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Observations from the Russo–Ukrainian War: Implications for Southern African Regional Expeditionary Logistics

Ronald Ti[*]
King's College London

Abstract

A number of key observations affecting military logistics taken from the Russo–Ukrainian War carry important implications for logistic operations in Southern Africa. Despite these two areas of operations being quite dissimilar at a number of levels (i.e. geographically, climatically and politically), these have distinct implications, and the aim of this article is to outline five principal observations. Briefly stated, these are the use and evolution of uncrewed aerial systems and their role as surveillance and weapons platforms; the elongation of the so-called "last logistic mile"; the denial of airspace; the strategic importance of medical support; and the increasing presence of civilian contractors in the battlespace. This article will reflect on the importance of these observations, and highlight their importance in operational logistic planning in a future Southern African battlespace. Military logistic planners within South African Development Community[1] militaries should note and apply these observations to their own specific circumstances.

Keywords: Logistics; Expeditionary Logistics; Uncrewed Aerial Systems; Operational Logistics; Medical Support

Introduction

The term "expeditionary logistics", is generally considered to describe sustainment occurring at long distances with increased time intervals from a given national support area;[2] however, the term "expeditionary" itself is poorly defined. As one example, the 2023 *Australian Defence Strategic Review* has emphasised archipelagic manoeuvre operations to the north of Australia[3] and, given the distances involved, this clearly requires expeditionary logistics; however, the actual definition of "expeditionary" is missing. In an analogous way (with ocean replaced by land), potential operational areas extending northwards from South Africa also require sustainment through expeditionary logistics. Focussing on the current Russo–Ukrainian War[4] since 2022, logistic difficulties encountered by the Russian military in the initial phases have exposed its inability to deliver expeditionary logistics, with some observers arguing that logistic deficiencies have had a greater influence on the campaign than strategic deficiencies.[5] The distances involved are significantly less than those in Southern Africa, indicating that the term "expeditionary distances" represents any distance that is sufficiently long enough to attenuate and degrade a given military logistic (MILOG) system, regardless of absolute kilometres.

The study on which this article is based, demonstrated that, despite apparent differences across a number of parameters (for example in terms of geography, distances, character of war, operational intensity), key observations on military logistics gathered from the Russo–Ukrainian conflict can be applied to logistic operations undertaken regionally in Southern Africa.

The article will proceed in the following way. Following an initial disclaimer, the first section will define logistics, providing essential background information for non-specialist readers. The discussion will then proceed to a section focussing on the North Atlantic Treaty Organization (NATO) definition of logistics before outlining an archetypal joint logistic support network considered for current standard echelon deployment when undertaking logistic operations. A summary of the key logistics concept of push-and-pull sustainment then follows.[6] Subsequent sections will highlight five key operational observations that have been prominent in the Russo–Ukrainian War, and will also provide both observations gathered and clear implications for military logistic operations in the Southern African region. These extend to future Southern African military logistic operations, and each will be discussed according to every key observation identified in this article.

The five observations described in this article are based on recent commentary from writings by experienced military commentators since 2022.[7] The key observations arising from the Russo–Ukrainian War, which are the focus of this article, are:

- The development and constant evolution of uncrewed systems;
- The elongation of the "last logistic mile" concept;
- The presence of commercial logistic providers in the battlespace;
- The strategic importance of medical support; and
- Denied airspace.

While part of the intent of this special issue is to examine whether South African Development Community (SADC) militaries,[8] including the South African National Defence Force (SANDF), are fit for purpose over expeditionary distances in Africa, the emphasis in this article will be different. The aim of this article is to highlight operational logistics lessons learnt from the Russo–Ukrainian war since large-scale combat operations commenced in February 2022. The article does not discuss the operational capabilities of the military logistic system of each individual SADC member state, except in a general way with some brief comments. Further detail falls outside the scope of the current study. The article further assumes that military logistics is being conducted by small to medium-sized land forces typical of SADC militaries. Individual SADC militaries – and the degree of interoperability between the logistic systems of SADC militaries, especially in terms of doctrine and policy- are not discussed. In particular, the current study did not examine the operational logistics practised by the SANDF, although this would be widely considered the most prominent of these SADC militaries. While this article focusses

on generic medium-capability land forces (of which the SANDF could be considered a representative example) no direct commentary on the actual capability of the SANDF will be included. References to recent SANDF African operations will be made but only to emphasise certain points. The next section will provide a summary of logistics for the non-specialist reader.

Logistics

Militaries of all eras have always required sustainment and replenishment to continue to wage war and win battles. The first formal mention of the term "logistics" dates back to *The Art of War* by the nineteenth-century French general, Baron Henri de Jomini.[9] This work was the first to offer a succinct definition of logistics as the practical art of moving armies. In Article XLI of the work, Jomini considers one of the major functions of logistics to be the preparation of all the material necessary for setting the army in motion. This fundamental Jominian concept of movement continued to underpin the modern theory and practice of logistics, and the principles of supply movement elucidated in the nineteenth century have remained a fundamental doctrinal principle of modern military logistics. Every principal element of logistics discussed by Jomini in his 1838 work continues to be present in modern logistic doctrine.[10]

Logistics shares sustainment, support, and transport functions with the contemporary discipline of supply chain management (SCM). Much as with the term "defence logistics", the terms "supply chain management" and "logistics" are frequently used loosely and interchangeably in popular discourse and even combined as in the common use of the phrase "logistics and supply chain management". There is no agreement about the differences between SCM and logistics, with multiple definitions appearing in non-academic writing that are often inconsistent. A common point of difference is centred on whether the commentator holds a military versus a non-military, academic, supply chain discipline, or commercial provider perspective.[11] What is generally accepted, particularly in industry, is that the term "logistics" is regarded as one originating from the military, and that there is an equally broad definition of "supply chain management". Given the historical origin of logistics in the military, the following sections will define "military logistics" briefly.

Military Logistics

Following the description of logistics in the previous section, military logistics is a specific branch of logistics that enables the mobility, endurance, and sustainment of military forces, and is often referred to as "defence logistics", with the terms "military logistics" and "defence logistics" commonly used interchangeably. The current research utilised the NATO doctrinal definition as it reflects a widely accepted, multinational logistics doctrine that is in current, mainstream use. By being multinational, NATO doctrine is not nation-specific and is consistent with the generic content of this article. In addition, operational logistic doctrine in many Southern African countries is especially under-documented; hence, the use of multinational NATO doctrine addresses this gap. The principal reference is the NATO capstone logistic doctrine contained in Allied Joint Doctrine for Logistics

(AJP 4) Edition B, Version 1. According to AJP 4, "logistics" is defined as:

> [T]he science of planning and carrying out the movement and maintenance of forces. In its most comprehensive sense, the aspects of military operations which deal with:
>
> - design and development, acquisition, storage, movement, distribution, maintenance, evacuation, and disposition of materiel;
> - transport of personnel;
> - acquisition, construction, maintenance, operation, and disposition of facilities;
> - acquisition or furnishing of services; and
> - medical and health service support.[12]

North Atlantic Treaty Organization (NATO) logistic doctrine further defines military logistics as a grouping of logistic functional areas. This logistic doctrine identifies six discrete logistic functional areas.[13] These six NATO logistic functional areas as defined in AJP 4, the current, capstone NATO logistic doctrine document, are:

- Supply;
- Materiel life cycle support;
- Equipment maintenance;
- Movement and transportation;
- Services; and
- Medical.[14,15]

The NATO MILOG functional areas are effectively a collection of separate but non-mutually exclusive systems. A military logistic system can be regarded as a "system of systems" with each interacting dynamically with the others as well as with the external operational environment. Like the NATO doctrinal definitions presented above, the logistic functional areas can also be assumed in the present discussion on the Southern African operational context.

Operational Logistic Networks

Current NATO logistic doctrine describes operational logistic support as a system of logistic bases connected through logistic lines of communication. This doctrinal NATO operational logistic network is known as the Joint Logistic Support Network (JLSN) and is defined as:

> [A] system of interconnecting logistic nodes, activities, organisations and sites, and their multimodal links in the Joint Operations Area (JOA) … a typical JLSN will consist of, but not be limited to, points of debarkation points of embarkation; lines of communication (LOCs); logistic bases principally the theatre logistic bases (TLB); convoy support centres and staging areas.[16]

The JLSN is shown in Figure 1, as reproduced from NATO logistic doctrine. This shows a typical NATO force-level configuration of logistic units and support bases with representative communications and transport architecture connecting each part of the network. Figure 1 below shows the theatre logistic base (TLB), a force-level logistic structure sitting centrally within the NATO JLSN. The TLB is a concentration of force-level logistic force elements around which the JLSN is constructed. Typical logistic force elements located in the TLB are bulk fuel facilities, medical facilities, workshops, and other personnel support components, all of which are highly aggregated.

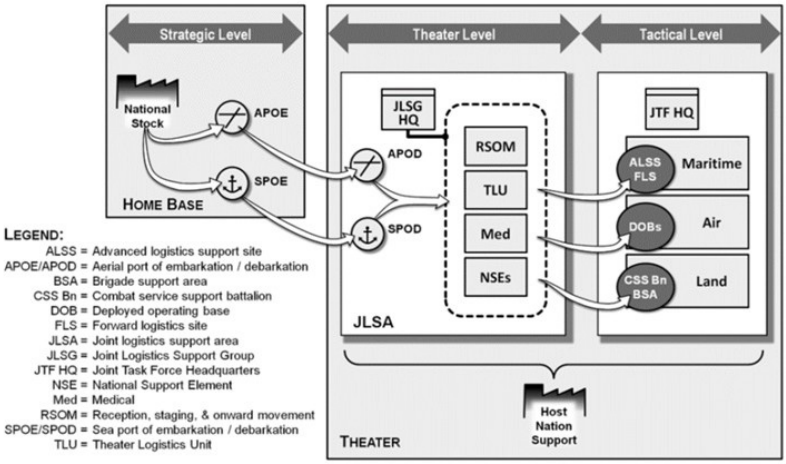

Figure 1: NATO land forces logistic support organisational chart[17]

The TLB itself occupies a substantial area, and, in the case of a NATO response force, comprises several brigade-sized units, may occupy tens of square kilometres representing a large logistic footprint. Until now, these facilities have been considered safe areas, well out of range of adversary strike. This particular logistic configuration has been employed successfully by NATO in the low-intensity environment, for example that of the International Security Assistance Force (ISAF) and OP RESOLUTE NATO[i] deployments in Afghanistan. Important enabling factors in this operational scenario were the presence of NATO air supremacy, as well as an indigenous adversary, which lacked major offensive support and effective standoff distance strike. Whilst this arrangement had worked well previously in a situation with a rear area relatively unaffected by adversary offensive fires, the Russo–Ukrainian War has shown that this is no longer the case. Whilst the NATO JLSN arrangement was adequate in providing sustainment in low-intensity and counter-insurgency environments, the Ukrainian conflict has exposed the vulnerability of aggregated logistic assets, such as a NATO JLSN TLB vulnerable to Russian stand-off

[i] The International Security Assistance Force operated under the auspices of NATO Operation Resolute from 2004 to 2010.

distance strike in the form of missiles or loitering munitions, such as the Iranian Shaheed uncrewed aerial system. For NATO to persist in concentrating its joint logistic support as aggregations of targetable logistic assets, would be inviting destruction in a zone of the battlespace previously considered out of range. The requirement for NATO logistics to deliver sustainment, all while disaggregated to reduce targetability, has been a major lesson learnt. This represented a substantial operational adjustment for NATO logistics, as systems and force structures will need to be modified to mitigate the evolving threat environment.

This description of a NATO doctrinal JLSN is relevant to a Southern African operational context for a number of reasons. First, conventional military deployments in Southern Africa employ much the same generic logistic echelon deployment as that which could be considered the equivalent of a TLB with logistic lines of communication (LLOCs) extending to more peripheral logistic nodes. It is therefore a valid model to present. Secondly, despite the likelihood that no potential Southern African conflict will involve major conflict, the same vulnerabilities to stand off distant strike, particularly in the form of weaponised uncrewed aerial systems (UAS) will be encountered. The same requirement for sustainment to be delivered by logistic nodes that are not aggregated in order to decrease their vulnerability to targeting applies to the Southern African operational context as much as it applies in Ukraine. This key fact will be highlighted in a later section of this article when the impact of UAS on logistics is discussed.

Push and Pull Logistics

In logistics, "push" and "pull" are terms used to differentiate the two principal methods of logistic sustainment. This particular terminology refers literally to whether logistics is "pushed forward" according to schedules determined by non-frontline echelon determinants, or, alternatively, is "pulled forward", with the key determinant being demand signals reflecting consumer need and usage rates. In the case of pull logistics, the end-user generates the usage-generating demand. Pull logistics ideally generates a series of demand signals, which drive the movement of sustainment forward through echelons. In the case of conflict, the end user will be the unit at the "sharp end" (frontline), which pulls sustainment from any notional rear area towards a notional forward edge of the battle area. Requests for materiel in the pull system are primarily centred on real-time demand and consumption. The main theoretical advantage of pull logistics is its responsiveness. In theory, given an effective and timely ordering system, pull logistics is the most appropriate arrangement for mitigating the invariable peaks and troughs of demand resulting from the ebb and flow of battle. The critical enabler in pull logistics is the de-centralisation and delegation of demand signal generation to the unit, which is actually located at the sharp end of the battle. The philosophy of mission command[18] underpins this approach. Expressed more formally, it is the forward logistic control element embedded within its respective combat formation, exercising flexibility and independent thought, which is the key enabler of pull logistics. Decentralised command elements, while not altogether absent, are less well represented in African military logistic systems, especially when compared to Western militaries.

By contrast, push logistics represents the conceptual opposite of pull logistics. As its name implies, push logistics is primarily driven by sustainment that is largely pre-determined. In push systems, materiel and resources are literally pushed forward, typically according to pre-determined usage rates. By contrast to pull logistics that is fundamentally consumption-driven – usage schedules determine the rate of push logistic replenishment, often determined at higher echelon levels, which are at some distance from the frontlines. By its nature, push logistics is not as reliant on the key features of decentralised command and high levels of delegation displayed in military logistic systems that emphasise pull logistics.

The diagrams below are oversimplified representations of these two logistic conceptual systems. Figure 2 depicts pull logistics, and here the end user drives the feedback loop (the red arrow) for sustainment (the blue arrow), enabled by command delegation and a degree of independence. The entire feedback loop achieves a degree of logistic homeostasis with adjustments being made primarily by the end user. It is important to note that this representation of a single demand and feedback loop is an oversimplification that does not show the multiple feedback loops that exist between the end-user and the pull logistic system, because these systems tend to be complex and adaptive, possessing multiple parallel nodes that confer intrinsic redundancy.[19] These are important reasons underlying why pull systems empirically tend towards greater resilience than push systems.

Figure 3 shows the push logistic system placing the locus of control centrally with secondary emphasis on feedback and flexibility on the part of the end user. This is a system that reflects centralised command and control. In the stress of battle, what little feedback exists may disappear, as represented by the lightning bolt. As a result of the dominance of centrally directed logistic command and control, push systems, by contrast, tend to be channelled and lack multiple nodes. The tendency of push systems to lack collateral feedback loops is a major factor leading to lower levels of system resilience characterising these arrangements. In these stylised representations of push and pull logistics, the relative sizes of the arrows are intended to represent the volume of movement and their relative importance. In Figure 3, the push logistic systems, feedback is less prominent, as reflected by the relative size of the red arrow, whereas centrally driven sustainment tends to be pushed forward according to perceived demand.

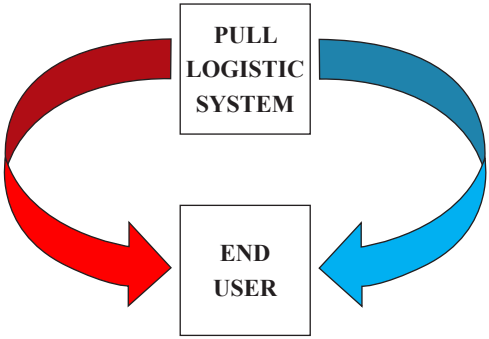

Figure 2: Pull logistics: feedback and sustainment form a dynamic feedback loop. Resilience is built into this system through delegation and flexibility.

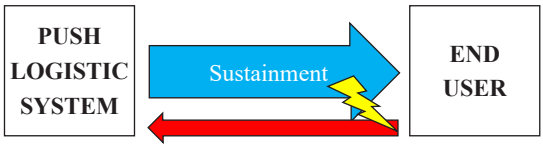

Figure 3: Push logistics: minimal feedback plus sustainment driven by usage schedules. These form a centrally driven system with poorly developed feedback loops. Push logistics is shown here intentionally as a linear system. Where what feedback exists may break down under the critical stress of warfare (as shown by the lightning flash), it becomes unidirectional.

In reality, the construct described above is an oversimplification. Military logistic systems are not exclusively push or pull in nature, and the mix will be modified according to a number of variables. One example related to Western military logistics is the extent to which contemporary SCM principles in widespread use in the commercial logistics sector have been adopted in military structures.[20] Western military logistics features widespread use of just in time (JIT) logistics, which is essentially a pull-driven system focussed primarily on cost-efficiencies, and stock management, developments which owe their origin to the SCM discipline, which in turn, is based heavily on commercial sector requirements. Notwithstanding this, in any given military logistic system, one of these methods will tend to predominate. In the Russian military, it is push logistics that dominates the Russian MILOG system. Amongst other factors, this situation reflects Russian centrally driven command systems.[21] This is a reflection of the persistence of centrally driven, relatively inflexible logistic demand systems of Soviet logistics manifesting in the newer NATO member militaries. The persistence of central control, a lack of peripheral decision-making, and the territorial, non-expeditionary nature of these former Warsaw Pact militaries (formerly aligned with the Soviet Union) have all hindered successful integration. The prior use of push logistics in such new NATO militaries is virtually universal.

It is apparent that critical deficiencies will arise in each logistic method given the shifting, unpredictable battlespace of modern warfare. Push logistics works best if usage is relatively predictable, particularly regarding optimisation of resource allocation, but can be inflexible, particularly when usage has been determined by higher logistic echelons. When the amount of friction naturally present in military command systems is factored in, the resulting time lag exacerbates the inflexibility of push logistics, handicapping its responsiveness. The comparative inflexibility of push logistics – when compared to demand-driven pull logistics – is its greatest disadvantage. In a shifting, unpredictable operational battlespace obscured by a dense, "Clausewitzian fog of war", a relatively annoying peacetime disadvantage can rapidly transform itself into a dangerous critical vulnerability. The inflexibility of Russian push logistics in the unpredictable operational battlespace of the Northern Kyiv front early in the Russo-Ukrainian war, exposed Russian critical vulnerabilities in logistics, leading to the failure of its strategic plan. The centrally driven system of push logistics was responsible for logistic difficulties in the initial stages of the 2022 invasion. Images of stalled and banked up Russian supply convoys reflected Russian push logistics, which continued to feed supplies forward without regard to the tactical and operational situation. The predominance of push systems in Russian military logistics is consistent with centrally driven, top-down command philosophies in the Russian military that are the ongoing legacy of deeply entrenched cultural and historical influences.

In the Southern African context, given the preponderance of centrally driven command systems, the most likely logistic methodology that will be employed will be push logistics. The relevance is that African military logistic systems – lacking well-developed demand signals and logistic information and relying on predetermined supply schedules – make it likely that logistic delays due to chokepoints and backlog will occur. Any expeditionary logistic planner in a Southern African military would do well to consider the balance and functionality of pull versus push logistics in their own military, particularly the level and development of the SCM system, and to plan accordingly.

Lethal Microclimates within Low-Intensity Operations

At first glance, the Ukrainian and Southern African areas of operation appear quite dissimilar. Obvious differences include not only shorter distances, a different climate and more benign terrain in Ukraine, but also fundamental differences in the character of conflict. The Russo–Ukrainian War is a major armed conflict at a much greater scale than the small wars that have characterised Southern African conflicts, notwithstanding historical engagements in which the South African Defence Force (SADF) was involved.[22] Regardless of intensity, these two situations are however linked across the spectrum of conflict by the presence of high lethality effects. While military operations in the past decade in Southern Africa have been characterised as "peacekeeping", "peace support" or "counterinsurgency operations", it is important to note that, despite these being low-intensity operations, high-lethality elements have been present, if not always applied. A useful analogy is that of a climate system, which can be described in general terms but within which microclimates exist, which may be quite the opposite of the prevailing

weather. A good example of this would be cloud forests existing in tropical climate zones. Due to the effects of altitude, precipitation and other factors, a microclimate is created that is altogether different from the prevalent one. In much the same way, the presence of certain weapons within a low-intensity battlespace creates a "high-lethality microclimate" just as deadly as that in Ukraine. Three of the five key observations that will be discussed below are directly attributable to logistics while two are high-lethality effects in the Ukrainian battlespace with directly attributable effects on operational logistics. The presence of these in the prevalent low-intensity operational environment of Southern Africa[23] results in an operational situation as lethal as the one in Ukraine. As described previously, the five key observations arising from the Russo–Ukrainian war and that will be shown to be relevant to a Southern African operational context are:

- the development and constant evolution of uncrewed systems;
- the elongation of the "last logistic mile" concept;
- the effect of commercial logistic providers in the battlespace;
- the strategic importance of medical support; and
- the effect of denied airspace.

In the sections below, each of these key observations and their relevance to expeditionary operational military logistics in Southern Africa will be highlighted.

Development and Constant Evolution of Uncrewed Aerial Systems

The Ukraine conflict has highlighted two major outcomes of widespread employment of uncrewed aerial systems (UAS) in the logistic battlespace. The first outcome is in the area of intelligence, target acquisition and reconnaissance (ISTAR). This emphasises the surveillance aspect of UAS ranging over the battlespace and acting as target acquisition enablers for long-range standoff distance strike. The second is the effect of UAS as flying ordnance highlighting their use as weaponised strike platforms.[24] The employment and evolution of these systems during the course of the Russo–Ukrainian war have changed the conduct of tactical-level logistics in particular. The effect of UAS in the tactical and operational battlespace in Ukraine is not novel, as the brief 2020 Nagorno–Karabakh conflict between Armenia and Azerbaijan was a distinct precursor, highlighting the employment of weapons systems, such as the Turkish Bayraktar TB 2 UAS, which have become well known on account of their use in the Ukraine war.[25] The Russo–Ukrainian war has highlighted the use of weaponised, UAS, employed increasingly as loitering munitions. The deployment of these particular assets with offensive-strike capability, whilst retaining their real-time surveillance functions, has increased the threat to logistic forces substantially. The ever-increasing range and persistence of UAS is further reason why the forward edge of battle area (FEBA) has now effectively been pushed further and further away from any notional frontline, presenting a real threat to rearward logistic units. In addition, the smaller size of many micro-UAS (often deployed at squad- or platoon-size tactical-level units) allows them to remain well below the detection threshold

of conventional ground-based air defence (GBAD) radar systems, further compounding the threat. Finally, despite current research, there remains a widespread lack of readily available effective weaponry against UAS, particularly for operational or tactical unit-level NATO logisticians, who often carry little more than individual small arms. This deficiency is also likely to be reflected in the case of African military logistic units.

Both Ukrainian and Russian use of UAS operating at multiple levels over the tactical battlespace in Ukraine, have been labelled by certain commentators as a game changer leading to the obsolescence of the tank in the modern land battlespace. While these kinds of opinions remain rightly disputed, what is beyond argument is the lesson that greatly enhanced ISTAR represents distinct increased risk and lethality for operational-level NATO logisticians. In addition, the Russian military deploys UAS directly from lower echelon, tactical-level units, unlike most equivalent NATO forces where UAS are generally deployed from centralised units often in brigade-sized formations or at higher divisional levels. It should be noted that, although this may have been the case at the beginning of the Russo-Ukrainian war, this situation has changed as a result of lessons observed from the conflict, with further refinement expected in NATO forces. Furthermore, the net result of such a preponderance of UAS across echelon levels within Russian organisational charts was an overall reduction in the 'reconnaissance-target acquisition-targeting-battle damage assessment' loop.[26] This has not only increased the rapidity by which Russian indirect fire assets acquire targets and execute fire missions, but also the speed at which these assets can adjust and then re-direct targeting. The result is to increase risk even further to NATO logistic units who are vulnerable at greater distances than previously. In a potential Southern African battlespace, whether during international or non-international armed conflict, deployed militaries can expect to encounter UAS deployed by potential adversaries. In a potential Southern African conflict, such adversaries may include non-state actors or insurgent groups.[27] The comparatively low costs of these systems has led to their widespread use and their cheapness and availability has made these systems a particular threat in asymmetric conflict situations of the kind that are likely to be encountered in a Southern African operational context.

The lethality of UASs has recently been increased considerably through augmentation of weaponised UAS with real-time streaming of flight vision in the form of "First-Person View" UAS (FPV UAS). Reports from the Ukrainian battlespace reflect how the use of these weapons in particular has affected MILOG survivability-and resilience.[28] Although both UASs and FPV drones are obviously not a logistic issue, what is important is that both their presence and effect in the modern battlespace have a direct influence on military logistics. Especially given the increasing range of these systems, safe rear area logistics bases (such as the TLB and logistic nodes located within an archetypal JLSN described earlier in this article) are no longer secure but directly targetable. Finally, the increasing use of wire-guided UAS which are not able to be jammed by conventional counter-UAS methods as well as the appearance of UAS enabled by artificial intelligence (AI) are worrying developments whose appearance in a Southern African operational battlespace can be expected. Countries in the SADC deployed to eastern Democratic Republic of the Congo (DRC) have already encountered weaponised UAS in eastern DRC. Recently

(August 2025) these have included "unjammable" fibre-optic cable-controlled first-person view drones.[29] One consequence of the appearance of UAS in the battlespace is the prolongation of the so-called "last logistic mile", a situation that will be described in the next section.

The Elongation of the "Last Logistic Mile" Concept

The phrase "last logistic mile" is used in logistic literature but, like the word "expeditionary", it is ill defined. In general, "last logistic mile" is used as a metaphor for that part of the logistic supply line subject to adversary action. The last logistic mile has generally been reckoned to be 15 km, a figure, which equated directly to the average 9-mile range of field artillery in 1914. In 2025, the reach of standoff distance strike weapons platforms and the increasing ranges of weaponised UAS have exposed these previously "safe" rear area logistic installations to attack far from any frontline. The last logistic mile now stretches effectively hundreds of kilometres, and has long since exceeded an actual mile. In the case of operational logistic nodes occurring along a logistic line of communication (LLOC) in future Southern African operations, the implications on force protection requirements are significant. Joint logistic support network arrangements consisting of operating bases, theatre logistic bases, and other aggregations of logistic facilities have been prominent in much of the African operational context. In the current threat environment, to mitigate the risk of targeting, such long-established logistic arrangements require re-evaluation, particularly with regard to key elements, such as dispersal, concealment, electromagnetic signature management, disaggregation, command arrangements and force protection. The last logistic mile concept has now been elongated to extend over hundreds or even thousands of miles. In fact, the phrase may now be a true metaphor, especially given that any relation to actual linear distance is now obsolete. If the last logistic mile is the distance over which operational logistic units can be targeted, then – given contested logistics in all five operational domains – the last logistic mile starts at the national support area itself. As an example of this, contested logistics in the cyber domain can target commercial shipping providers who may be responsible for expeditionary sea movement of land forces. As these commercial networks are overwhelmingly insecure, targeting these logistic elements would produce contested logistics before a force had even left port. The last logistic mile would then begin at the very first logistic node, and not the last. In the next section, the increasing presence and dilemmas of using commercial logistic providers in the modern battlespace are discussed.

Effect of Commercial Logistic Providers in the Battlespace

Observations related to contractors and commercial firms supporting expeditionary logistics are considered in this section. While these have not been a prominent feature of operational logistics in Ukraine, operational commercial support has now become a major component of Western expeditionary logistics and has resulted in widespread use of commercial firms to provide logistic capabilities, such as strategic airlift, fuel services, camp real-life support services, and multi-modal transport in major Western militaries. The key force protection issue with commercial firms relates to their "targetability" in a battlespace where the last logistic mile (as outlined in the previous section) is now

potentially hundreds of kilometres long and starts essentially from the national support area itself.[30]

Civilian contractors are generally considered under international law to be non-combatants;[31] however, this rule is not ironclad. There is insufficient space here to discuss the full scope of international law; however, as a generalisation, it is possible for an adversary to target contractors who are regarded as directly engaging in operations aimed against that adversary. A commercial logistic firm providing transport of fuel or ammunition close to the forward edge of battle area might be considered a legitimate target. In the Southern African context where adversaries may not be nation states but non-state actors, where non-international armed conflict (NIAC), rather than international armed conflict (IAC) was present, the situation becomes less clear-cut. The greater question is how an adversary – which might be a non-state actor and which, by definition, cannot be a signatory to international law and the laws of armed conflict (LOAC), engaged in a non-international armed conflict – can be held accountable, or indeed, will respect these rules at all. Furthermore, international law and LOAC only apply during IAC. On the commercial side, critical issues manifest as a result of the presence of contractors, such as insurance, commercial risk mitigation, compensation arrangements, and contract pricing effects. Any future Southern African military considering expansion of its expeditionary logistics capability to include commercial logistic outsourcing will need to consider all the relevant risk and force protection issues and then factor these into its logistic operational planning. It should be noted that virtually all current SADC member states place significant reliance on commercial logistics providers at all levels (strategic-operational and even tactical).[32] The next section highlights the key logistic functional area of medical support and its strategic importance.

The Strategic Importance of Medical Support

Ukrainian forces in the Russo–Ukrainian war have not only been challenged logistically by maintaining forward movement of materiel but also by rearwards movement of battle casualties. In future Southern African expeditionary situations, medical stabilisation followed by strategic aeromedical evacuation is not only a critical logistic, personnel support task, but it will also have major political importance in terms of strategic communication and perception management.[33] This is not the situation of a strategic corporal but rather that of a strategic casualty. In a constrained political environment where political will and perceived domestic support are critical enablers of any military operation, the effectiveness of medical personnel support may be a determinant of operational success in future African military operations, particularly if casualties are anticipated.[34] Strategic communication issues arising from medical support issues may well be a critical factor for future Southern African governments in retaining public support for future military operations. The essential requirement is for expeditionary logistics to include robust medical support systems, including deployable medical units suitable for treating, stabilising and evacuating casualties from the Southern African area of operations back to fixed tertiary facilities in the respective national support area. A critical element in the effective medical evacuation of casualties is aerial movement, which requires access to

the airspace. Denial of airspace has been a key feature of the battlespace with adverse effects on aeromedical evacuation, essentially stopping this means of emergency transport. The problem of denied airspace is presented in the next section.

Denied Airspace

Denial of the tactical and operational air battlespace over Ukraine has been a prominent feature of the Russo–Ukrainian war.[35] This has produced important lessons for NATO logistic planners, and in this air-denied battlespace, the NATO reliance on airpower, particularly its reliance on air superiority, has been highlighted. Some commentators have cited NATO over-reliance on airpower as a critical vulnerability exposed by the war.[36] The reliance by NATO on airpower has, in turn, resulted in a reciprocal under-emphasis on both ground-based air defence (GBAD) systems and on investment in surface-based strike capabilities, such as surface-to-surface missiles (SSMs). Another important capability required by NATO logistic units exposed by the Russo–Ukrainian war is the requirement for intrinsic GBAD systems at operational logistic levels. The war has demonstrated how lower operational echelon-based GBAD systems can produce a lethal tactical airspace for aircraft, at all altitudes and distances, resulting in denied airspace. The clear implication for Southern African military logistic operations is the vulnerability of logistic units and assets, which only a short time ago, were considered to be in "safe areas" well out of range of adversary action. As discussed in previous sections of this article, given the availability, cheapness, accessibility, lethality and range of UAS, the clear implication for Southern African logistic operations is the need to protect logistic assets as well as to disperse them. Unless Southern African military logistic units have organic GBAD systems, which are also effective against near-ground UAS, they will be critically vulnerable in a future operation. The important observation is that the GBAD system must be available at tactical and operational levels in land forces undertaking Southern Africa operations, particularly in supporting logistic units. With the increasing proliferation of UAS, the near-ground air domain has become a critical space, with its importance emphasised by the relative lack of effective counter-UAS systems.

Finally, as observed in the Russo–Ukrainian war, air denial has particular important implications for the essential personnel support function of aeromedical evacuation. The air-denied environment in the Russo–Ukrainian war has virtually halted the widespread evacuation of casualties by helicopter, a major feature of past low-intensity conflicts where Western forces have enjoyed air supremacy. The wider availability and distribution of GBAD systems have severely restricted the virtually unrestricted movement of helicopters in the land battlespace. Such unimpaired air movement was a common feature of the "bush wars", which the SADF undertook especially in Namibia and southern Angola from 1966 to 1989. Given an adversary with access to GBAD systems, particularly man-portable ones, this is no longer the case. The more widespread use of GBAD systems in Southern Africa has been shown recently in the DRC with both the United Nations Organization Stabilization Mission in the Democratic Republic of the Congo (MONUSCO)[37] and SADC forces being confronted by Rwandan-backed M-23 rebels equipped with sophisticated mobile GBAD systems in the eastern DRC.

Conclusion

The overall principal observation for logistics obtained from the Russo–Ukrainian war is that operational logistics has become more dangerous and considerably more vulnerable than ever before. Whereas in previous conflicts, logistic units were placed further back in rear echelons removed from the frontline of a linear battlespace, this is now no longer the case. Due to the appearance of uncrewed aerial systems together with the range, availability and lethality they represent, the long-standing concept of a logistic rear area, where logisticians would historically conduct sustainment operations in relative safety, has ceased to exist in the modern battlespace, as particularly demonstrated by the Russo–Ukrainian war. This article has highlighted five observations from the Russo–Ukrainian war, which would affect the conduct of operational logistics in future Southern African operations involving SADC militaries. These five key observations have a considerable implication for logistic planning for militaries with a high dependence on commercial logistic providers (such as the SADC militaries) for the reasons previously stated. Civilian, non-combatant contractors are even more vulnerable to the effects described in this article. Given the recent logistic difficulties experienced in eastern Congo by the SADC regional peacekeeping force, SADC military logisticians would do well to take note of the observations from the Russo–Ukrainian war described here.[38]

Endnotes

[*] Dr Ronald Ti was awarded a PhD in Military Logistics from Defence Studies Department of King's College London in 2025. He researched the resilience of NATO military logistic units at the tactical level of war in NATO Article V large-scale combat operations. Dr Ti is currently an affiliate lecturer in the Defence Studies Department, King's College London at the UK Defence Academy at Shrivenham, an affiliate lecturer at Maynooth University, Ireland, and a visiting lecturer at the Finnish National Defence University in Helsinki, Finland, Baltic Defence College in Tartu, Estonia, and the Swiss Military Academy in Zurich, Switzerland. He is currently a colonel in the Australian Army Reserve and in a 30-year career has been engaged principally as a logistician/staff officer.

[1] The Southern African Development Community (SADC) is a regional economic community comprising 16 member states.

[2] The term "national support area" is generally taken to mean the nation from which that military originates and which is the primary source of its sustainment. For example, for a given SADC country, the national support area would be that particular nation, i.e. Botswana in the case of the Botswana Defence Force.

[3] Australian Government, *National Defence: Defence Strategic Review* (Canberra 2023), 7.

[4] This article focussed on the period from February 2022 when the Russian invasion or so-called special military operation commenced. It is acknowledged that Ukraine has been in direct conflict with Russia since 2014.

[5] R Ti & C Kinsey, 'Lessons from the Russo-Ukrainian Conflict : The Primacy of Logistics over Strategy', *Defence Studies*, 23, 3 (2023), 381–98. https://doi.org/https://doi.org/10.1080/14702436.2023.2238613

[6] Specialist (logistician) readers may choose to skip these initial sections and read from this point forward.

[7] Ti & Kinsey, 'Lessons from the Russo-Ukrainian Conflict'; P Skogland, T Listou & T Ekström, 'Russian Logistics in the Ukrainian War: Can Operational Failures Be Attributed to Logistics?', *Scandinavian Journal of Military Studies*, 5, 1 (2022), 99–110. https://doi.org/10.31374/sjms.158; M Zabrodskyi, J Watling, OV Danylyuk & N Reynolds, 'Preliminary Lessons in Conventional Warfighting from Russia's Invasion of Ukraine: February–July 2022', *RUSI Special Report*, 30 (2022), 69; J Watling, *The Arms of the Future* (London: Bloomsbury Academic, 2024); R Ti, *Russian Military Logistics* (Tallinn: International Centre for Defence and Security, 2022); R Ti, 'Logistics Lessons Observed: A Critical Enabler and Vulnerability', in T-D Young & J Gryz (eds.), *Tactical and Strategic Insights from the Russo-Ukrainian War* (Exeter: University of Exeter Press, 2025), 184–202.

[8] For SADC, see https://www.sadc.int/pillars/defence

[9] AH de Jomini, *The Art of War* (GH Mendell & WP Craighill, trans.) (Philadelphia: J B Lippincott & Co, 1862), 69.

[10] For example, quoted in current Australian Defence Force (ADF) logistics doctrine, see ADF, Australian Defence Doctrine Publication 4-0, *Defence Logistics*, AL1 (2017), 1A-2.

11 For a typical and recent (2021) commentary originating from the commercial supply chain management sector, see A Jenkins, 'Supply Chain Management vs Logistics: Differences, Similarities and Roles', *NetSuite*, 25 July 2022. <https://www.netsuite.com/portal/resource/articles/erp/supply-chain-management-vs-logistics.shtml> [Accessed on 30 December 2025]. This offers a commonly repeated definition of the "difference" between logistics and SCM; however, the definitions presented in non-academic writing of this kind frequently lack supporting research or references.

12 NATO, Allied Joint Publication (AJP-4) *Logistics*, Edition B, Version 2 (2018).

13 NATO, Allied Joint Publication (AJP-4) *Logistics*, Edition B, Version 2 (2018), 5-5.

14 NATO, Allied Joint Publication (AJP-4) *Logistics*, Edition B, Version 2 (2018), 5-5.

15 The NATO Logistics Committee is the highest-level authority in NATO on logistics. On 10 February 2023, a working paper was circulated that reclassified the NATO logistic functional groups and added a number of "logistic-related areas". The working paper differentiates between "logistics" and "sustainment" and describes four logistic functional areas, being supply, movement, maintenance and services. "Medical" is classified by this paper as a 'logistic-associated area' and no longer a core logistic functional area. While this working paper was written to reflect lessons emerging from the Russo-Ukrainian war and the 2022 NATO Summit in Madrid, it has not yet been reflected in current NATO logistic doctrine, which accordingly is yet to be updated. The current AJP 4, from which the current study took its basic definitions, is likely to remain unchanged for at least two years (Source: Personal communication with the Department Head of the NATO Multinational Logistic Coordination Centre, Finnish National Defence University, Helsinki, 26 November 2023); NATO Logistics Committee, *NATO Policies and Principles for Logistics*, Working Paper, MC 319-4, 23 January 2023.

16 NATO Logistics Committee, *NATO Policies and Principles for Logistics.*

17 NATO, Allied Logistics Publication (ALP 4.2) *Land Forces Logistics Doctrine*, Edition B, Version 1 (2015), 2–9.

18 Mission command philosophy is universally taught, practised and promoted throughout many militaries, particularly in the West. Mission command makes units less reliant on one central point of command, devolving command and leadership away so that in the event of the central point of command being neutralised or made ineffective, subordinate units can (theoretically) continue to function. Mission command devolves much decision-making to subordinate levels of command and aims to make clear to these subordinate levels what the intent of the commander is. Mission command imbues the subordinate with an understanding of the mission. It enables the subordinate with the resources needed to achieve the assigned mission, but leaves the actual details of execution to the subordinate. For a comprehensive reference, see Department of the US Army HQ, *US Army Publication ADP 6-0: 'Mission Command'* (Washington, 2019).

19 H Kim, S Moon & H Moon, 'Parallel Military Supply Chain for Resilience', *International Journal of Advanced Logistics*, 6, 2 (2017), 80–87. https://doi.org/10.1080/2287108X.2018.1472966.

20 R Acero, M Torralba, R Pérez-Moya & JA Pozo, 'Value Stream Analysis in Military Logistics: The Improvement in Order Processing Procedure', *Applied Sciences*, 10, 1 (2020). https://doi.org/10.3390/app10010106

[21] It should be noted here that legacy Soviet logistic systems have been described by certain commentators as one of the principal blockages to NATO interoperability and modernisation in former Warsaw Pact nations acquiring NATO membership over the past two decades, particularly as these are inconsistent with the predominant Western mission command philosophy. See T-D Young, 'The Challenge of Reforming European Communist Legacy "Logistics"', *Journal of Slavic Military Studies*, 29, 3 (2016), 352–370. https://doi.org/10.1080/13518046.2016.1200376

[22] E Kleynhans & D Katz, *20 Battles: Searching for a South African Way of War* (Johannesburg: Delta Books, 2023), 199–255.

[23] It should be noted that this is a generalisation that obviously may not be applicable, particularly given the variation in actual scenarios. For example, operations carried out by the SADF in the 1960s, 1970s and 1980s could not be considered low-intensity operations and involved multi-domain operations, such as air combat over Angola. Compared to major, large-scale combat operations, it would however be safe to say that the majority of operations carried out in Southern Africa have been of the low-intensity, counter-insurgency kind and not major war.

[24] O Molloy, *Drones in Modern Warfare: Lessons Learnt from the War in Ukraine* (Canberra: Australian Army Research Centre, 2024).

[25] A Bakir, 'Turkey's Electronic Warfare Capabilities: The Invisible Power Behind Its UACVs', *RUSI*, 2021. <https://www.rusi.org/explore-our-research/publications/commentary/turkeys-electronic-warfare-capabilities-invisible-power-behind-its-uacvs> [Accessed on 30 December 2025].

[26] LW Grau & CK Bartles, *The Russian Reconaissance Fire Complex Comes of Age* (Oxford: Changing Character of War Centre, 2018), 180–82.

[27] H Haugstvedt & JO Jacobsen, 'Taking Fourth-generation Warfare to the Skies? An Empirical Exploration of Non-state Actors' Use of Weaponized Unmanned Aerial Vehicles (UAVs – "Drones")', *Perspectives on Terrorism*, 14, 5 (2020), 26–40.

[28] Zabrodskyi *et al*., 'Preliminary Lessons in Conventional Warfighting', 69.

[29] Military Africa, 'Fiber Optic FPV Drones Emerge on African Battlefields', 2025, https://www.military.africa/2025/08/fiber-optic-fpv-drones-emerge-on-african-battlefields/ [Accessed on 23 September 2025].

[30] R Ti, 'Military and Civilian Integrated Logistics: Caveat Emptor (Let the Buyer Beware)! Considerations for the NATO Article V Battlefield', *War Studies University Scientific Quarterly* 113, 4 (2018), 19–33.

[31] The principle of "distinction" is employed to distinguish between combatants and non-combatants, and it is in the latter category that non-uniformed civilians fall. See the International Committee of the Red Cross website, which defines these rules quite clearly: https://ihl-databases.icrc.org/en/customary-ihl/v1/rule1

[32] Personal communication with Prof. A Esterhuyse, Professor of Military Science, Stellenbosch University, Saldanha, 19 February 2024.

[33] R Ti, 'The Strategic Vulnerability of NATO Blood Supply Logistics : A Case Study of Estonian National Defence', *Defense and Security Analysis*, 38, 3 (2022), 1–20, https://doi.org/10.1080/14751798.2022.2076343

[34] A Epstein, R Lim, J Johannigman, CJ Fox, K Inaba, GA Vercruysse, RW Thomas, MJ Martin, G Konstantyn & SD Schwaitzberg, 'Putting Medical Boots on the Ground: Lessons from the War in Ukraine and Applications for Future Conflict with Near Peer Adversaries', *Journal of the American College of Surgeons*, 237, 2 (2023), 364–73, https://doi.org/10.1097/xcs.0000000000000707.

[35] J Bronk, N Reynolds & J Watling, 'The Russian Air War and Ukrainian Requirements for Air Defence Special Report', *RUSI*, 2022. <https://rusi.org/explore-our-research/publications/special-resources/russian-air-war-and-ukrainian-requirements-air-defence> [Accessed on 30 December 2025].

[36] J Bronk, 'Regenerating Warfighting Credibility for European NATO Air Forces', *RUSI*, 2023. <https://static.rusi.org/whr_regenerating-warfighting-credibility-nato_0.pdf

[37] Established in July 2010, MONUSCO is the UN Peacekeeping mission established in Eastern DRC. See: https://peacekeeping.un.org/en/mission/monusco

[38] As one recent example of the failure of SANDF logistic support in the recent SANDF deployment to eastern Congo, see G Martin, 'Budget Cuts Have Facilitated SANDF's Decline, Holomisa Says Amid DRC Crisis', *Defenceweb,* 30 January 2025. <https://www.defenceweb.co.za/sa-defence/sa-defence-sa-defence/budgets-cuts-have-facilitated-sandfs-decline-holomisa-says-amid-drc-crisis/> [Accessed on 23 September 2025]. For another source that specifically describes logistic support as "limited" or "absent", see T Mandrup, 'Lessons From the SADC Mission in Mozambique (SAMIM)', Conflict & Resilience Monitor, African Centre for the Constructive Resolution of Disputes (ACCORD), 2024. <https://www.accord.org.za/analysis/lessons-from-the-sadc-mission-in-mozambique-samim/> [Accessed on 23 September 2025].