

POTENTIAL BARRIERS FOR MILITARY MODERNIZATION THROUGH TECHNOLOGY TRANSFER IN THE UPCOMING EUROPEAN REARMING EFFORTS

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Abstract: As of now Europe is on track to drastically boost military capabilities through modernizing and expanding their portfolio (Politico, 2025). The demand for new technologies is driving technology transfers between domestic and foreign defense enterprises—a goal pursued by many nations (Ankit, 2024). The global security landscape in the recent years has been increasingly marked by contradiction, uncertainty, and volatility, with unpredictable risks and threats (EEAS, 2023). Humanity is currently grappling with the negative consequences of globalization, encountering serious challenges and dangers. As a result, new military alliances are forming on the world stage (EDIDP, 2024), accompanied by the expansion of defense industries in various countries, underscoring the need for future transfers of military technology (Vergun, 2023). Additionally, most militaries must adopt a data-driven approach and embrace digital transformation to effectively respond to great power competition and prevail in larger-scale conflicts. However, some countries are experiencing manufacturing challenges in meeting national demand due to ongoing global conflicts and their reliance on foreign suppliers (GAO, 2024). One of NATO's (2023) three primary objectives for 2030 is to enhance understanding which, based on their strategic approach and involves "leveraging innovation and connectivity between Nations, Academia, and Industry." Currently, as the European Union plans to unveil €800bn to "rearm" their Ministries of Defense (The Guardian, 2025), technology transfer is essential not only to keep pace with new technologies but also to adapt proven products to achieve supply independence from foreign powers outside of the EU. This creates new opportunities for scientific exploration and debate, emphasizing the importance of this publication. The central research question is what constitutes technology transfer and how it can be effectively executed between defense industry enterprises to achieve military modernization. This study will examine the process of acquiring technology from foreign providers to identify potential barriers companies may encounter. The publication's goal is to investigate the theoretical foundations of technology transfer, with key factors identified as critical to a successful transfer: a clear definition of the transfer, transfer barriers, absorptive capacity, management stability, cultural influences, time frames and legal considerations. Future work will analyze the current state and challenges of technology transfer, along with strategic solutions for its effective implementation. Given the space constraints of this publication, the primary focus will be on the theoretical foundations, paving the way for a more detailed analysis in subsequent work.

Keywords: military modernization, transfer of technology, barriers of transfer;

1. PURPOSE

The topic of this paper was inspired by theoretically looking at a potential fictional European based private company wishing to make use of the present situation in Europe and further penetrate the market but as a supplier or absorber of technology. Due to the size limitations of this article the main focus will be at the barriers that could possibly arise in venture such as this. We will assume for the purposes of this article that the private company is a distinguished multi-functional infrastructural company with substantial market share in design, manufacturing, engineering and trade in military and civilian products based somewhere in Eastern Europe but a part of the EU. Discussing the "ReArm Europe" package in Brussels, Ursula von der Leyen (The Guardian, 2025) states: "This is a moment for Europe, and we are ready to step up." the proposals "could mobilize close to €800bn of defense expenditures for a safe and resilient Europe", she adds strengthening the point that Europe has become one of the world's most attractive markets for defense equipment producers. Furthermore, European Union nations have increasingly relied on foreign suppliers for their defense needs, with an estimated 63% of EU defense contracts awarded to U.S. companies from mid-2022 to mid-2023. Additionally, another 15% of defense orders were placed with suppliers outside the EU. This growing dependence has sparked concerns regarding Europe's strategic autonomy, as relying on external sources for critical military equipment introduces potential vulnerabilities. One of the key issues identified is the fragmented nature of European defense procurement, which can result in logistical challenges and inefficiencies. To mitigate these concerns, the EU has launched several initiatives, such as the European Defence Industry Reinforcement through Common Procurement Act (EDIRPA), which encourages collaborative defense spending and investment in domestic projects. The European Defence Industrial Strategy (EDIS) further aims to increase the proportion of defense procurement within the EU to 50% by 2030 and 60% by

2035. These actions reflect the EU's determination to strengthen its defense capabilities and reduce its reliance on foreign suppliers through enhanced collaboration and resource consolidation.

2. METHODOLOGY

The primary motivation for formulating the topic of this article in its current form was to examine the models and tools discussed in this study from both academic and practical perspectives, aiming to support relevant entities in their decision-making within a dynamic global security environment. As the research topic suggests, this paper focuses on military modernization, particularly in the context of acquiring new technologies and enhancing capabilities by integrating foreign technology into the military-industrial complex. To avoid any misunderstandings and to clarify the concept of Transfer of Technology (ToT) for readers unfamiliar with it, this paper will analyze its essence and briefly describe it from various angles. Additionally, the paper was developed with the goal of providing future readers with foundational knowledge on how to approach military modernization, particularly in terms of local production, to strengthen the defense capabilities of a country or strategic alliance such as EU/NATO. It explores theories on the rationale and process of technology transfer, offering readers guidelines on the steps required for effective implementation. While various techniques and models are considered, the paper also highlights the limitations in available public studies and empirical data, underscoring the importance and necessity of this topic. Secondary research serves as the main method of analysis, incorporating market reports, synthesizing existing research, and reviewing journals and studies related to military modernization, technology transfer, and related cultural and managerial challenges. The following chapters present findings based on secondary research and diverse perspectives on the discussed topics.

The research addresses the following seven sub-questions:

What is military modernization?

Why is military modernization essential for the European Union?

What is Transfer of Technology?

What factors influence the success of a Transfer of Technology?

How can the transfer be clearly defined?

What potential barriers an entity may face in this process?

3. RESULTS

Military modernization is a critical process for enhancing a nation's defense capabilities in response to evolving security challenges. Buzan (1987) highlights the dynamic between states' military advancements, domestic structures, and technological imperatives as key drivers of this process. The need for modernized weapon systems, which often increase lethality, is essential to ensure a military's effectiveness in both deterring adversaries in peacetime and defeating them in wartime. This article explores the multifaceted nature of military modernization, discussing its technological, organizational, and strategic dimensions, while addressing the challenges faced by nations, particularly within the European Union, in adapting to emerging defense needs. Buzan (1987) suggests that the arms dynamic and the process of military modernization are driven by three key factors: the action-reaction relationship between a state and its adversaries, the domestic structures within the state that may not always align with this dynamic, and the technological imperative that influences both elements. Given that the primary function of a military is to protect the state from external and existential threats, pursuing "modernized" weapons systems is both intuitive and necessary. Modernization typically refers to advancements in military technology, which often translate into increased lethality. Bernard (2020) notes that when a military organization embarks on a modernization program, it is expected that existing capabilities will be upgraded with more advanced systems. Central to this expectation is the notion that improved lethality, while not the sole purpose, is a critical factor for achieving enhanced strategic military effectiveness. It is widely accepted that military organizations are established to protect a nation's security. During peacetime, this is accomplished by deterring potential adversaries from engaging in conflict, whereas, in times of war, the military's role shifts to defeating those adversaries. These two goals are inherently linked: "The best way to prevent war is to be prepared to win one," making it essential to maintain a modernized defense industry. Future studies should aim to develop an optimal framework for military modernization, addressing the key questions that policymakers and military planners must consider when upgrading their country's military forces. According to the U.S. National Defense Strategy (2022), lethality is shaped by several critical factors. First, precision in sensing and targeting is crucial, as it allows forces to detect adversaries before being detected, enabling more accurate and effective strikes. This is particularly important considering the high costs associated with modern weaponry. Second, the integration of data linkages and bandwidths across air, land, and sea platforms is essential in the era of networked military operations, facilitating joint action and reducing inter-service competition. Third, survivability plays a key role, as more resilient weapons systems allow military

forces to maintain operational effectiveness even under threat, thereby sustaining a higher level of lethality. Lethality is crucial to both peacetime deterrence and wartime success. During peacetime, the military seeks to deter adversaries from initiating hostilities, while in wartime, it aims to defeat those adversaries and achieve strategic success. Goure (2018) describes military modernization as a process designed to close gaps in existing capabilities by introducing superior systems that are both more effective and cost-efficient. However, modernization extends beyond acquiring new equipment. As Vera Delzo (2019) points out, achieving enhanced military effectiveness requires integrating this new equipment with the appropriate organizational structure, operational concepts, tactics, command-and-control systems, and support infrastructure. Military modernization involves comprehensive changes across various dimensions, including doctrine, organization, training, leadership, personnel, facilities, and policy. Nevertheless, these changes are not as profound as those driven by military transformation, particularly regarding shifts in organizational culture. While scientific progress yields technological advancements that benefit humanity, it also introduces new security challenges. Modern states must confront these emerging threats by effectively leveraging all elements of national power. Consequently, military institutions are compelled to modernize or transform to adapt to new roles and technological advances, aligning their capabilities with the state's strategic objectives. According to Blakeney (1989), the transfer of technology (ToT) refers to the dissemination of commercial technology, involving the transfer of relevant knowledge from the provider to the recipient. The United Nations Conference on Trade and Development (UNCTAD) (1996, vol. I) defines technology as "systematic knowledge for the manufacture of a product, the application of a process, or the rendering of services," which includes entrepreneurial expertise and professional know-how (Santikarn, 1981). The Draft International Transfer of Technology Code (UNCTAD, 1996) lists various forms of ToT, including feasibility studies, technical expertise, engineering designs, and personnel training. Barrett and Sexton (1999) note that, whether based on explicit or tacit knowledge, some technologies are more complex than others, making them more difficult to transfer. Inter-organizational technology transfer, as discussed by Mowery, Oxley, and Silverman (1996), poses significant managerial challenges due to the complexity of transferring technological knowledge across organizational boundaries. For simplicity, Naito (1989) outlines four key elements in technology transfer: information, human resources, capital, and resources. Sung and Gibson (2000) further emphasize the importance of elements such as values, communication channels, common purpose, and incentives for successful ToT. Additionally, Baskaran (2004) highlights the impact of monitoring systems, management stability, and cultural factors on the success of ToT, especially in foreign markets. Baskaran argues that while some defense industries successfully transfer technology, others struggle to acquire sufficient skills to close the technological gap with more advanced nations. A common issue arises when technology transfers are less effective at the systems level compared to the component level, as suppliers often retain control over core technologies. Key considerations for successful technology transfer include a clear definition of the transfer process, absorptive and desorptive capacity, and the legal and managerial challenges involved. Absorptive capacity, as defined by Lichtenthaler (2010), refers to the military's ability to acquire and utilize external knowledge and skills. This concept, originally developed by Cohen and Levinthal (2001), emphasizes the importance of prior technological knowledge in successfully acquiring and integrating new technologies. NATO (2023) has noted that some of its members have long relied on foreign suppliers for military equipment, despite efforts to achieve self-sufficiency. Desorptive capacity, as explained by Lichtenthaler (2010), refers to an organization's ability to identify opportunities for technology transfer and facilitate the application of this technology within the recipient organization. This involves two stages: identifying transfer opportunities and executing the transfer. Davis and Harrison (2001) argue that misidentified transfer opportunities are a common reason for the failure of strategic alliances and licensing agreements. Once technology is developed, desorptive capacity incurs relatively limited additional costs (Rivette & Kline, 2000). The European Union faces several significant barriers to achieving military modernization. One of the primary challenges is budgetary constraints, as many EU member states are unable to allocate sufficient funds to defense due to competing financial priorities, such as social welfare programs. Additionally, aligning defense budgets with EU fiscal rules creates further difficulty in increasing military expenditure (Reuters, 2025). Another major issue is the EU's dependence on external defense suppliers, particularly from the U.S., which limits the EU's strategic autonomy in defense procurement. Efforts to shift procurement toward European suppliers have been ongoing but face resistance due to long-established relationships with foreign defense producers and concerns over costs (Associated Press, 2025). The decline in industrial capacity within Europe's defense sector also poses a significant barrier. As the defense manufacturing base in Europe has diminished, there are increasing concerns about the ability to produce sufficient quantities of advanced military equipment, such as tanks, artillery, and fighter jets, especially during periods of heightened demand (European Defense Agency, 2020). Moreover, there are diverse strategic priorities among EU member states. Different countries within the union have varying defense priorities and threat perceptions, making it challenging to develop a unified military modernization strategy. Achieving consensus among these nations requires

extensive coordination and compromises (Financial Times, 2025). Finally, technological and capability gaps between member states also hinder military modernization. Disparities in areas such as anti-aircraft defense systems, cyber capabilities, and precision strike technologies can limit the overall effectiveness of EU military forces, requiring substantial investment to close these gaps (European Defense Agency, 2020). In conclusion, the EU faces numerous barriers to military modernization, including budgetary restrictions, dependence on external suppliers, industrial limitations, varying strategic interests, and technological disparities. Overcoming these challenges requires coordinated efforts, strategic planning, and significant investment in defense capabilities.

4. DISCUSSIONS AND CONCLUSIONS

Based on the findings from the previous chapter, the European Union is progressing toward modernizing its defense manufacturing capabilities, which will require the involvement of foreign technology suppliers. The EU should aim to gain a competitive edge over other foreign manufacturers by increasing financial returns through either co-production or receiving annual royalties for transferred know-how, while also enhancing their absorptive capacity. For a private company to successfully engage in this process, it is essential to focus on key elements such as clearly defining the transfer process, absorptive capacity, desorptive capacity, technology transfer barriers, management stability, and cultural factors. These factors were selected after a thorough review of existing studies on technology transfer and cross-referencing with interviews, ensuring that the study is designed in the most suitable way for the company. Some factors were also discussed under broader global sections in the study, but the final selection remains practical and objective. The absorptive capacity is a critical element for acquiring and utilizing external knowledge and skills. Gilbert and Cordey-Hayes (1996) developed a model that tracks the stages of knowledge transfer within an organization, ultimately leading to the development of routines embedded in the behavior and practices of employees. This process, referred to as assimilation, includes stages such as “acquisition” of knowledge, “communication,” “application,” and “assimilation” of the transferred knowledge. The emphasis lies on the transfer process itself, particularly the assimilation of results and the application of the acquired know-how. Malik (2001) suggests that a useful analogy for the transfer process is broadcasting, where the transmitters are responsible for disseminating relevant technological information. In this context, the role of transmitters is to effectively communicate the technology’s characteristics. Furthermore, Levin (1997) highlights that one of the major management challenges in technology transfer is using the process as a means to foster a learning environment. The technology transfer process involves establishing key relationships, transferring information to the appropriate organizational levels, and delivering the necessary know-how, which can then be integrated into routine practices for educating the targeted employees. In conclusion, military modernization is essential for ensuring national security, as it enables states to adapt to evolving threats and technological advancements. The process involves not only upgrading weapon systems for increased lethality but also integrating new technologies within the military’s organizational and operational frameworks. While technological advancements are critical for improving military effectiveness, challenges such as budgetary constraints, reliance on external suppliers, and disparities in technological capabilities pose significant barriers to modernization, particularly within the European Union. Addressing these issues requires strategic coordination, investment in defense capabilities, and fostering self-sufficiency in military procurement to enhance the overall effectiveness of defense forces.

REFERENCES:

- Ankit, K. (2024). Indian Army's year of technological advancement in 2024. ORF. Retrieved from <https://www.orfonline.org/expert-speak/indian-army-s-year-of-technological-advancement-in-2024>
- Army Digital Transformation Strategy. (2021). Headquarters, Department of the US Army. Retrieved from <https://api.army.mil/e2/c/downloads/2021/10/20/3b64248b/army-digital-transformation-strategy.pdf>
- Barrett, P., & Sexton, M. (1999). The transmission of out-of-industry knowledge into pharmaceutical industry wisdom. In *Linking pharmaceutical research and innovation in other sectors*, Pharmaceutical Research and Innovation Strategy Panel. London.
- Barrett, P., & Sexton, M. (2003). A literature synthesis of innovation in small construction firms: Insights, ambiguities, and questions. *The Technology Transfer System*.
- Buzan, B. (1987). An introduction to strategic studies: Military technology and international politics. *Studies in International Security (SIS)*.
- Loo, B. F. W. (2020). The challenges facing 21st-century military modernization. National Defense University Press. Retrieved from <https://ndupress.ndu.edu/Media/News/News-Article-View/Article/2054165/the-challenges-facing-21st-century-military-modernization/>
- Blakeney, M. (1989). *Legal aspects of technology transfer to developing countries*. Oxford: ESC Publishing.

- Cohen, W., & Levinthal, D. (2001). Knowledge transfer in intraorganizational networks: Effects of network position and absorptive capacity on business unit innovation and performance. *Academy of Management Journal*, 44(5), 996-1004.
- Commission Regulation (EC) No 772/2004 of 27 April 2004 on the application of Article 81(3) of the Treaty to categories of technology transfer agreements. Article 1.
- Gouré, D. (2018, October 4). Winning future wars: Modernization and a 21st century defense industrial base. The Heritage Foundation. Retrieved from <https://www.heritage.org/military-strength/topical-essays/winning-future-wars-modernization-and-21st-century-defense>
- Davis, J. L., & Harrison, S. S. (2001). *Edison in the boardroom: How leading companies realize value from their intellectual assets*. John Wiley & Sons.
- Defense News. (2024, September 9). EU buys too much defense equipment abroad, especially from the U.S., report says. Defense News. Retrieved from <https://www.defensenews.com/global/europe/2024/09/09/eu-buys-too-much-defense-equipment-abroad-especially-from-us-report/>
- Defence Industry. (2024, September 8). EU's reliance on foreign defense equipment and lack of investment in joint military projects highlighted. Defence Industry News. Retrieved from <https://defence-industry.eu/eus-reliance-on-foreign-defence-equipment-and-lack-of-investment-in-joint-military-projects-highlighted-in-draghis-report/>
- European Defence Industrial Development Programme. (2024). European Commission. Retrieved from https://defence-industry-space.ec.europa.eu/eu-defence-industry/european-defence-industrial-development-programme-edidp_en
- Gilbert, M., & Cordey-Hayes, M. (1996). Understanding the process of knowledge transfer to achieve successful technological innovation. *Technovation*, 16(6), 301–312.
- Kamara, H. M. (2023). Tenets of army modernization. Association of United States Army. Retrieved from <https://www.ausa.org/publications/tenets-army-modernization>
- Lichtenthaler, E. (2009). Absorptive capacity, environmental turbulence, and the complementarity of organizational learning processes. *Academy of Management Journal*, 52(4), 822-846.
- Levin, M. (1997). Technology transfer is organizational development: An investigation into the relationship between technology transfer and organizational change. *International Journal of Technology Management*, 14(2-4), 297–308.
- Strategic Communication Editorial Team. (2023). EU peace, security and defence. European External Action Service. Retrieved from https://www.eeas.europa.eu/taxonomy/term/400164_en
- Santikarn, M. (1981). *Technology transfer*. Singapore: Singapore University Press.
- Sung, T. K., & Gibson, D. V. (2000). Knowledge and technology transfer: Levels and key factors. Proceedings of the 4th International Conference on Technology Policy and Innovation, Brazil, August.
- The Guardian. (2025, March 4). EU chief unveils €800bn plan to 'rearm' Europe. The Guardian. Retrieved from https://www.theguardian.com/world/2025/mar/04/eu-plan-to-bolster-europes-defences-could-raise-800bn-for-ukraine?utm_source=chatgpt.com
- Delzo, P. E. V. (2019). *Peruvian army, military transformation, effort and institutional commitment*. Army University Press. Retrieved from <https://www.armyupress.army.mil/Journals/Military-Review/English-Edition-Archives/November-December-2019/Delzo-Military-Transformation/>
- Politico. (2025, March 11). EU considers giving countries wiggle room to boost defense spending. Politico. Retrieved from <https://www.politico.eu/article/eu-commission-expanding-definition-defense-spending/>
- Rivette, K. G., & Kline, D. (2000). *Rembrandts in the attic: Unlocking the hidden value of patents*. Harvard Business School Press.
- Mowery, D. C., Oxley, J. E., & Silverman, B. S. (1996). Strategic alliances and interfirm knowledge transfer. *Strategic Management Journal*, 17, 77-91.
- Vergun, D. (2023). DOD modernization relies on rapidly leveraging commercial technology. Defense.gov. Retrieved from <https://www.defense.gov/News/News-Stories/Article/Article/3277453/dod-modernization-relies-on-rapidly-leveraging-commercial-technology/>
- U.S. Government Accountability Office. (2024). *Army modernization: Actions needed to support fielding new equipment*. GAO. Retrieved from <https://www.gao.gov/products/gao-24-107566>
- NATO. (2023). Ongoing military transformation, leading to NATO 2030 – Multi-domain operations, deterrence and defence, improved understanding. NATO ACT. Retrieved from <https://www.act.nato.int/article/ongoing-military-transformation-leading-to-nato-2030-multi-domain-operations-deterrence-and-defence-improved-understanding/>

- France24. (2024, September 9). The EU buys too much defense equipment from abroad, report says. France24. Retrieved from <https://www.france24.com/en/europe/20240909-the-eu-buys-too-much-defence-equipment-from-abroad-report-says>
- ASD Europe. (2024, September 9). The costs of relying on non-European defense suppliers. ASD Europe. Retrieved from <https://www.asd-europe.org/our-industry/defence/the-costs-of-relying-on-non-european-defence-suppliers>
- Associated Press. (2025, March 11). EU chief says member countries must use a new defense loan to buy European, not American. Associated Press. Retrieved from <https://apnews.com/article/8cbd54ba81c086aa8e47ea3a0971febb>
- Financial Times. (2025, March 8). Why Poland is still pushing for more EU-wide defense funding ideas. Financial Times. Retrieved from <https://www.ft.com/content/97e1d8ed-8fd6-4919-99d4-9ddf1a47f623>
- Reuters. (2025, March 11). EU ministers explore ways to spend on defense without breaking EU rules. Reuters. Retrieved from <https://www.reuters.com/world/europe/eu-ministers-explore-ways-spend-defence-without-breaking-eu-rules-2025-03-11/>