



THESSISMUN



Study Guide

NATO

North Atlantic Council



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1. Welcoming Letter

Distinguished Delegates,

On behalf of the board members, it is with great pleasure that we extend a warm and sincere welcome to all the delegates that will participate in the North Atlantic Council of ThessISMUN2025. In this year's NATO Simulation, you will embark on a challenging and insightful journey addressing one of the most critical issues facing the alliance today: *Resilience and Supply Chain Security*. In today's globalised world, disruptions to supply chains can have wide-ranging impacts on national and international security, making the task before you as important as it is complex. We are thrilled to see bright, engaged minds ready to tackle these pressing issues through collaboration, strategic thinking, and diplomacy.

This year's topic on resilience and supply chain security brings together multifaceted issues that demand a multi-dimensional approach. Whether considering the implications of cyberattacks on communication networks, natural disasters impacting logistical routes, or dependencies on non-allied states for critical materials, you will need to balance immediate responses with long-term resilience-building strategies. In recent years, NATO has increasingly prioritised resilience to ensure operational continuity, particularly in sectors like transportation, energy, and digital communications. As delegates, your insights and proposals will contribute to ongoing discussions about how NATO can reinforce its capacities and reduce vulnerabilities in this crucial area.

In this simulation, you will find yourself engaging in intense negotiations, policy debates, and strategy sessions. We encourage you to explore how traditional and emerging threats to supply chains impact not just the security of individual nations but the collective security of the alliance. Remember that in this arena, no one country can succeed in isolation. Effective collaboration, mutual understanding, and adaptability are paramount. We are confident that your participation will bring new perspectives to light, fostering an environment where bold ideas can lead to impactful, practical solutions.



This Study Guide is aimed to shed some light at the complex dynamics within and outside of the alliance. It is important to keep in mind that this paper is designed only to guide and assist the delegates in their journey of understanding the topic area, their country's policies on the matter and the possible solutions and steps that need to be taken in order to further enhance NATO's resilience and supply chain security. Hence the delegates are strongly advised to conduct their research on their country's interests, policies and views using this study guide, precisely as guide, helping them navigate through information presented.

Over the simulation, you'll take part in dynamic sessions where creativity, adaptability, and teamwork will be essential. We hope you'll come away from this experience with not only new insights into supply chain security but also a greater appreciation for the challenges and rewards of international collaboration. It's our sincere hope that this simulation will inspire you, as future leaders, to think deeply about resilience, diplomacy, and the critical role of partnerships in today's interconnected world.

Kind Regards,

The board of the North Atlantic Council,

Charisis-Daldogiannis Orfeas, *Secretary General*

Ioanna Maria Varotsi, *Deputy Secretary General*



2. Introduction to the Committee.

The North Atlantic Treaty Organisation (NATO) was founded, in 1949, as the cornerstone of defence of the Western Allies against the Soviet Aggression during the Cold War. A political and defensive military alliance, NATO's primary goal is the collective defence of its member states by providing the military and diplomatic means guaranteeing their freedom and security.

Today the Alliance consists of 32 member states, with the newest being the Scandinavian states, Finland and Sweden, joining in 2023 and 2024 respectively. After the fall of the U.S.S.R. in 1991, NATO sought to open its doors to the states outside of Europe and expand. By 1994, the Clinton¹ Administration had put forward the NATO Initiative Partnership for Peace and NATO's expansion began a few years later.

As the decades passed NATO faced multiple threats to its existence but has pushed through, proving to be a durable and important international alliance. The North Atlantic Treaty Organisation has also evolved significantly from the time of its conception. The Alliance now stands as something greater than a collective effort for defence of the few. NATO has grown to be an important political, alongside military, alliance overtaking multiple crisis-management operations around the globe in cooperation with the UN and other international organisations. The main political objective of the Alliance is the promotion of democratic values, trust-building operations and long-term conflict prevention. While NATO remains deeply committed to the peaceful resolution of conflict, it has the power to undertake crisis-management operations under Article 5 of the Washington Treaty, falling under the collective defence principle.

¹ Jonathan Masters, "What Is NATO?," Council on Foreign Relations, May 4, 2022, <https://www.cfr.org/background/what-nato>.



The very essence of the Alliance can be found behind the principle of collective defence. The meaning of the principle is translated to “*an attack against one or several of its members is considered as an attack against all.*”² The principle of collective defence is enshrined in Article 5 of the Washington Treaty and has only been invoked once, after the 9/11 attack of 2001.

The North Atlantic Treaty Organisation poses an important transatlantic link between the countries of North America and Europe. Its existence allows for the two continents to consult and cooperate in the field of defence and security and conduct multinational crisis-management operations together.

As for its structure, NATO has its headquarters in Brussels, and its main decision-making body is the North Atlantic Council. Each member country has a seat at the NAC. It meets at least once a week or whenever the need arises, at different levels. It is chaired by the Secretary General, who helps members reach agreement on key issues. The decision-making procedure during the meetings of NAC requires unanimity. NATO’s military structure comprises two strategic commands: the Supreme Headquarters Allied Powers Europe, located near Mons, Belgium, and the Allied Command Transformation, located in Norfolk, Virginia. All NATO military operations are overseen by the Supreme Allied Commander Europe.

The core tasks and principles of the Alliance are laid down in a Strategic Concept which is adopted by the NAC. A Strategic Concept is a key document that reaffirms NATO’s values and purpose, assesses the security environment and guides NATO’s approach to the threats, challenges and opportunities ahead. As for the latest adoption of the Strategic Concept 2022, NATO’s fundamental objective is to safeguard its members’ collective defence through a 360-

² NATO, “What Is NATO?,” NATO, 2023, <https://www.nato.int/nato-welcome/>.



degree strategy. Its three main tasks are cooperative security, crisis prevention and management, and deterrence and defence³.

3. Introduction to the Topic Area

In today's increasingly interconnected and unpredictable global landscape, NATO's resilience and the security of its supply chains is gradually recognized as a fundamental aspect of the alliance's security⁴. The security of NATO's supply chains ensures that the alliance is adequately equipped to face a crisis in a moment's notice. Disruptions in the supply chain may have devastating results for NATO's ability to provide security to its members. Hence it is crucial to ensure that the supply chains remain protected and operational at all times, as the ability of the alliance to realise its goal and ensure collective defence may as well be dependent on the operational effectiveness of its supply chains. The latest global developments, namely the COVID-19 pandemic and the Russian Invasion of Ukraine, have underscored the chronic vulnerabilities in the alliance's supply chain. Notably, NATO has struggled to rearm Ukraine, to line up training and equipment deliveries, to mitigate duplicate and missing deliveries, track information from providers, and to deter Russian hacking⁵. These events have highlighted how fragile supply chains can impact military readiness, economic stability, and even political cohesion among allied nations.

At its core, supply chain resilience for NATO involves having reliable access to essential resources, such as fuel, medical supplies, ammunition, and advanced technology, during both peacetime and crisis situations. For NATO to meet its requirements in supplies, reliance on

³ NATO, "Strategic Concept Adopted by Heads of State and Government at the NATO Summit in Madrid" (NATO, June 29, 2022), https://www.nato.int/nato_static_fl2014/assets/pdf/2022/6/pdf/290622-strategic-concept.pdf.

⁴ Sinziana Iancu, "NATO's RESILIENCE CONCERNS," *Annals – Series on Military Sciences* 16, no. 1 (2024): 46–62, <https://www.ceeol.com/search/article-detail?id=1248451>.

⁵ Emili Sabanovic, "Could Blockchain Help NATO's Supply Chain?," CEPA, November 20, 2023, <https://cepa.org/article/could-blockchain-help-natos-supply-chain/>.



complex international trade routes and supply chain pathways is essential. That very fact, however, is what makes the supply chains vulnerable to third factor disruptions. In an environment where adversaries can exploit these dependencies through economic leverage, cyberattacks, or direct disruptions, an environment where climate change is continuously posing an imminent danger⁶, NATO's ability to ensure a secure, redundant, and adaptable supply chain becomes vital⁷.

Moreover, the concept of resilience extends beyond just the physical flow of goods. It includes a secure, technology-enhanced logistics infrastructure, collaborative procurement and intelligence-sharing mechanisms among member states, and a proactive approach to anticipating and mitigating emerging risks. NATO's focus on resilience is not just about mitigating the different threats it faces but also strengthening the alliance's capacities in the pre-disruption, during-disruption and after-disruption⁸ phases of possible interferences in the supply chains. The capability of the alliance to protect and secure its supply chains is synonymous with its capacity to maintain a status of continuous operational readiness.

With the global expansion of the alliance and the forward position in the international scene, NATO, now more than ever, needs to address the vulnerabilities of its supply chains and focus on the resilience of its operational capabilities. Modern military operations often require rapid deployments to distant theatres, where secure logistics and reliable access to resources are essential for success. For instance, NATO's missions in Afghanistan, Iraq, and the broader Middle East demonstrated the need for robust supply chains capable of supporting troops in

⁶ Anum Farhan, Signe Kossmann, and Armida Van Rij, "Preparing NATO for Climate-Related Security Challenges Environment and Society Programme International Security Programme," 2023, <https://www.chathamhouse.org/sites/default/files/2023-09/2023-07-05-preparing-nato-climate-security-challenges-farhan-et-al.pdf>.

⁷ Grala, Dariusz. "Resilience of military supply chains." In *Digital Synergy*, pp. 257-263. CRC Press, 2024.

⁸ Ekström, Thomas. "Towards Defence Supply Chain Resilience—A Prestudy of the Swedish Defence Sector." In *NATO STO review*. 2023.



remote and hostile environments. These operations also highlighted the complexities of coordinating logistics across diverse terrains and with multinational forces.

The assessment of the risks and vulnerabilities of NATO's supply chains and the immediate redevelopment with the goal of securing such pathways is of utmost importance to the future of the alliance as a global organisation as well as a provider of defence to its member states. As NATO's global responsibilities expand, addressing supply chain vulnerabilities is crucial to safeguarding the alliance's deterrence capabilities, supporting its strategic goals, and ensuring that NATO is equipped to face the security challenges of the future.

4. Key Terms.

4.1. Resilience

Resilience is the ability of systems, nations, or organizations to absorb, adapt, and recover from shocks or disruptions. In NATO, resilience involves staff and military systems, including logistics and energy networks, communication, and cybersecurity infrastructure. Resilient systems absorb a sudden shock, change to reduce damage done, and recover in a timely fashion to restore function. Resilience is critical in ensuring operational continuity during crisis situations caused by natural disasters, economic turmoil, cyberattacks, or geopolitical instability. NATO's resilience policies have focused on member states' collaboration to identify vulnerabilities and create robust contingency measures to protect supply chains and critical infrastructure.

4.2. Supply Chain Security

Supply chain security is the protection of networks and systems that facilitate the manufacture, shipment, and distribution of necessities. NATO sees this operationally in terms of protecting resources, such as energy supplies, military hardware, food, and medical logistics, highly crucial to defence capabilities. A secure supply chain enables uninterrupted performance of NATO operations and stability of the societies from sudden disruptions, be it from trade



restrictions, geopolitical unrest, or cyber-attacks. Supply chain security involves redundancy in the establishment of alternate supply channels to ensure backup systems and variety as the preference between similar alternatives.

4.3. Critical Infrastructure

Critical infrastructure is the set of digital and physical systems needed for economies and societies to function. Examples include transportation networks, electric power distribution networks, medical providers, and communication networks. Cyber resilience is the skill to guess resist and recover from online attacks is called cyber resilience. Supply chains are open to big online dangers like ransomware data leaks and hacking tries due to their growing use of digital tools.

4.4. Security of Energy

Energy security refers to the uninterrupted and sustainable supplies of energy like fuel, oil, natural gas, and electricity. The key to NATO's energy security strategy is the protection of essential infrastructure and the reduction of dependence on unreliable suppliers or regions.

4.5. Critical Raw Materials (CRM)

Critical raw materials are unfavorable because, although their development is needed for advanced manufacturing, defense systems, and scientific progress, they pose a unique challenge operationally. They include semiconductors and rare earth element m materials, such as cobalt and lithium, which are crucial in the manufacture of communication devices and radar systems.

4.6. Hybrid Threats

Hybrid threats are threats combining traditional and non-traditional approaches, including cyber threats, information warfare, economic coercion, and physical sabotage. Their aim is to weaken security, undermine partnerships, and destabilize societies. NATO considers



infrastructure or logistical-related assaults a serious threat to supplychain security should such attacks undermine military readiness or delay important delivery. ROTC and business, technology, and military cooperation will ensure that comprehensive defense plans are developed to counter hybrid threats.

5. Legal Framework

The legal framework surrounding the security of NATO's supply chain and resilience is deeply enshrined in the North Atlantic Treaty, the foundational treaties of the alliance, international law and the various interstate agreements of its member states. These frameworks provide the cornerstone of cooperation between NATO's member states, the allocation of responsibilities and resources, the methodology and the enforcement of security measures to ensure that supply chains supporting NATO's missions are robust and resilient against disruptions.

The North Atlantic Treaty, Article 3: Article 3 of the Treaty, calls upon the allies to “*separately and jointly, by means of continuous and effective self-help and mutual aid, will maintain and develop their individual and collective capacity to resist armed attack.*”⁹. In essence this means that allies are to build the essential resilience and frameworks in order to be able to counter possible attacks from third parties, hence providing collective defence to the alliance as a whole. The implementation of Article 3, namely the national resilience, comes in the form of developing military capacities, burden-sharing and interoperability¹⁰. Under the same prism, the Article embodies the importance of Civil readiness and the role of the private sector in building resilience. Article 3 provides also the basis for NATO's cooperation with industry, international organisations, and partner nations¹¹.

⁹ North Atlantic Treaty, supra note 2, art. 3.

¹⁰ Matjaž Kačič, “Commentary on Articles 2 and 3 of the Washington Treaty COMMENTARY on ARTICLES 2 and 3 of the WASHINGTON TREATY †,” 2019, <https://scholarlycommons.law.emory.edu/cgi/viewcontent.cgi?article=1223&context=eilr>.

¹¹ Christian Tuschhoff, “Why NATO Is Still Relevant,” *International Politics* 40, no. 1 (March 2003): 101–20, <https://doi.org/10.1057/palgrave.ip.8800007>.



The North Atlantic Treaty, Article 5: The very existence of the alliance is expressed through the Article 5 of the Washington Treaty (the North Atlantic Treaty), through which the member states agree that “*an armed attack against one or more of them shall be considered an attack against them all*”¹². Any action constituting an attack gives the right to member states to activate the principle of collective defence, as recognized under Article 51 of the UN Charter, citing cause of self-defence. Article 5 was invoked for the first time in 2001 after the terrorist attack of 9/11. It has not been invoked ever since. It is important to note that for NAC to invoke Article 5 there are a few conditions that must be met beforehand. Most notably, the attack on a member state must be considered armed, carried out in a geographical area of a member’s state sovereignty and that the source of the attack is evidently located outside of the country¹³.

Baseline Requirements for Resilience (2016):As aforementioned NATO has categorised resilience as the cornerstone of its success in providing adequate security for its members. In 2016 during the Warsaw Summit, NAC issued the Warsaw Summit Communique, in which the Baseline Requirements for Resilience were introduced¹⁴. The BRR aim to ensure the alliance’s resilience with respect to the¹⁵:

- Assured continuity of Government and Critical services
- Energy security
- Civilian telecommunications systems
- Food and water resources

¹² David G. Haglund, “NATO | Founders, Members, & History,” in *Encyclopædia Britannica*, 2019, <https://www.britannica.com/topic/North-Atlantic-Treaty-Organization>.

¹³ Sebastian Clapp and Anne Verhelst, “Author: Sebastian Clapp with Anne Verhelst, Members’ Research Service PE 739,” December 2022, [https://www.europarl.europa.eu/RegData/etudes/ATAG/2022/739250/EPRS_ATA\(2022\)739250_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/ATAG/2022/739250/EPRS_ATA(2022)739250_EN.pdf).

¹⁴ NATO, “Warsaw Summit Communiqué - Issued by the Heads of State and Government Participating in the Meeting of the North Atlantic Council in Warsaw, 8-9 July 2016,” NATO, July 9, 2016, https://www.nato.int/cps/en/natohq/official_texts_133169.htm.

¹⁵ Tatjana Gerginova, “BUILDING RESILIENCE – the NATO and EUROPEAN UNION APPROACH TO BUILDING RESILIENCE,” *International Scientific Conference* 8, no. 1 (September 22, 2023): 27–40, <https://doi.org/10.20544/icp.8.1.23.p03>.



- Transportation Systems
- Health systems
- Civil preparedness

In 2021, with the Brussels Communique, the alliance adopted a strengthened resilience commitment. With the Communique now NATO would monitor and evaluate the progress of its members states towards achieving continuous resilience¹⁶.

International and National Laws: NATO's supply chains, depending on their nature can follow under various international law treaties or national constitutions. For example, the alliance is dependent on third parties for its supply through trade routes. These trade routes fall under international trade laws and agreements, such as those of the WTO. For instance, as NATO is often dependent on adversaries that can be influenced, it is probable for the alliance to find itself in need of restricting trade in certain sectors. That exact right can be found in Article 21 of the GATT, which can be invoked in cases of national security¹⁷.

Under the same prism the alliance can find itself in situations where Status of Forces Agreements (SOFAs) and Host Nation Support Agreements, which govern the movement and storage of supplies, may go against the individual states constitution. The same can be said in instances of cybersecurity needs where the alliance has to adhere to standards like the General Data Protection Regulation (GDPR) for protecting sensitive information.

In conclusion, NATO has to collaborate with member states in order to comply with treaties enforcing international law, as well as the individual member state's national laws, ensuring that the alliance as a whole comply with the rule of law.

¹⁶ NATO, "Brussels Summit Communiqué Issued by the Heads of State and Government Participating in the Meeting of the North Atlantic Council in Brussels 14 June 2021," NATO, June 14, 2021, https://www.nato.int/cps/en/natohq/news_185000.htm.

¹⁷ World Trade Organisation, "WTO Analytical Index: GATT 1994," *WTO Analytical Index: GATT 1994*, September 30, 2024, <https://doi.org/10.30875/0000709a-en>.



6. Main Topic Area

NATO can only credibly deter adversaries and defend the Alliance's population and territory if it is resilient¹⁸. The alliance has been deeply committed to remaining resilient throughout the ever-changing international board. But what exactly does being resilient mean?

In the context of the North Atlantic Alliance, being resilient refers, to the capacity of NATO, collectively and individually, to prepare, to deter, to counter, to respond and to quickly recover from threats all across the spectrum and geographical points on the map¹⁹. Simply put, resilience for NATO is the ability to be able to respond to attacks anywhere on its sovereignty swiftly and effectively but also the ability to recover operational capacity when disrupted and/or damage has been inflicted. Resilience is fundamental to NATO's collective defense framework, enabling member states to withstand, adapt to, and recover from crises. It encompasses the ability to maintain critical societal functions, infrastructure, and operations during periods of stress, including natural disasters, cyberattacks, and armed conflict. NATO's 2016 Baseline Requirements for Resilience outline seven critical areas for member states, ranging from energy security to civil preparedness, ensuring that nations are capable of sustaining essential functions in any scenario²⁰.

Under the prism of the global reach of NATO and its commitment to remaining resilient one must wonder how can the alliance achieve this level of operational readiness of that scale. One of the most important aspects of it is the supply chains. Supply chains, in short, are the

¹⁸ Paolo Giordano, "Resilience in NATO - NATO's ACT," NATO's ACT, December 15, 2023, <https://www.act.nato.int/article/resilience-in-nato/>.

¹⁹ Jan Hodicky et al., "Dynamic Modeling for Resilience Measurement: NATO Resilience Decision Support Model," *Applied Sciences* 10, no. 8 (April 11, 2020): 2639, <https://doi.org/10.3390/app10082639>.

²⁰ Guillaume LASCONJARIAS, "DETERRENCE through RESILIENCE NATO, the NATIONS and the CHALLENGES of BEING PREPARED," *Romanian Military Thinking*, no. 3 (2018): 46–57, <https://www.ceeol.com/search/article-detail?id=1243238>.



interconnected routes that provide the ultimate customer, in this case NATO, with critical and essential goods²¹. Global supply chains underpin NATO's ability to operate effectively, supplying member states with critical resources, military equipment, and technological components. Supply chains engulf not only the essential physical equipment, but also the movements of personnel and the flow of information.

That being said, supply chains, by definition, involve a plethora of players while also spanning in vast geographical locations. These embedded characteristics make them extremely vulnerable to third party interferences and disturbances. For NATO to be truly a resilient military defence alliance, the security of its supply chains is a prominent matter to be attended and investigated. The alliance remains committed to realizing the goals of a resilient NATO and in the 2024 Washington Summit reiterated the importance of securing its supply chains and critical infrastructure²².

6.1. Strategic Importance of Supply Chain Security

As aforementioned supply chains are the backbones of the operational readiness of the alliance and hence its ability to protect. For NATO, their strategic importance lies in their role in ensuring the uninterrupted flow of resources, equipment, and information required for defense, crisis response, and humanitarian operations. In the context of an increasingly interconnected and competitive world, securing these supply chains is critical to maintaining NATO's strategic edge and operational integrity.

²¹ Houlihan, John B. "International supply chain management." *International journal of physical distribution & materials management* 15, no. 1 (1985): 22-38.

²² NATO, "Washington Summit Declaration Issued by the Heads of State and Government Participating in the Meeting of the North Atlantic Council in Washington, D.C. 10 July 2024," NATO, July 10, 2024, https://www.nato.int/cps/en/natohq/official_texts_227678.htm.



The strategic importance of these supply chains stretches from the military operational readiness of NATO to its ability to secure its member states' civilian population and economies²³. Under the military prism, supply chains are vital for the timely delivery of military assets, including fuel, ammunition, spare parts, and advanced technologies. In modern conflicts, the ability to sustain operations often hinges on the resilience of these supply chains. Any disruption—whether from logistical challenges, cyberattacks, or geopolitical interference—can hinder NATO's ability to respond rapidly to emerging threats. The scale of its importance was clearly highlighted and measured during NATO's ISAF mission. NATO assumed operational control of the UN mandated ISAF in Afghanistan on 11 August 2003²⁴. ISAF was the first large-scale expeditionary mission that the alliance undertook. The vast rocky landscape of Afghanistan is extremely difficult to navigate and cross. That being said, the NATO logistical operation and operational frameworks were, to say the least, immature²⁵. One of the greatest examples that highlighted the importance of secure supply chains and the resilience of the alliance are the missions of the ISAF Fuel Team. During the mission in Afghanistan NATO's forces needed close to four million litres of fuel to support its operations. The inability of the alliance to establish a robust and concrete supply chain, both due to political reasons and third parties, hindered the mission significantly. Navigating the hostile territory of Afghanistan was by itself a complex and dangerous task, however the lack of timely delivered assets, such as fuel, personnel and essential medical supplies, along with the severed flow of information minimized the chances of success of the allied operations.

²³ Jesse M Keenan et al., "The Role of Science in Resilience Planning for Military-Civilian Domains in the U.S. And NATO," *Defence Studies*, June 21, 2024, 1–32, <https://doi.org/10.1080/14702436.2024.2365218>.

²⁴ NATO, "ISAF's Mission in Afghanistan (2001-2014) (Archived)," NATO, May 30, 2022, https://www.nato.int/cps/en/natohq/topics_69366.htm.

²⁵ Carol Evans et al., "Enabling NATO's Collective Defense: Critical Infrastructure Enabling NATO's Collective Defense: Critical Infrastructure Security and Resiliency (NATO COE-DAT Handbook 1) Security and Resiliency (NATO COE-DAT Handbook 1) Part of the Defense and Security Studies Commons, International Relations Commons, and the Terrorism Studies Commons," November 15, 2022, <https://www.coedat.nato.int/publication/researches/12-Enabling%20NATO%20s%20Collective%20Defense%20Critical%20Infrastructure%20Secur.pdf>.



The ISAF mission, however, has taught the alliance countless lessons in the field of logistics. Ever since 2003, NAC has been affirming and updating NATO's frameworks regularly, with the main focus being the continuous operational capacity and a resilient alliance.

6.2. Risk Assessment and Vulnerability Analysis

It should be clear by now that for NATO to achieve its goals of resilience and continuous operational capacity, it is imperative for the alliance to secure its supply chains. At this time, however, "supply chain resilience" does not have a widely accepted definition and hence methodology of efficiently securing these lines²⁶. Be that as it may, due to the extreme globalization of the supply chains in recent years, there has been an influx of papers regarding supply chain security²⁷. The interstate complexity and interconnectivity of supply chains, along with the pairing of the private sector around the globe, has left them exposed to a plethora of threats. The allied supply chains are no exception to the global trends. NATO has various factors to fend off. Geopolitical tensions, dependency, hybrid threats, cyber threats could all have catastrophic results for NATO's operational capacity.

NATO faces a long list of vulnerabilities of its supply chains. Most importantly, however, there are a few that stand out and should be highlighted. A prominent lesson learned from the Russian invasion of Ukraine, is the effects of heavy dependencies on parties not members of the alliance for its members. Essentially, the European members of NATO were, and still are, heavily reliant on Russia for their energy needs. Russia used the dependency to create waves of uncertainty towards European economies which contributed significantly to inflation, political instability and evidently the shift of the European political environment. NATO relies heavily

²⁶ Ekström, Thomas. "Towards Defence Supply Chain Resilience—A Prestudy of the Swedish Defence Sector." In *NATO STO review*. 2023.

²⁷ Pires Ribeiro, J. and Barbosa-Povoa, A. Supply chain resilience: Definitions and quantitative modelling approaches – A literature review. *Computers & Industrial Engineering*, (115) 109-122. 2018. Pires Ribeiro, J. and Barbosa-Povoa, A. Supply chain resilience: Definitions and quantitative modelling approaches – A literature review. *Computers & Industrial Engineering*, (115) 109-122. 2018.



on external suppliers for components like advanced electronics, fuels, and medical supplies. Single-source suppliers or concentration of production in specific regions increase risks of disruption. One other such supplier is China. Many of the member states have significant economic ties with China, regardless of its status as NATO's main adversary on the global stage.

Another prominent threat to NATO's supply chains are cyberattacks. The alliance is already up to date with its perception of the cyber vulnerability of automation systems and the interconnected global supply. The allies have already set in place frameworks and road maps to secure their supply chains by employing various risk assessment tools and doing significant background checks on its supplies²⁸. The roadmap outlines specific opportunities for collective and/or multinational cooperation to protect Allies' supply chains from any possible disruption that could impact NATO's deterrence and defence. The allied member states should mobilize and safeguard their cyber security in order to achieve the desired resilience of the Alliance as a whole.

What is more, the case studies of the Ukraine war and the COVID-19 pandemic has shown that the allied member states have not cared for their supply chains adequately for the alliance to have a structured and efficient response to such events. The alliance struggled to rearm Ukraine, to line up training and equipment deliveries, to mitigate duplicate and missing deliveries, track information from providers, and to deter Russian hacking. It is imperative for NATO to enhance its frameworks and practises to safeguard infrastructure of critical importance, such as the NordStream²⁹.

²⁸ NATO, "Defence-Critical Supply Chain Security Roadmap (July 2024)," NATO Press factsheets and media backgrounders, 2024, https://www.nato.int/nato_static_fl2014/assets/pdf/2024/7/pdf/240712-Factsheet-Defence-Supply-Chain-Ro.pdf.

²⁹ Joseph Majkut et al., "Security Implications of Nord Stream Sabotage," [www.csis.org](https://www.csis.org/analysis/security-implications-nord-stream-sabotage), September 29, 2022, <https://www.csis.org/analysis/security-implications-nord-stream-sabotage>.



6.3. Diversification and Redundancy

One of the most prominent proposed ways of countering disruptions in the supply chain continuity is redundancy. Over the years there have been numerous researches and empirical researches that have been proposing either redundancy or the increase of flexibility over each other³⁰. Redundancy can take two distinct forms when implemented. On the one hand we can have proactive redundancies and on the other hand we can have reactive redundancies³¹.

Proactive redundancies are investments made by parties to insure their supply chains. Essentially, in the same way that companies take insurances to protect themselves from future possible losses, parties, in this case NATO or individual member states, can adopt stances of proactive redundancies, using them to safeguard themselves from possible disruptions in the supply flow. These actions can help mitigate the impact of expected future losses³² or buffer the space between uncertainty when planning for operations. Insurance can take multiple forms depending on the details and specifics of different situations. In the context of NATO, two possible forms are either the countering of disruptions before significant damage has occurred, or take the form of mechanisms and frameworks that can swiftly replace the lost supplies with the same or similar, in a timely manner so the continuous flow of supplies is not disrupted significantly³³. Safety stocks is a way used in military and humanitarian logistics to counter the effect of disruptions. Safety stocks are strategically stockpiled and placed, critical supplies in a network. This method of stockpiling and distributing can help increase the resilience and

³⁰ Sheffi, Y. *The Resilient Enterprise: Overcoming Vulnerability for Competitive Advantage*. MIT Press, 2005. Sheffi, Y. *The Resilient Enterprise: Overcoming Vulnerability for Competitive Advantage*. MIT Press, 2005.

³¹ Jonathon Mackay, Albert Munoz, and Matthew Pepper, "Conceptualising Redundancy and Flexibility towards Supply Chain Robustness and Resilience," *Journal of Risk Research* 23, no. 12 (November 26, 2019): 1–21, <https://doi.org/10.1080/13669877.2019.1694964>.

³² Amos Tversky and Daniel Kahneman, "Advances in Prospect Theory: Cumulative Representation of Uncertainty," *Journal of Risk and Uncertainty* 5, no. 4 (October 1992): 297–323, <https://doi.org/10.1007/BF00122574>.

³³ Sheffi, Yossi, and James B. Rice Jr. "A supply chain view of the resilient enterprise." *MIT Sloan management review*(2005).



robustness of the supply chains as it can absorb most of the impact caused by disruptions in the supply network³⁴.

Reactive redundancies on the other hand are frameworks that seek to be a buffer zone between swift changes of the status quo, namely the change of a state of peace to a state of war or the change is a continuous flow of supplies to a disrupted flow. The two concepts, of reactive and proactive redundancies, work in similar fashion. Reactive redundancies are practices that seek to expedite inventory as a way to mitigate the effects of disruptions during volatile situations³⁵.

Redundancy is critical to supply chain resilience and should be the first capability developed. In terms of lowering risk and minimising the effects of disruption, redundancy improves supply chain resilience more effectively than flexibility. The easiest and most efficient strategy to reduce risks is to have redundant resources. For example, according to a simulation model, a backup factory can increase production capacity and expedite the completion of past-due orders by making up for the absence of critical factories³⁶. In order to respond quickly and effectively to supply shortages or demand spikes during a crisis, redundancy also involves the strategic and selective use of spare capacity and stocks³⁷. By having backup supplies, contingency plans, different transit routes, and other measures, redundancy enables the fastest reaction during emergencies, including natural catastrophes³⁸. The backup vendors are more successful than

³⁴ B. Balcik and B. M. Beamon, "Facility Location in Humanitarian Relief," *International Journal of Logistics Research and Applications* 11, no. 2 (February 13, 2008): 101–21, <https://doi.org/10.1080/13675560701561789>.

³⁵ Sean X. Zhou and Xiuli Chao, "Dynamic Pricing and Inventory Management with Regular and Expedited Supplies," *Production and Operations Management* 23, no. 1 (July 19, 2013): 65–80, <https://doi.org/10.1111/poms.12047>.

³⁶ Wen Jun Tan, Wentong Cai, and Allan N. Zhang, "Structural-Aware Simulation Analysis of Supply Chain Resilience," *International Journal of Production Research* 58, no. 17 (December 26, 2019): 5175–95, <https://doi.org/10.1080/00207543.2019.1705421>.

³⁷ Ying Wang et al., "Building Supply Chain Resilience through Ambidexterity: An Information Processing Perspective," *International Journal of Logistics Research and Applications* 26, no. 2 (July 1, 2021): 1–18, <https://doi.org/10.1080/13675567.2021.1944070>.

³⁸ Amelie A. Hecht et al., "Urban Food Supply Chain Resilience for Crises Threatening Food Security: A Qualitative Study," *Journal of the Academy of Nutrition and Dietetics* 119, no. 2 (February 2019): 211–24, <https://doi.org/10.1016/j.jand.2018.09.001>.



flexible suppliers at enhancing supply chain resilience, cutting production costs, and ensuring the timely and efficient flow of supplies. To lessen the negative effects of significant supply chain interruptions, NATO ought to make investments in inventory redundancy³⁹. Depending on risk levels, different redundancy solutions can be implemented, even though redundancy has a long-term favourable impact on supply chain performance.

Another important aspect and commonly used practice to bolster supply chain resilience and security is the diversification in product and suppliers. Researchers have found that there is a significant reduction of risk associated with having more than one supplier per subproduct or subservice, adding sub product diversification does not affect risk, but improves the structural reliability of the supply chain and that the structural reliability of the supply chain is increased with an increase in the number of suppliers providing the same subproduct or subservice⁴⁰. However at the same time, the coordination costs and coordination efficiency are vastly improved when the number of suppliers and sub products are reduced. Hence while diversification can be an extremely effective weapon in the arsenal of the alliance to mitigate the effects of disruptions it doesn't come without its drawbacks.

6.4. Critical Infrastructure Protection

Infrastructure is the backbone of NATO's ability to sustain operations, support member states, and ensure economic and societal stability. This infrastructure includes transportation networks, energy systems, communication networks, and logistical hubs essential for the smooth functioning of supply chains. But what makes a portion of the infrastructure critical?

³⁹ Milad Baghersad and Christopher W. Zobel, "Organizational Resilience to Disruption Risks: Developing Metrics and Testing Effectiveness of Operational Strategies," *Risk Analysis* 42, no. 3 (June 21, 2021), <https://doi.org/10.1111/risa.13769>.

⁴⁰ Brian D. Neureuther and George Kenyon, "Mitigating Supply Chain Vulnerability," *Journal of Marketing Channels* 16, no. 3 (June 26, 2009): 245–63, <https://doi.org/10.1080/10466690902934532>.



Although there is not a universal definition on the concept of critical infrastructure, NATO, the EU and individual states have plans at hand to safeguard them. In general, critical infrastructure is defined as those physical and cyber systems, facilities, and assets that are so vital that their incapacity or their destruction would have a debilitating impact on a nation's national security, economic security, or national public health and safety⁴¹.

As such critical infrastructures have to be the first to be safeguarded in order to maintain operational capacity. The current views on critical infrastructure safeguarding frameworks, however, are mainly focused on their protection⁴². This is the point for an important distinction to be made. Protection and resilience are two concepts that go very much hand in hand, completing each other. Be that as it may, when we talk about protection, we mainly refer to the preemptive actions and plans implemented, that seek to protect the critical infrastructures before disruptions or damage has occurred to them. The significant contribution of the concept of resilience shows at this point. It is statistically impossible to ensure the complete protection of such infrastructure, in this interconnected globe. A framework designed to enhance the resilience of critical infrastructure consists of practices and actions to protect such infrastructure, but also a comprehensive mechanism that in case of interference, is activated and swift damage control measures, recovery and reconstitution are implemented⁴³. A resilient infrastructure is a component, system or facility that is able to withstand damage or disruption, but if affected, can be readily and cost-effectively restored⁴⁴. Very often, achieving the desired

⁴¹ Ronald Bearse, "Understanding Critical Infrastructure' from Enabling NATO's Collective Defense CISR (NATO)," US Army War College - Strategic Studies Institute, January 6, 2023, <https://ssi.armywarcollege.edu/SSI-Media/Recent-Publications/Article/3946047/understanding-critical-infrastructure-from-enabling-natos-collective-defense-ci/>.

⁴² Christer Pursiainen, "The Challenges for European Critical Infrastructure Protection," *Journal of European Integration* 31, no. 6 (November 2009): 721–39, <https://doi.org/10.1080/07036330903199846>.

⁴³ Landstedt, Jyrki, and Petter Holmström. "Electric power systems blackouts and the rescue services: the case of Finland." *Emergency Services College of Finland and State Provincial Office of Western Finland* (2007).

⁴⁴ Arsenault, David, and Arun Sood. *Critical Thinking: Moving from Infrastructure Protection to Infrastructure Resilience*. CIP Program Discussion Paper Series, 1-9, 2007.



level of protection is simply not cost-effective in relation to the actual threats. A small amount of extra protection might introduce a large amount of additional costs.

As aforementioned in the context of NATO, the concept of resilience is enshrined in Article 3. For the individual states to reach the level of resilience envisioned by the alliance, they must safeguard their critical infrastructure. NATO is actively developing policies, establishing frameworks and guidelines, such as the Baseline Requirements for National Resilience, to ensure member states maintain robust protective measures for critical infrastructure. In addition, joint exercises, information sharing and cooperation of the member states augment the ability of the allies to provide adequate protection to the critical infrastructure of the alliance, hence making NATO all the more a resilient alliance.

It is important to highlight the important and positive steps the alliance has taken towards ensuring a resilient future for its members, however events of the past decade have proven that NATO needs to improve the resilience of its critical infrastructure. The Ukraine power grid attacks of 2015-2016 and the SolarWinds Cyberattacks have proved that the cybersecurity of the alliance is lacking and vulnerable. The Nord Stream Pipeline sabotage of 2022 underscored the risks to energy infrastructure in contested geopolitical regions. This incident highlighted the need for NATO to increase maritime surveillance and invest in the protection of underwater assets. Under the same prism, the destruction of transportation and energy infrastructure during Hurricane Katrina revealed how natural disasters can disrupt critical supply chains. NATO has since emphasized climate adaptation measures in its resilience planning. Critical infrastructure is indispensable to NATO's operational success, economic stability, and societal resilience. As threats to this infrastructure become more diverse and complex, NATO must adopt a comprehensive approach that combines physical security, cybersecurity, redundancy, and international cooperation. By safeguarding these assets, NATO ensures its ability to respond to crises, maintain collective defense, and uphold the security of its member states in an increasingly uncertain world.



7. NATO's Environmental Strategy for Resilience and Collective Defense

7.1. The Strategic Importance of Climate Security

Climate change acts as a threat multiplier, exacerbating existing security risks and destabilizing vulnerable regions. Extreme weather events, rising sea levels, and resource scarcity contributes to conflicts over land, water, and energy. These disruptions can trigger mass migrations, intensify geopolitical tensions, and place additional pressure on military forces during humanitarian crises. NATO's commitment to addressing climate security reflects its broader goal of safeguarding global peace and stability. In 2021, NATO adopted its Climate Change and Security Action Plan, integrating climate considerations into all aspects of defense and military planning. This initiative underscores NATO's recognition that climate change directly impacts mission effectiveness, troop readiness, and infrastructure resilience. By embedding climate risk assessments into defense strategies, NATO aims to build a forward-looking approach that anticipates and mitigates future threats.

7.2. Greening NATO's Defense Operations

Sustainability is becoming a cornerstone of NATO's operational planning. Recognizing the significant carbon footprint of military activities, the Alliance is actively pursuing green defense technologies and renewable energy solutions. NATO's Green Defence Framework, launched in 2022, seeks to reduce greenhouse gas emissions across military operations and infrastructure. One of NATO's key strategies is the adoption of energy-efficient technologies in military installations and vehicles. Hybrid and electric-powered military transport systems, solar energy facilities at bases, and sustainable fuel alternatives are being tested and deployed across member states. By reducing dependency on fossil fuels, NATO enhances operational



resilience, lowers costs, and contributes to global decarbonization efforts. Moreover, NATO's member states are collaborating to develop environmentally friendly defense procurement practices. Incorporating sustainability criteria in military contracts and fostering green innovation within the defense sector encourages the adoption of circular economy principles, reducing waste and maximizing resource efficiency.

7.3. Strengthening Climate-Resilient Infrastructure

As part of its broader adaptation efforts, NATO is enhancing the resilience of its infrastructure against climate risks. Flooding, wildfires, and heatwaves threaten critical military facilities, supply chains, and deployment capabilities. NATO is conducting climate impact assessments on key installations to identify vulnerabilities and implement adaptive measures. For example, NATO's adaptation strategy includes reinforcing coastal military bases against sea-level rise and constructing flood defenses around essential command centers. Investments in resilient materials and smart infrastructure further safeguard NATO's assets against climate-induced disruptions, ensuring operational continuity under adverse conditions. Additionally, NATO is promoting joint exercises that simulate climate-related disaster scenarios, strengthening cooperation and preparedness among member states. These exercises enhance NATO's ability to respond rapidly to natural disasters, providing humanitarian aid and support to affected populations.

7.4. Expanding Multilateral Cooperation on Climate Security

NATO's response to climate security extends beyond its member states, involving collaboration with international organizations, non-governmental organizations (NGOs), and climate-focused institutions. Partnerships with the United Nations, the European Union, and regional organizations are crucial for addressing transnational climate risks. Through joint initiatives, NATO shares best practices, enhances data collection on climate risks, and coordinates responses to climate-induced crises. The Alliance's commitment to fostering resilience in partner nations strengthens global stability by reducing the potential for conflicts



driven by environmental degradation. NATO also engages with the scientific community to better understand the security implications of climate change. By leveraging climate data, satellite imagery, and predictive analytics, NATO enhances its strategic foresight, enabling proactive rather than reactive responses to emerging threats.

7.5. Ethical and Policy Dimensions of Climate Action.

As NATO amplifies its focus on climate security, ethical and governance frameworks play a critical role in shaping policy. The pursuit of climate-conscious defense practices aligns with international efforts to achieve carbon neutrality and environmental sustainability. NATO's initiatives reflect a balance between operational demands and the responsibility to mitigate the Alliance's environmental impact. Transparency, accountability, and public engagement are essential in ensuring that NATO's climate strategies gain the trust and support of global communities. The Alliance is committed to reporting progress on its climate goals, reinforcing the importance of collaborative governance and policy alignment among its members.

8. NATO's Economic Strategy for Resilience and Collective Defense.

As the global economic landscape undergoes rapid transformation, NATO is increasingly focusing on the economic dimensions of security and resilience. The interconnectedness of economic stability and defense readiness highlights the need for robust economic policies and investment strategies to safeguard the Alliance's operational capacity. This document explores NATO's evolving economic strategy, emphasizing supply chain resilience, defense spending, and the economic partnerships essential for sustaining collective defense.

8.1. Economic Security as a Pillar of Defense

NATO acknowledges that economic security is integral to military readiness and strategic autonomy. Economic vulnerabilities, such as trade disruptions, supply chain dependencies, and energy insecurity, can undermine national defense capabilities. To mitigate these risks, NATO



is implementing comprehensive economic policies that reinforce critical sectors, foster innovation, and reduce external dependencies.

One of the key aspects of NATO's economic strategy is reducing reliance on single-source suppliers, particularly for defense equipment and energy. By diversifying supply chains and promoting regional partnerships, NATO enhances its capacity to withstand economic shocks. The COVID-19 pandemic underscored the fragility of global supply networks, prompting the Alliance to prioritize resilient economic frameworks that ensure the uninterrupted flow of essential goods and services.

8.2. Investing in Defense Innovation and Infrastructure

NATO's economic approach places significant emphasis on technological innovation and infrastructure development. Investment in emerging technologies, cybersecurity systems, and advanced manufacturing, is crucial for maintaining the Alliance's technological edge. NATO member states are collaborating to fund defense innovation hubs and technology accelerators, fostering research and development in areas critical to future defense.

In addition to technological advancements, NATO is allocating resources towards modernizing military infrastructure. Ports, air bases, and logistical hubs across member states are undergoing upgrades to improve operational efficiency and resilience. These infrastructure investments not only bolster NATO's defense posture but also stimulate economic growth, creating jobs and fostering industrial development across allied nations.

8.3. Strengthening Defense Industrial Base and Supply Chains

A resilient defense industrial base is vital for sustaining long-term security and operational readiness. NATO is actively working to strengthen domestic defense industries within member states by encouraging greater collaboration between governments and private sector entities.



By promoting joint procurement initiatives and streamlining defense contracts, NATO enhances interoperability while driving down costs.

Efforts to localize production of critical defense materials and technologies are also gaining momentum. NATO's defense procurement policies now include incentives for domestic production and innovation, reducing dependence on external markets. This approach not only mitigates supply chain risks but also ensures that NATO member states maintain strategic control over key defense assets.

8.4. Energy Security and Economic Stability

Energy security remains a cornerstone of NATO's economic strategy, recognizing that stable and reliable energy supplies are essential for military operations and national resilience. NATO is advocating for diversification of energy sources, greater investment in renewable energy, and the development of strategic energy reserves. The Alliance's Energy Security Strategy focuses on reducing reliance on adversarial energy suppliers, promoting energy-efficient technologies, and enhancing cross-border energy infrastructure. By integrating energy security into defense planning, NATO reduces the risk of energy-related disruptions and strengthens the collective economic resilience of member states. Energy cooperation agreements and joint initiatives further cement NATO's role in securing global energy flows, safeguarding critical energy assets, and preventing economic coercion.

9. Recent developments

Over the past two decades NATO has come face to face with the vulnerabilities of its supply chains and its resilience when it comes to the optimal management of operations. There are multiple case studies in the history of NATO that highlight the importance of logistics and the immense consequences of disruptions in the supply chains. The COVID-19 pandemic, the war



in Ukraine, the Suez Canal Blockage, the SolarWinds cyberattacks⁴⁵ and notably the alliance's experience in Afghanistan as a whole are just a few instances of suboptimal defence of supply chains and cracks in a resilient NATO. But all the above have contributed valuable lessons to the alliance in the spectrum of logistics and their, ever growing, consideration as the strategic national power of the "lower" battlefield⁴⁶.

In the most recent years, two are the events that have shocked the alliance to its core with regards to the collective defence of its member states. These being the COVID-19 pandemic and the Russian aggression on NATO's doorstep. During the last decade the debate on the impact of climate change and ways to safeguard supply chains have been prominent, but be that as it may, the same cannot be said for the possible consequences of a global pandemic. NATO came forth with the "health area"⁴⁷ as a future sector of concern with its 2010 Strategic Concept, entering the debate quite early. Although that was a quite important step taken by the alliance, NATO has not followed through with adequate measures taken to counter the consequences of a global pandemic. Over the past 15 years and after the hit of the COVID-19 pandemic, NATO's Euro-Atlantic Disaster Response Coordination Center (EADRCC)⁴⁸, the main Civil Emergency response body and NATO's International Staff, have been repeatedly cut in favour of strengthening geopolitical and cyber defence frameworks as threats from China and Russia emerge⁴⁹. While a military defence alliance NATO is not the appropriate first responder or response team to a pandemic. Even so the pandemic is directly impacting the

⁴⁵ Reuters Staff, "SolarWinds Hack Was 'Largest and Most Sophisticated Attack' Ever: Microsoft President," *Reuters*, February 15, 2021, <https://www.reuters.com/article/technology/solarwinds-hack-was-largest-and-most-sophisticated-attack-ever-microsoft-pres-idUSKBN2AF03Q/>.

⁴⁶ Ronald Ti, "Lessons from the Russo-Ukrainian Conflict: The Primacy of Logistics over Strategy," *Defence Studies* 23, no. 3 (July 3, 2023): 381–98, <https://doi.org/10.1080/14702436.2023.2238613>.

⁴⁷ NATO, "Strategic Concept 2010," NATO, November 19, 2010, https://www.nato.int/cps/en/natohq/topics_82705.htm.

⁴⁸ NATO, "Euro-Atlantic Disaster Response Coordination Centre," NATO, August 26, 2024, https://www.nato.int/cps/en/natohq/topics_52057.htm?.

⁴⁹ Giovanna De Maio, "NATO'S RESPONSE to COVID-19: LESSONS for RESILIENCE and READINESS," 2020, https://www.brookings.edu/wp-content/uploads/2020/10/FP_20201028_nato_covid_demaio-1.pdf.



alliance and its missions by putting the health of its personnel at risk and secondly by underestimating the global interdependency of the supply chains⁵⁰.

In regards to the global situation, NATO handled the pandemic quite flexibly, following the protocol designed for Hybrid Threats⁵¹, managing to transition and redesign its missions, training and priorities smoothly amidst the health risks. However, shortages of medical supplies, personal protective equipment (PPE), and pharmaceuticals demonstrated the risks of overreliance on single suppliers or regions for essential goods. NATO member states struggled with delays in acquiring and distributing medical resources, which affected both civilian populations and military readiness.

It is important to understand that NATO's resilience along with the security of its supply chains is equivalent to the resilience of its member states independently. The Russian invasion of Ukraine disrupted global energy supplies, grain exports, and critical raw materials like neon gas, which is essential for semiconductor production, and commenced an alarming energy crisis throughout Europe, with significant consequences in the economies and the energy production sectors of many allied countries⁵². For NATO, this conflict underscored the vulnerability of supply chains to geopolitical events. Ukraine's status as a major supplier of materials for defence technologies highlighted the risks of reliance on non-NATO partners for critical resources.

As aforementioned, however, the alliance has been taking notes of the events and has been evolving and learning alongside them. After incidents like the Nord Stream pipeline

⁵⁰ Giovanna De Maio, "NATO'S RESPONSE to COVID-19: LESSONS for RESILIENCE and READINESS," 2020, https://www.brookings.edu/wp-content/uploads/2020/10/FP_20201028_nato_covid_demaio-1.pdf.

⁵¹ NATO Defense College, "A Renewed Collective Defense Bargain? NATO in COVID's Shadow," NDC, 2020, <https://www.ndc.nato.int/news/news.php?icode=1468>.

⁵² Ngoc, Nguyen Minh, Dinh Thanh Viet, Nguyen Hoang Tien, Phuoc Minh Hiep, Nguyen Tuan Anh, Le Dinh Hue Anh, and V. T. P. Dung. "Russia-Ukraine war and risks to global supply chains." *International Journal of Mechanical Engineering* 7, no. 6 (2022): 633-640.



explosions, NATO increased its efforts to safeguard critical energy infrastructure⁵³ through heightened monitoring, intelligence sharing, and joint exercises focused on maritime and cyber threats. The alliance has also prioritised improving logistics and transportation routes to ensure uninterrupted movement of troops and equipment. This included reinforcing supply lines across Europe and enhancing the readiness of transport hubs and infrastructure. At the same time important steps have been taken in regard to cybersecurity, stockpiling and burden sharing, reinforcing allied industrial bases and enhancing resilience protocols and frameworks. These efforts underscore NATO's commitment to adapting to a rapidly evolving security environment. While the invasion of Ukraine served as a wake-up call, prompting the alliance to strengthen its collective resilience and ensure that its supply chains remain robust in the face of both traditional and hybrid threats, there is an enormous amount of work yet to be made.

10. Challenges and Future Perspectives on Resilience and Supply Chain Security

The world's rapidly changing geopolitical, technological, and environmental landscape poses significant challenges to NATO's resilience and supply chain security. These two elements are central to the alliance's ability to protect its member states, sustain military readiness, and ensure collective stability. Modern supply chains, while efficient and interconnected, are increasingly vulnerable to geopolitical fragmentation, cyber threats, climate change, and technological dependencies. Overcoming these challenges requires NATO to adapt, innovate, and strengthen collaboration to protect critical resources and maintain operational effectiveness. This section outlines the key challenges NATO faces and explores its strategic vision for building future resilience.

⁵³ Helga Kalm, "NATO's Path to Securing Undersea Infrastructure in the Baltic Sea," [carnegieendowment.org](https://carnegieendowment.org/research/2024/05/nato-baltic-sea-security-nord-stream-balticconnector?lang=en), May 24, 2024, <https://carnegieendowment.org/research/2024/05/nato-baltic-sea-security-nord-stream-balticconnector?lang=en>.



10.1. Geopolitical Tensions and Supply Chain Vulnerabilities

One of the most critical challenges is the rise of geopolitical competition and its impact on global supply chains. As nations adopt protectionist policies and prioritize economic independence, the previously integrated flow of goods and resources is becoming fragmented. NATO's dependence on a limited number of suppliers for critical goods, particularly rare earth elements and energy resources, remains a major risk. For instance, China dominates the production of rare earth materials necessary for military technologies, while Europe's past reliance on Russian energy supplies exposed vulnerabilities during the Russia-Ukraine conflict. Economic sanctions, resource monopolization, and trade restrictions further disrupt access to these essential materials, threatening NATO's ability to sustain military and civilian systems during crises.

10.2. Cyber Threats and Technological Weaknesses

With the increasing reliance on digital technologies, NATO faces growing cyber threats that target supply chain networks and critical infrastructure. Modern supply chains depend on digital systems for automation, real-time tracking, and data management, making them susceptible to cyberattacks, data breaches, and malware infiltration. State-sponsored cyber attacks have become more advanced, capable of paralyzing supply chains and compromising sensitive systems. For example, the Colonial Pipeline ransomware attack disrupted fuel distribution in the United States, underscoring how a single breach can have widespread consequences. Within NATO, a cyberattack on logistics providers or defense contractors could delay military deployments and weaken collective security efforts.

10.3. The Impact of Climate Change on Resilience

Climate change presents a complex and escalating threat to NATO's supply chain resilience. The increase in extreme weather events, such as hurricanes, floods, and wildfires, directly impacts transportation routes, energy grids, and production systems. For example, severe



floods in Germany and Belgium in 2021 disrupted local infrastructure, delaying the movement of goods and forcing recovery efforts. Environmental disruptions are not limited to natural disasters. Resource scarcity caused by climate change, including water shortages and agricultural declines, exacerbates global competition for critical materials. Additionally, the melting of Arctic ice introduces new challenges. While it creates opportunities for trade routes, it has also intensified competition among nations over the region's untapped resources, raising strategic concerns for NATO. To combat these environmental challenges, NATO must integrate climate resilience into its supply chain strategies by developing sustainable infrastructure capable of enduring extreme weather conditions, transitioning to green energy solutions to reduce reliance on fossil fuels and minimize environmental risks. and by creating contingency plans to prepare for and recover from climate-related disruptions.

10.4. Energy Dependency and the Renewable Transition

Energy security remains a core concern for NATO, as military and civilian operations depend heavily on stable and continuous access to energy resources. Historically, the reliance on fossil fuels particularly imports from geopolitically unstable regions has created significant risks. For example, Russia's use of natural gas as a geopolitical tool during the Ukraine conflict exposed Europe's energy vulnerabilities, resulting in economic disruptions and operational uncertainty. While transitioning to renewable energy sources offers a long-term solution, it also introduces challenges. Renewable technologies require significant infrastructure investments and access to critical raw materials, such as lithium and cobalt, which are often concentrated in politically sensitive regions.

10.5. Technological Dependencies and Supply Chain Disruptions

The modern world's increasing reliance on advanced technologies such as semiconductors, automation systems, and artificial intelligence presents both opportunities and vulnerabilities for NATO. Semiconductors, for example, are indispensable to defense systems, communication networks, and industrial operations. However, the concentration of



semiconductor production in a handful of regions, primarily in East Asia, leaves NATO member states highly exposed to geopolitical tensions, natural disasters, and trade restrictions.

This heavy dependence creates the potential for significant disruptions. Supply chain attacks, where compromised hardware or software infiltrates critical systems, represent an additional layer of risk. In such cases, adversarial actors could sabotage or delay the delivery of key technologies, severely undermining NATO's ability to mobilize forces and maintain its technological edge during crises. Such vulnerabilities highlight the urgent need for NATO to address these weaknesses and safeguard its critical technology supply chains.

One solution lies in encouraging the onshoring of semiconductor and technology production within NATO member states. By investing in domestic manufacturing capabilities, NATO can reduce its reliance on external suppliers and ensure a stable supply of essential technological components. Additionally, fostering closer cooperation with trusted allied nations can help establish secure and transparent technology supply chains, thereby mitigating the risk of geopolitical disruptions.

To further enhance security, NATO can leverage emerging blockchain technologies to improve transparency and traceability across global supply chains. Blockchain solutions enable real-time monitoring of shipments, ensuring that components remain uncompromised and reducing the risk of infiltration. Through such measures, NATO can build a resilient technological infrastructure that supports its strategic and operational needs while adapting to an increasingly competitive global environment.

10.6. Hybrid Threats and Misinformation

The rise of hybrid threats poses another major challenge to NATO's supply chain security and operational resilience. Hybrid threats refer to tactics that combine traditional and unconventional strategies, such as cyberattacks, economic pressure, and deliberate



disinformation campaigns. These approaches aim to destabilize societies, undermine trust in institutions, and create vulnerabilities within critical supply chains.

Misinformation, in particular, can have profound consequences. For example, false narratives regarding shortages of food, fuel, or medical supplies can spark panic among populations, leading to economic strain and social unrest. Adversarial actors may also weaponize economic coercion by imposing trade restrictions, manipulating supply chains, or monopolizing critical resources to exert political influence over NATO member states.

Addressing these challenges requires a comprehensive and proactive approach. NATO must focus on strengthening information resilience, which involves identifying and countering disinformation campaigns in real time to prevent the spread of false narratives. At the same time, developing economic safeguards, such as contingency plans to address trade restrictions or resource shortage, will help NATO mitigate the impacts of economic coercion. Furthermore, enhancing intelligence-sharing mechanisms among member states is essential for detecting and neutralizing hybrid operations before they escalate into broader security threats.

10.7. Looking Ahead: NATO's Strategic Vision for Resilience

The challenges NATO faces today ranging from geopolitical fragmentation and cyber threats to environmental disruption and hybrid warfare demand a forward-looking, multi-faceted strategy. Building resilience and securing supply chains will require NATO to prioritize innovation, preparedness, and enhanced cooperation among its member states and partners.

A critical element of NATO's future strategy lies in strengthening alliances and partnerships. By collaborating with international organizations, private industries, and trusted nations, NATO can pool resources, share intelligence, and develop unified strategies for addressing vulnerabilities in global supply chains. Such collaboration is vital to creating secure,



transparent, and redundant systems that can withstand disruptions caused by geopolitical, economic, or technological shocks.

Simultaneously, NATO must focus on investing in innovation to modernize its supply chain infrastructure and enhance resilience. Leveraging cutting-edge technologies such as artificial intelligence, blockchain systems, and advanced analytics will enable NATO to predict disruptions, optimize logistics, and improve the traceability of essential resources. By harnessing these tools, NATO can strengthen its ability to adapt to emerging challenges and secure critical systems.

Equally important is the need for preparedness through regular resilience exercises and crisis simulations. Conducting joint training operations allows NATO member states to test their response mechanisms, identify gaps in supply chain security, and build collective capacity to manage disruptions. These exercises serve as a valuable opportunity to refine NATO's strategies, enhance cooperation, and ensure that member states are ready to address both conventional and unconventional threats in real time.

11. Conclusion

The challenges surrounding NATO's resilience and supply chain security reflect the complexities of a rapidly changing global environment. From reducing strategic dependencies and safeguarding digital infrastructure to addressing climate risks, energy instability, and hybrid threats, NATO must take decisive steps to fortify its systems. Diversification of supply chains, strengthened cyber defenses, climate adaptation strategies, and technological innovation will be critical to building a resilient future.

By addressing these key areas with a forward-thinking approach, NATO can enhance its operational readiness, protect its member states, and maintain stability in the face of emerging



global threats. Ensuring resilience is not only a strategic necessity but also a commitment to safeguarding the shared security and values that unite the alliance.

In a world defined by growing uncertainty, interdependence, and emerging threats, NATO's mission to strengthen resilience and safeguard supply chain security has never been more vital. The alliance's success in confronting geopolitical pressures, technological risks, climate-related disruptions, and hybrid warfare will determine its ability to protect its member states and maintain stability in an unpredictable global environment. These challenges are profound, but they also present an opportunity for NATO to adapt, innovate, and reinforce its leadership in collective defense.

The vulnerabilities of modern supply chains are a stark reminder of how deeply interconnected and fragile our systems have become. Over-dependence on single suppliers or regions for critical goods, such as semiconductors and rare earth materials, has exposed NATO members to considerable risks. Trade restrictions, regional instabilities, and global competition for resources can swiftly disrupt the availability of essential technologies and supplies. The energy crises experienced during the Russia-Ukraine conflict revealed how geopolitical tensions can weaponize reliance on critical resources, jeopardizing both civilian and military infrastructure.

Addressing these vulnerabilities requires a concerted effort to diversify supply chains and reduce dependencies on geopolitically sensitive regions. NATO must deepen its partnerships with trusted allies, prioritize domestic production of vital resources, and build regional networks capable of supporting logistical needs. Developing strategic reserves and creating alternative supply routes will further ensure that critical materials remain accessible, even during periods of disruption. By embracing these measures, NATO can secure the flow of essential resources and maintain operational readiness in the face of future challenges.



As supply chains grow increasingly reliant on digital technologies, the risks associated with cyberattacks have become both widespread and severe. NATO's infrastructure, communication systems, and logistical networks are prime targets for adversarial actors aiming to disrupt operations, delay resource delivery, or compromise critical defense systems. Sophisticated cyber incidents like the ransomware attack on the Colonial Pipeline demonstrate how a single breach can ripple across an entire infrastructure, paralyzing essential systems and services.

To counter such threats, NATO must prioritize the protection of its digital infrastructure by strengthening cybersecurity across all levels. Implementing advanced systems capable of detecting and mitigating cyber risks in real time is essential for safeguarding critical supply chains. Collaboration with private sector actors, who manage significant portions of digital infrastructure, will also be key to fortifying defenses and sharing timely intelligence. Regular cyber resilience drills will enable member states to test their readiness, identify weaknesses, and enhance coordinated responses to cyber disruptions. By securing its digital backbone, NATO can ensure that its logistical operations remain reliable, adaptable, and resilient against malicious threats.

Furthermore, energy security remains a fundamental component of NATO's overall resilience. The dependence on fossil fuels sourced from unstable or adversarial regions leaves NATO member states vulnerable to disruptions. This risk was made evident during the Russia-Ukraine conflict, where the weaponization of natural gas supplies created significant energy shortages across Europe, threatening both economic stability and military readiness.

While securing short-term energy supplies remains critical, the long-term solution lies in transitioning to renewable energy sources. Investments in technologies such as wind, solar, and hydrogen can provide NATO with sustainable and diversified energy options, reducing dependence on geopolitically risky suppliers. Developing strategic reserves of energy resources



and modernizing energy infrastructure will further ensure that NATO can maintain operations during crises.

The rise of hybrid threats, a blend of traditional warfare, cyberattacks, economic manipulation, and disinformation represents a growing challenge for NATO's security. Adversarial actors increasingly exploit weaknesses within supply chains and societies to destabilize member states, spread false narratives, and erode public trust. Misinformation campaigns, for instance, can create panic about shortages of food, fuel, or medical supplies, weakening societal confidence and amplifying economic strain.

To combat such difficulties, NATO must bolster its information resilience by identifying and addressing disinformation campaigns in real time. Strategic communication efforts will play a critical role in maintaining public confidence and preventing unnecessary disruptions caused by false narratives. Additionally, NATO must enhance intelligence sharing among member states to detect and respond to hybrid threats early, mitigating their impact on critical supply chains. By addressing these unconventional challenges, NATO can protect its logistical networks and reinforce its ability to respond to emerging threats effectively.

Looking ahead, NATO must embrace innovation and preparedness to address the complex challenges of resilience and supply chain security. Emerging technologies such as artificial intelligence and blockchain systems offer transformative solutions for improving supply chain transparency, detecting disruptions, and optimizing logistical operations. By leveraging these tools, NATO can enhance its ability to anticipate risks, respond swiftly, and maintain its operational edge.

Furthermore, fostering collaborative partnerships will remain central to NATO's resilience strategy. Strengthening alliances with international organizations, the private sector, and trusted partners will enable NATO to share resources, pool expertise, and align strategies to



confront global challenges collectively. Joint exercises and crisis simulations will also allow member states to refine their preparedness and improve their ability to respond to supply chain disruptions and hybrid threats.

The path to resilience is not without obstacles. Emerging threats, technological dependencies, and environmental changes will continue to test NATO's adaptability and unity. Yet, NATO's history demonstrates its ability to rise to the occasion, evolving and innovating to address new challenges.

Let us all remember that the strength of the Alliance lies not just in its collective power, but in its ability to adapt, endure, and overcome challenges together. Resilience is the foundation upon which security is built, and together, we forge a path toward a more stable and secure future.



12. Points to be addressed.

1. *How can NATO develop a unified approach to assess and prioritize threats to critical infrastructure and supply chains, integrating cyber, physical, hybrid, and geopolitical risks?*
2. *With digital infrastructure deeply embedded in supply chains, how should NATO prepare for cyberattacks that disrupt logistics, infrastructure, and military readiness?*
3. *How can NATO and its members diversify supply chains and critical infrastructure to minimize dependence on specific nations or regions while maintaining efficiency?*
4. *What strategies can NATO implement to secure its military supply chains and infrastructure against disruptions from conflicts, hybrid warfare, or natural disasters?*
5. *Given the private sector's control over much of NATO's critical infrastructure, what governance models can enhance collaboration for resilience and security?*
6. *How can NATO leverage AI, blockchain, and IoT to enhance security, monitoring, and resilience of critical infrastructure while mitigating new vulnerabilities?*
7. *What proactive measures should NATO take to protect global trade routes and ensure the stability of critical resources like semiconductors, energy, and raw materials?*
8. *How can NATO adapt infrastructure and supply chains to withstand extreme weather events and long-term environmental shifts?*
9. *How can NATO ensure uniform resilience across member states, addressing disparities in infrastructure vulnerabilities and supply chain security?*
10. *What lessons can NATO apply from events like the Nord Stream sabotage or the Suez Canal blockage to strengthen infrastructure and supply chain security?*
11. *How can NATO harmonize legal and policy frameworks across member states to improve cross-border cooperation in protecting infrastructure?*



12. *In an era of hybrid threats, what coordinated deterrence and rapid response strategies should NATO develop to safeguard infrastructure and supply chains?*

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