

Towards Creating a NATO Standard Methodology for Assessing Multinational Interoperability: A Canadian Perspective

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ABSTRACT

As a multinational Alliance, NATO is most effective when its member nations can bring their forces together with confidence on short notice. A critical information requirement is therefore to understand the degree to which its national forces are interoperable. To effectively communicate this understanding, uniform, repeatable, reliable, and structured methods and frameworks are required. SAS-156 was formed with the intent to develop a NATO standard for interoperability data measurement, collection, and assessment. Information age requirements challenge the ability for disparate units to quickly, easily and securely connect and share information, but the human and procedural elements remain just as important. The authors will present their work on synthesizing and extending the existing assessment frameworks from the participating nations, informed by their experience working within the Canadian Joint Operations Command. The experience of the Canadian Armed Forces is particularly relevant as the Framework Nation of the multinational NATO enhanced Forward Presence Battle Group in Latvia, and its rotational leadership of Standing NATO Maritime Groups.

KEYWORDS

Operations Assessment; Interoperability; Operations Measurement; Military, Requirements Evaluation; Military, Force effectiveness

1.0 INTRODUCTION

Alliances and partnerships have been a critical component to successful large scale combat operations of the last century. Interoperability – the ability to act together coherently, effectively and efficiently to achieve tactical, operational, and strategic objectives – is the key to achieving success. NATO nations and partners understand the importance of interoperability, and vast amounts of data have been and are being collected on operations and at exercises and events to assess how well multinational coalitions are able to achieve it. However, barriers such as a lack of standard terminology remain, and reliable and valid methods for data collection remain elusive. To remedy this, a technical activity proposal to the Systems Analysis and Studies (SAS) Panel [1], approved in 2019, and the resulting follow on activity, NATO Task Group SAS-156, “Developing a Standard Methodology for Assessing Multinational Interoperability” are pursuing these explicit research and exploitation goals:

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- To help NATO move towards a standard for interoperability data definition, collection, and management.
- To allow military planners to better understand their state of interoperability with their partners and discuss those assessments in a common manner among them.
- To inform resourcing decisions of individual nations pursuing their own interoperability objectives.

It is important to emphasize that this is an effort to standardize the *assessment of interoperability*, not to create interoperability standards or to achieve a specific interoperability goal. The research task group is keenly aware of the many ongoing NATO efforts to achieve interoperability in specific areas, for instance the Federated Mission Networking Coalition Interoperability Assurance and Validation Working Group [2].

This paper concerns Canada's contributions to NATO Research Task Group (RTG) SAS-156. Both the proposal and the task group have been and are led by members of the USA Center for Army Analysis (CAA). Canada, the United Kingdom, and Turkey also participate, along with NATO Allied Command Transformation (ACT) and Allied Land Command (LANDCOM). NATO ACT's Interoperability Verification & Validation director has been identified as the potential custodian of the results [3].

As a starting point, CAA suggested assessing the utility of an assessment instrument named the Army Interoperability Measurement System (AIMS) [4], which is an adaptation of a CAA prototype tool known as the Communications Interoperability Appraisal Table [1], while acknowledging that other methodologies/frameworks/tools exist and should also be considered. The development of the proposal occurred in parallel with Army-to-Army discussions within the American, British, Canadian, Australian and New Zealand Armies' Program (ABCANZ) – a program aimed at optimizing interoperability and standardization of training and equipment, which has been exploring the use of both AIMS [4] and the Multinational Interoperability Assessment Tool (MIAT) developed by the UK [5].

While the group is progressing in a number of areas, it must be stated that the Coronavirus disease 2019 (COVID-19) pandemic has created limitations for the group meeting, working and finding experimental opportunities for the framework, and the participation of researchers in operations and exercises has been significantly curtailed.

This paper begins with brief review of the motivation for Canadian participation. It will then highlight some of the issues NATO RTG SAS-156 must address to deliver a framework that meets the needs of both member nations and the Alliance to meaningfully assess interoperability. These include: the levels to be assessed and the detail of those measures (sect 3.1), the policies, standards and agreements in place versus the practical ability of entities to interoperate (sect. 3.2), standards by which to assess interoperability (sect. 3.3), perils and pitfalls of assessment frameworks (sect. 3.4), and planning for changing priorities (sect. 3.5).

2.0 RESEARCH SOURCES

The contributions in this document draw heavily on a Scientific Report by the authors, as well as their experience with the assessment organizations at Canadian Joint Operations Command (CJOC) and the Canadian Army [6-9]. The authors have also been conducting a literature review of Canadian documentation related more specifically to interoperability assessment, as members of SAS-156 lead similar reviews of their respective national literatures as well as the open scientific record.

2.1 Canadian Context

Parallel to the initiation of SAS-156, Dr. Banko was embedded with the Canadian Army Land Warfare Centre and was preparing with them for participation in the Joint Warfighting Assessment (JWA) 2020 experiment [10], a key component of which was to be exposed to and preliminarily evaluate the AIMS and

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MIAT tools. While participation in this experiment was dramatically curtailed by the pandemic, Army-to-Army interoperability discussions continue through ABCANZ Armies, and participation in future JWA experiments remains a possibility for the authors to further the goals of SAS-156 and the Canadian Army.

Also key to Canada's military interest in the topic is the role of CJOC, which leads most Canadian Armed Forces (CAF) operations in Canada, North America and around the world. It also serves as the Joint Readiness Authority for the CAF [11]. Mr. MacLeod was embedded there from 2017-2020, while Dr. Banko has been embedded there since 2020 (and previously for five years at one of its predecessor organizations). It is a central point for overseeing and assessing both Canada's NATO commitments, and CAF's preparedness to operate in a joint, interagency, multi-national and public context [12]. Three examples of CJOC operations highlighting different interoperability challenges will be given, followed by a discussion of CJOC's extant assessment items on interoperability readiness.

The first is Canada's leadership of the NATO enhanced Forward Presence battlegroup Latvia as Framework Nation from June 2017 to the present [13]. This highly integrated multinational battlegroup has experienced many challenges and learned many lessons from this ongoing operation. Commanding Officers rotating out of the battlegroup provide formal back briefs at CJOC headquarters, while their staff provide after action reports, lessons learned and other documentation that can be accessed from CJOC information management systems.

A second example is Canada's participation in the Multinational Joint Commission established by Canada, Lithuania, Poland, Ukraine, the United Kingdom, the United States, Denmark and Sweden to harmonize responses from requests for military training from Ukraine [14]. Two of these nations are not members of NATO, although they belong to the Partnership for Peace. That said, it is not a NATO mission, highlighting the need for Alliance members to understand their ability to operate outside of a purely NATO construct.

A third example is CAF's periodic leadership of and participation in Canadian Task Force (CTF) -150, a task force of the Combined Maritime Forces (CMF) [15], a 34-nation maritime partnership. Mr. MacLeod deployed to CMF in 2014-2015, and observations from that mission inform his perspective on the dynamic formation of multinational task forces with a variety of partners [16]. Particularly notable were periods where three separate task forces with overlapping membership operated counter-piracy task forces off the Horn of Africa – CMF's CTF-151, NATO's Operation OCEAN SHIELD [17], and the European Union's Operation Atalanta [18]. For multiple reasons, the ability of two units to interoperate binationally was sometimes observably different from their ability to interoperate as part of a NATO or CMF task force. While OCEAN SHIELD ended in 2016, the other two operations continue, and NATO members remain part of both of them, providing an opportunity to observe the challenges experienced by members of NATO dynamically moving between multiple partnerships and coalitions.

More generally, CJOC maintains a Joint Task List [19], similar to the Universal Joint Task List in the United States [20]. The CJOC list aims to describe "activities where two or more services, or joint enablers are required to operate together to achieve a task" [19] – suggesting the whole list is inherently evaluated in the context of joint interoperability, if not multinational interoperability. Achieving and assessing joint interoperability and intra-operability can be an issue as much as multinational interoperability, as has been acknowledged by the US Army Headquarters [4] regarding the future development of AIMS. The joint training plan is built to ensure all of these tasks are routinely exercised [11]. While the term "interoperable" explicitly appears in relatively few sub-tasks, it is embedded within the measures or description of many more tasks.

The understanding of the full scope of interoperability is wider than network or systems aspects, but is better embodied by the NATO terminology of technical, procedural and human *dimensions* of interoperability [21]. For instance, a sub-task titled "Enhance politico-military relations to promote security and interoperability," considers elements such as cultural awareness and familiarity, mutual participation in social events, and

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collective pride. Another sub-task titled as “Contribute to the Development of Headquarters/Coordination Structures for Coalitions,” is described as including ideas such as avoiding duplication of reporting to different chains and actual joint planning and execution of exercises and operations – i.e., it focuses more on what nations *actually* do together, rather than what they *could* do. For tasks on joint targeting and intelligence, surveillance and reconnaissance, the doctrine and governance aspects of interoperability are stressed alongside the technical aspects. Several of the tasks within the Shield function discuss assessing the risk of allowing systems to interoperate – i.e., in some cases a nation or service may technically be able to interoperate, but not be willing to do so.

3.0 PRELIMINARY FINDINGS

The task group remains in a relatively early stage of research, as the pandemic has challenged the ability of the group to work collaboratively with each other, and also that of its members to gain access to participate in the experiments, exercises and operations where interoperability and assessment frameworks can be observed and utilized. That said, discussions within the group and national and group literature reviews allow us to highlight some of the issues the group will need to address to deliver a framework that meets the needs of both member nations and the Alliance to meaningfully assess interoperability.

3.1 Granularity of Interoperability

The concept of granularity applies to interoperability assessment in two ways. One is the organizational level being assessed, i.e., whether interoperability is being measured between nations, forces, commands, formations or units. The other is the granularity of the measurement being applied between those organizations, be it the number of topics and sub-topics being assessed, or the granularity of the measurement scale itself.

While broad categories and definitions of levels of interoperability (e.g., “not interoperable,” “deconflicted,” “compatible,” “integrated” [22]; or “compatibility,” “interchangeability,” and “commonality” [23]) are certainly useful, applying these levels as blanket assessments of country-to-country or army-to-army interoperability will almost certainly gloss over more specific challenges. One can consider as an example the deep Canadian-American integration represented by the North American Aerospace Defense Command (NORAD): does its existence imply that all Canadian and American units, or even Air Force units, can work together at that high level of integration? Other pairs of nations maintain bilateral forces that may similarly operate at a much higher level of integration than those nations may otherwise achieve – e.g., the United Kingdom Netherlands Amphibious Force and the Spanish Italian Amphibious Force/Spanish Italian Landing Force [24].

While certain questions of interoperability fit naturally at the national or force level – e.g., those of policy, and operational level command and control (C2) systems – a complete assessment framework should also be able to address questions like “how interoperable is Country A’s fighter aircraft with Country B’s joint terminal attack controllers?”, and provide different answers if that answer differs between specific aircraft operated by that nation, or between different services within that nation.

It is also worth considering that nations with small and even medium-sized militaries rarely operate independently, and thus must be keenly aware of their ability to interoperate with others. Questions of force or formation-level interoperability may be less relevant to them. For an interoperability assessment framework to be relevant to all NATO nations, it should encompass questions of relevance to these smaller forces.

3.2 De Jure and De Facto Interoperability

There is a meaningful distinction to be made between what might be termed *de jure* interoperability – i.e., that the policies, standards and agreements are in place for two entities to interoperate; and *de facto* interoperability – the actual practical ability of those two entities to interoperate. One does not always preclude the other.

For example, all the formal procedures and standards may be in place between two nations, but due to lack of training, experience, or other human factors, two of those nations' units may not in practice be able to effectively and efficiently interoperate at a high level. An example of this can be units that are fitted with NATO C2 systems, but whose operators are primarily trained on and default to using their national C2 system.

Conversely, two nations may not have the official agreements and policies in place to interoperate on a routine basis, but on clearly defined missions, in times of crisis, or with specific national approval they may have the practical ability to do so. This can be seen in partnerships such as Combined Maritime Forces, where each nation brings its own rules of engagement (ROE), as opposed to NATO task forces that operate under agreed NATO ROE for an operation [25]. While this works reasonably well, there can be situations where an action is allowed under the national ROE of the force commander and the individual unit, but not under that of the task force commander – so while the force largely interoperates well, the lack of formal policies may cause this to break down.

The relative importance of these two types of interoperability may differ somewhat based on the audience or user of the framework, but ultimately they are both required in most situations. A similar framing distinguishes between an institutional perspective and a unit level perspective [23]. On balance, *de jure* interoperability may be more important within an institutional treaty organization like NATO or other alliance, while maintaining the *de facto* ability to interoperate with other partners may be all that is necessary or indeed desirable. As stated in a recent review by Rand (led by an expert member of SAS-156), “Interoperability is valuable as a means to an end, not as an end in and of itself. Interoperability is only beneficial for what it allows multinational forces to accomplish” [26]. As noted above, there may also be security or other risks in allowing national systems to directly interoperate [19], making the desired level of interoperability a context-specific choice. A standardized assessment framework should therefore be built to assess what *is*, rather than define what it *ought* to be.

3.3 Pair-wise versus Collective or Standardized Interoperability

A potential approach to assessing interoperability is to assess everyone against their progress towards adopting a single set of standards – e.g., NATO Standardization Agreements (STANAGs). Leaving aside the question of whether any set of standards can be complete enough for conformance to directly imply interoperability, the reality is that NATO members have allies or other partners outside of the core NATO membership with whom they may have interoperability goals, and NATO membership or standard compliance may not be an option for some of these partners.

It is also the case that some member nations have particularly close relationships in certain areas or happen to operate manufacturer-specific systems that can work together more seamlessly than the level covered by NATO standards. Where there is no NATO-wide standard covering an area of military interoperability, it is still desirable for nations to assess their mutual interoperability in that area, whether for conducting NATO operations or operating outside of an alliance task force. Put another way, without even considering outside partners, it may be understating the Alliance's own capability to interoperate in practice if the assessment scale only considers the use of NATO-standard systems.

Interoperability may not even be commutative, even in the presence of standards. It is possible Country A

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could interoperate seamlessly with both Country B and Country C in a given area, with Country B and C having more limited capability to mutually interoperate (e.g., if Country A operates both Link 16 and 22 military tactical data link networks, and the other two countries operate only one of them). Countries that specialize in or otherwise operate support functions may logically have a higher need for “one-to-many” interoperability in order to replenish or communicate with units of many other nations.

There is also an understanding that nations may be sensitive to any “assessment” being necessarily understood as a measure of the quality of their performance and/or effectiveness of their military. The NATO assessments handbook puts this sharply, stating that assessments are “inherently political as they question the capability and operating assumptions of organization[s], and affect how funding is allocated” [27]. This may lead to the assessments process being politicized, the results being elevated to higher security levels, or both.

For all these reasons, the authors suggest that while the intent is to provide a standard way for nations to communicate about interoperability, this does not mean that the assessments need to be centralized or benchmarked against a common way of doing things. Rather, individual combinations of nations, forces, or even units should be able to use the framework to assess their mutual interoperability, and if they are willing to share the results with other parties, they will have a standard language and framework for doing so. As stated in the introduction, the intent of SAS-156 is to standardize the *assessment of interoperability*, which is quite distinct from standardizing interoperability itself.

3.4 Simplicity, Ease of Use, Reliability and Validity

A more complete treatment of common perils and pitfalls of the design and use assessment frameworks generally can be found in an earlier report by the authors [6], from which the authors will draw the most relevant examples here.

While there are benefits to keeping an assessment system simple, especially when it is to be used in the field (whether on operations or exercises), it is important to understand the trade-offs inherent in reducing an assessment of a complicated topic to all dichotomous (i.e., “yes/no” – it happened or it did not happen) questions. Even ordinal, interval or ratio scales can be problematic if the raters or those completing the assessment have different views as to “how well” something is working. While a simple system may on the surface be easy to use for non-experts in the field, if the aggregated results that are produced are inaccurate, inconsistent, unrepeatable, or uninterpretable, the cost-benefit of conducting the assessment at all may be in question. Such a “failure cycle” has been described as a chronic issue in the field of military assessments [28] (or “cycle of ineffectiveness” in a later author’s terminology [29]), in which poor assessment doctrine and/or training, leads to poor processes and products, resulting in commander disinterest, and finally a lack of advocacy for fixing those issues.

The utility of low resolution scales to military assessment has been frequently questioned [28,30-32], including in the NATO handbook on operations assessment [27], with a common theme that presentations of simple scales inevitably lead to questions from the audience that require further explanation, with one author noting that “smart staffs often provide such narratives anyway” [30]. Particularly when it comes to issues like policy and human elements of interoperability, it is easy to see that a simple 1-4 scale – especially when aggregated across multiple sub-elements – may fail to convey important nuances. Even with technical aspects that seem more unambiguous, given the variety of sensors and sub-systems on modern military equipment, it is not hard to imagine situations where two ships can share surface contacts and visual imagery seamlessly but have a more difficult time sharing sub-surface contacts and acoustic recordings, for example.

The aggregation issue touches on what has been called “colour math” (alluding to the use of stoplight scales), in which Arnhart and King [31] describe the tendency to “average” good progress in five areas and poor progress in five others to an overall “marginal success.” One can imagine two nations whose air forces

work together regularly and seamlessly, but whose naval forces have not worked together before and lack the systems to do so – is it useful for a mission planner or decision-maker to think of these two nations as being moderately interoperable, or would they need to know that depending on what kind of mission is proposed, they may be very interoperable, or not interoperable at all? While perhaps a simplistic example, similar examples can be constructed within forces and even units, who may be perfectly interoperable in a patrol mission, but may have technical or policy blockages that prevent effective interoperation when it comes to refuelling, cybersecurity, or some other mission.

All this being said, while a simple quantitative scale may provide a useful communication tool for showing high level progress to organizations that have clearly defined interoperability goals, it is unlikely to provide the granularity needed for mission planners and commanders to realistically understand in advance what interoperability strengths and weaknesses a given multinational force has to address a specific need – whether for a deliberate mission or in a crisis response scenario. Where a real-world requirement requires two units with a less than perfect interoperability history to come together, perhaps more important than the precise level of interoperability is to understand what barriers exist to resolving the issue. A middle ground approach in which simple quantitative or binary qualitative questions lead to structured or semi-structured qualitative questioning is one possible solution [23]. A key challenge for SAS-156 will be to craft a framework that allows for adequate qualitative detail, without reducing to the current *status quo* of narrative observations buried in unstructured after action reports across a variety of national and NATO lessons learned databases.

3.5 Expecting the Unexpected

As Heraclitus is purported to have said, the only constant in life is change. Any assessment framework built around the goals in today's five or ten-year plan is unlikely to be particularly robust for even that long. This can be a particular challenge in military circles, where even the groupings of interoperability functions, dimensions, or elements changes over time, and is rarely standard across nations or alliances – at least not for very long. The relative importance of these may also shift.

A recent example of such was brought on by the COVID-19 pandemic itself. Varying national requirements for when and how service members should be tested for infection, and what isolation protocols would apply during repatriation created what could be considered an interoperability challenge on NATO missions [33]. Interoperability of healthcare protocols may not previously have been seen as a primary concern for mission commanders, but suddenly had direct bearing on the conduct of the mission, acceptability of barracks, and rotation of battlegroups.

In addition to traditional capabilities taking on unexpected importance, there is also a more general issue wherein standardization almost inevitably trails the introduction of new capabilities into military forces. In that sense, an assessment standard that is overly tied to today's capabilities, today's terminologies, and today's hierarchical groupings of functions is unlikely to remain relevant. A framework whose sub-components can be rearranged and used selectively is more likely to be relevant to more nations for a longer period of time.

4.0 CONCLUSION

While still at early stages, the authors believe that SAS-156 has a strong foundation from which to build towards a standard methodology for assessing multinational interoperability. From the perspective of Canadian operational research analysts, the team has identified some key aspects and challenges to keep in mind as that framework develops. Specifically, the authors recommend that the interoperability framework: has sufficient granularity to be of use to smaller nations and specific units, considers both the policy and practicalities, allows pair-wise or group-wise assessments, and is simple but has sufficient

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qualitative detail to understand the barriers to interoperability. The framework must be sufficiently flexible to adapt to unpredictable future strategies, operations, and events. Importantly, as with any military piece of kit, weapon or vehicle, there must be adequate training in its use.

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