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TAMÁS CSIKI VARGA*

Kickstarting the Hungarian defence industry in the 2020s – Synergies, opportunities, and obstacles for smaller member states within EDTIB**

ABSTRACT: Since 2016, Hungary has embarked upon developing its national defence industrial capacities as part of a comprehensive homeland defence and armed forces modernisation programme. Once underfinanced and degraded, with minimal capacity remaining, the national defence technology and industrial base have been reorganised and developed over the past decade as an integral part of the defence modernisation programme. Meaningful production, research, and development capacities have been developed in close cooperation with Tier-1 European (particularly German) defence industry firms, with a focus on regionalisation; cooperation with Turkish, Austrian, and Czech firms; and various joint ventures. Relying on the opportunities offered by European cooperation initiatives (both within the EU and NATO), these projects aim to tie Hungarian and joint ventures to the European Defence Technological and Industrial Base, as well as to make use of joint technology development and available resources for multinational cooperation. Based on the thorough assessment of primary sources (strategic documents, expenditure data) and secondary literature (expert analyses and media reports) this paper provides an overview of these processes. The goal of the paper is to assess the synergies, opportunities, and obstacles for developing the Hungarian defence industry in the 2020s, presenting the lessons learned to its European allies. The conclusions of the research show that kick-starting a rapid, large-scale industrialisation and modernisation programme with an innovation edge by the early 2030s is a "high risk – high reward" strategy. This ambitious goal is supported by sizeable midterm procurement programmes driven forward by a record-breaking defence budget; redesigned institutional, legal, and innovation frameworks; and an integrated long-term national industry development programme. Still, sustaining high-level investment, providing skilled and

* Tamas Csiki Varga, PhD, is senior research fellow at John Lukacs Institute for Strategy and Politics, affiliated with Ludovika – University of Public Service, Hungary. https://orcid.org/0000-0003-3971-8231, csiki.tamas@uni-nke.hu.

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qualified workforce, and developing innovative capacities remain the most crucial pillars of developing the Hungarian defence industry.

KEYWORDS: Hungary, industry, strategy, defence spending, technology, EDTIB.

1. Introduction

When examining national defence industrial capacities and capabilities in Europe, Hungary should be considered a special case compared to other countries, as much of its national defence technological and industrial base was reconstructed, redeveloped, or newly established after 2016. There are several reasons for this as follows. First, because of an overarching trend, the Hungarian defence sector has been chronically underfinanced since the 1990s, thus leading to abandoning complete services and weapons systems (e.g. artillery of almost every kind and much of the heavy equipment), losing hardware, and leaving the Hungarian Defence Forces (HDF) exposed and vulnerable by the 2010s. Therefore, the national defence industry was not involved in supporting modernisation and was only occasionally employed in the operation and maintenance (O&M) of equipment. Second, partly in parallel to these processes, the Hungarian defence industry has continually been decreasing production capability, technological know-how, management expertise, the number of skilled workers such as technicians and engineers, and the capabilities necessary to run a complex, modern defence industrial ecosystem. This downward spiral was driven by the limited modernisation of HDF until the late 2010s, off-the-shelf procurement from foreign companies whenever modernisation was taking place, and a lack of incentives to develop national firms' production and innovation capacities. As such, the workshare and added value of Hungarian firms were marginal. Third, since the innovation infrastructure and management in Hungary has remained underdeveloped in a general sense, particularly regarding defence innovation, defence industrial supply chains have become degraded, with small and middle enterprises (SMEs) only occasionally involved in supporting defence production and innovation. Most importantly, even the most capable national defence firms remained weakly integrated in European defence industrial cooperation.

This downward trajectory had been changed by initiating the comprehensive Homeland Defence and Armed Forces Modernization

Programme – originally dubbed 'Zrínyi 2026' – in 2016. Since then, the modernisation has become not only the largest for the HDF since the 1980s, but also a comprehensive action to strengthen military capabilities, as well as the system of homeland (territorial) defence, and to reinforce the defence industry. The latter goal envisages the rebuilding and advancement of the defence industry based both on national pillars and through international cooperation with leading innovators able to push key players in the Hungarian defence industry to excel in industrial competition.

After decades, this was the first defence modernisation programme to include a determining industrial defence element. At the same time, this took place based on the remnants of Hungarian defence industrial capacities from the 2000s, now aimed at kick-starting a rapid, large-scale industrialisation and modernisation programme with an innovation edge by the early 2030s. This ambitious goal is supported by sizeable midterm procurement programmes driven forward by a record-breaking defence budget; redesigned institutional, legal, and innovation frameworks; and an integrated long-term national industry development programme.

The current international environment is favourable for accommodating and supporting such industrial defence plans. European countries have witnessed subsequent crises in the 2010s and a large-scale, high-intensity conventional war in Ukraine following Russia's 2022 military aggression. Regional instability and threat perceptions focusing on Russia drive European countries' strategic considerations towards strengthening their armed forces' defence capabilities. As most European countries have undergone similar capability losses, while the research and development of modern technologies lags behind the U.S. and its potential rivals, there is a lack of capabilities and production capacities that motivate European countries to develop their national defence industries. Many European countries not only strive to make up for lost capabilities and strengthen national and allied capacities but also to support Ukraine with weapons and war material in its war of self-defence. Joint European defence collaboration has been gaining momentum in recent years, with the European Defence Industrial Strategy adopted in 2024 as the latest example, along with many other financial, technological, and institutional initiatives. The current era of rapid technological advancement in dual-use and military technologies, as well as the combination of emerging and disruptive technologies, serves as a strong driving force behind the research, technology, and innovation in the defence sector.

2. Goals and methodology

Following these drivers, this study aims to provide an overview and assessment of the synergies, opportunities, and obstacles to developing the Hungarian defence industry in the 2020s, thus presenting the lessons learned to other member states within the European Defence Technological and Industrial Base (EDTIB). As the modernisation and upgrading of the Hungarian defence industry is primarily driven by the ongoing Homeland Defence and Armed Forces Modernization Programme, the underlying drivers and goals, as well as the strategic framework, will be introduced to determine which areas of the defence industry are to be developed. This is followed by the introduction of Hungary's national defence technological and industrial base (NDTIB), highlighting primary development projects and outlining the new institutional setup that underpins them. An assessment of the defence investment background will show the material sustainability of the sectoral transformation, while an outlook on the coming years and the identification of inherent risks to success will conclude the paper.

The thorough investigation of these issues was realised through the analysis of national strategic documents, available government reports, and commentaries, as well as the comprehensive context and goals of the armed forces' modernisation programme. The Hungarian case study is mapped on the major initiatives and projects related to the development of the defence industry, such as the purchase of military equipment, cooperation with European manufacturers, and reorganisation of the national defence technology and industrial base. These steps make it possible to identify the major innovation trends in the defence industry intertwined with international technological cooperation, thus identifying opportunities for growth and synergies. At the same time, structural weaknesses and risks to the successful development of the defence industrial ecosystem, as well as its efficient functioning and stable production capacities, can be identified. This may also hinder the integration of the Hungarian defence industry with its European partners. However, throughout this evaluative process, a possible shortcoming is the limited transparency of ongoing processes, visible only through government communication (of success) because independent critical analyses remain scarce.

3. Underlying drivers and goals

The comprehensive armed forces modernisation programme, which serves as the direct background for the development of the defence industry, is both an opportunity and a constraint. We can identify several drivers that have led to political decisions mandating these development programmes over the past decade.

The security environment of Hungary – and of Europe – has been deteriorating during the past decade, as non-military challenges and military threats appeared in the security perception of Hungarian society and the political elite. The Russo–Georgian war (2008), the global economic crisis (2008–2009), the 'Arab Spring' (2010) and the ongoing resulting crises and civil wars (Syria, Libya 2011–), the rise of the Islamic State (IS) in the Middle East (2014) and IS-motivated terrorist attacks in Europe (2015), uncontrolled mass migration (2015), the coronavirus pandemic (2019–2021), the Armenia–Azerbaijan war (2020), the escalation of the Russia–Ukraine war (2022–) with subsequent energy and economic crises (2022–2023), and the latest Hamas–Israel war in Gaza (2024) all acted as stress factors for European security and stability. It was not a coincidence that Hungarian defence modernisation, coupled with defence industrial upgrades, began in the mid-2010s.

Meanwhile, European integration stalled and despite external threats and challenges, joint European action to manage crises has not become more effective due to the different approaches of its member states; for instance, the increasing popularity of the 'Europe of strong nation-states' model weakens integrated, joint action. In the military field, Russia's repeated aggression in 2014 and 2022 triggered NATO's united political action and strengthened its collective defence and deterrence on the eastern flank, bringing about a general modernisation drive of national armed forces. This was coupled with a significant transition in legacy military equipment from Central European countries to Ukraine as military aid, leaving a caveat that must be filled with new modern equipment as soon as possible.

Since the 1990s, despite joining NATO (1999) and the European Union (2004), the Hungarian Defence Forces have been moving on an almost unbroken trajectory of reducing personnel, military equipment, and military capabilities. The last systemic procurement took place in the early

1980s, but since then, there have only been episodes of gaining relatively modern equipment (T72 tanks, Mig 29 fighter aircraft, and Mistral air defence systems). Since the regime change (1989), it was only possible to keep up with the development of military technology on a case-by-case basis for individual weapon systems (e.g. the multi-purpose Gripen aircraft); in general, the lifecycle extension of the equipment (helicopters, transport aircraft) or the abandonment of capabilities (artillery, tanks) was typical. This made the comprehensive modernisation of HDF inevitable in the 2010s.

Thus, Hungarian military modernisation fits into regional trends: although with time differences, all Eastern and Central European militaries have been modernising, and in many cases even expanding their forces, through strengthening territorial defence capabilities as a general trend. This means the procurement of heavy military equipment (armoured vehicles and artillery) and strengthening of (territorial defence) reserve forces, which is also a priority for Hungary.

As assessed in detail later in this paper, the necessary economic background – the dynamic and predictable growth of the national defence budget – became available for defence modernisation in 2015 and has been sustained since then. Based on this transformation of the threat landscape and allied responses, the planning of a comprehensive homeland defence and armed forces modernisation programme (2016) enjoyed the government's conviction and commitment. This commitment has been maintained throughout the execution phase, despite the economic downturns caused by COVID (2019–2021) and the economic fallout of Russian aggression against Ukraine (2022–).

Moreover, large-scale military modernisation was directly embedded in the development of the Hungarian defence industry, either through new investment in international (German, Turkish, and French), cooperation and from the perspective of innovation, or through the foundation of new capacities in the national defence industry from R&D and innovation through production to the future export of arms. This means that, beyond the off-the-shelf procurement of advanced systems that had no meaningful technological footprint in Hungary (helicopters, aircraft, air defence systems, and tanks), large-scale co-production and co-development projects have also been initiated (infantry fighting vehicles and mine-resistant ambush-protected vehicles). Some basic building blocks of arm production,

such as gunpowder, explosives, small arms, and small-calibre artillery, must be established from scratch.

4. Strategic framework

The strategic objectives and main pillars of the programmes that constitute the framework of the comprehensive homeland defence and armed forces development programme can be mapped indirectly based on the 2020 National Security Strategy (NSS)[1], 2021 National Military Strategy (NMS),[2] policy statements, and scientific articles. Specific Defence Industrial Strategies were also adopted in 2021 and 2023, but these – similar to the planning documents of the Armed Forces Development Program – are not publicly disclosed and can only be assessed based on secondary sources.

The strategic goal for 2030 is to create a comprehensive national defence system that can defend against military threats, hybrid challenges, and civilian crisis-management tasks (NSS, Article 126). To this end:

> The Hungarian Armed Forces must have well-equipped and well-trained forces, as well as flexible, effectively applicable, deployable, and sustainable, interoperable capabilities, striving to improve quality indicators in addition to quantity. In addition to its traditional national defence and international crisis management tasks, it must be equally capable of contributing to the management of crisis situations caused by mass immigration or terrorist threats, to play a role in preventing hybrid attacks, and to contribute to the elimination of the consequences of natural or industrial disasters. The armed forces must be developed in such a way that they are able to produce effects in the operational spaces relevant to our country: on land, in the air and in cyberspace. [3]

Therefore, the armed forces development plans did not aim at creating specialised (‘niche’) capabilities, but rather a – relatively – broad spectrum HDF capabilities. The means of realising these goals were the homeland defence and armed forces development programme (NSS, Art. 27-28), the

[1] Government Decree 1163/2020.
[2] Government Decree 1393/2021.
[3] NSS, Art. 135.

strengthening of military cyber defence capabilities (NSS, Art. 159), and the development of the national defence industry (NSS, Art. 2, 5, 6, 28-29, 105, 128, 136).[4]

In accordance with the NSS, the National Military Strategy not only squared the government's strategic considerations behind the armed forces development programme and the views of military commanders on modern warfare but also summarised the drivers of the developments between 2016 and 2021 and set tasks for the 2020s. The strategy organised the tasks of the Hungarian Defence Forces into two comprehensive groups: the national dimension contained nine comprehensive tasks and six international comprehensive tasks with numerous sub-tasks. Increased ambition and underlying goals in procurement, personnel, and structure were also observed, with a modernisation horizon of 2032. Current force structure development plans are built on a four-brigade structure by increasing the number of troops from 26,700 active soldiers plus 11,000 reserves to 37,650 active-duty soldiers plus 20,000 reserve soldiers.

Regarding the specific capability requirements for military equipment, that is, modernisation priorities, we can formulate guidelines based on the work of Ferenc Márkus and Balázs Szloszjár. Accordingly, systems-based development covers the entire range of equipment and weapons of infantry riflemen and squads, infantry fighting vehicles, tanks for heavy brigades, command and control, surveillance and reconnaissance systems, IT, and cyber defence systems at the battalion level that form the backbone of the brigades, army air defence, self-propelled artillery, direct fire support, CBRN protection, and maintenance and logistics assets.[5] In 2017, Szloszjár also added that

> it is advisable to procure certain military equipment of high importance – the individual military equipment of the soldiers, infantry fighting vehicles, mechanized vehicles – preferably from domestically developed or domestically produced sources (through purchase of licenses, production based on cooperation).[6]

[4] Csiki Varga and Tálas, 2020, pp. 89–112.
[5] Márkus, 2013, pp. 30–33.
[6] Szloszjár, 2017, p. 27.

These guidelines were incorporated both in the acquisition of equipment and in the development of the defence industry for the subsequent years.

Based on publicly disclosed information and practical experience from procurement, force development can be characterised retrospectively according to the following general principles:

- The HDF must become a highly mobile joint force equipped with modern arms and capable of rapid reaction and effective intervention simultaneously in several theatres by possessing information and decision-making superiority and relying on its all-volunteer professional and reserve forces within both national and allied frameworks.[7]
- As a result, by 2030, the Hungarian Defence Forces

  > will be able to guarantee the security and sovereignty of Hungary both through credible deterrence based on its national capabilities, and within the framework of collective defence together with allies (benefitting from security guarantees and contributing to strengthening these), as well as through international peace operations that contribute to the stability of the international system by building partnerships, security sector reform, and training.[8]

- A systemic approach was applied throughout the planning of modernisation, from the individual fighters to the brigade level, and in terms of the ability to integrate forces, weapons, and specialised teams in both human and technological dimensions.
- Capability-based force planning was applied.
- Lifecycle planning considers procurement costs, infrastructure, logistics, operations, and maintenance.
- Where possible, the procurement of ‘product families’ was realised for weapons systems as this increases efficiency in logistics, operations, and maintenance.
- R&D, innovation, production, procurement, and maintenance have been viewed as joint processes with integrated implementation

[7] Sticz and Seprődi-Kiss, 2020, p. 6.
[8] Ibid.

supported by the expansion and development of the national defence technology and industrial base.

- The national production and supply bases of some highly important military industry segments (e.g. small arms, gunpowder, explosives, armoured vehicles, and artillery) have been established.
- New 'incoming' technologies (even those still under development) were acquired and combined into new products (Lynx and Gidrán) to further develop the fourth-generation military technology and offer the perspective of international sales of new products.
- The national defence technological and industrial base was developed with a regional focus and networked approach, developing connections with the German, Czech, Austrian, and Turkish defence industries.

In sum, technological modernization has been a central element of the ongoing armed forces development programme, which encompasses across-the-board procurements in almost every armed service: small and light weapons, ammunition, anti-tank weapons, infantry fighting vehicles, tanks, artillery ranging from mortars to long-range artillery; light and medium utility and multi-purpose helicopters, military transport, training and combat aircraft, air defence and missile defence; command, control and communication, as well as logistics, repair and maintenance capabilities are under modernization. The current and future development of national defence technology and industrial bases support this endeavour.

5. National defence technological and industrial base (NDTIB) in Hungary by 2024

The entire Hungarian defence ecosystem is undergoing a fundamental transformation through the comprehensive homeland defence and armed forces modernisation programme, constituting not only a generational upgrade in technology but also the adoption of suitable modern doctrines and operating procedures, as well as adapting the workforce and service (wo)men's training to the use of new hardware and software.[9] This transformation of NDTIB had two main goals. One is to create and/or strengthen certain pillars of the defence industry that have been weak or non-existent in Hungary since the Cold War. These include the assembly,

[9] Budavári, 2021, pp. 137–151.

production (and future development) of small arms and light weapons, artillery, armoured vehicles (IFVs), radars, and sensors. Some niche products (e.g. helicopter parts) have also been targeted. The second goal is to develop strong tie-ins to major European arm manufacturers' networks (Rheinmetall, Krauss-Maffei Wegmann, Airbus) or through the acquisition (Hirtenberger, Aero Vodochody) or establishment (ZalaZone, Lynx, Gidran) of new defence industrial plants, which can support the successful transformation of the NDTIB. This (prospective) tie-in to top European value chains is accompanied by 'networked' regional defence industrial cooperation, involving German, Austrian, Czech, and Turkish firms, as mentioned above.

Currently, 568 entities are registered in Hungary for defence-related activities, of which 187 have self-declared production capacities (the others provide security and defence-related services and/or have such an export portfolio).[10] These include dual-use technologies and services. The Hungarian Defence Industry Association, which is currently undergoing transformation, had (only) 40 registered members as of 2023, and the current number is not disclosed publicly. The forty members includes 'old' MoD-governed major enterprises (e.g. Currus, Arzenál, Armcom, or EI), but the newly established/acquisitioned national and joint international ventures (e.g. Rheinmetall Hungary, Hirtenberger Defence Systems, Aero Vodochody) had not yet joined. Of these 40 companies, 23 listed production and R&D capacities in their portfolios (different subsets), 19 listed maintenance, and only seven indicated existing test laboratories. Among the services provided, 13 indicated manufacturing, engineering, and test equipment; 13 indicated engineering services, training, and R&D; nine companies produced military and special-purpose vehicles; and seven military vehicle parts and spares. Eight companies provide services related to IT, computing, and software; seven companies provide C4I; and seven offer communication systems and equipment, sometimes in cross-cutting subsets.[11] Most of these companies are SMEs, and the more significant enterprises have limited resources, know-how, manpower, and expertise. The degree of development after 2023 in this subset cannot be estimated because the change is not transparent.

[10] In spring 2023, the number of registered entities was 525, of which 169 had production capacities, which indicates a ca. 10%, dynamic increase in a year. Source of data: Government Office of the Capital City of Budapest, 2024.

[11] Defence Industry Association of Hungary, 2023, pp. 184–185.

Altogether, the total number of employees currently directly involved in the defence industry was estimated to be around 2,000 people, the Ministry of Innovation and Technology plans to increase this number to 5,000–8,000 employees by 2030, driven by ongoing investment projects involving large-scale manufacturing and the associated production chain.[12]

Furthermore, the Hungarian defence sector is expected by the Ministry of Defence to generate a HUF 500 billion[13] output by 2030, becoming 'one of the determining defence industrial hubs of the region'. This would be a gigantic leap from the EUR 40 million annual average from defence exports in the 2010s and a significant increase compared to the approximately EUR 900 million dual-use export value.[14] The latest data available (for 2019) show that arms exports primarily involve ammunition, land vehicles and parts, radio and communication systems, CBRN equipment, and personal protection gear. The overall trade amounted to EUR 231.45 million, out of which exports represented EUR 53.39 million; thus, the balance was negative.[15] Hungary's main defence export partners were Germany, Switzerland, the U.S., and Canada, with minor/occasional shares from Malaysia, Austria, France, Italy, and Slovakia.

To achieve this ambition, the Defence Industrial Strategy (adopted in 2021, publicly unavailable) identified six clusters around which investments, partnerships, and development will be centred in the next decade. The clusters and their flagship projects are as follows:

- *IVF, APC production, and military vehicles manufacturing in the Zala, Somogy, and Győr counties (SW and NW Hungary)*. As the most important element, joint venture Rheinmetall Hungary will provide Lynx infantry-fighting vehicles (218 pieces, out of which 172 will be manufactured in Zalaegerszeg) supplied with a StrikeShield active protection system, including Israeli LR-2 Spyke anti-tank rockets. Future innovation projects may include integrating the Israeli-made Trophy active protection system and Rheinmetall's Oerlikon Skyranger anti-aircraft system into Lynx. Cooperation with Rheinmetall also includes the procurement/manufacturing of 300 armoured personnel carriers, 40 of which bought from Turkish Norul Makina in its original design (Ejder Yalcin), while the remaining 260

[12] Hecker, 2022.
[13] EUR 1.28 billion at a HUF/EUR 390 exchange rate.
[14] Guttray, 2018, p. 64.
[15] Budapest Főváros Kormányhivatala, 2019, pp. 24–25.

will become a Hungarian configuration, called Gidran, equipped with a wide range of sensors and flexible in functional fitting (produced in Győr, in cooperation with Hungarian vehicle manufacturer Rába). Moreover, 4 x 4 vehicles and military trucks will be manufactured in Kaposvár. This cluster also includes a test range (ZalaZone) and validation labourers to support innovation, particularly for autonomous vehicles based on Rheinmetall's Mission Master XT. The design and development of a new 8 × 8 hybrid next-generation fighting vehicle in cooperation with Rheinmetall and Krauss-Maffei Wegmann is also an option that might even serve as a long-term replacement for the BTR-80 IFV in the HDF (currently unresolved). Furthermore, news of participating in the research and development phase of Rheinmetall's next-generation main battle tank, the KF51 Panther, equipped with a 130 mm gun, active defence systems, AI-assisted fire control system, associated drones, and a range of sensors, has been aired in 2023.[16]

- *Aviation industry in Békés county (SE Hungary)*. A rather small but high-value footprint from Airbus Helicopters will provide for the production of helicopter engine parts in Gyula, accompanied by the surface treatment of helicopter parts by Satys PSP Hungary Ltd. The Brazilian Embraer, from whom the HDF procures two KC-390 military transport planes, also announced the establishment of an R&D centre in Hungary.
- *Small arms production in Bács-Kiskun county (S Hungary)*. Based on the licence of Ceská Zbrojovka, the MoD Arzenál assembles small arms in Kiskunfélegyháza together with Unique Alpine machine guns and develops the Hungarian-designed Gestamen small arms family. Colt CZ Group and N7 Holding Ltd. established a joint venture for small arms production. Dynamit Noble Defence and MoD Arzenál will produce reactive armour (possibly a DND ERA to be integrated into the Lynx IFV) and anti-tank weapons for light infantry.
- *Ammunition and explosives production in Veszprém and Fejér counties (Central Hungary)*. Rheinmetall Waffe Ammunition has developed two facilities in the vicinity of Várpalota: one to manufacture 30-, 120-, and 155-mm artillery shells (for the Leopard-2 tanks, Lynx IFVs, and PzH-2000 artillery) and the other to produce

[16] Huszák, 2023.

hexogen/RDX explosives. The relocation of Hirtenberger Defence Systems' mortar production capacities in this area will occur in 2024.

- *Radio and satellite communication systems manufacturing in Budapest and Fejér county (Central Hungary)*. In the field of defence information technology, communication, and the space industry, 4iG, a joint venture of Rheinmetall AG (51%), 4iG Ltd. (39%), and MoD EI Ltd. (10%) is the leading actor and serves as a system integrator for network-based C4 functions. The 4iG Group has been expanding its portfolio beyond telecommunication services and IT system integration to include space, unmanned aerial vehicles (UAVs), counter-UAVs, and defence digitalisation. Furthermore, in 2022, 4iG will acquire an initial 20% stake in the Israeli company Spacecom, with the option of an additional 31% over the next three years. Since 2024, the orbital slot, currently providing space-based telecommunication opportunities for Spacecom leased from Hungary, has been occupied by CarpathiaSat, a 4iG joint venture. The slot will be used to launch Hungary's first commercial satellite in approximately five years. Most recently, the 4iG subsidy Remred Space Technologies began developing a facility (Remtech) in Martonvásár capable of producing, testing, and validating space systems, including satellites weighing up to 400 kg, entering the market of low Earth orbit space assets in the coming years.
- *Radar and locator production in Szabolcs-Szatmár-Bereg county (NE Hungary)*. When providing for the procurement of ELM-2084 multi-mission radars (11 pieces) for the HDF, Rheinmetall, Canada, places the production and maintenance of these assets in Nyírtelek.

In sum, one could characterise the next decade of the Hungarian defence industry as an attempt to grow from a backward garage-operated SME into a well-established national and, in some areas, an internationally recognised company with an innovative edge and sizeable arms export potential. This evolutionary jump situates the Hungarian defence industry in a particular position and creates unique requirements for the years ahead.

6. Developing the defence industrial ecosystem

Owing to the underdeveloped Hungarian defence industry by the 2010s, a two-track approach was applied in developing the sector. For highly advanced products for which Hungarian firms have no chance to compete in

the short term, renowned Tier-1 international firms with strong market positions became involved in joint projects, creating an industrial footprint involving both manufacturing and R&D in Hungary. Therefore, high market-entry costs were reduced to some extent. These flagship projects, most importantly, IVF, APC production, ammunition/artillery production, and space technologies, involve new multinational partnerships from Europe, particularly German, Turkish, and Israeli enterprises. The first tier of defence modernisation in the armed forces modernisation programme, the procurement of modern equipment, was designed and realised in a manner that focused on European manufacturers getting involved in a long-term production and innovation cooperation model, establishing new facilities in Hungary. In a general sense, a strongly 'networked' feature of these developments is observable: Hungary has been buying-in to German, Czech, Austrian, Turkish, and Israeli cooperations, with a prospect of acquiring technologies and know-how that can be combined and further innovated into new, high-tech marketable products. There is a certain risk involved in this approach because of the lack of battle-proof experience for these assets (Lynx and Gidran) and some of the experimental technologies combined with them. Moreover, for less advanced products and services, in which Hungarian firms have better chances of involvement, national enterprises receive tailored support from the government to improve their position and develop their capacity to join advanced production chains. Since 2021, SMEs have been competing for the resources of a defence industry supply chain venture fund worth HUF 50 billion (EUR 130 million).

The realisation of strategic goals related to the defence industry was first overseen by the Ministry of Innovation and Technology (until 2022), then by the Ministry of Technology and Industry (2023), and eventually delegated to the Ministry of Defence, where it belongs. The reason for the initial institutional setup was that, after not conducting meaningful defence industrial development activities and losing much of the R&D knowledge, the MoD seemed to lack the necessary management expertise, which had been developed as of 2024.

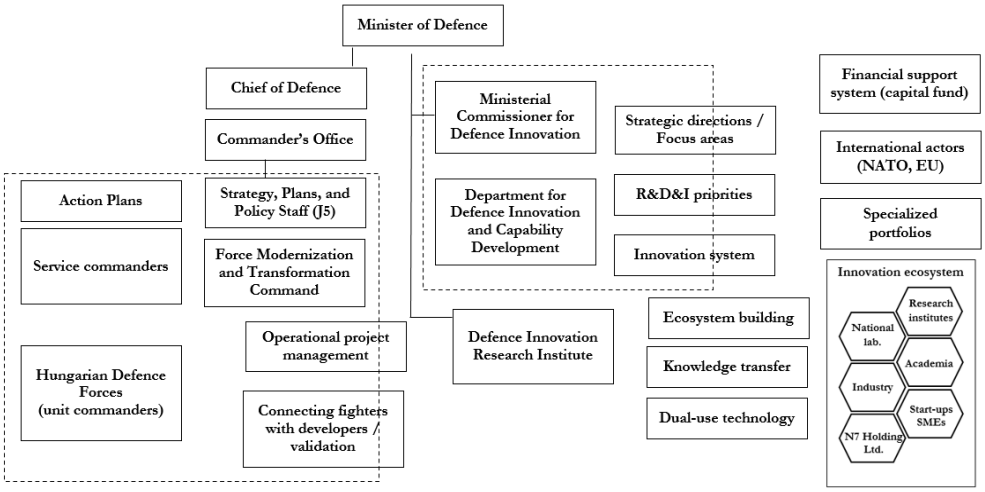
As a large number of procurement and development projects have been established as part of the armed forces modernisation programme, sometimes with the participation of newly established Hungarian companies and companies entering the Hungarian defence sector as newcomers from abroad establishing joint ventures, coordination and management have become crucial issues. To effectively coordinate their work, the institutional

and ownership concentrations of national government-owned entities became necessary. Just as the defence sphere is wider than companies with an exclusive military profile, the reorganisation of control over the most important companies took place with the cooperation of the Ministry of the Interior and the Ministry of Innovation and Technology by 2022.

As then minister of innovation László Palkovics summarised, defence industrial activity relies on two national pillars.[17] The first was the National Defence Industrial Innovation CLC., where, in 2021, the ownership rights of elements with a defence industry profile from the national asset management organisations were merged; this is thus responsible for the management of, at least, partially state-owned companies, including the former MoD companies (Currus, Armcom, Arzenal), Rába, the ZalaZone test track, HungaroControl, Aeroplex, the state share in the Airbus plant in Gyula, the surface treatment plant in Gyula, Hirtenberger, Aero Vodochody, and the Hungarian business part of Rheinmetall Hungary CLC, as well as the state-owned part of the Várpalota munitions and explosives manufacturing joint venture, and finally, BM Heros.[18] The other pillar is the Defence Innovation Research Institute (VIKI), which is the centre of the domestic defence innovation ecosystem. I would like to emphasize that this is a defence organization in a broad sense – that is, it is meant to support the general security of our country – and not a military industrial organization only. It is involved in developing dual-use products and technologies as well. It conducts research independently, but also oversees Hungarian and international R&D projects. Is also tasked with creating the conditions for technology transfer. VIKI is practically the domestic implementation of the American DARPA and NATO's DIANA program, summarised Palkovics.[19] As Figure 1 shows, the defence industrial ecosystem now functionally involves R&D, with connections to the international defence industry and allied R&D programmes.

[17] Hecker, 2022.
[18] Ternovácz, 2021.
[19] Hecker, 2022.

Figure 1 *Research, development and innovation in the Hungarian defence industrial ecosystem*



Source: Végvári, 2023, p. 77.

Thus, involvement in the European and NATO defence innovation cooperation has become ever more important for enhancing Hungarian capacities. Innovation in the field of emerging and disruptive technologies in Hungary focuses on four aspects (out of eight identified by NATO): big data, AI, autonomous systems, and quantum computing. NATO's innovation accelerator programme, DIANA. first accepted two test centres from Hungary, linked to autonomous systems (ZalaZONE Automotive Proving Ground and ZalaZONE Research and Technology Center), with six test centres under the network brand VIKI-NOKIA accredited by NATO in 2024 (University of Pécs, University of Óbuda, BHE Bonn Hungary Electronics Ltd., Alverad Technology Focus Ltd., ITSec Area Ltd. and Nokia Bell Labs).

The 2021 European Defence Fund call sponsored six defence innovation projects with Hungarian participation: 5G COMPAD (Saab – BHE Bonn Hungary Electronics Ltd.), focusing on 5G communications for peacekeeping and defence; EuroHAPS (Thales – C3S Elektronikai Fejlesztő Ltd.), focusing on high altitude platform systems demonstration; FaRADAI (Ethniko Kentro Erevnas Kai Technologikis Anaptyxis – Certh Számítástechnikai és Automatizálási Kutatóintézet) diving into frugal and

robust AI for defence advanced intelligence; iFURTHER (Hellenic Aerospace Industry SA – BHE Bonn Hungary Electronics Ltd.), developing a high frequency over the horizon sensors' cognitive network; NOMAD (Equipos Móviles de Campana Arpa, S.A.S. – F4STER–FUTURE 4 Co.), focusing on novel energy storage technologies at military deployments in forward operating bases; and ALTISS (Magellium S.A.S. – SAGAX Communications Ltd.), developing highly automated swarm of affordable ISR long endurance UAVs for force protection.[20] It is important to note that the SMEs that became involved in EDF projects in 2023 were among the Hungarian test centres accredited by NATO DIANA in 2024, showing the aim of creating synergies. However, among the 53 EDF-sponsored R&D projects awarded in the 2023 call, only one has Hungarian participation: CALIPSO, researching innovative propulsion solutions for land and naval defence applications with the participation of the Defence Innovation Research Institute.[21] This may indicate that Hungarian innovation capacities are still limited in terms of the actors (companies) involved and research areas addressed. Hungary also leads one PESCO project (EUROSIM) and participates in eight other projects.[22]

Directly driven by Ursula von der Leyen's 'geopolitical Commission' and particularly triggered by the Russia–Ukraine war, the dynamic development of EU defence industrial policy reached new milestones throughout 2022–2024, eventually culminating in the adoption of the European Defence Industrial Strategy. Previous initiatives, such as EDIRPA and EDIP, created a role model for supporting early R&D in defence and a framework for co-sponsoring production. These new multinational solutions were also brought forward by EDIS. A programme that has already directly impacted Hungarian projects is ASAP, providing EUR 4.5 million in 2024 for extending Hungarian explosives and EUR 22.5 million for ammunition (shells) production capacities.[23]

As the Hungarian NDTIB is still in the early development phase, its limited capacities and participation are not surprising; however, meaningful trends and results will likely be visible by the end of the 2020s. Cooperation is strongly focused on EDTIB, and dependence on European enterprises is seen as an opportunity (access to technology and international markets that

[20] European Commission, 2022.
[21] European Commission, 2024a.
[22] Nádudvari, Etl, and Berecky, 2020.
[23] European Commission, 2024b.

would otherwise not be open to Hungarian defence products) rather than a risk.

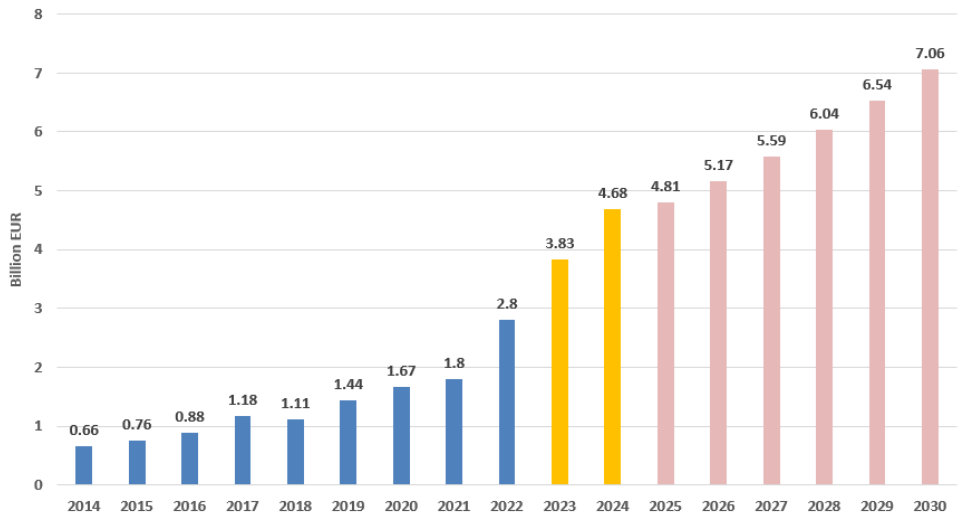
7. Defence investment trends

To sustain the current momentum of defence industry's development, there is one prerequisite that cannot be neglected: financial incentives and direct investment in the sector. After more than a decade of underinvestment and a practically flat defence expenditure trend between 2004–2014, leaving no room for modernisation, the Hungarian government began to substantially increase defence investment from 2015, paving the way for the modernisation programme of its armed forces.[24] As Figure 2 shows, following the 'lost decade'[25], the defence expenditure increased sevenfold between 2014–2024, EUR reaching 4.68 billion, thus fulfilling both NATO member states' Wales defence pledge for spending 2% of the GDP for defence and the commitment to spend a minimum of 20% of defence expenditures on procurements and modernization (actually exceeding 35% since 2019).[26]

The current forecast of the Ministry of Defence for 2030 not only sustains the 2% GDP ratio but also expands it, with a gradual increase of 0.1% annually to reach 2.6% by 2030, which would amount to approximately EUR 7 billion. This investment background can stabilise the development of the armed forces and offer substantial development prospects for the NDTIB.

[24] Csiki Varga, 2023, pp. 1–2.
[25] Csiki Varga and Lázár, 2022.
[26] NATO, 2024.

Figure 2 *Hungarian defence spending trend, 2014–2030*



Source: Respective national laws on closing accounts (blue columns), on the annual state budget (yellow columns), and forecast of the Hungarian Ministry of Defence (MoD). The conversion to euros has been calculated using a 390 HUF/EUR exchange rate. Source of the MoD forecast: the public presentation of Lt. Gen. Ferenc Kajári, Deputy Chief of Defence of the Hungarian Defence Forces, at the Hungarian Defence Industry Summit, on May 10, 2024, in Budapest.

However, both the FY 2023 and FY 2024 defence budgets have included some degree of uncertainty, as 56% and 71% of the annual defence budgets were to be covered from the newly created 'Homeland Defence Fund', respectively. This Fund is the designated source of procurement and modernisation spending, and funds are collected from newly introduced taxes from the banking, finance, and insurance sectors, if achievable. This and any possible economic downturn must be observed in the coming years to make realistic planning and forecasting achievable.

8. Analysis of potential risks

While the goals identified above outline an ambitious plan to dynamically re-establish and build the Hungarian defence industrial capacities with an innovative edge, there are internal and external risks associated with this process. Some are internal, namely developing a practically new branch of industry out of scratch poses challenges, while others are structural, originating from the international embeddedness of the Hungarian defence industry (or lack thereof).

Internal risks stem from a lack of a consolidated defence industrial background on which new initiatives or projects are built: underdeveloped industries, non-existing national supply chains founded on a fragmented SME network, limited capacity in defence industrial start-ups, newly developed research institutions, and educational programmes; thus, new talent management needs to provide a skilled workforce in larger quantities and higher quality to meet the requirements of 21st century work requirements. Expertise in the management of individual defence industrial projects and their parallel coordination – not only in terms of defence planning by the MoD and the HDF but also on the wider coordination in the defence sphere – is scarce after neglecting such projects since the Gripen procurement, the last major procurement programme before the current comprehensive modernisation of the HDF. In addition, as mentioned above, long-term funding for structural development must be provided at a time when the Hungarian economy is still suffering the effects of COVID and the Russia–Ukraine war.

Certain risks can be associated with external and structural factors related to international frameworks and EDTIB, which the Hungarian national defence industry is part of and is becoming increasingly integrated into. Because of the transitional nature of the Hungarian defence industry, many background-enabling processes, such as the stable supply of raw materials and specialised parts in international supply chains, are currently unclear. This aspect is present in the strategic deliberations and contributes to choosing mostly European products for procurement and partners for enhanced manufacturing and R&D cooperation (not U.S. or Asian ones). However, Hungary has limited diplomatic, political, and economic capacity to influence such international processes on its own. Therefore, relying on the influence of European (particularly German) partners can be an asset.

Similarly, participating in international arms trade is expected to be particularly valuable, together with German companies or joint ventures, because more restrictive German arms export policies might offer windows of opportunity for exports through Hungary (even to crisis areas). Simultaneously, international competition puts pressure on newly established firms and projects, which can be balanced by good strategic foresight, identifying marketable products and new niche areas of technological development, and connecting with emerging markets. Whether these risks will be effectively tackled will only be seen in a couple of years as developments unfold and R&D and production expand.

9. Instead of conclusion: Outlook to 2030

When the comprehensive homeland defence and armed forces modernisation programme was launched in 2017,[27] its defence industrial pillar was to be built around the 2016 long-term national re-industrialisation strategy (Irinyi Plan[28]), which identified the defence industry ('personal defence equipment, small arms, light armoured vehicles') as a possible break-out area for Hungary among seven areas to be developed. Currently, the Research, Development, and Innovation Strategy for 2021–2030[29] serves as the backbone for initiating new defence industry projects through investment and partnership. The confidential Defence Industrial Strategy (2021), referred to earlier, was based on four pillars, each of which needs to excel to achieve the ambitious goals of the government on 1) actors, structures, processes; 2) innovation; 3) human resources; and 4) management.

The exact development areas and projects, as well as their respective partners, are outlined here with an outlook for 2030. Based on the agreements concluded during the first major phase of the Armed Forces Development programme (2016–2023), one can envision the main projects until the 2030s; in other words, actors, structures, and processes have been calibrated.

However, a general feature can be identified as a crucial area in which progress (and long-term success) clearly depends on Hungary's weak

[27] Government Decree No. 298/2017 (02.06.2017).
[28] Drafted by the Ministry of Economy, endorsed by the government on 05.02.2016.
[29] Government Decree No. 1456/2021, replacing the R&D&I Strategy for 2013-2020 (Gov. Decree No. 1414/2013, adopted on 04.07.2013).

performance as an innovator. The 2023 European Innovation Scoreboard listed Hungary among 'moderate innovators', 21st among 27 EU member states in 2023 and at 70.4% innovation output compared to the EU average. However, this is already an improvement, as in 2021, Hungary was only assessed as an 'emerging innovator' (22nd in the EU), with 67.9% innovation output. Based on data from 2018, only 9.5% of (all) industrial companies in Hungary engaged in continuous innovation activities (compared to the 29.6% EU average), and only 28.4% conducted innovation occasionally (compared to the 53.1% EU average).[30] Unfortunately, no updated data are available on these aspects. However, this is inadequate if the ambitious goals outlined for 2030 are satisfied. Bringing high-tech defence enterprises with an innovation edge to Hungary (e.g. Rheinmetall) was successful, and the government introduced funding programmes tailored to the needs of SMEs to develop the national actors in the supply chain.

To provide a skilled and qualified workforce, tighter and deeper cooperation programmes with institutions of higher education, innovation hubs, and research centres have also been initiated. Of course, these will bear the first results in the next few years, and the competitiveness of the defence sector as an employer will remain in question.

Considering other internal and external–structural–risks associated with Hungarian defence industry development, the outlook to 2030 can be characterised as "high risk–high reward".

[30] European Commission, 2023.

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