, in order to profit from the interacting nature of innovation where the mixture of visions is a key driver for success. Furthermore, the flexibility and quick response that innovation often demands face constraints due to the norms of public contracts regarding transparency, accountability, and non-discrimination.

Secondly, the need to support the whole life cycle has often restricted the bidding of platforms and systems to a few national incumbents, discarding tenders of new entrants

[12] Open innovation has provided large benefits in some civilian sectors such as software development. Open source communities have been fundamental in the achievement of largely used products such as the Linux operating system or the Apache server. See for example Chesbrough (2013).
[13] Rigid technical specifications may unduly restrain the creativity that is needed in the innovation process.

or foreign challengers[14]. Moreover, working for the Ministry of Defence involves extra costs for outsiders, such as the implementation of information security norms or the fulfilment of certain military standards[15], which dissuade them from entering this market. This is an important problem for Spain since the variety of sources providing alternatives, a desirable feature of innovation (Martí, 2016), is somehow lost.

This problem translates into the supply chain where openness may be reduced when the industry has invested a considerable amount in building up its supply chain. However, paralleling the EDA code of best practices in the supply chain, the Ministry of Defence has developed a code of conduct (Instruction 44/2011) on a voluntary basis aimed at opening the supply chain of main contractors. Its voluntary character, the reduced number of specialised suppliers, and the long-term agreements usually held between main contractors and subcontractors may have had a low impact (no measure available) on a richer defence ecosystem.

Thirdly, national policies aimed to promote this industry, preserve autonomy and maintain political ties with some allies[16], may restrict innovation openness and reduce the variety of the industrial ecosystem. In this case, exemptions supported by article 346 of the TFUE may constrain the main goal of Directive 2009/81/EC, i.e. the achievement of a true European Defence Equipment Market able to expand and sustain an ecosystem beyond national borders. Even the wide margin to set technical specifications in the request for proposals by the Ministry of Defence or Main Contractors can reduce the chance of foreign bidders due to unbearable costs, hence the number of alternative suppliers.

Finally, the confidentiality of defence projects joined with the firm desire to preserve the chance of rewarding, instead of partnering and sharing knowledge and benefits with other firms, may negatively impact openness. Yet, the complexity of developments, the networked nature of the innovation and supply processes, and the participation rules of the EDF are forcing Spanish firms to open themselves to alliances, partnerships and joint undertakings. A good example is the agreement reached between the industry and the

[14] Foreign firms have entered in the supply chain when subsystems and components are too expensive to be developed nationally (e.g. the weapon system of the S-80 submarine). The gathering of many diverse technologies in a single weapon system is forcing innovation networks beyond national borders, yet not necessarily European.
[15] E.g. NATO STANAGs.
[16] For example, intergovernmental purchasing contracts of defence equipment may be influenced largely by the aim of improving friendship and political ties.

Ministry of Defence regarding the industrial organisation in the FCAS programme that includes the most important firms in the electronic and aerospace sector, namely Indra, Airbus, IPT, GMV, Sener and Tecnobit[17].

The formation of consortia in defence international collaboration programmes has also promoted more networked innovation as well as wider information sharing between partners. The Spanish industry has certainly benefited from such information sharing, as in the EU Research Framework Programme (H2020, FP 7 and previous ones). Whereas direct evidence is still lacking in the Preparatory Action of Defence Research (PADR) and the EDIDP due to their recency, some cases in point such as the collaboration of the DCNS and Navantia in the Scorpene submarine, suggest relevant spill-overs of knowledge and technology that were exploited in the S-80 submarine.

The European Defence Fund as a leverage of defence innovation in Spain

The creation of the European Defence Fund (EDF) was seen by both the Ministry of Defence and the industry as an important initiative to support the necessary update and renewal of industrial capabilities of the Spanish DTIB in a period of scarceness of funds to finance R&T, R&D, and acquisition projects and programmes in this industrial sector.

Whereas an inter-ministerial working group was created in 2017, the EDF has only awakened a working group of European defence initiatives in the Secretary of State of Defence led by the DGAM. It manages the initiatives of industry for including topics in the EDIDP work programme and provides supporting letters for industries when they submit proposals. This group has representatives of the Chief of Staff, the DGAM's subdirectors and the Directorate General of Defence Policy. However, little is known about this group in terms of reference or responsibilities. Furthermore, industrial associations still have not expressed the strategies and changes required to increase the chance of Spanish firms obtaining funds from the EDF. Despite that, the results of the calls show a significant participation of the Spanish industry and suggest an important role of competitive tenders for pushing firms in the path desired by the Commission[18].

[17] "Futuro Caza Europeo", *Revista española de defensa*, March 2020.
[18] Spain participates in thirteen of the sixteen tenders and leads four projects in the first EDIDP call.

Certainly, the EDF will help Spain overcome the current shortcomings to improve its military capabilities. Furthermore, the requirement of three nations and three firms to access these funds as well as the provisions for the participation of SMEs and mid-caps means an enlargement of the defence ecosystem, raising variety and helping to form new combinations, a key element of innovation according to Schumpeter (1934:74). Hence, as for other international collaboration programmes in which Spain participates, the environment will be more favourable for innovation openness, and the chances of success will be higher, keeping in mind that a larger budget translates in a larger stock of complementary skills and knowledge. Yet, the complexity of international collaboration programmes and their rate of failure are well-known (Braddon and Hartley, 2013). Whereas the EDF will favour excellence in innovative collaboration programmes, it cannot be discarded that due to the inherent hazardous nature of innovation, the unexpected results of some of them will ultimately lead to an *impasse,* thus preventing their entry in production phase.

CONCLUSIONS

The race in defence equipment by nations as well as the constant technological progress of the world economy pushed innovation in the defence industry. This is the case of the Spanish industry which displays a more innovative behaviour than firms in other economic sectors (Ortega *et al.*, 2010). The Spanish government has chosen different instruments to support the innovation needed to modernise their military capabilities. Supported by the current legislation, Spain has chosen the type of contract that better fits the achievement of its military and industrial goals[19]. Under this framework, some acquisition programmes have succeeded and have even led to the export of defence products (e.g. frigates for Norway and Australia).

However, this legal framework seems too rigid due to the complex nature of innovation which demands permanent adaptation and amendments of contracts to face its inherent uncertainty. Programmes involving a significant amount of innovation have suffered constant problems, even after the centralisation of defence acquisition programmes in the

[19] Still, Instruction 67/2011 refers to the use of offset agreements for foreign equipment purchases, which suggests the permanence of this practice, despite the EU desire of its withdrawal.

Ministry of Defence, giving way to painful renegotiations and costly transaction costs[20]. There are many cases, ranging from naval ships (S-80 submarine) to land systems (VCR 8x8 Dragon), where underperformance, delays, and price increases were more the rule than the exception. Yet, these problems seem to be more universal, appearing also under collaboration programmes such as the Eurofighter or the A-400M; or even cancellations such as the SOSTAR-X programme.

The limited amount invested in Research and Technology as well as new developments have impeded the coverage of key operational equipment and systems forcing its purchase from allies (mainly the USA) thus penalising national autonomy. The openness of innovation is more a consequence of the general evolution of the industry where value proceeds from system integration, specialisation and a complex supply chain, rather than the fruit of government initiatives promoting this policy.

The creation of the EDF represents a step forward in this question. It represents a new source of financing that will feed an industry in need of constant support to gain knowledge and keep up with advanced technologies as well as liaise with foreign firms in order to provide products of higher value to the armed forces. Yet, it remains to be seen, under the current background, to which extend the Spanish armies and industry profit from this chance, gaining in military capabilities and competitiveness within Europe as well as in the international defence market.

Regarding the EDF, there are helpful lessons from the past. When the Independent European Programme Group (IEPG) was created in 1976 to promote European collaboration in defence equipment issues, Spain eagerly joined many initiatives. When these initiatives were initial studies, with low financial commitment, participation was easy, however as programmes progressed and their budget grew, Spain was unable to allocate appropriate funds and had to disengage from most of them. This can be the case if PeSCo initiatives continue to proliferate, because many participating Member States will lack budget to fund, in the long-term, the projects they have chosen. Whereas some waste is inevitable in innovation, the effort to contain excessive and unnecessary waste shall always guide the choice of projects that deserve funding. ■

[20] On this question see for example Williamson (1975).

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BY
Carlos MARTÍ SEMPERE / Carlos MARTÍ SEMPERE has a bachelor's degree in computer sciences, one in economics, and a Ph.D. in International Security. His professional life is divided between consultancy and technical assistance in defence and security for the Spanish Administration as well as professor in different post-graduate master's degrees at the Spanish University (UPM, UNED, UDIMA). He has worked in many national acquisition projects as well as international project for NATO, the European Defence Agency, and the European Union. He is specialised in system engineering, information and communications systems, project management and industrial studies. He has published many papers and books on these questions that can be consulted at ResearchGate.
Contact : carlos.marti.sempere@gmail.com

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ARES GROUP

The Armament Industry European Research Group (Ares Group) was created in 2016 by The French Institute for International and Strategic Affairs (Iris), who coordinates the Group. The aim of the Ares Group, a high-level network of security and defence specialists across Europe, is to provide a forum to the European armament community, bringing together top defence industrial policy specialists, to encourage fresh strategic thinking in the field, develop innovative policy proposals and conduct studies for public and private actors.

CONTACT [Pilots]:
Jean-Pierre Maulny, Édouard Simon, Olivier de France, Sylvie Matelly
ares@iris-france.org
+33 (0)1 53 27 60 60

www.iris-france.org/ares
#AresGroup