Supplemental Material: 'Formal Learning in Military Operations: Selecting Lessons for Implementation'

Table of Contents

I. Theorizing the Formal Lessons Learned Process 2
Figure S.1. Theorized Lessons Learned Process Decision Tree 3
II. Methodology 5
i. Approach 5
ii. Selection of Militaries 6
iii. Sample 8
Table S.1: List of Survey-based Interviews with Military Officials 9
iv. Subject Recruitment 10
v. Survey-based Interview Questions 11
vi. Methodological Limitations 12
III. Considering Alternative Explanations: Politicization of Learning 14
IV. Discussion of Four Militaries' Formal Lessons Learned Processes 19
i. Overview 19
ii. Canadian Army 21
Figure S.2: Canadian Joint Lessons Learned Process 21
iii. French Army 22
Figure S.3: French Joint Lessons Learned Process 22
iv. UK Army 22
v. US Army 24
Figure S.4: US Center for Army Lessons Learned Mission and Method 24
V. Analyses of Survey-based Interview Responses 25
Table S.2: Qualitative Coded Responses to Selective Learning Interviews 25
Table S.3: Examples of Operational Lessons from Multilateral Operations 26
Table S.4: Selective Learning Codebook 27

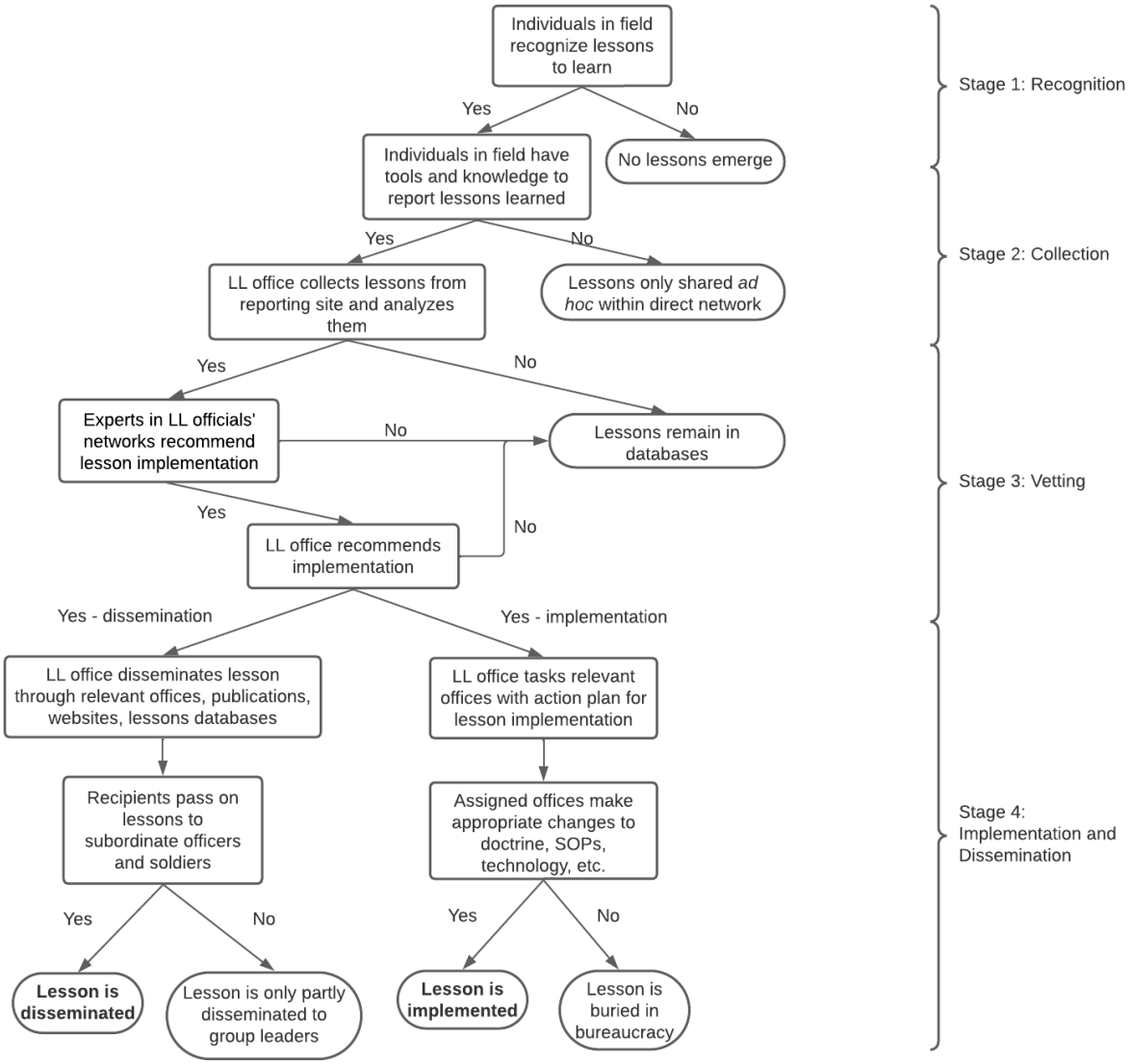
I. Theorizing the Formal Lessons Learned Process

Much of the literature on military learning focuses on the processes of adaptation (or ad-hoc "change to tactics, techniques or existing technologies to improve operational performance"[1]) and innovation (or "major changes that [are] institutionalized in new doctrine, a new organizational structure and/or a new technology"[2]). Formal learning may originate from adaptation in the field, and may result in major innovations in doctrine or technology. But solutions in the formal learning process may also arise from bureaucratic processes, information sharing, and training. In contrast to adaptation, formal learning is by definition institutionalized in documentation, and repeated by other parts of the organization. In contrast to innovation, formal learning need not be an entirely new development, but might rather be a formalization of existing adaptations in the field. Nevertheless, there is much overlap between adaptation, innovation, and formal learning, and therefore our theories to explain variations in formal lessons selection draw from existing literature on adaptation and innovation.

As noted in our study, we introduce a generalized formal learning process (as seen in Figure S.1 below) that we have theorized for professional militaries possessing formal learning infrastructure. To model it, we draw on existing military learning scholarship about formal learning processes and publicly-available lessons learned process organizational charts from official military websites.

[1] Theo Farrell, "Improving in War: Military Adaptation and the British in Helmand Province, Afghanistan, 2006–2009," *Journal of Strategic Studies* 33, no. 4 (August 1, 2010): 2.
[2] Farrell, 2.

Figure S.1. Theorized Lessons Learned Process Decision Tree



As seen in Figure S.1, we identify this generalized learning process via four stages: 1) recognition, 2) collection, 3) vetting, 4) implementation and dissemination. In the first stage *(1. Recognition)*, soldiers in the field recognize a situation in which a problem arises that could have been prevented or avoided. Here, they are identifying what is and what is not a lesson. (As aforementioned, we define these as possible changes to capabilities, doctrine, tactics, techniques

and procedures [TTPs].) The awareness stage occurs in any military, regardless of size or resources.

During the second stage *(2. Collection),* soldiers and other military officials in the operation codify the lessons that they have recognized. That is, a soldier may decide to enter a lesson into knowledge management software or the corresponding internal learning database within the soldier's military branch of service. (Again, we focus strictly on militaries that do have such infrastructure.) Certainly, some lessons simply never get collected at all either due to self-censorship or the normalization of certain deviances (e.g. flaws and failures that repeatedly 'escape scrutiny').[3] However, we view the internal centralized repository as a collection point for classifying and preserving lessons across time. Multiple types of procedures are available for adding lessons to that repository throughout professional militaries. In the US Army CALL, deployed soldiers can use a Request For Information (RFI) capability to submit lessons, concerns and questions, and CALL also 'conducts post-deployment collection visits' involving interviews that result in lessons from the theater of operations.[4] The repository ensures that those analyzing the lessons have a more comprehensive view of the scope and scale of lessons reported across multiple operations and units and, in the case of joint lessons learned offices, across multiple branches of the military.

In the third stage *(3. Vetting),* lessons learned officials, who are working in the offices that manage the repository, filter lessons out first based on viability and practicality – tossing out, for example, requests for hover tanks.[5] Alternatively, this vetting stage may be referred to as the 'analysis' stage. Officials are likely to dismiss any lessons deemed to be too niche to be of

[3] Joseph Lorenzo Hall, "Columbia and Challenger: Organizational Failure at NASA," *Space Policy* 19, no. 4 (November 1, 2003): 239–47.
[4] Michael Benvenuto, "Why the Center for Army Lessons Learned Is More Relevant than Ever: (And How NCOs Can Harness This Resource)," *NCO Journal*, September 2018.
[5] UK Lessons Learned Official, Subject #1790, Zoom interview.

broader interest to those within the service or of utility to the doctrinal office. Lessons learned officials must then determine which of the remaining feasible and practical lessons will be recommended for implementation and dissemination, and which will be set aside. As we discuss in detail in the study, we theorize that during this stage lessons learned officials rely on internal trusted experts within interpersonal networks to select lessons. (We go into detail about our theorizing on this and the subsequent stage in the main text of our study.)

In the final learning stage *(4. Implementation and Dissemination)*, lessons learned offices work together with implementing offices to ensure steps are taken to codify the lesson in doctrine, training, and practice. At this stage, lessons can still fail to be fully implemented due to lack of cooperation by implementing offices, red tape, budgets, poor dissemination of information, or lack of time or staff resources. Here, trusted experts can facilitate implementation, as we discuss in more detail in the main text of our study. Thus, while some lessons may languish in a drawer or electronic folder for years, we theorize that those lessons receiving assistance from experts in networks are more likely to be implemented. (Most lessons learned offices do also have procedures in place to follow up on lessons forwarded on to implementers.) Dissemination of the lesson follows a slightly different path in that lessons learned officials will work to increase awareness of the lesson across the relevant service/s and corresponding office/s while the lesson itself is being translated into action via the implementation process. Ensuring that people are aware of the change is an important part of ensuring that the change has a real impact.

II. Methodology

i. Approach

Why employ interviews instead of focusing on existing, publicly-available lessons? First, doing so allowed for us to test our argument about the selection of lessons for implementation in the broader context of military lessons that exist - rather than only the small subset that have been made public. Most lessons that are public are more than two decades old since declassification typically happens between 10-25 years out from creation. Second, viewing contemporary lessons in national militaries' computer systems was not an option for us; we are scholars without military affiliations and yet the overwhelming majority of lessons are classified. While we were shown an example of a form that soldiers fill out to submit lessons, we were (understandably) not provided access to militaries' private lessons databases since we are scholars and not military officials with a clear need to know. Third, if we had started with the publicly-available lessons and then tried to track down the individuals likely to be working in the learning offices at the time, such an approach would be extremely logistically challenging. Even in cases where the learning official's name may be indicated in the record of the lesson, we would still not be able to answer our question because it concerns why the individuals made the decisions that they did. Thus, interviews would be necessary either way and the latter individuals may or may not be accessible or available. Fourth, another problem in focusing on analyzing the lessons that are publicly available would be a sampling bias issue; that is, we would lack data on lessons that were considered but not ultimately selected for implementation. The lessons that are chosen to be declassified and made available to the public via databases are also more likely to be more positive in nature and/or already have been learned for reasons ranging from security concerns, reputational concerns or budgetary concerns (e.g. in the form of legislative oversight).

Finally, the declassification process in itself could have been biased; perhaps militaries tend not to declassify lessons that were not implemented and/or may be perceived as harmful to the military's reputation in some way. Therefore, we chose to employ interviews instead in order to indirectly gain insights into the private process of selecting lessons for implementation for several reasons.

ii. Selection of Militaries

With respect to sample selection, we chose to interview officials working in the learning and doctrinal offices of militaries from four states: Canada, France, the UK, and the US. While we recognize that there are some differences in size and capabilities across the militaries, we selected these militaries based on our scope conditions (i.e. professional militaries serving democratic states) and on their similarities on relevant metrics. These include that they are all militaries from democratic states, based on professional volunteer troops, had all engaged in many of the same military operations, were members of the NATO alliance and even shared a military size per capita (e.g. between 0.2-0.5%: US 0.4%, UK 0.2%, France 0.5%, 0.2%, according to the IISS). On relative power, France, UK and the US are all UNSC permanent members possessing nuclear power. The four militaries had also all served in the same operation (i.e. ISAF) during approximately the same time, contributing similarly high numbers of troops to the operation.[6] We also chose to study the selection of learning in multiple militaries in order to have a large enough sample of interviews (with these particular types of officials) from which we could sample in order to draw conclusions about militaries' selection of lessons.

[6] Here, we wish to acknowledge that the US - particularly in light of the surge - was contributing at levels much higher than other allies.

We were also able to control for other relevant factors in our selection of these four militaries. We chose ones that all have histories of joint operations, joint training exercises, and agreements on information sharing in the framework of NATO military operations (e.g. Iraq, Afghanistan, Kosovo, etc.). The experience of operating together has resulted in a convergence of terminology, procedures, and tactics over time.[7]

To further control for factors, we also selected militaries that had similarly designed learning processes, used similar methods for collecting and analyzing lessons, with similar degrees of institutionalization of such processes and similarly took cues from and contributed to NATO's own learning processes. For example, lessons learned methodologies in many ways mirrored steps in the official NATO Lessons Learned Process. Additionally, the four militaries share intelligence in the format of the 'Five Eyes plus France'[8] (Five Eyes intelligence alliance of the US, UK, Canada, Australia and New Zealand). (Three of the four are members of the ABCANZ (American British Canadian Australian New Zealand) Armies Program. The army learning offices are similarly small and follow similar patterns in terms of the order in which they collect, analyze and implement - leading us to feel confident assessing the viability of our argument among officials from all four militaries.

iii. Sample

With respect to sample size, we began with a target sample size of 10 officials from each country. However, in the course of doing the interviews and discovering the size of the offices (which is not publicly available for most), we found that most of the lessons learned offices

[7] David Lambert, "Adapting the Canadian Army Organisation: 'Transformation' and the Enduring Nature of Warfare," *Security Challenges* 6, no. 1 (2010): 63.
[8] Pierre Tran, "French Official Details Intelligence-Sharing Relationship with Five Eyes," *Defense News*, February 22, 2018, sec. name, https://www.defensenews.com/global/europe/2018/02/05/french-official-details-intelligence-sharing-relationship-with-five-eyes/.

contained fewer than 10 officials. Also, despite contacting all learning and doctrine officials whose contact information we could find, we had some subjects who did not reply to repeated (i.e. 3) email requests for interviews. Therefore, we ultimately achieved a sample size of 17 total (2 from Canada, 6 from France, 5 from the UK, and 4 from the US). A list of our interviews appears in the table below.

Table S.1: List of Survey-based Interviews with Military Officials

Identifier	Date	Format	State	Office
1790	5/13/21	Zoom	UK	Army - Lessons Exploitation Centre
2527	4/28/21	Zoom, then Phone[9]	USA	US Army
3415	4/15/21	Zoom	UK	Joint Forces
3510	3/23/21	Zoom	USA	Joint Lessons Learned Division
4726	3/16/21	Zoom	USA	Center for Army Lessons Learned
5818	5/12/21	Zoom	UK	Army - Lessons Exploitation Centre
6606	4/14/21	Zoom	Canada	Army Lessons Learned Centre
7309	4/30/21	Zoom	UK	Army - Lessons Exploitation Centre
8013	3/30/21	Zoom	UK	UK Military
8937	5/1/20	Phone	USA	Center for Army Lessons Learned
9649	4/6/21	Zoom	France	Joint Forces
9998	3/29/21	Zoom	Canada	Joint Forces
9977	3/4/20	In-person	France	Army - RETEX (Lessons Learned)
6756	3/4/20	In-person	France	Army - RETEX (Lessons Learned)
1435	3/4/20	In-person	France	Army - RETEX (Lessons Learned)
9452	3/4/20	In-person	France	Army - RETEX (Lessons Learned)
3650	3/4/20	In-person	France	Army - RETEX (Lessons Learned)

[9] The subject needed to split the interview in two parts due to scheduling.

iv. Subject Recruitment

Subject recruitment occurred in three waves. First, we identified learning and doctrinal officials whose names and contact information were publicly available on the respective army websites and we also contacted the press offices of these offices where contact information was available. Second, we sought out and recruited officials via LinkedIn by searching for those who had the key terms 'learning', 'lessons', 'doctrine', 'doctrinal' in their job titles from the respective armies. Third, after still finding our sample to be too small, we finally emailed our existing contacts in US, UK, French and Canadian militaries, from previous research, and requested the contact information of officials in the specific offices of focus. We employed email to invite all our subjects to participate and provided informed consent. We had a very high acceptance rate, with only four recruits declining due to lack of expertise, one due to scheduling problems, and one due to delays in approval from supervisors, however, again there are many learning officials whose contact information is not publicly available and who are not on social media or professional websites. One phone interview in the US and five in-person interviews occurred in Paris, France in early 2020. Due to the pandemic, we had to wait until late 2021 to carry out additional subject recruitment via Zoom and by phone. Interviews were semi-structured, and the base questions are included in the Appendix (Table 1). In-person interviews were recorded via notes by the interviewer, and Zoom and phone interviews were recorded and automatically transcribed by Zoom. All notes, recordings, and transcriptions were then loaded into NVivo (versions 12 and 14), where we cleaned up transcripts for accuracy and to remove identifying information.

To provide descriptive information on our subjects without violating their anonymity, our interview sample included three civilians and 14 commissioned or retired officers. We interviewed 16 men and one woman. Their ranks ranged from mid-tier to upper-tier ranks. We refrain from giving specific ranks since the number of individuals working in the offices is small and we wish to protect their anonymity. At the joint level (both in joint lessons learned and joint doctrinal offices), we interviewed two air force and two retired naval officers, while the remaining ten officers served in the army. The actively serving military officers were all somewhere between one to three years into their three-year tours, while the civilians and retired military officers had mostly worked in the lessons learned office for over fifteen years. All those interviewed had extensive military experience, averaging over 28 years of service (including the civilians - they had all worked for the military their entire careers). There was no apparent difference in ranks or experience between the subjects in lessons learned offices and those in doctrinal offices.

v. Survey-based Interview Questions

A: Lesson Collection and Vetting

1. For this study, we are specifically interested in operational lessons. What is the official mission and/or obligations that your office has concerning this level of lessons?
2. Within the Army, which are the specific office/s responsible for collecting operational lessons from multilateral operations? Is your office the only one? How do you coordinate the collection of lessons with other offices?
3. Can you briefly describe the process of the collection of lessons from multinational operations? For example, are there lessons collected in real-time from the field?
4. By which mode are these lessons collected – electronic (which type of system), phone, interviews, etc?
5. Who reviews and vets the lessons? How does that person/s determine whether to keep, reject or elevate a lesson (within the official internal system)?
6. Have you yourself ever collected lessons via the online learning system? If yes, do you know if it/they was/were ever implemented? Why or why not?

B: Lesson Implementation

7. How would you describe the implementation of a lesson? Is it normally a change in doctrine? A change in training? Which are the most frequent and most rare forms of lesson implementation?
8. In your opinion, why are some lessons are implemented but others never are?
9. Without giving me individual names, who determines which lessons are implemented and which are not? Similarly, who influences the decision to implement or not?
10. Which types of lessons are implemented and which types are not? Why?
11. Can you provide an example of a lesson that was implemented and an example of one that was not implemented?
12. On average, what % of lessons become implemented?
13. What are the biggest challenges to implementing a lesson?

C. Case of Afghanistan

14. In NATO's Resolute Support Mission in Afghanistan, what role did your learning office play in:
    a. collecting lessons?
    b. implementing lessons?
15. Can you give me some examples?
16. What were some of the biggest challenges in:
    a. collecting lessons?
    b. implementing lessons?
17. Relative to learning processes in other NATO allies, how does your learning process compare? What are the advantages and disadvantages?
18. Within the Army, what reputation does your learning office have? How much influence does this office have?

vi. Methodological Limitations

We acknowledge, as with any methodology, that our approach has several limitations that we wish to address. First, as aforementioned, our interview is small relative to the number of professional militaries in the world that have formal learning processes. The small size of most army lessons learned offices (i.e. typically less than 30) and the difficulty of accessing and gaining permission to interview military leadership meant that a large sample would not be feasible, and there were some officials who declined to participate in the study because they had just rotated into the position and felt insufficiently knowledgeable of the subject to participate. Additionally, doctrinal and joint lessons learned offices were even smaller, usually with only one or two officers working actively on lesson implementation. As a result, the number of subjects

we were able to interview in each office for each country was lower than we had anticipated. To compensate, we thus have focused on careful content analysis of responses. Each interview was coded in accordance with our codebook, which was designed based on the questions themselves to consider competing explanations (based on our propositions) and also captured descriptive characteristics of the learning process and latent categories (e.g. different themes related to learning and implementation). We analyzed the content of responses to examine whether these responses supported or refuted our propositions. We report the total frequencies of respective categories of responses in the Supplemental Material, V.

Second, our approach of interviewing those responsible for learning means that we have had less access to the details of specific lessons. While we invited officials to share examples of lessons implemented and not implemented in interviews, our subjects were in many cases either prohibited from sharing specifics for confidentiality reasons due to lessons being classified or were unable to think of examples on the spot. We offer a list of examples shared from interviews in the Supplemental Material, V. Another limitation may be the use of multiple modes of interviewing (i.e. in-person, Zoom and phone), however, we believe this has not introduced bias since we did not observe differences in types of responses across these types of interviews. Those interviewed by Zoom and phone were, in fact, equally as forthcoming as those we met in person.

Finally, it is important to recognize that in assessing learning processes and the collection of lessons, we do not assume that lesson collection guarantees the *quality* of those lessons. Certainly, formal learning processes add value to organizations, but they remain imperfect. We also acknowledge that self-censorship may be occurring at multiple levels (e.g. a solider unwilling to report out of fear of retaliation). Extant scholarship has acknowledged that lessons

can have built-in 'biases' as military organizations refrain from 'revealing dysfunction.'[10] Thus, we can only report our findings from those types of lessons that our subjects are willing to share with us, however, we believe that if self-censorship is occurring on a significant scale, officials should be likely to share this with us given the anonymity promised to them in the study.

III. Considering Alternative Explanations: Politicization of Learning

As noted in the body of the text, we also had initially considered an additional alternative explanation for why we might see variation in which lessons are adopted and which are not. In civil-military relations literature, some scholars have suggested that militaries may be more likely to implement and disseminate lessons that align with broader political interests. Certainly, as Huntington famously argued, professional militaries should operate *outside* the sphere of political influence (Huntington 1957), yet there exists an important paradox within this claim. The first paradox that Huntington reveals is that although the structure of the military profession is that while the professionalization of the military should "prevent partisan and political behavior by military personnel, it can also enable these activities" (Brooks 2020). As militaries remain beholden to civilian oversight and because civilian principles are inherently political, military officials may in fact be both a) keenly aware of political sensitivities higher-up and b) willing to exert pressure to see changes occur that would avert an operation's interference with clear political redlines (e.g. as illustrated in Goodman 2020). Moreover, Avant's work examining military change argued that differences in the extent to which civilian leaders could intervene in military decision-making explained differences in the US' versus the UK's abilities to change doctrine in Vietnam.

[10] Nina Kollars, "Military Innovation's Dialectic: Gun Trucks and Rapid Acquisition," *Security Studies* 23, no. 4 (October 2, 2014): 791.

In order for this alternative explanation to be correct, one would need to observe evidence of some civilian intervention. Harkness and Hunzeker argue, for example, that civilian intervention can affect military adaptation "by setting and changing objectives, determining and shifting metrics, allocating and reallocating resources, privileging and devaluing certain career paths, and by prescribing and proscribing acceptable options." (2015, 797) . In early civil-military relations work, Posen argued that innovation is often driven by civilian intervention as militaries tend to stick to the status quo (1984). However, such intervention may occur indirectly through sufficient communications from civilian offices about what is and is not acceptable for change or directly through explicit calls for what objectives should and should not be. In the case of Canada's adaptation in Afghanistan, for example, Saideman described, as part of the whole of government approach, many in the military were overly focused on 'satisfying' political officials of the minority government in charge in the capital (e.g. making the military coordinate with the Ministry of Foreign Affairs, Aid, and Public Safety) but not sufficiently adapting with respect to military objectives (2016: 118). Similarly, examples cited included efforts to do broad lessons learned reviews that then became stuck at what we refer to as the final learning stage: implementation / dissemination of results (2016: 114).

Applied to the case of multilateral operations, militaries may be particularly wary of lessons that involve speaking ill of other allies - clearly, a political sensitivity for alliances seeking to maintain cohesion. If a lesson requires calling out a specific ally, for example, one could expect that such lessons are less likely to be implemented since simply identifying and disseminating the lesson could risk political relations with that ally. Perhaps a military lesson acknowledges a key or repeated interoperability issue among aircraft with a specific ally; any adaptation to address this issue would require identifying the country in order to make the

changes necessary to improve interoperability. Bilateral mil-mil (military to military) communications would be critical. Similar examples of politically sensitive issues might be any lessons requiring the explicit identification of military leaders particularly high up in the chain of command - be it within one's own military, within the military of an ally or within the military of the state hosting the operation.

However, we have opted to exclude this politicization proposition from the main text of our study because we are skeptical that differences in civilian intervention are explaining differences in lesson implementation. First, formal learning processes in most professional militaries (representing democratic states) are typically operating deep within the military's bureaucracy. Second, there are significant information asymmetries across agencies (e.g. foreign ministries versus defense ministries) within these democratic states due to compartmentation[11]; that is, different agencies have different classification systems so politicians, executive officials and foreign ministry officials are unlikely to have access to or be requesting to see lessons in a lessons learned database. Third, civilian agencies (i.e. foreign ministries, executive offices) have high degrees of trust in militaries to adapt accordingly because they are professionalized. Therefore, we believe it to be highly unlikely that politicization is responsible for differences in implementation at this phase of learning since we do not expect civilian officials (e.g. such as these executive officials, legislative officials, foreign ministry officials, etc.) to have access to or be reviewing, let alone intervening, at this implementation phase within lessons learned and doctrinal offices. Nevertheless, given the aforementioned wealth of literature on civilian control and past examples of civilian intervention on military decisionmaking, we did consider and test a fourth proposition, which is as follows:

[11] Thomas H. Hammond, "Intelligence Organizations and the Organization of Intelligence," *International Journal of Intelligence and CounterIntelligence* 23, no. 4 (August 31, 2010): 680–724.

P4: *Militaries are more likely to select lessons for implementation when high-level civilian officials exert pressure on militaries to implement. Similarly, militaries should be less likely to select lessons that have high political sensitivities in the eyes of high-level civilian officials.*

In addition to the qualitative analysis that we conducted on propositions identified in the main text, we also coded interview responses for mention of political influence on the learning process, including to see if we found evidence of political interference with vetting of which lessons are sent up. Upon completion of analysis, we did not find support for this in our interview responses. There was scant mention of the role of civilian institutions and only one reference, for example, to a legislative body (here, Congress). In the case of one French official, the official described coordinating with civilian institutions, including France's foreign ministry and other agencies on the military's response to COVID, but this was more of a mention of a coordination action as a response rather than a civilian-led directive to divert learning in particular way or an example of a politicization of the learning process.

Consequently, we concluded that we have insufficient evidence to suggest that civilian institutions appear to be playing a limited role in influencing the decision to implement or not implement key operational lessons that the military takes. It is possible that this is because the lessons themselves that are identified may be held at a classification level to which civilian officials lack access or, more likely, a matter of information asymmetry. That is, civilian officials may not have sufficient information about which lessons have and have not been collected by the military to form an opinion and subsequently exert pressure to implement or drop a lesson.

To be clear, we do not conclude that political leaders have no influence on military decisions more broadly. Rather, we suggest that there may be little variation in the types of political influence that is being exerted on militaries' formalized learning processes. If there is any such influence, it is more likely to exist as a blanketed dampening effect on any learning at all out of risk of harming the military's reputation. From the field to headquarters, military officials are highly aware of strong interests in the civilian space - from political leadership, interest groups to domestic publics - in maintaining the public's perception of the military as having high operational effectiveness and maintaining high prestige.[12] We also chose to exclude this explanation from the main body of the text for the reason already cited therein. That is, there are real challenges in empirically observing and testing political influence on military learning because, if political leaders or their staff are interfering in this process, political and military officials would be highly unlikely to ever admit this since professional militaries are meant, by definition, to be apolitical institutions.

Another competing explanation that we excluded from this study was emulation;[13] that is, military officials in lessons learned offices and doctrinal offices may be 'importing' partial or entire solutions from other militaries.[14] However, we also dismissed this because even though we agree that militaries may from time-to-time find inspiration from other militaries (especially allies) for problem-solving, we do not expect that emulation answers our specific question of *why* officials are rejecting as opposed to keeping certain lessons. This specific formal vetting process is unlikely to have much outside input at such an early stage in the learning process. Additionally, our survey responses found extremely few references to emulation.

[12] Michael R. Kenwick and Sarah Maxey, "You and Whose Army? How Civilian Leaders Leverage the Military's Prestige to Shape Public Opinion," *The Journal of Politics* 84, no. 4 (October 2022): 1963–78.
[13] Tom Dyson, "Unpacking Military Emulation: Absorptive Capacity and German Counterinsurgency Doctrine during ISAF," *European Security* 29, no. 1 (January 2, 2020): 33–54; Olivier Schmitt, "French Military Adaptation in the Afghan War: Looking Inward or Outward?," *Journal of Strategic Studies* 40, no. 4 (June 7, 2017): 577–99.
[14] Schmitt, "French Military Adaptation in the Afghan War."

IV. Discussion of Four Militaries' Formal Lessons Learned Processes

i. Overview

We begin our discussion of these four militaries' lessons learned processes by briefly summarizing their origins. The formation of the UK's lessons-learned restructuring, for example, was their experience with the US lessons learned apparatus in Iraq.[15] Additionally, both the US and UK militaries have adopted learning-centric doctrines – strongly emphasizing the need for 'bottom-up learning.'[16] Both cultures of learning developed from joint experiences (and failures) in Iraq, driving calls for changes in the way the militaries were learning and adapting.[17] The Canadian lessons learned process, by contrast, grew out of public scandals from operations in Somalia.[18]

Additionally, with respect to the design and function of the militaries' formal learning processes, we found, as predicted, that the four militaries were quite similar in their processes, and, with a closer investigation, these similarities provided evidence suggesting that our theorized learning process (Figure S.1) should be generalizable across many leading professional militaries. Among the Canadian, French, US and UK, they have multiple forms of lessons collection in place, including an electronic system open to all soldiers and regular after-action reports from officers. Lessons learned offices vet received lessons before submitting recommendations for action to a panel or group with representatives from implementation offices and lessons learned officers.

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[15] Tom Dyson, *Organisational Learning and the Modern Army: A New Model for Lessons-Learned Processes*, Cass Military Studies (London ; New York: Routledge, Taylor & Francis Group, 2020), 79.
[16] Robert T. Foley, Stuart Griffin, and Helen McCartney, "'Transformation in Contact': Learning the Lessons of Modern War," *International Affairs (Royal Institute of International Affairs 1944-)* 87, no. 2 (2011): 253–70.
[17] Foley, Griffin, and McCartney, 255–56, 260.
[18] Emily Robinson, "Lessons Learned Performance Measurement," Scientific Report (Ottawa, CAN: Defence Research and Development Canada, August 2017), 6.

All four militaries participate in NATO's lessons learned training and conferences, thus over time, there has likely been iterative influence between NATO's own process and national processes. For example, to varying degrees, the respective four armies receive and review NATO's lessons learned materials as part of their formal lessons learned documentation and procedures. For example, an internal presentation on the French Joint Lessons Learned Process states that it is "inspired from the NATO doctrine." A Canadian review of the lessons learned process repeatedly refers to NATO's documentation.[19] In an interview with the British Army Review on the Land Warfare Centre, MG Tim Hyams stated "it is axiomatic that preparing for NATO operations is crucial to what we do."[20] The US Center for Army Lessons Learned Handbook cites NATO as a primary source for the handbook's material.[21]

There are some slight differences respecting design and resource allocation, including some differences in terms of civilian control.[22] The US embeds lessons learned officers in deployed units to assist soldiers in the field in identifying and collecting lessons and best practices,[23] whereas, other militaries, such as the UK, have removed doctrine creation and revision from individual services to the joint level, adding some additional layers of bureaucracy to the process.[24]

Concerning resources, different militaries devote different financial and material investments into learning personnel and infrastructure, which affects the capacity, reach and level of access lessons learned offices and doctrinal offices can provide to the field and relevant

[19] Robinson, "Lessons Learned Performance Measurement."
[20] BAR Interview, "The New Land Warfare Centre," *The British Army Review*, August 2018, 8.
[21] Center for Army Lessons Learned, "Establishing a Lessons Learned Program: Observations, Insights, and Lessons," Handbook (Fort Leavenworth, KS: Center for Army Lessons Learned, June 2011).
[22] Deborah D. Avant, "The Institutional Sources of Military Doctrine: Hegemons in Peripheral Wars," *International Studies Quarterly* 37, no. 4 (1993): 409–30.
[23] Dyson, *Organisational Learning and the Modern Army*, 23–24.
[24] Foley, Griffin, and McCartney, "'Transformation in Contact,'" 261.

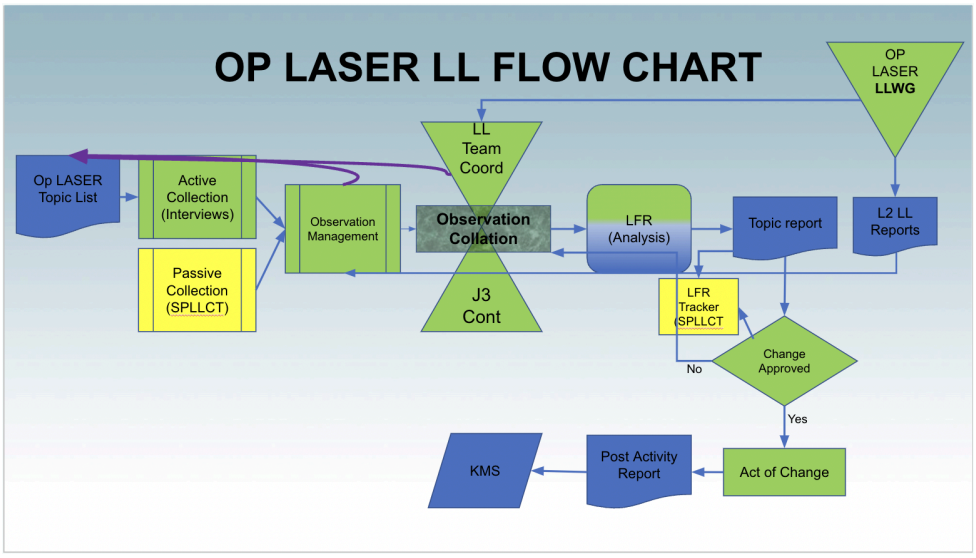
implementation offices[25]. With respect to personnel, at the time of this study, the US's Center for Army Lessons Learned (CALL) had approximately 100 officials at the time of data collection, whereas Canada's Army Lessons Learned Centre had 13 officials. Smaller lessons learned offices may be forced to focus on implementing a smaller number of high-importance lessons due to lack of resources, while larger lessons learned offices may be able to effectively process much larger volumes of lessons.

Finally, there were some differences in meeting frequency. Some conducted regular meetings between the lessons learned office and key decision makers in implementation offices, such as the Army Lessons Learned Forum (ALLF) in the US and the Military Judgment Panels (MJPs) in the UK. Others gave more discretion to the lessons learned office to forward lessons for implementation to the relevant departments. Nevertheless, across all four militaries, lessons learned officials played the important first step in determining which lessons are elevated and which are not.

[25] For example, in NATO's lessons learned office (the Joint Analysis and Lessons Learned Centre or JALLC), the number of learning officials has gradually increased from 30 people to now closer to 50 despite the enormous task of collection and analysis for the Alliance.

ii. Canadian Army

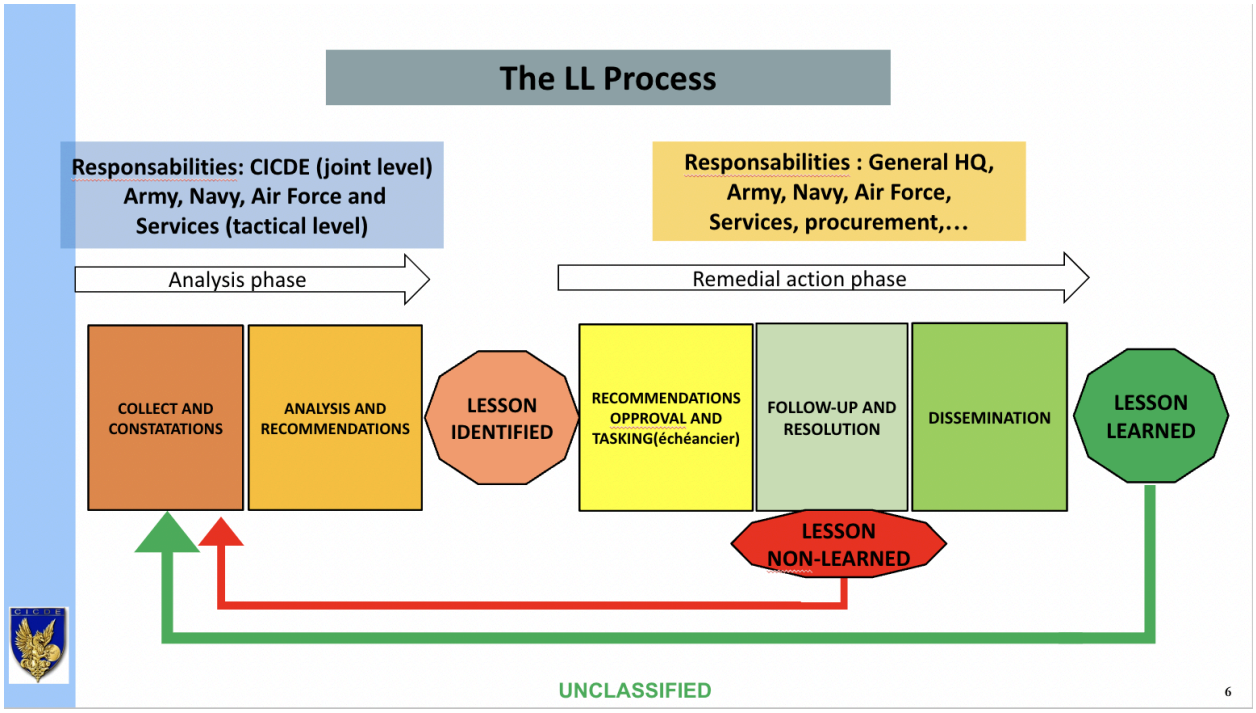
Figure S.2: Canadian Joint Lessons Learned Process



Source: Canadian Army. 'OP Laser Lessons Learned', Canadian Joint Operations Command (CJOC), Powerpoint Presentation, Slide 10, March 2021. Note from Slide 9: "Yellow items are tools. Green items are actions or meetings. Blue items are documents.
Observation and Topic (LFR) management are described in detail in the CJOC LL Aide-Memoire; 75% of observations will be managed internally and will not generate potential topics for LFRs. The blue arrows show the advancement of observations to topics to LFRs to the act of change (the result). The purple arrows show the feedback loop for observations to be promoted to the topic list (they cannot be managed within the submitting team) and the movement of closed observations (the 75% noted above) into final reporting." Unclassified. Provided with permission by Canadian military official.

iii. French Army

Figure S.3: French Joint Lessons Learned Process



Source: Ministère des Armées, 'Joint Lessons Learned within the French armed forces' Powerpoint Presentation, (April 6 2021), Paris, France. Presentation provided with permission by French Army official.

iv. UK Army

Note: The document and corresponding flowchart describing the formal lessons learned process in the UK Army is unclassified and was shared with us for context, however, we were informed that it is not for public distribution. Therefore, we have been asked to instead only describe the process in generalities. The UK lessons learned process is managed by Strategic Command's Joint Warfare Analysis Team through the Defence Lessons Working Group.[26] According to internal UK army documents and quotes from UK military officials, the UK operational lessons

[26] NATO NSO, "Allied Joint Doctrine Development," Allied Administrative Publication (Swindon, UK: DCDC Ministry of Defence, February 2019), 5, https://assets.publishing.service.gov.uk/media/620a2f82d3bf7f4f06550094/AAP_47_with_UK_national_elements_Feb19_EdC-access.pdf.

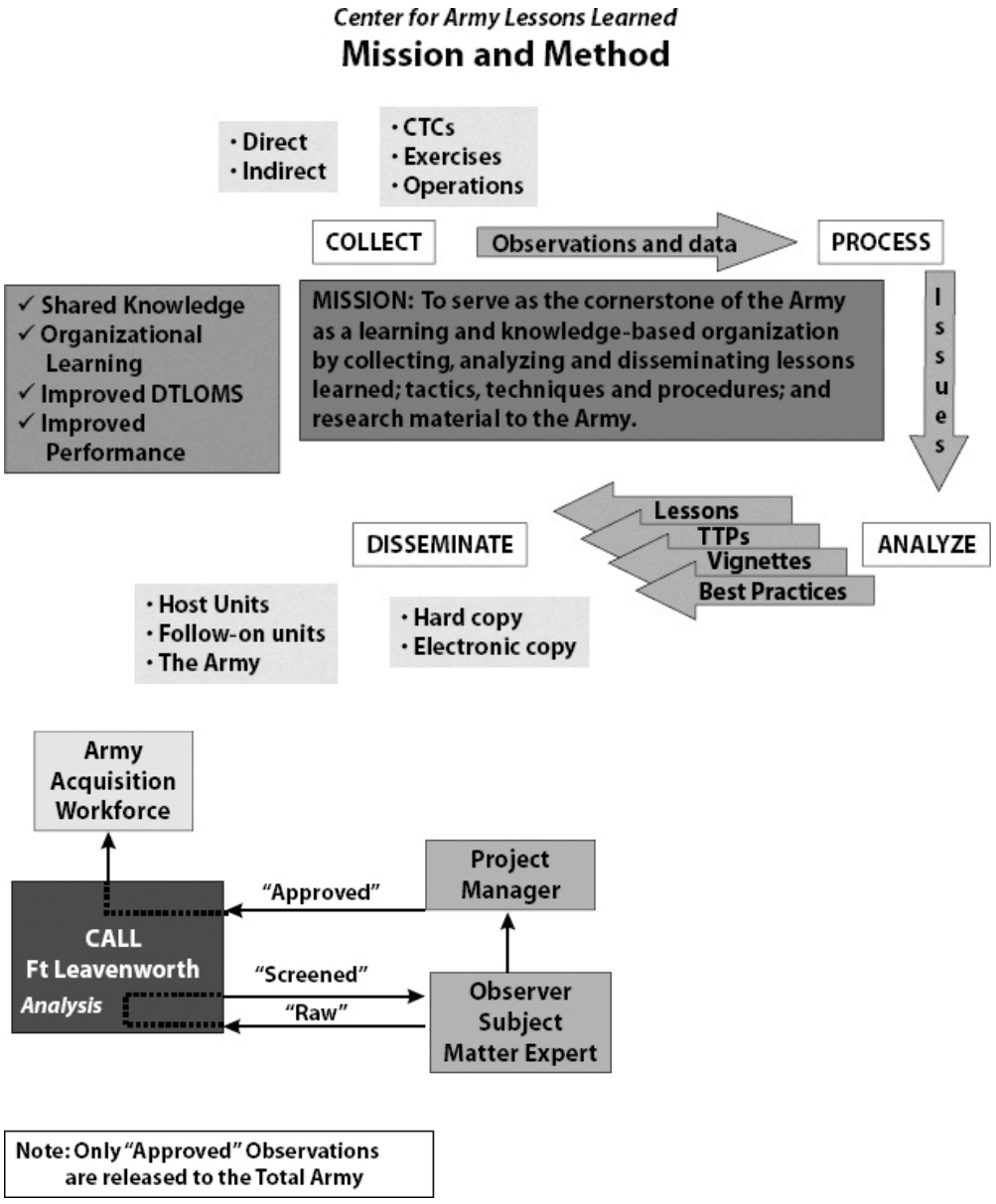
learned process has both ‘short’ lesson loops and ‘long’ lesson loops of learning, wherein the short loops respond to immediate problems and the long longs respond to lessons that are more long-term. In both cases, the process begins with the lesson being captured from the field, then analyzed by coordinating authorities, resolved and exploited. For short term problems, solutions may be provided directly in the field, whereas, for longer-term problems, there may be changes to pre-deployment training, to orders themselves, to Defence Equipment and Support (DE&S) or to the Defence Line of Development (DLOD). Thus, the learning process still involves these same steps of collection, vetting or analysis and implementation but the terminology for describing them is different (i.e. input, processing, output).

Source: Interview with UK Military Official and UK Army learning document, 2021.

(Continues on Next Page)

v. US Army

Figure S.4: US Center for Army Lessons Learned Mission and Method



Source: Lloyd Crosman, 'Lessons learned—the army way. Paper presented at Project Management Institute Annual Seminars & Symposium', San Antonio, TX. 2002: Newtown Square, PA: Project Management Institute.

Whereas our study focuses on selection of lessons rather than implementation, we briefly note that one - of many - formal ways in which lessons are implemented into the doctrine cycle is via AARs (After Action Reviews). This particular step is described in detail in the U.S. Army's

training doctrine manual (FM 7-0, June 2021)[27] and we reproduce the text here:
"STEP 4: INTEGRATE AND SHARE LESSONS LEARNED

K-42. Implementing and sharing lessons learned from AARs are an important last step in the AAR process. Commanders must use AARs and lessons learned to shape training and operations to correct identified deficiencies and sustain superior performance. Lessons learned from the AAR process are always recorded. Additionally, at higher echelons the results of AARs and their lessons learned are shared with other units— and the Army—in the after action report.

K-43. Commanders organize and write after action reports and lessons learned in a logical, chronological order, usually by operational phase or warfighting function. The after action report provides observations and insights from the lessons learned that allow the unit to reflect on the operation, and share these lessons with After Action Reviews the Army. Documenting what did not work well and the actions established to correct future performance, should receive as much attention as what did work well.

K-44. The format and content of an after action report is at the discretion of the commander. They are retained by the unit, periodically reviewed and discussed by leaders, and provided to the next higher commander for comment and possible dissemination outside the unit and to the Army as appropriate."

V. Analyses of Survey-based Interview Responses

As noted in the main text, we interpreted higher support for a given proposition if we observed a higher frequency of coded responses in line with corresponding sub-categories. For example, on the survey question regarding why lessons were implemented versus not, if we observed a higher number of references across all survey responses to the subcategory labeled 'influential advocate', that would indicate strong support for Proposition 3 since the subcategory refers to the influence of trusted experts. By contrast, if we were to observe a low number of such references to that subcategory, that would indicate lower support for Proposition 3.

Table S.2: Qualitative Coded Responses to Selective Learning Interviews

Propositions with corresponding codes	Description	# of Subjects	Total References
P1 Org. Culture	Implement when lesson matches interests of dominant organizational or strategic culture	17	93

[27] U.S. Army. 'FM-70 Training' . June 2021. Headquarters, Department of the Army. https://armypubs.army.mil/epubs/DR_pubs/DR_a/ARN35076-FM_7-0-000-WEB-1.pdf

Propositions with corresponding codes	Description	# of Subjects	Total References
P1A Hierarchical Culture[28]	Implementation determined by military hierarchy	17	65
Predetermined Learning Themes	Predetermined themes shape implementation	10	17
Top-Down	Lessons are more likely to be implemented with orders and/or support from above	12	40
P1B Strategic Culture	Implement lessons that support the dominant strategic culture of the military, ignore lessons that challenge it	7	11
P2 Threat Response	Implement if threats to military performance are growing	15	43
Civilian Casualties	Higher civilian casualties drive implementation	2	2
Mission Failure	Failure to meet mission objectives drives implementation	7	12
Soldier Deaths	Higher numbers of soldier deaths drive implementation	11	28
P3 Experts in Networks	Implement when one or more perceived internal experts within their professional social network encourages them to do so.	14	38
Critical Mass	A minimum threshold of key people across different units report the same problem / call for same solution	5	5
Individual - Change Reputation	Individual with reputation for pushing for change, adaptation/learning within network	6	13
Individual Charisma	Key individuals have code-switching skills, are personable, have high degree of trust within network	1	2

[28] Note: many of these coded responses did not actually address our dependent variable (variation in lessons learned). See Findings from P1 in main text for full explanation.

Propositions with corresponding codes	Description	# of Subjects	Total References
Proximity to Change Levers	Key individuals have close ties to those officials in doctrine offices and other implementation offices	11	14
(Dismissed Explanation) P4: Politicization	Implement when civilian officials exert influence	3	4
Executive Branch	Pressure to implement comes from the administration in power	0	0
Legislature	Pressure to implement comes from the legislature	2	3

Table S.3: Examples of Operational Lessons from Multilateral Operations

Lesson	Country	Implemented
Improve inter-army air-ground links after friendly-fire incident from American A-10	Canada and US	Yes
Implementing Covid-related quarantine during deployment	All	Yes
Alter equipment use and unit spacing when dealing with improvised explosives	UK	Yes
More driving instructions and simulations with MRAPs after numerous deaths and injuries caused by rollovers	US	Yes
New rules of engagement in response to operational casualties in Mali	France	Yes
Adapt strategic communications to cater to multiple audiences	US	Yes
Unify communications framework across allies	All	Yes
Reinforce vehicles against IEDs	France	Yes
Adjust exhaust from vehicles due to burning soldiers	France	Yes
Lack of financial resources for certain operations	UK	No
Laser-guidance system difficult to repair in field	France	No

Balancing investments in materiel and doctrine useful against future threats versus current wars	All	Not satisfactorily

Table S.4: Selective Learning Codebook

Note: A copy of the codebook appears on the attached PDF.