

Analyzing and Addressing Interoperability Issues in the North Atlantic Treaty Organization

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Author Note: The views expressed herein are those of the authors and do not reflect the position of the United States Military Academy, the Department of the Army, or the Department of Defense.

Abstract: Interoperability allows different technology systems, devices, or software to exchange data smoothly and work together seamlessly. While often applied to technical systems, interoperability can also be applied to organizations. One organization with large interoperability challenges is the North Atlantic Treaty Organization (NATO), a military alliance of 31 countries. These countries have technical, cultural, social, and political gaps that hinder interoperability. This study seeks to better understand the interoperability challenges faced by NATO through an in-depth stakeholder analysis. These challenges are broadly grouped into the following four categories: communication, doctrine, equipment, and leadership. From these recommendations are made to help alleviate the interoperability “pain points” faced by NATO. These include the establishment of a NATO communication plan, conducting command post exercises at standard intervals, the development of a standard Joint Military Information-Sharing policy, the establishment of a NATO leadership program, and the establishment of a Spectrum Management Council. While these recommendations will not solve the interoperability issues facing NATO, it will promote smoother operations in future conflicts.

Keywords: Interoperability, NATO

1. Introduction

Interoperability is the ability of different systems, devices, or software to communicate and exchange data with each other in a seamless and effective manner, enabling them to work together in a coordinated way. However, ensuring interoperability is a large issue that plagues numerous organizations. Indeed, there are technical, social, and cultural issues that can result in parallel organizations not being able to adequately work together (Monaghan, 2012). Interoperability issues especially plague the North Atlantic Treaty Organization (NATO), a political and military alliance of 31 North American and European countries formed in 1949 with the aim of providing collective defense against potential security threats. Its core principle is that an attack against one ally is considered an attack against all, requiring a collective response. To highlight these interoperability issues, consider the following scenario:

In 2035, a US Army brigade combat team -- consisting of two American battalions and one multinational battalion comprised of five different NATO countries -- is completing a rotation at the Joint Mission Readiness Center (JMRC). During the operation, each battalion is tasked with similar missions to seize key terrain following standard American doctrine. The multi-national battalion begins to take heavy casualties and needs support. However, their radios are not able to communicate with the American battalions. The battalion continues to take heavy casualties while the American battalions continue with the mission unaware of the heavy casualties their partners are taking. After the exercise, the multi-national commander is frustrated with how the exercise went, explaining they had no means of communication and struggled following the American doctrine. They were unfamiliar with the doctrine and suggested they need to better work as a group and fix these communication and doctrine issues before the next exercise begins. The multi-national commander expresses his lack of trust with interoperating multi-national, which built a sore relationship between the commanders. There was no sense of building positive relationships or a shared understanding.

If NATO cannot identify methods to improve their interoperability issues, the above scenario will become a reality. This study sets out to understand the causes of interoperability issues in NATO and provide possible solutions to resolve these issues.

2. Methodology

The approach used in this study follows the process shown in Figure 1. Following an initial client meeting, a number of relevant stakeholders were identified and interviewed. These interviews are outlined in Section 3.1. From the initial set of interviews, the problem statement and problem tree were derived. The problem tree identifies the “pain points” for the client. The problem tree provided insight into possible solutions. These solutions were further refined through further stakeholder interviews.

The information from the project was compiled into a “Mission Model Canvas,” a tool that helps organizations align their activities with their mission and vision (Sparviero, 2019). The Mission Model Canvas is shown in Figure 1. It provides a visual framework for organizing and communicating the key elements of a mission-driven organization. The canvas consists of nine building blocks that help organizations articulate their purpose, values, customer segments, value propositions, and channels, among other things. The blocks include:

- Key Partners: groups and individuals that can provide insight into the problem.
- Key Activities: steps in solving/alleviating the client’s problems.
- Key Resources: resources required to alleviate the client’s problems.
- Value Proposition: benefits that can be achieved from the solution.
- Buy-in and Support: individuals that support the solution.
- Deployment: how will the solution be deployed.
- Beneficiaries: individuals and groups that would benefit from solving the problem.
- Mission Budget and Cost: financial considerations related to solving the problem.
- Mission Achievement and Impact Factor: overall impact that can be achieved from the solution.

Underlying the methodology and the Mission Model Canvas is a substantial number of interviews with subject matter experts. The stakeholder analysis initially focused on the users that feel the pains associated with interoperability, including the NATO training organizations, liaison officers, and soldiers commonly tasked with tackling interoperability issues. As the project moved into the solution phases, these interviews changed over to being technical subject matter experts that can provide feedback and refinement of the solution designs.

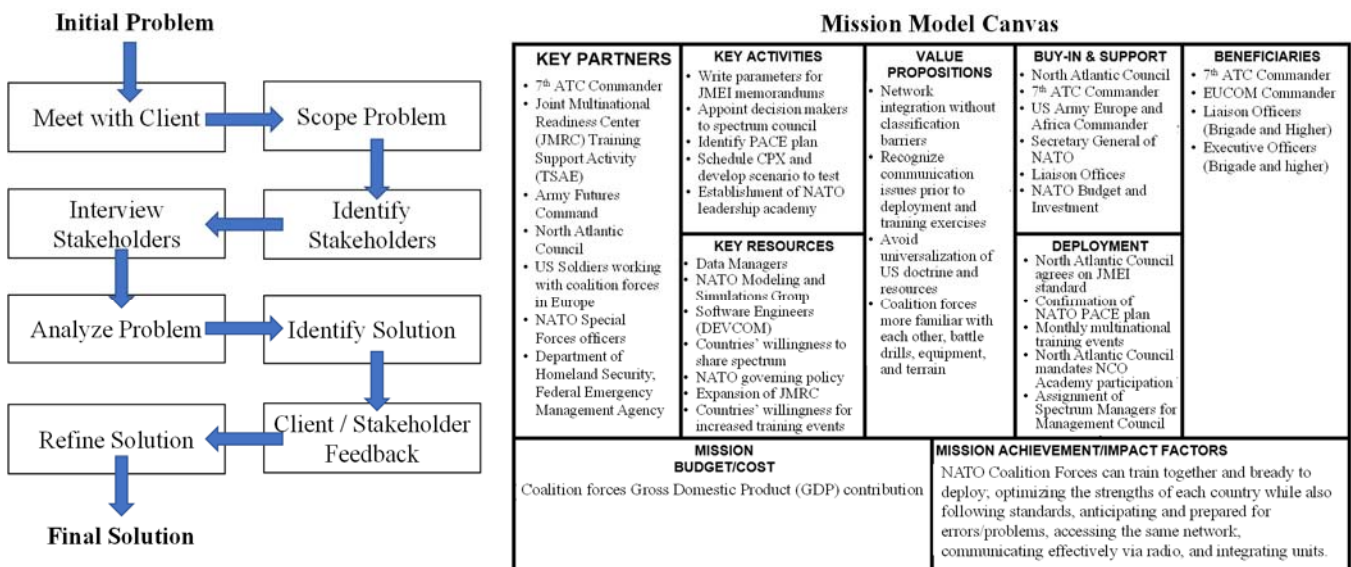


Figure 1. (Left) Methodology used in this study. (Right) Mission Model Canvas, which was used for framing the problem and defining the solution.

3. Problem Definition

3.1 Background of NATO and Interoperability Challenges

NATO is a military alliance consisting of 31 member countries from North America and Europe, with its member countries including the U.S., Canada, the U.K., France, and Germany. It was established in 1949 as a collective defense agreement, with the primary goal of protecting its members against potential military threats from outside the alliance, primarily the former Soviet Union. Since its inception, NATO has played a crucial role in maintaining peace and stability in the Euro-Atlantic region through various military and political initiatives. NATO's key activities include joint military exercises, intelligence sharing, and coordinated efforts to counter cyber threats and terrorism.

The military alliance of NATO indicates that an attack against one member state will result in a military response from all NATO member states. This was seen following the terror attacks on the U.S. on September 11, 2001, after which all NATO forces supported the invasion of Afghanistan. More recently, the importance of NATO has reemerged given the Russian aggression in Ukraine and fears that Russia will push into NATO countries.

One of the major challenges faced by NATO is interoperability (Moon, 2008). This refers to the ability of different military forces to work together effectively, despite differences in equipment, tactics, and procedures. NATO member countries often have different military structures, languages, and equipment, which can make it difficult to coordinate and operate in joint missions (Maranian, 2015). To address this challenge, NATO has established common standards and procedures for communication, logistics, and other military operations. NATO also conducts regular training and exercises to improve the interoperability of its member forces. However, achieving full interoperability remains a complex and ongoing process for NATO.

3.2 Stakeholder Analysis

In the process of developing a solution for interoperability, the project team met with its sponsor to gain an understanding of the definition of interoperability and identify areas of focus. Subject matter experts were consulted to gain insight into the different components of interoperability, and the team identified the largest pain points for beneficiaries. Conversations were held with military and non-military experts, including CEOs and IT managers, to gain a diverse perspective on the issue. Altogether 46 interviews were conducted with people from various organizations. A summary of these interviews is provided in Table 1. The team found that interoperability is a significant problem that applies to multiple fields and can be broken down into various domains. Additionally, the interviews found that while technology and communication systems are a major issue connected to interoperability, there are also cultural, language, and doctrine issues that result in the forces not being able to interoperate. Moreover, the interoperable challenge is further complicated by the defense spending of the different countries, with many NATO members using legacy systems.

One of the identified beneficiaries is the 7th Army Training Command (ATC) Commander, who manages training and readiness exercises for US Army Europe and Africa forces. He would benefit from an interoperable NATO force as it would improve the integration of troops from different units, forces, and countries. Another beneficiary is the maneuver unit XO, who coordinates maneuvers with other countries and ensures proper communication with coalition partners.

The 7th ATC commander's largest pain point is the lack of uniformity in communication protocols between nations, resulting in issues such as the inability to access networks and unsynchronized data. The team's recommendation to alleviate this pain point is to establish a standard NATO Primary Alternate Contingency Emergency (PACE) plan, designating four common methods of communication for coalition forces. Another pain point is the difficulty in sharing data between countries due to classification levels, and the team recommends implementing a Joining Membership Exiting Instruction (JMEI) standard policy that produces Mission Partner Environment networks without a classification barrier.

Another pain point is the leadership and understanding between coalition forces, with varied levels of leadership among coalition forces as well as little knowledge of their allied counterparts. The team would like to continue the project if given more time to speak to more civilian organizations that work with international partners and to address this problem.

3.3. Problem Statement and Tree

The initial problem statement for this analysis was the following: *The US will not fight alone; what is needed to enable US forces (Army/Navy/Air Force) and Coalition forces to be prepared to fight a peer-adversary in an interoperable multi-domain environment?*

Table 1. Summary of stakeholder analysis

Organization	Description	Key Takeaways
7 th Army Training Command	Key stakeholder who is responsible for training of NATO forces	Interoperability is a major issue that needs to be solved. Technology is important, but there are other issues including doctrine and culture.
Joint Mission Readiness Center	Mangers of the training center for NATO forces	Units typically show up for collective training, but their communication systems do not work. This diminishes the value of the training
Army Futures Command – Development Command	Research scientists that develop future solutions and requirements for Army warfighters	Fielding of communication equipment is difficult due to timeframes resulting in legacy systems still on battlefield. NATO forces do not spend as much money on technology development. Typically need communication/data bridges.
U.S. Army (Active)	Soldiers with relevant multi-national experience	Soldiers on the ground have the best of intentions. However, there are language and cultural issues. Communication is difficult, but Soldiers will figure out how to make things work.
U.S. Army (Reserve)	Soldiers with relevant multi-national experience	There are interoperability issues internal to the Army between Active Duty, Reserve, and Special Forces. Root cause is partially due to different communication technologies with Reserve units having legacy systems.
Special Operations Command	Warfighters with relevant multi-national experience	
NATO Forces	Warfighters with relevant multi-national experience	Communication between nations is hard. Even if solved, there are other language and cultural issues.
External (Government)	DHS and FEMA officials	Interoperability issues are not a unique issue to the military. Other organizations have tackled interoperability issues. Consider leveraging work done by other organizations.
External (Non-government)	CEOs of Arch Insurance, Boodle, Cany, McNeil & Company	

After the stakeholder analysis, the final problem statement became the following: *With NATO being considered an “alliance for deterrence” force for the past 70+ years, Coalition forces train and fight with varying levels of technology, preparation, and leadership. To preserve operational advantage, NATO will need to unite, adapt, and work as an operational force that is interoperable in terms of communication, doctrine, equipment, and leadership.*

The problem statement underwent a progressive transformation from an initial focus on a singular interoperability aspect to a more comprehensive statement, which still maintained adequate specificity for addressing the issue. Improvements to the problem statement stemmed from extensive research and expert consultations, which underscored the need for NATO-centric considerations for the 7th ATC. To validate the problem statement hypothesis, rigorous research and expert interviews were conducted to obtain insights into systems and processes that effectively address interoperability issues.

The problem tree was developed as a mutually exclusive and collectively exhaustive framework. Interoperability was divided into four key issues, which were identified after subject matter expert consultations. Each topic was scrutinized individually to address all possible friction points. The four issues were communication, leadership, doctrine, and equipment. After consultations with beneficiaries, communication and leadership were found to be the most frequent and critical issues. This was established by recording and analyzing repeated problems raised by beneficiaries and subject matter experts. Effective leadership was deemed important because some equipment and doctrine issues can be challenging to resolve. However, with efficient leadership and robust relationships, these issues can be surmounted. Subject matter experts and beneficiaries emphasized the significance of building relationships and shared understanding to overcome many of the interoperability challenges within NATO.

Communication was identified as the most frequent interoperability problem. Many countries encounter difficulties with encryption keys, classification barriers, and spectrum ownership issues, hindering efficient communication (Tolk, 2007). Poor communication on networks and radios leads to inefficiencies during training and operations, necessitating additional time and troops to share information. To mitigate this challenge, the 7th ATC Commander, the top beneficiary, advised investigating communication policy making. While technological advancements have been made in militaries, nations' cybersecurity policies must align to enable effective communication with Coalition forces. Cybersecurity policies are often contingent on the extent to which countries are willing to compromise the security of their networks in favor of effective communication with Coalition forces.

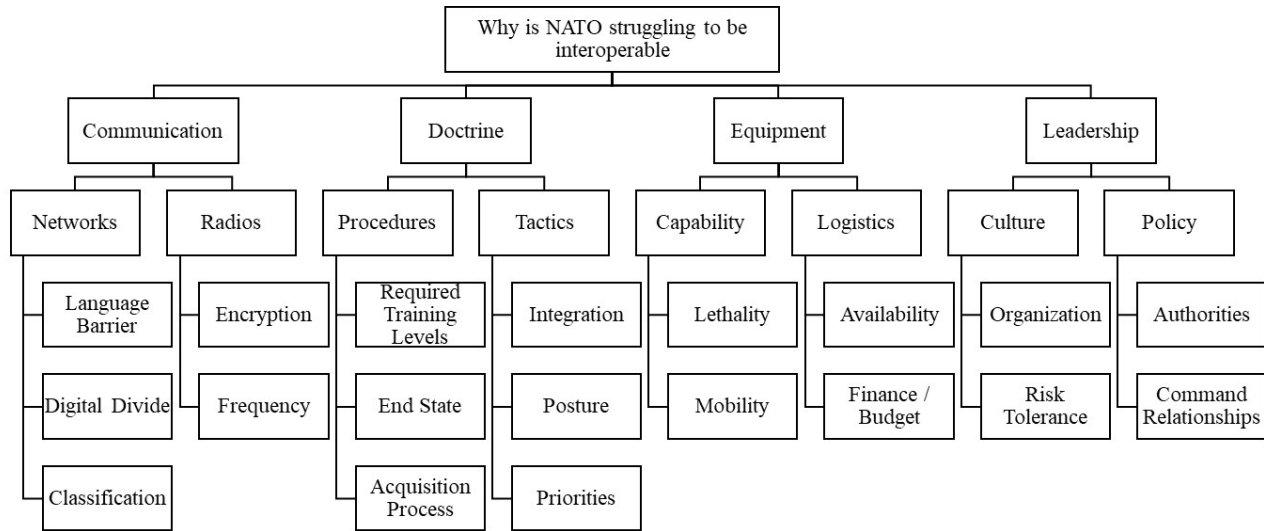


Figure 2. Problem tree grouping the different issues underlying NATO Interoperability

4. Solution Design

The Problem Tree uncovered a number of issues with NATO Interoperability across four different dimensions. As such, the solution space similarly must span these dimensions. Based on the problems uncovered through the stakeholder analysis, this study has the following five recommendations:

- 1) Standardization of a NATO PACE plan and creation of a universal data bridge
- 2) Conduct Command Post Exercises at standard intervals to identify interoperability issues.
- 3) Development of a standard Joint Military Information-Sharing policy
- 4) Establishment of a Spectrum Management Council
- 5) Development of a NATO leadership program

Establishing a standard NATO PACE plan, falling under the Communication branch and Network sub-branch, would require NATO forces decide on four common communication methods for operations. Given current communication practices, there would need to be separate PACE plans for voice communication and data transfer. An example of a possible standardized PACE plan is given in Figure 3. Both the voice and data transfers would likely require the use bridges to ensure interoperability. The development of a tactical voice bridge and a universal data bridge are key towards ensuring ongoing interoperability. Currently, countries develop specialized bridges to allow their command systems to share data or to connect their radios. The establishment of these standardized bridges would allow every country to share data and communicate with each other.

With the establishment of a NATO PACE plan and data/voice bridges, different countries would have the ability to communicate with each other. However, Command Post Exercises (CPXs) would ensure that the countries are properly using their systems to allow for them to communicate. A CPX requires higher echelon teams to establish their command posts and ensure interoperability with adjacent units; in doing so, they are able to identify obstacles prior to larger training exercises. In a multinational training environment, CPXs are a great way to expose obscure difficulties and create solutions. These exercises relieve the pain of unpreparedness and ensure that leaders become aware of their operational weaknesses with enough time to make improvements.

To reduce issues that could potentially arise during CPXs, it is recommended that the 7th ATC propose a NATO standard for Joint Military Information-Sharing (JMEI) policies. This standard would require that all new systems integrate with the aforementioned data and voice bridges. Additionally, it would set clear parameters around the classification authorities of individual countries. This would enable the programming of nation classification into networks and alleviate lower echelon troops from constantly having to acquire authorization to access data on integrated networks.

Additionally, this study recommends the creation of a Spectrum Management Council to address issues of spectrum disorganization and ownership in multinational training environments. Every country would appoint delegates to this council, and they would establish oversight of the electromagnetic spectrum. In doing so, NATO can ensure that each country is allocated certain frequencies to ensure that they can communicate without radio frequency interference from other countries.

Moreover, the establishment of this council would be critical for ensuring that electronic warfare equipment does not damage NATO's communication networks.

With communication interoperability improved, the next issue is related to leadership and cultural differences between the forces. The establishment of a NATO required enhanced leadership program is recommended. By focusing on developing coalition forces as problem solvers who can understand their allies' capabilities and how they operate, they will be prepared to interoperate with them. This will include additional training specifically for the purpose of leading troops from all echelons.

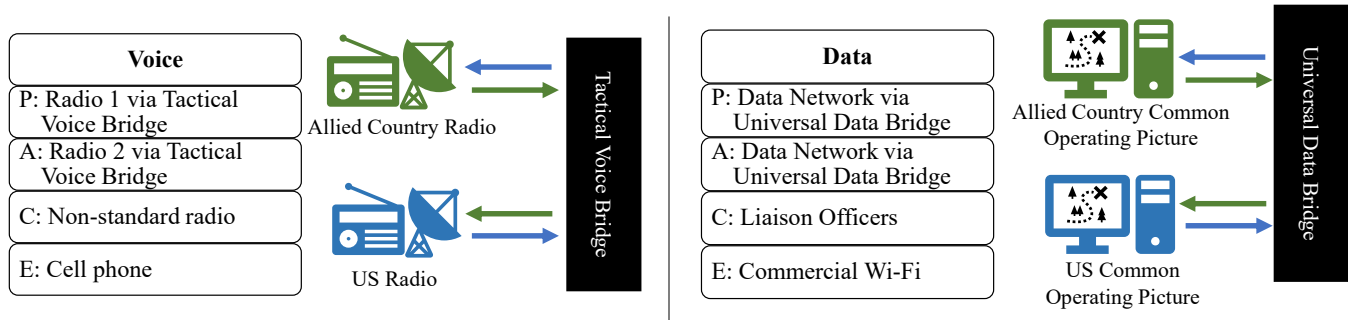


Figure 3. Example of a NATO PACE plan using a tactical voice bridge and universal data bridge.

5. Conclusion

NATO faces several challenges in achieving interoperability among its member countries and their respective military forces. These include disconnects between member states related to communication, doctrine, equipment, and leadership. Moving to future wars, these interoperability issues must be addressed to ensure smooth, coordinated operations.

This study set out to understand the problems faced by NATO and to offer possible solutions to remedy some of its larger pain points. These include the establishment of a NATO communication plan, conducting command post exercises at standard intervals, the development of a standard Joint Military Information-Sharing policy, the establishment of a NATO leadership program, and the establishment of a Spectrum Management Council. While these recommendations will not solve the interoperability issues facing NATO, it will promote smoother operations in future conflicts.

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