Defence Techno-Industrial Bases in Hungary and the United States

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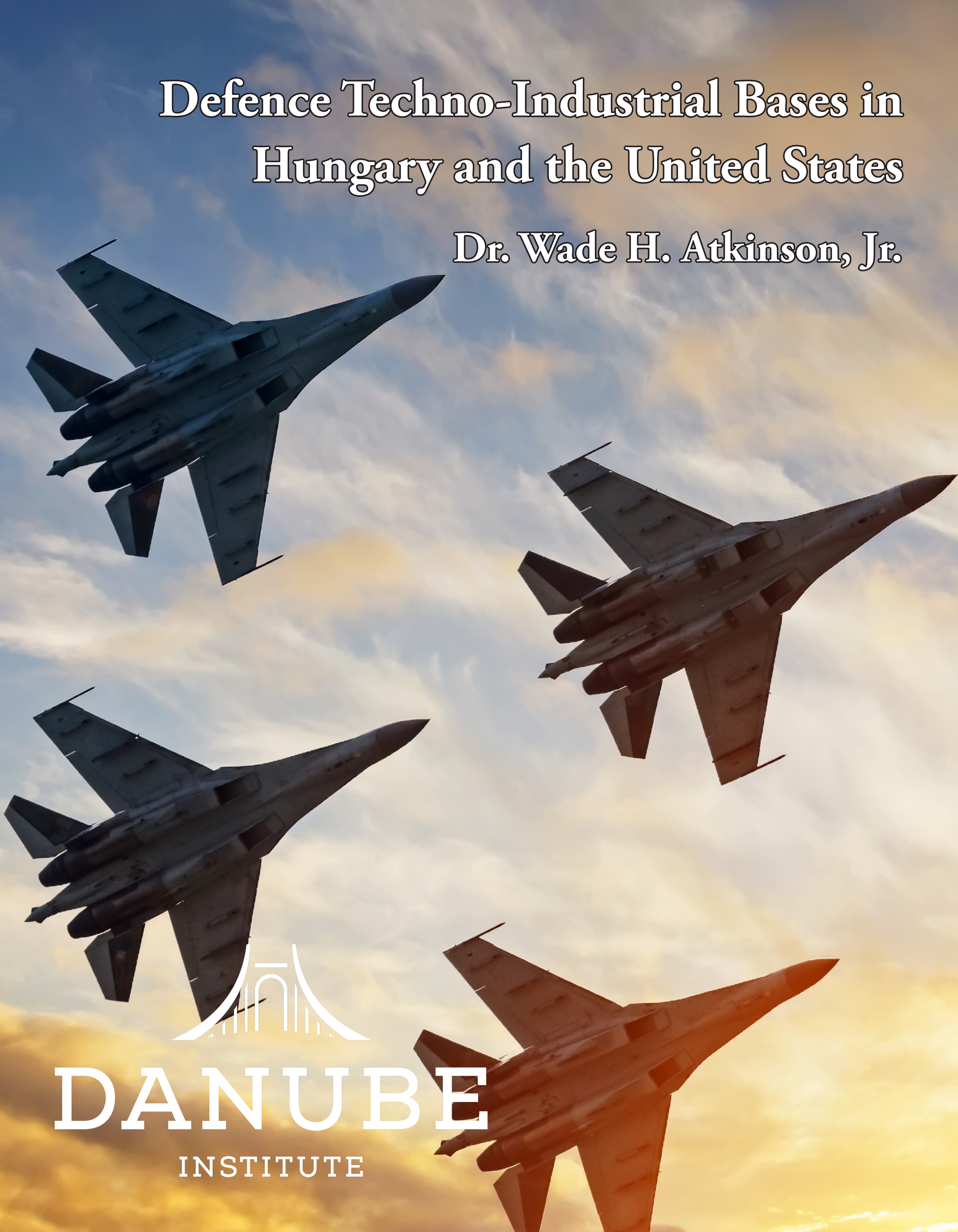

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August 2025

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About the Author

Dr. Wade H. Atkinson Jr. received his BA and JD degrees from the University of Virginia and his MA and DS degrees in National Security from The Institute of World Politics in Washington, D.C. The topic of his 2024 doctoral dissertation was: "The Political Economy, Functionality, and Strategic Optimisation of the Defence Techno-Industrial and Cybersecurity Bases in the 21st Century United States". His dissertation, along with research and conversations with Hungarian policymakers and scholars on the Hungarian Defence Technological and Industrial Base (DTIB) while a Visiting Research Fellow at The Danube Institute in Budapest in May-June 2025, form the basis of his research and recommendations for this article.

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Dr. Wade H. Atkinson, Jr.

Abstract

Defence Techno-Industrial Bases (DTIB) are essential to the modern security architecture of both Hungary and the United States. Acting as hubs for research, design, and manufacuring of critical technologies and military equipment, the continued robust development of this area is a shared interest of Hungary and the United States. In an increasingly volatile geopolitical environment in Ukraine, the Caucuses, and Central Asia, the importance of Hungary's defence policy for the shared security interests of NATO member states is clear.

Outlined here is an explanation of the origins of Hungarian and American defence industrial bases, and their respective transformations into modern Defence Techno-Industrial Bases. Yet there remains an incentive for adaptation and shared development of these techno-industrial bases, namely to strategically optimise their abilities to promote economic growth and to facilitate further security cooperation between Hungary and the United States.

Introduction:

Russia's 2022 invasion of Ukraine and threats to the North Atlantic Treaty Organisation (NATO) Members, Chinese Communist military spending, "Civil-Military Fusion" (C-MF) and expansionism in East Asia, and a rapidly changing balance of power in the Middle East after the Israel-Iran "Twelve Day War" have brought questions of exactly how democracies research and develop, supply-source, finance, manufacture, and distribute highly complex and increasingly expensive weapons systems to the forefront of national security dialogue.

The US "Public-Private Partnership" (PPP) for research development, production, and distribution (via alliances, Foreign Military Sales (FMS), and Foreign Military Aid (FMA)) of highly complex and sought-after weapons systems, including Patriot missile batteries, the Joint Strike Fighter, stealth fighter and bombers, nuclear submarines, guided missile frigates, and sophisticated unmanned vehicles, is often referred to as the "Defence Industrial Base" (DIB).[1]

For most of its history (1776-1938), US weapons, such as small arms, cannons, and warships; were produced by the US government's Department of War (Army) and Department of Navy under "The Arsenal System."[2] By 1938, the complexity of producing war planes and intense pressures from the rise of Nazi Germany and Imperial Japan caused the US to abandon (partially) the Arsenal System. The US Congress authorised the Defence Plant Corporation (DPC) in 1938. The Congressional authorization of the DPC accelerated an existing movement to combine government, private sector, and academic research towards the development and manufacturing of the most complex weapons systems.

This trend was reinforced by the massive government production required in the World War II war effort—a united national war effort in which defence spending approached 38% of US GDP. This effort included The Manhattan Project and the temporary conversion of almost all US automobile plants and shipbuilding yards to produce tanks, airplanes, and warships. It was reinforced by the passage of the National Security Act of 1947 and the Defence Production Act of 1950—the latter provides legal authority for ubiquitous Presidential Executive Orders in weapons production, including massive recent US efforts in AI and superintelligence.[3]

The development of the Hungarian defence industry, over a much longer period originating with 11th century centralization under Saint Stephen I, both parallels and differs from the 249-year US experience. Yet it has the same goals: protection of democracy, strong national security, and strategic autonomy.

The US had three major events which transformed its DIB: (the existential needs of the US Army in the Civil War, US entry into World War I in 1917, and the assumption of US world-wide weapons production and leadership in World War II and the Nuclear Age)—leading to expanding borders, resources, and exponentially expanding technological capacity.

Hungarian geopolitical history in Central Europe and its collateral effects on the developing Hungarian DIB, particularly since 1918 has, unfortunately, been far more complicated, resulting in shrinking borders, resources, human capital flight, and technological disruption. Fortunately, this turbulent history culminated in democracy in the Republic of Hungary in 1991, Hungarian Membership in NATO in 1999, Hungarian Trans-Atlanticism, and a reinvigorated Hungarian DIB—particularly under the leadership of Prime Minister Viktor Orbán.

[1] The US Defence Industrial Base (DIB) is defined as: "The worldwide industrial complex that enables research and development, as well as design, production, delivery, and maintenance of military weapons systems, subsystems, components, and parts to meet US military requirements." See, "DIB Annex to the National Infrastructure Plan," (Washington, DC: Cybersecurity and Infrastructure Security Agency (2013). The term "DIB" was first mentioned as the term describing the relationship of the government and commercial defence industries in the late 1930's. See, Lieutenant Col Shane Upton, "US Defence Industrial Base: Strong But At Risk" (Monograph), (Fort Leavenworth KS: School of Advanced Military Studies, US Army Command and General Staff College, (2018)).

[2] See, Daniel H. Else, "The Arsenal Act: Context and Legislative History" (Washington, DC: Congressional Research Service, 2011).

[3] See, President Trump Executive Order 13806 implementing "Report on Assessing and Strengthening Manufacturing and the Defence Industrial Base and Supply Chain Resilience of the US;" President Biden Executive Order 14100 on "Artificial Intelligence.

Since Hungary and the US have been united in purpose following Hungarian ascension to NATO in 1999, there has been more progress on Hungarian public-private development of weapons systems and joint Hungarian-NATO military-industrial development. This rapid progress includes: Hungary's joint production of the Lynx Fighting Vehicle with Rheinmetall; joint ventures with Dynamit Nobel Defence, Colt CZ Group, Airbus, and Uvision; and in the NATO Defence Innovation Accelerator for the North Atlantic Program (DIANA). This effort has run parallel to the Hungarian domestic efforts to increase military spending and readiness under the Zrinyi 2026 Program and technological innovation and integration under the Defence Innovation Research Institute of Hungary's Ministry of Defence (VIKI). Additionally, the Defence Industry Association of Hungary (MVSZ) has worked hard to represent Hungarian companies with common interests in developing and selling goods and services in the defence and security markets and in cooperation with other defence and defence-technology industries, particularly in Central Europe.

Prior to 1999, Hungary, always blessed with world-class scientific and technological talent, fine universities, and high-quality manufacturing, had been hampered by the fundamental dismantling of its domestic arms industry under the Treaty of Trianon (1920), the severe dislocations of Soviet occupation and engineering on its DIB (1944-1991), and, more recently, macroeconomic challenges, lack of an indigenous aerospace industry (Hungarian aerospace was nascent but eliminated by the Soviets after the Axis collapse in 1945), and a technology recovery period during the post-Soviet "hangover" of the 1990'.

More recently, since the late 1980s, the widespread use of systems of integrated computers, battlefield sensors, semiconductors, satellites, unmanned air and sea vehicles, and defensive and offensive cybersecurity programmes in the US has caused what use to be referred to as the "Defence Industrial Base" into the even more complex "Defence Techno-Industrial Base" (DTIB), which is increasingly beholden to multinational technology companies.[4]

In layman's terms, the term "DIB" refers to the research, development, and industrial processes that make complex war machines, such as the World War II-era B-24 Bomber. The term "DTIB" refers to the addition of complex systems guided by sensors, satellites, advanced computer programmes working with humans, which guide the hardware, such as the Stealth Bomber. The modern civilian analogy to the DTIB is increasingly called "the Internet of Things." Examples of the latter are sensors and computers guiding automobile maintenance and home heating, air conditioning, and security systems.

The research and development, financing of, manufacturing, and distribution of DTIB manufactured products and software has caused serious considerations for both the US and Hungary in NATO in the context of the War in Ukraine; for the US with Asian Bilateral Treaty Partners; and for both with Israel and Turkey.[5] Under the more dynamic leadership of Viktor Orbán and Donald Trump, the DTIB optimisation and allocation debate has brought into focus efforts between close Allies (Hungary and the US) to develop and cross-fertilise their 21st-century DTIB's (bilaterally via joint ventures and in NATO) to meet security needs, control costs, and boost domestic economies and technology leadership. The success of the US and Hungarian DTIBs is vital for collective security in NATO, 21st century technology leadership, continued economic prosperity, and strategic autonomy—albeit in Alliance contexts.

This article seeks to trace the comparative historical and technological developments of the 21st-century DTIB's in the US and Hungary with a focus on strategic optimisation and economic efficiency. It will then offer recommendations on how to enhance each DTIB for the second quarter of the 21st century to encourage further mutual security, economic and technological cooperation, and "dual-use" economic growth.

[4] See, Special Competitive Studies Project, "Mid-Decade Challenges to National Competitiveness" (Washington, DC: Special Competitive Studies Project (SCSP), 2022). The SCSP includes on its Executive Board such notable defence-technology thinkers as Eric Schmidt of Goggle and Robert O. Work and Michele Flournoy, former senior officials of the US Department of Defence (DOD). SCSP defines the DTIB as: "Distributed and networked operations, human-machine collaboration, human-machine teaming, primacy in software centric warfare, resilience, and greater technological interoperability and interchangeability with Allies and Partners" quoting "Mid-Decade Challenges to National Competitiveness" at p. 38.

[5] For instance, US Allies Japan and South Korea are participants in design and production in the Joint Strike Fighter Program, while The Philippines and Australia are not. Australia is now jointly producing multi-billion-dollar Virginia Class Nuclear Attack Submarines with the US and UK under the AUKUS Program, which does not include Japan, South Korea, or The Philippines.

Memorial Day Parade, Washington. (Shutterstock)

The Evolution of the American Defence Technology Base

President Calvin Coolidge once remarked: "America's business is business." While this might seem an oversimplification when applied to the complex, globalisd 21st-century US DTIB, it is still true. America's robust economic strength and innovative genius have provided the foundation for its world-standard DTIB.[6] However, US strength is diminishing in the face of declining government-sponsored Research and Development (R&D), declining US manufacturing and share of world GDP, conflicting strategic goals, greater private sector commercial opportunities, globalisation, and large budget deficits.

Significant problems with the US DTIB since around 1990 have been compounded by what legal scholars refer to as government v. private sector "Agency Problems." An "Agency Problem" is defined as: "A conflict of interest in any relationship where one party is expected to act in another's best interest."[7] A private sector Agent may be motivated by profit-seeking or opportunity costs and benefits to act favorably to the Principal, if the Agent is not properly incentivised or the conflicting motives or costs and benefits are not mitigated.[8] Agency Problems in the DTIB were foreseen by President Eisenhower in his 1961 "Farewell Address", when he praised the remarkable achievements of the US DTIB, but warned of the dangers of the "military-industrial complex."[9]

From 1794-1938, the Department of War (US Army) and US Navy were delegated responsibility for weapons design and production using the government-owned Organic Industrial Base (OIB) of the "Arsenal System." Government production was the rule except in wartime or where it could be shown that commercial production was more "economically feasible than government production."[10] Since 1938, the US has had a hybrid public-private DTIB, which achieved brilliant innovations and unprecedented production heights in World War II and the Cold War because of high government R&D and acquisition funding.

Since the 1990's, the hybrid US DTIB has experienced severe Agency Problems—declining and unfocused R&D, spiraling costs, lower output, and quality control issues.

The US Department of Defence (DOD), which has overseen the DTIB since 1944, and commercial contractors each bear some responsibility for R&D, design, production, and cost problems. This Agency Problem is primarily created by inherent conflicts between the US government (a near-monopsonist buyer of defence goods and services seeking to maximise national defence at the least cost to taxpayers) and DTIB "Prime Contractors" and other contractors (sometimes oligopolists whose goal is to maximise shareholder wealth and produce high quality goods). The Agency Problem in the DTIB has been exacerbated by increased government DTIB spending on services, software, and cybersecurity, over hardware. It has been exacerbated by the roles of large multinational technology firms working with DOD and other government agencies in cybersecurity and Artificial Intelligence (AI).[11]

The Agency Problem in the 21st-century DTIB must be addressed and mitigated. Bluntly stated, Agency Problems must be mitigated and reduced via prudent incentivisation, realignment of interests, and stronger national industrial and technology policy. This must happen before excessive spending bankrupts the US Treasury trying to "fix the DTIB", or the US' increasingly sophisticated state and non-state adversaries dilute US core strengths or inflict unprecedented damage.

[6] See, definition at Footnote 5.
[7] See, Investopedia, "Agency Problem: Definition, Examples and Ways to Minimise Risk," https://www.investopedia.com/terms/a/agencyproblem.asp#. See also, Saul Levmore, "Commissions and Conflicts in Agency Arrangements: Lawyers, Real Estate Brokers, Underwriters, and Other Agents' Rewards," Vol. XXXVI, Journal of Law and Economics 503 (April 1993). Steven Shavell, "Risk Sharing and Incentives in the Principal and Agent Relationship," 10 Bell. J. Econ. 55 (1979).
[8] Id.
[9] President Dwight D. Eisenhower's "Farewell Address," January 17, 1961. https://www.archives.gov/milestone-documetns/president-dwight-d-eisenhower-farewell-address.
[10] See, Daniel H. Else, "The Arsenal Act: Context and Legislative History" (Washington, DC: Congressional Research Service, 2011).
[11] See, P.W. Singer and Allan Friedman, Cybersecurity and Cyberwar: What Everyone Needs to Know (Oxford: Oxford University Press, 2014) at pp. 162-165, discussing the potential dangers of a "cyber-industrial complex."

Historical Analysis of the US Defence Industrial Base

During the American Revolution and the War of 1812, the US had to improvise to support its armed forces. In the 19th century, the US relied on its Organic Industrial Base (OIB) and the Arsenal System with the government controlling and directing manufacturing of guns, cannons, ships, and war supplies. The Arsenal System survived through World War I (with substantial government and private sector assistance in 1917-1918) until 1938.

In 1938, Congress chartered the Defence Plant Corporation (DPC), initiating what has come to be known as "the hybrid DTIB." The Arsenal System supplied the military from the US' OIB and was supported by its rich industrial and innovation base. It was primarily operated by US government-owned and operated facilities, designing and manufacturing weapons, munitions, and warships with increasing assistance from industry. The Arsenal System also contributed to the development of American industry in the 19th century by sponsoring artisans and encouraging technical innovation.[12]

World War II brought tremendous needs for the US and its Allies for ships, tanks, airplanes, submarines, and integrated technology as the "Arsenal of Democracy." World War II caused the US to move, in part, from the Arsenal System into a more hybrid DTIB with government direction of commercial industry, particularly the US auto, shipbuilding, and aviation industries.[13] The nationwide scientific R&D and industrial effort, using government and commercial enterprises, superb weapons, such as Sherman Tanks, Mustang Fighters, B-24 Bombers, Liberty Ships, and dozens of aircraft carriers. It was accompanied by other massive, combined projects of government, industry, and academia, including the Manhattan Project, to build the world's first nuclear weapon, and far-reaching developments in computing power and telecommunications. This laid the groundwork for the explosive growth of the US computer and telecommunications industries in the 1960's and the Internet Economy post-2000.

The World War II and Cold War collaboration among government, industry, and academia was named, in honor of its greatest proponent, the "Vannevar Bush Innovation Triangle" (VBIT). It pioneered applications of radar, nuclear and thermonuclear weapons, the development of the aerospace industry, penicillin, industrial uses of aluminum and titanium, advanced semiconductors, GPS, precision-guided weapons, stealth technology, and the Internet. Significantly, in a reversal of the Industrial Revolution to World War I Cycle (1870-1917), the World War II to early Cold War VBIT (1938-1960) frequently used government-sponsored R&D to produce advanced, defence-oriented technology—particularly in aerospace, computing, communications, and nuclear technology. This technology later had enormous commercial applications. Monetisation of this technological advancement, particularly in communications, computers, and advanced semiconductors, created opportunity costs that later decelerated the DTIB—as human and investment capital surged to meet commercial opportunities.

The hybrid US DTIB evolved after WWII based on national security needs, world leadership, contemporary events, and commercial opportunities. It is imperative to understand this evolution to improve strategic optimisation, economic efficiency, and "dual-use" growth for the US DTIB in the second quarter of the 21st century.

The post-World War II US DTIB evolved in five distinct phases:

1. The Early Cold War Growth Period (1945-1960) – Characterised by high government spending on R&D and the demands of world leadership.

2. The Mature Period (1960-1990) – Characterised by superb integration of high technology and military machines culminating in the "Second Competitive Offset Strategy" that won the Cold War and achieved a degree of nuclear security. These achievements were publicly demonstrated in the First Gulf War (1991). However, in the 1960-1990 period, great US economic and technological success came at a cost to the DTIB. Consumer needs and wants, rising social welfare demands, and business profit-seeking caused a migration from government-led, defence-oriented R&D to commercial R&D and technology.

3. The Immediate Post-Cold War Restructuring Phase (1990-2001) - Characterised by large budget cuts, declining R&D spending, major industry consolidation, recognition of changes in warfare, fighting regional conflicts, and emerging globalisation. Commercial R&D and Venture Capital (VC) financing upended government-directed R&D, resulting in less long-term R&D—particularly "deep tech" and

[12] Committee on Defence Manufacturing in 2010 and Beyond, Defence Manufacturing in 2010 and Beyond: Military Challenges of National Defence (Washington, DC: National Academy Press, 1999).
[13] Id.

"disruptive R&D." Human and investment capital migrated to commercial R&D to satisfy commercial demands.

4. The Post-9/11 Global War on Terrorism (GWOT) Transformation Period (2001-2012) - Characterised by increased spending on homeland security and GWOT, conflicting strategic goals, substitution of private contractors for military actors in non-lethal capacities, increasing importance of cybersecurity, and a budget crisis, all combined with large structural deficits that contributed to the Great Recession of 2008-09.

5. The New Restructuring Period (2012-Present) - Characterised by continued GWOT, exploding costs, the need to address a "Rising China", "budget binds" arising from the Budget Control Act (2011), integration of offensive and defensive cybersecurity into national security strategy, and AI. Starting around 2012, there was growing recognition that the once-shinning WWII and Cold War DTIB was perceived as both a major, long-term manufacturing and cost problem and a potential salvation via application of even more advanced technology, cybersecurity, and AI. On the positive side, this period was characterised by the recognition of the full benefits of cost-sharing with Allies in joint venture projects, such as the Joint Strike Fighter (JSF), anti-missile defence sales, and the expansion of the Virginia Class Submarine Program in the AUKUS Program

The first election of Donald Trump in 2016 on a platform of increased US manufacturing, defence and DIB readiness, and "America First" marked a turning point for the US DTIB. Trump embraced DTIB revitalisation and gave the US its first comprehensive National Cybersecurity Strategy. Trump's Executive Order (EO)13806 and "Report on Assessing and Strengthening Manufacturing and the Defence Industrial Base and Supply Chain Resilience of the US" was the first frank, self-effacing, and comprehensive reprot and action plan linking the dramatic economic problems in US manufacturing and the related, relative decline of the DTIB.

The Trump Administration heightened law enforcement methods to protect the US domestic DTIB, including enhanced counterespionage activities, enhanced cybersecurity regulations for both DOD and DTIB vendors, expanded Committee on Foreign Investment in the US (CFIUS) review and enforcement, and enhanced use of the Export Control Act (ECA) following the expansion of CFIUS and the ECA in FIRRMA (2018).[15]

In 2021, the Biden Administration continued these offensive and defensive DTIB measures to expand Trump I's efforts with: EO 14017 on America's Supply Chain Resilience; the CHIPS and Science Act; a new National Cybersecurity Strategy (joining the US Cyber Command and NSA); a DOD–DTIB cybersecurity ; and EO 14100 on Artificial Intelligence. Biden asked US Allies to secure intellectual property for semiconductors; design and manufacturing equipment for semiconductors; and other high-end technologies with strategic uses. Biden expanded joint ventures to address cost issues, continued the Trump's trend toward a national manufacturing and technology policy, and embraced advantages from offensive and defensive cybersecurity and AI.

Since January of 2025, the Trump II Administration has seen a revival of Trump's "American First Plan" with an increase on US defence spending to nearly $ 900 Billion for fiscal Year 2028. The Trump Administration has seen renewed interest in advanced defence technology and concurrent "dual-use" economic prosperity. This has included renewed interest in modernisation of the US nuclear triad, hypersonics, a US national missile defence system, shipbuilding (both US Navy warships and the commercial US fleet), autonomous vehicles for air and sea, and space defence (including the US Space Force).

It has also seen increased concern about the vital military-industrial semiconductor supply chain, with huge incentives for strategic technology leaders, such as Taiwan Semiconductor Company (TSMC) building plants in the US and a revival of the Pentagon's Defence Innovation Unit (DUI) bringing more cutting-edge Silicon Valley technology directly to the DOD. Trump's geopolitical focus has been for higher spending for the Indo-Pacific and increased NATO spending and self-reliance—though in recent weeks Trump, has shown renewed appreciation for NATO and US assistance to Ukraine.

[14] See, SPSC, "Mid-Decade Challenges to National Competitiveness" (Washington, DC: Special Competitive Studies Project, 2022).
[15] The Foreign Investment Risk Review and Modernization Act (FIRRMA), US Code, Title XVII, P.L. 115-232 (August 13, 2018).

President Donald Trump hosts the Naval Academy football team, Washington. (Shutterstock)

The Origins and Transformation of Hungary's Defence Techno-Industrial Base

The history and development of the Hungarian DIB is much longer and richer than the US', reflecting Hungary's geopolitical location in Central Europe and the broader military, political, and technological transformations in Central Europe over one thousand years. The Hungarian DIB has seen far more peaks and valleys than its counterpart in the US—especially since The Great Compromise of 1867—including promising development during the Austro-Hungarian Empire until 1918, the devastation of two World Wars and Soviet occupation, and 21st-century resurgence following the return of democracy to Hungary in 1991, NATO Membership, and the development of a 21st-century techno-industrial economy in Hungary.

Hungary's military origins began when Saint Stephen I established the Christian Kingdom of Hungary in 1001 AD. Saint Stephen established a feudal system where nobles were obliged to provide armed service under the Árpád Dynasty (1000-1301). The early Hungarian Army relied on cavalry, influenced by its Magyar nomadic roots. Local blacksmiths and artisans in castles and royal domains were the primary producers of weapons like swords, lances, bows, and armour. The spread of Christianity and feudalism introduced Western-style arms, including chainmail, crossbows, and iron helmets. No large-scale arms manufacturing existed, but monasteries and royal courts often sponsored smiths and artisans.

In the Angevine and Sigismund Eras (1301-1437), the Angevin Kings, such as Charles Robert and Louis the Great, established royal armories. They encouraged the import of better-quality weapons, including swords, halberds, and siege engines—with knights and cavalry dominating the military. Sigesmund of Luxembourg invested in castle fortifications and weapons manufacturing to support campaigns against the Ottoman Turks. Hungarian metallurgy began to develop near mining centers like Besztercebany and Selmecbanya, where raw materials for arms were refined.[16]

In the Hunyadi Period (15th-Century), King Matthias Corvinus built Hungary's military power through modernisation. Matthias' Black Army (*Fekete sereg*) was one of Europe's first standing mercenary armies. It required sustained weapons production including early firearms, pikes, cannons, and standardised armour. Weapons workshops and foundries were developed in Buda and Visegrád. The first Hungarian cannon production began in the 15th century, following European trends. Bronze and iron cannons were manufactured locally in preparation for wars against the Ottomans.

Following the Battle of Mohacs (1526), Hungary was divided into three parts: Habsburg Royal Hungary, Ottoman Hungary, and the Principality of Transylvania. Under the Habsburgs, Royal Hungary built and operated machine foundries in Upper Hungary (modern-day Slovakia) and western cities, such as Pozsony (Bratislava). Hungary became a frontier buffer, with weapons primarily imported from Austria and Germany. However, Royal Hungary also locally manufactured small arms and cannons. Ottoman-controlled Hungary saw the establishment of small-scale arms production to equip local troops, blending Islamic and European styles, such as curved sabres and matchlocks.[17]

The late 17th and 18th centuries were a period of reconquest and centralisation in Hungary. After the Ottoman expulsion in 1686, the Habsburgs incorporated Hungary into their centralised Empire. Military production became more formalised, but also increasingly centralised in Vienna, Wiener Neustadt, and other Imperial centers, for cannon and musket production. While major weapons production was outside Hungary, some local arms workshops persisted in Kassa (Košice), Debrecen, and Pest. Hungarian curved sabers (especially the hussar sabre) gained fame and were used effectively by hussar cavalry units across Europe. Hungary developed metallurgy in its

[16] See, Pal Engel, The Realm of Saint Stephen: A History of Medieval Hungary, 895-1526.
[17] See, Geza Palffy, The Kingdom of Hungary and the Habsburg Monarchy in the Sixteenth Century.

rich mining regions for cannons and gunpowder for muskets. During the 18th century, Hungary essentially supported the Habsburg military-industrial system and military logistics by providing horses, sabres, and officers. Firearms were still often imported from Austria and Germany.[18]

The 19th and Early 20th Century Hungarian Defence Industrial Base Until 1943

The 19th century and the Industrial Revolution witnessed Hungary's transition from the artisanal, decentralised weapons production of the previous period to a sophisticated, semi-autonomous industrial base integrated into the larger Austro-Hungarian military-industrial system. This was especially true after the Austro-Hungarian Compromise (*Augsleich*) of 1867. By 1900, Hungary was poised to become a powerhouse of arms manufacturing and defence-industrial technology—a role that would expand dramatically in World War I (1914-1918).

By the 1900s, Hungarian factories could produce locomotives, boilers for ships, field guns, mounted artillery, and their carriages, and a variety of small arms. MÁVAG (the Royal Hungarian Iron, Steel, and Machine Works), founded in Budapest in 1870, became a hub of heavy industry and dual use (civilian and military) engineering. Companies such as Weiss Manfred Steel and Metal Works and FÉG produced standard rifles, pistols, cartridges, and ammunition for domestic Honvéd and Imperial units. The same factories that produced civilian railway engines, boilers, machine tools, dyes, and farm equipment could pivot to full-time wartime armaments production in WWI.

For instance, production lines for steel and rolling mills at Weiss Manfred and steam engines at MÁVAG were later used for armaments production under military contracts. Ganz Works, a major engineering firm, produced cast steel products for buildings and bridges and later produced armor plating, torpedo boat engines, and munitions parts. Many Hungarian arms firms became integrated with the Austro-Hungarian (KuK) War Ministry, supplying both Austrian and Hungarian Regiments. Railway and bridge-building equipment was later used for troop transport and logistics in WWI.

This defence-industrial foundation was crucial as the dual monarchy transitioned into full-scale mobilisation in 1914. During WWI, Hungary played a major role supplying the Austro-Hungarian Army by producing rifles and machine guns, cartridges, artillery shells and components, and airframes and engines (under designs and licenses from Astro-Daimler and Lohner). Labor shortages during the war led to increased female and youth employment in arms factories.[19]

However, following the loss of WWI and the Treaty of Trianon in 1920, Hungary lost nearly 70% of its territory and most of its military-industrial infrastructure. Hungary was limited to a small internal security force and forbidden to produce heavy weapons such as aircraft, tanks, artillery, and modern rifles. It was also subject to foreign military inspectors monitoring its industry until 1927.

Despite the restrictions of the Treaty of Trianon, Hungary retained and disguised military industry under civilian covers after 1928. Weiss Manfred shifted to automotive, food canning, and steel production, but covertly stockpiled military materials and designs. FÉG continued manufacturing pistols, small arms components, and sporting weapons. The Diosgyor Ironworks continued producing machine tools and dual-use steel products. By the late 1920s, with French and Italian tolerance, Hungary began secretly rearming.

In the 1930s, Hungary began a rearmament policy under Admiral Miklós Horthy and Prime Minister Gyula Gömbös, which initiated military expansion. The Győr Program of 1938 was a national military initiative that invested over one billion pengő (the currency of Hungary between 1921 and 1946) into rearmament. This led to an expansion of arms factories at Weiss Manfred, FÉG and Diosgyor, among others. The weapons produced in this period were sophisticated and included: modified Mannlicher rifles, machine guns, domestic copies of Škoda 75mm and 105mm field guns, tanks (under licensed production of Italian CV-35 "tankettes" and German designed armored vehicles), and the first Hungarian-produced aircraft under Italian and German licenses (CR-32 biplanes).

[18] Id.

[19] Istvan Seak, Beyond Nationalism: A Social History of the Habsburg Officer Corps, 1848-1918 (Oxford: Oxford University Press, 1990).

Ceremonial guards in Revolution-era Hungarian military dress, Budapest. (Shutterstock)

The period 1938-1943 saw Hungary align with the Axis and enter full-scale wartime production and militarisation after Hungary joined the Axis Powers in 1940. Hungary received German weapons and licenses for the production of Panzer 38 tanks and the Messerschmitt Bf 109 fighter-bombers. It also received German blueprints for the retooling of factories, with Hungarian engineers making local improvements and adaptions. Hungarian factories produced Hungarian adaptations of the Toldi Light Tank, the Turan Tank, armoured cars, and self-propelled guns. Hungary's Weiss Manfred manufactured aircraft, including Italian Fiat CR 42 biplanes and RE-2000 fighters under license from Italy and manufactured modified German Heinkel and Messerschmitt aircraft. It also developed a few indigenous aircraft prototypes such as the RMI-8 fighter-bomber. However, mass production was dominated by licensed German and Italian designs.

Moreover, while Hungary built a relatively modern defence-industrial base from 1938-1943, geographic and resource limitations meant production volume could not approach German or Soviet levels. Many designs were outdated by mid-war standards and Hungary's infrastructure was vulnerable to Allied bombing by 1944.[20]

The Decline of the Hungarian Defence Industrial Base Under Soviet Occupation (1945-1991)

Hungary's defence industrial based during the Soviet occupation (1945-1991) was shaped by the grim geopolitical realities of being a Warsaw Pact satellites state under Soviet political, military, and economic influence. The Hungarian defence industrial base was severely reduced, nationalised, and restructured to fit into the broader Soviet-led military-industrial complex. This focused heavily on supplying constabulary-type equipment for domestic defence and law enforcement, as well as supporting the Warsaw pact's logistics and technology needs. The nascent Hungarian aerospace industry in 1938, which had started producing aircraft both under license and of original design, was eliminated.[21]

The period 1945-1949 saw demilitarisation, nationalisation, and assertion of Soviet control. Many Hungarian engineers and military specialists were involuntarily deported as part of the repression and the major industrial producers were nationalised, renamed and reconfigured to prevent strategic production.

During the Stalinist militarisation and rearmament phase (1950-1956), a Stalinist regime under Mátyás Rákosi partially rearmed Hungary as part of the Warsaw Pact. Factories were converted to support Soviet weapons production under Soviet design and licenses. Hungarian workers and engineers were retrained to manufacture Soviet-designed arms. Any attempt to revive indigenous designs for strategic or technologically-advanced weapons, such as tanks or airplanes, was banned. Weapons production was severely limited to small arms, ammunition, artillery and mortar shells, military uniforms, and personal gear for the Warsaw Pact.

The Hungarian Uprising of October-November 1956 and its suppression saw destruction of some military plants by rebels; retaliatory purges of engineers, officers, and plant managers; tighter Soviet control over remaining defence-industrial sectors; and subsequent rebuilding focused on military loyalty and ideological reliability.

Following its reintegration into the Warsaw pact in the 1960s–1980s, Hungary became a logistics hub, but not a primary defence-industrial or arms production innovator. There was no strategic weapons production of missiles, tanks, or aircraft. Hungary specialised and excelled in providing electronics components, optics, truck chassis, and military machinery compatible with Soviet standards. Domestic industry produced small arms, support equipment, and industrial

[20] Sandor Szakaly (Ed.), Hungary's Military History in the 21st Century (Budapest: Zrinyi Kiado. 1994).

[21] The abolition of the Hungarian aerospace industry by the Soviets, along with the loss of human capital and factory capacity in aerospace, probably represents the single greatest setback which must be overcome to develop an integrated 21st-century Hungarian DTIB. Not only did Hungary not have the opportunity to develop an aerospace industry from 1945-1991, but many of the related technologies associated with aerospace, such as advanced computing for positioning, telecommunications, telemetry, advanced material science, and satellite technology were foregone. Fortunately, recent developments in drone technology and Hungary's recent joint venture with Israel's Uvision may offer the possibility of "leap-frogging" aspects of its aerospace deficit by developing combat and commercial drones and using this technology to fill concurrent gap areas. Additionally, Hungary's membership in both NATO and the EU offers additional opportunities to participate in costly advanced aerospace research and development.

tools. The major state enterprises produced according to Soviet licenses and for military radios, targeting systems, and metal components. However, Hungary did export military goods to other Warsaw Pact countries and Soviet-aligned Third World states, such as Vietnam, Libya, and Angola.

The period 1980-1991 was one of late Cold War decline. Soviet military demand slowed and Hungary's economy suffered chronic inefficiency, high debt, and loss of almost all defence-industrial exports. There was no modernisation compared to the "revolution in military affairs" sweeping through NATO in the 1980s or even by Soviet standards, with Hungary being relegated to producing older Soviet-designed models.

After the Soviet collapse in 1990-1991, Hungary's defence-industrial base was obsolete and overstaffed. Major factories like FÉG, Caspel, and Videoton were downsized, privatised, or completely closed. Moreover, Hungary lost its traditional export markets in the Soviet bloc. There was massive downsizing at defence firms, such as FÉG, Caspel Works and Diosgyor Works. Defence spending dropped from 2.5% in the Cold War to 1.1% by the late 1990s.[22]

Hungary Since 1991: The Development of a Modern Defence Techno-Industrial Base

Since the birth of the Republic of Hungary in 1991, Hungary's DTIB and cybersecurity postures has undergone a fundamental transformation from Soviet-aligned, state-run arms manufacturing to modernising, NATO-aligned security ecosystems. This has gone a long way, from beginning to modernise and integrate the Hungarian DIB, to the development of a FÉG compatible with 21st-century standards. There is an increasing focus on the complete-manufacturing of select complex systems (such as the Lynx Fighting Vehicle), dual-use technologies, cyber defence, operations and maintenance of integrated technology, and integration into European and Transatlantic defence initiatives. All of these advances will have important dual-use benefits synergies for the Hungarian economy.

During the transition period following the Soviet collapse (1991-1999), there was massive downsizing, defence spending dropped to 1.1% of GDP, and approximately 75% of defence manufacturing jobs were lost.

Fortunately, Hungary's accession to NATO brought needed changes, concentration of effort, joint ventures and design-sharing with the US and other NATO Partners, and a renewed interest in the PPP of government, business and technology, and academia, which are all prerequisites to a 21st century DTIB. This massive effort has included: the standardisation to NATO equipment and logistics regulations; the retirement of outdated Soviet-era hardware; the modernisation of weapons, radios, transport, air control systems, maintenance and training programmes; and a partial revival of the Hungarian aerospace industry in the select areas of helicopters with Airbus and drones with Israel's Uvision and others.

The most important initial developments involved joint NATO logistics, standardised NATO design and procurement, military servicing, and electronics subcontracting. Small and medium-sized domestic Hungarian firms began focusing on traditional Hungarian areas of excellence: advanced computing, electronics, design, optics, command and control, and simulations. Foreign partnerships and joint ventures developed with Rheinmetall, Airbus Helicopters, Saab, and Israel Aerospace.

Significantly, in his re-election campaign in 2010, President Orbán stressed the need to rebuild Hungary's armed forces, build an independent defence industrial base, and achieve strategic autonomy within the NATO structure. This culminated in the birth of the Defence and Armed Forces Development Program, aka Zrinyi 2026. Zrinyi 2026 was a government-sponsored ten-year military and defence-industrial modernisation programme to rebuild domestic defence production capabilities, increase defence spending to the then 2% NATO goal (it is projected to be 5% by the 2030s), improve mobility and training, produce select systems domestically in Hungary, and purchase from allies high-end NATO-compatible weapons (US NASAMA air defence and radar, Airbus helicopters, and German Leopard tanks).

Significant investments have included: the Hungarian co-production of the Lynx Infantry fighting Vehicle with Rheinmetall in Zalaegerszeg; production of composite components and helicopter parts with Airbus Hungary in Gyula; the modernisation of ammunition, optics, and production of drones with Rubin Zrt., HM Arzenal, and Uvision; and the production of radar and command and control systems with C4i Systems and Pro Patria Electronics.[23]

[22] Margit Foldesi, "The History of the Hungarian Defence Industry, 1945-1990" (Monograph) (Budapest: HM Zrinyi Kiado, 2022)

There has been related Hungarian progress in cyber security and cyber capabilities, which are essential to the protection of DTIB machines. In addition to joining NATO in 1999, Hungary's 2004 entry into the European Union brought compliance with the EU's Network and Information Security (NIS) Directive. Hungary approved a National Cybersecurity Strategy (2011), created a National Cybersecurity Center (NKI) (2013) for threat monitoring and incident coordination of critical infrastructure in energy, telecommunications, and finance, and joined NATO's Cooperative Cyber Defence Centre of Excellence (CCDCOE) (2015). As a result, Hungary now participates in NATO's Locked Shields and Cyber Coalition Exercises and the EU Cyber Rapid Response Teams, in addition to cross-border cooperation with the V4, Germany, Austria, and Israel. Additionaly, in 2021, the Hungarian Defense Forces Cyber Operations Command was established with offensive and defensive cyber warfare capacities, threat detection, and hardened command and control networks. There are now successful private sector companies such as Cyber Services Zrt, Balasys IT, and Black Cell, which specialise in cyber defence and are supported by prestigious Hungarian Universities, in Óbuda University and the Budapest University of Technology and Economics, which operate cyber security degree programmes and AI research labs.

[23] M. B. Taksas, "Hungary's Defence Industrial Strategy and Its Integration Into the European defence and Technological Base," (2024). See also, "Hungary Is Building a High-Tech Military," Remarks of Defence Minister Kristof Szalay-Bobrovinczky at The National Defence Day Celebration, Buda Castle, May 22, 2024.

Hungarian soldiers in front of the Ministry of Defence building, Budapest. (Shutterstock)

Concluding Recommendations

The story of Hungary and the US as each move toward a more complete DITB has similarities and differences for historical reasons, as well as economic size, research and development capacity, and resource allocation reasons. Yet, each has the same goals for its 21st century DTIB: protection of democracy, strong national security, and strategic autonomy. These goals are rooted in their NATO Alliance Memberships, joint ventures, strong national security needs, long-standing diplomatic relationships, and mutual desires for peace, prosperity and security.

The success of the respective Hungarian and US DTIB's is in the interest of each Hungary and the US, individually, for economic and security reasons. It is also in the interest of collective security for NATO and all Euripe- as the recent war in Ukraine has demonstrated.

For the US, the DTIB is at a national and international crossroads. It is a crossroads with industrial, business, technological, cybersecurity, and AI intersections. These intersections and junctions will require a multi-track approach to DIB revitalisation, prioritisation, and advancement by increasing the traditional DIB manufacturing base and supply chain and surge capacity resiliency and redundancy. It will also require 21st-century DTIB, cybersecurity, and AI leadership with allies and partners. This multi-track approach must include the hybrid public-private DIB and the newer DTIB. It must also seek new advantages, efficiencies, and integration from 21st-century technologies, including machine-learning, autonomy, natural language processing, advanced semiconductors, biotechnology, and AI, in a responsible manner.

For Hungary, the future of its still-developing DTIB is even more vital given security volatility in Ukraine, Eastern Europe, the Caucuses, and Central Asia. Hungary has taken significant steps since 1991 with democracy, free markets, private enterprise, and the revival of Hungary's enterprising spirit and intellectual minds. This, of course, includes the institutional building blocks of NATO Membership since 1991 and EU Memberships since 2004.

Hungary has made great progress since 1999 in moving toward NATO-aligned security ecosystems. There has been a focus on both traditional Hungarian areas of cultural excellence, such as advanced computing, design, optics, and command and control. There has been a focus on complete product manufacturing of select complex systems, such as the production of the Lynx Fighting Vehicle. There has also been an emphasis on joint ventures with European companies, such as Dynamit Nobel defence, Colt CZ Group, Airbus, and Uvision. This has helped to revive the Hungarian aerospace industry by manufacturing combat drones and significant parts of Airbus helicopters. In addition, cybersecurity technology is being integrated into command-and-control systems, infrastructure, and financial markets.

What remains is the need to develop further Hungary's 21st-century DTIB with additional private research and development spending, more government sponsored projects in advanced manufacturing and robotics, broader joint venture agreements and partnerships, and more private investment in open capital markets.

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