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A CANADIAN REVOLUTION IN MILITARY LOGISTICS – IMPROVING THE CF OPERATIONAL SUPPLY CHAIN THROUGH BENCHMARKING

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A Canadian Revolution in Military Logistics –

Improving the CF Operational Supply Chain through Benchmarking

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INTRODUCTION

> [N]othing is more common than to find considerations of supply affecting the strategic lines of a campaign and a war.[1]
>
> Carl von Clausewitz, *On War*

The importance of logistics to warfare has remained constant throughout the ages. Great commanders from antiquity to the modern era have recognized that it is crucial to achieving success within a campaign at the operational level. It can be said that history defines them as great commanders in part due to their successful application of logistical principles aimed at reducing limitations on their ability to wage war. One such example is Alexander the Great who understood the importance of securing his lines of communication (LoC) and the requirement to amass resources to wage a protracted campaign, both key factors in the design of his campaign against Persia. Restricted to ground LoC by virtue of Persian control of the Mediterranean Sea, Alexander executed a strategy to defeat the Persian fleet by denying it of support bases along the coast, eventually capturing a significant number for his own use and gaining greater control of the Mediterranean.[2] Having secured both ground and sea supply routes and setting up firm bases in Syria and Egypt from which to project his forces into Persia, Alexander successfully defeated the Persian King Darius III and moved onwards to India.

Despite its recognized importance, logistics has not always been well understood or expertly applied. History is replete with many examples of logistical failures and

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[1] Carl von Clausewitz, *On War*, eds. Michael Howard and Peter Paret (Princeton, New Jersey: Princeton University Press, 1984), 131.

[2] General Sir John Hackett, ed., *Warfare in the Ancient World* (New York, NY: Facts on File, Inc., 1989), 117.

successes that have significantly affected the outcomes of military campaigns. Sun Tzu, arguably one of the most famous and well-read ancient writers, wrote in his study of war that, "It follows that an army which lacks heavy equipment, fodder, food and stores will be lost."[3] There is perhaps no better ancient example of logistical failure affecting the outcome of a campaign than that of Hannibal. Regarded as one of the most brilliant tacticians and greatest strategists in history, Hannibal led Carthage against Rome during the Second Punic War in the late 2nd Century BC in order to weaken its grasp on Europe. When contemplating the strategy for the invasion of Italy, Hannibal believed it sufficient to maintain ground supply routes from Spain and Africa despite the Roman domination of the seas.[4] Unfortunately, this logistical assumption proved incorrect and was eventually his undoing. One of the decisive factors that saved Rome was "her control of the sea, which stopped Hannibal getting reinforcements and supplies . . . ."[5] Unable to build up a siege army due to Roman interdiction of his LoCs, Hannibal was unable to target Rome, the seat of Roman power, and could therefore not decisively defeat his enemy. Although he occupied Italy for fifteen years, Hannibal's forces succumbed to the lack of resources and retreated to Carthage when it was attacked eventually suffering defeat at the hands of Scipio Africanus at the Battle of Zama.

These examples from antiquity highlight the importance of getting logistics right and the consequences of getting it wrong. As warfare evolved throughout the centuries,

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[3] Sun Tzu, *The Art of War*, trans. Samuel B. Griffith (New York: Oxford University Press, 1971), 104.

[4] Colonel G. B. Malleson, *Ambushes and Surprises: Being a Description of some of the most Famous Instances of the Leading into Ambush and the Surprise of Armies, from the Time of Hannibal to the Period of the Indian Revolt* (London: W.H. Allen & Co., 1885), 13.

[5] Hackett, *Warfare in the Ancient World*, 148.

logistics has transformed commensurately in order to literally keep pace with advancing armies. Just as Alexander pioneered the policy of soldiers carrying their own supplies in an effort to reduce the reliance on horses and the burden on his lines of communication to provide fodder,[6] modern armies have developed solutions to sustain the force particularly as they moved further away from traditional support bases. Logistics figured prominently in Napoléon's campaigns in the early 19th Century. Living off the land captured by invading French forces, he used militarized supply battalions extensively to deliver supplies to the forward lines that by 1812 had grown to include thousands of vehicles, horses and men to move supplies into Russia.[7] The evolution of the supply distribution pipeline was further refined by the German Field Marshal Helmuth von Moltke, the Elder with the introduction of the railway in Europe. The first to establish what is referred to as a relay system of supply, von Moltke used the system in conjunction with the railways to supply the German armies in the Austro-Prussian war of 1866 and the Franco-Prussian war of 1870-1871.[8] The aim of these and other initiatives was to build-up a significant amount of supplies sufficient to wage a protracted conflict that became known as the mass-based approach to logistics and remained the dominant system for supporting armies at the dawn of the 20th Century.

War consumed the world early in the new century. In an era of alliances between nations, the Great War expanded globally involving nations beyond the

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[6] D. McConnell, R. Hardemon and L. Ransburgh USAF, "The Logistics Constant Throughout the Ages," *Air Force Journal of Logistics* 34, no. 3/4 (2010): 82, http://proquest.umi.com/pqdweb?did=2354060841&Fmt=7&clientId=1711&RQT=309&VName=PQD.

[7] Milan N. Vego, "Operational Logistics," in *Joint Operational Warfare* (Newport, RI: Naval War College, 2007), VIII-76.

[8] Vego, *Operational Logistics*, VIII-76

continental borders of Europe and across oceans. "In many ways, the First World War resembled all past wars. However, its rapid consumption of supplies, especially ammunition, dictated that the times and ways of war were changing."[9] Many of the commonwealth nations involved in the war against the Central Powers including Canada travelled great distances to support the Allied Powers. Sustaining expeditionary forces like the Canadian Expeditionary Force fighting in Europe required long sea LoC from their respective homelands. Shipping convoys from Canada and other foreign ports delivering essential ammunition and other supplies had increased the scale of expeditionary warfare to a magnitude not previously seen. With the introduction of motorized vehicles towards the end of the war, albeit on a very small scale, the dynamics of the battlefield changed yet again creating a dependency on petroleum to sustain the iron horses.

By the time the Second World War erupted in 1939 with the German invasion of Poland, armies had become mechanized and aircraft dominated the sky. No longer capable of foraging for themselves, expeditionary forces became wholly reliant on their lines of communications for the delivery of essential supplies, specifically ammunition and petroleum. Perhaps it was best captured by the Desert Fox, German Field Marshall Erwin Rommel, who said that, "The battle is fought and decided by the quartermasters before the shooting begins."[10] The demand for petroleum alone was significant such that any disruption severely limited the flexibility of commanders to employ mechanized

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[9] McConnell, Hardemon and Ransburgh, *The Logistics Constant Throughout the Ages*, 84.

[10] Dr Cliff Welborn, "Supply Line Warfare," *Army Logistician* 40, no. 6 (November - December 2008, , http://www.almc.army.mil/alog/issues/NovDec08/spplyline_war.html (accessed 9 January 2012), n.p.

forces. The potentially disastrous consequences forced logisticians to employ new methods to sustain forces with petroleum that included the use of underground pipelines and convoys of trucks dubbed the 'Red Ball Express' that travelled distances upwards of 400 miles to supply General George S. Patton's Third Army.[11] The military supply chain adapted to the demand for new commodities by increasing the size of stockpiles. Yet despite new means with which to deliver supplies, the evolution of military logistics essentially remained stagnant still focused on the build-up of supplies in order to guard against uncertainty in supply and demand. Military logistics changed very little in the immediate post-World War Two period and remained constant until the late 20th Century when the United States of America and its coalition of nations rushed to the Middle East to dislodge Iraq from the tiny country it had invaded, Kuwait.

The world changed significantly following the Second World War. The subsequent 40 years was dominated by a Cold War between the Warsaw Pact and the North Atlantic Treaty Organization (NATO) in which the Soviet Union and United States respectively vied for global influence while the rest of the world lived under the threat of nuclear war. Although the nature of the conflict had changed with the arms race, it was still characterized by large forces with large stockpiles of supplies to support them measured in days of supply. The reality of supporting expeditionary forces around the globe with an increasing reliance on global supply chains to support technically sophisticated military hardware transformed military logistics into an inefficient and expensive endeavour. This was never more apparent than during the 1990-1991 Gulf

[11] McConnell, Hardemon and Ransburgh, *The Logistics Constant Throughout the Ages*, 85.

War. Operation DESERT SHIELD and Operation DESERT STORM, the named operations for the deterrence of Iraq and subsequent liberation of Kuwait from Iraq occupation respectively, included a substantial six month logistical effort to prepare for the conflict. Despite a desire to avoid creating large logistics bases that were perceived as limiting operational flexibility, the US-led coalition built up a significant amount of supplies to sustain forces in theatre aptly described as 'iron mountains'.[12]

> After the war, it took Army logisticians over a year to sort through the chaos and identify the contents of the containers stacked at the ports. The costs associated with shipping, storing, accounting for, and returning this mountain of unused supplies and equipment warranted investigation by the General Accounting Office (GAO) and served as a change engine to prevent such waste in the future.[13]

In terms of time and readiness, the Gulf War had proven that there was more to expeditionary logistics than simply building 'iron mountains'. From a strictly monetary perspective, mass-based logistics became cost prohibitive. Far from purely a US problem, other countries including Canada felt the burden of costs associated with maintaining and supporting expeditionary forces abroad. Coinciding with the end of the Cold War, many nations withdrew a peace dividend by bringing forces home and reducing the overall size of standing armed forces with a view to reducing the financial burden.

Viewed as the turning point, the 1991 Gulf War sparked a revolution in military logistics aimed at creating efficiencies while maintaining if not improving operational

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[12] K. Daniels USAR, "The Distribution Dilemma: That Last Tactical Mile," *Army Logistician* 40, no. 5 (Sep/Oct, 2008): 39, http://proquest.umi.com/pqdweb?did=1572607391&Fmt=7&clientId=1711&RQT=309&VName=PQD.

[13] Daniels, *The Distribution Dilemma: That Last Tactical Mile*, 40.

effectiveness. A period of significant transformation, nations sought to incorporate 'best practices' from such industry giants as Wal-Mart and FedEx, and to leverage advances in technology with a common goal of ensuring that the right commodities were at the right place at the right time in the right quantity. Transformation continues to this day unabated in an attempt to perfect military logistics in support of the warfighter. Much like the great captains of antiquity who relied on logistical ingenuity to provide the best chance at victory, logistics holds just as much importance for the Canadian Forces (CF) today.

The Canada First Defence Strategy (CFDS), announced by the Government of Canada in 2008, defined three roles for the Canadian Forces: the defence of Canada, Canadians' safety and security, and support the Government's foreign policy and national security objectives. To fulfill this mandate, the CF must be capable of conducting six core missions within Canada, in North America and globally potentially at the same time. Specifically, the Forces must maintain the capacity to participate in a major international operation for an extended period with the potential to command and respond to crises elsewhere in the world for shorter periods over and above its domestic and continental defence obligations.[14] If nothing else, the recent capital acquisitions and planned expenditures to further enhance the CF capabilities are a clear indication of the Government's intentions to maintain a presence on the international scene by deploying forces to hotspots. Based on recent trends, future expeditionary operations by the CF will likely occur in either a failed or failing state somewhere on the opposite side of the world.

[14] Canada. Department of National Defence, *Canada First Defence Strategy* (Ottawa: DND Canada,[2008]), http://www.forces.gc.ca/site/pri/first-premier/June18_0910_CFDS_english_low-res.pdf (accessed March 24, 2012), 3-4.

A robust CF logistics capability will be required to effectively deploy and sustain forces on these future missions.

As was demonstrated during the 1990s with deployments to the Former Republic of Yugoslavia, Somalia, Rwanda and Kosovo and more recently during the past decade of operations in Afghanistan, the CF has for the most part been successful at sustaining expeditionary operations. However, the relative success enjoyed by Canada on these operations has been achieved principally through the expenditure of enormous amounts of money, the tremendous support of its allies and the hard work of its logisticians. In light of current fiscal realities and the global economic environment, future operations will likely be constrained by budgetary concerns. Moreover, it is rather unlikely that the CF will be able to rely on its allies to the same degree that it has in Afghanistan and on other operations when these nations are coping with similar economic pressures. Likewise, continued reliance on the support community within the CF to make logistics work is not a sustainable course of action (COA). Rather, the military must become more efficient in its business and better at managing its resources if it wants to avoid a repeat of the 'the decade of darkness' that characterized the 1990s in which doing more with less was the norm.

Although one normally associates efficiency with finding savings at the expense of effectiveness, it is more accurately defined as achieving maximum output with the minimum amount of wasted effort or expense. "Contrary to popular belief, the attributes of efficiency and effectiveness are not mutually exclusive . . . they are mutually

dependent."[15] Employing efficient logistics processes in support of the warfighter is necessary to instill confidence, build trust and remain operationally effective.

> For every fuel truck that fails to turn up on time or every ammunition re-supply that brings the wrong calibre rounds, warfighters find it harder to trust—and harder to maintain morale. If a mechanic ordering parts for a fighter has little faith in the systems, he or she reorders. Yet this complicates the supply chain with excess transportation and inventory costs. Several high-ranking Pentagon officials have noted that only when warfighters have more confidence in logistics support will military leaders be able to reduce costs. They will do this by eliminating duplicate orders, minimizing cannibalization, eliminating reasons for misdirected cargo, and resolving disposition of retrograde materials.[16]

While the CF has successfully supported operations in the Balkans, Africa and South-West Asia over the past two decades, this does not mean that it was effective support. One need not look further than the ammunition situation leading up to the 2006 NATO Operation MEDUSA in Kandahar, Afghanistan to emphasize this point. As the Canadian Battle Group[17] prepared for battle, it came to light that the Canadian Joint Task Force-Afghanistan was dangerously low on a number of natures of ammunition including the artillery battery as a result of poor asset visibility and an inability to anticipate demand.[18] Fortunately for Canada, not so for the Taliban, the issue was resolved and the operation was a stunning success garnering many accolades for the CF. Despite this and likely countless other disasters adverted, the conduct of expeditionary operations around the

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[15] Robert E. Love, "Operation IRAQI FREEDOM-Marine Corps Logistics at its Best?" *Marine Corps Gazette* 88, no. 1 (Jan, 2004): 49-50, http://proquest.umi.com/pqdweb?did=526991751&Fmt=7&clientId=1711&RQT=309&VName=PQD.

[16] Roger W. Kallock and Lisa R. Williams, "DoD's SUPPLY CHAIN MANDATE: From Factory to Foxhole," *Supply Chain Management Review* 8, no. 4 (May/Jun, 2004): 50, http://proquest.umi.com/pqdweb?did=643895861&Fmt=7&clientId=1711&RQT=309&VName=PQD.

[17] A Battle Group is a tactical grouping based on either an armour regiment of infantry battalion supported by the other arm and includes a reconnaissance and an engineer squadron.

[18] Lieutenant-Colonel John Conrad, *What the Thunder Said: Reflections of a Canadian Officer in Kandahar* (Toronto: The Dundurn Group and Canadian Defence Academy Pres, 2009), 122.

world by the CF in the post-Cold War era has highlighted the need for the operational supply chain to evolve into an enabling capability that is responsive to the needs of the warfighter. The CF needs a proactive approach to transform the operational supply chain, streamlining processes and maximizing the use of technology, in order to provide the warfighter the support needed to accomplish the mission. Only then can the CF guarantee effective support towards achieving the goals articulated in the CFDS.

Articulating this point requires an analysis of the CF expeditionary operational supply chain. This will be accomplished by leveraging an industry approach called benchmarking that essentially compares and contrasts the end to end process of two organizations to identify areas for improvement. Using the Supply Chain Organization Council (SCOR) model as a basis for this comparison, this paper will seek to benchmark the CF supply chain against that of its principle allies, the US, the United Kingdom (UK), and Australia, each of which currently maintains a supply chain to Afghanistan. The aim of the benchmarking will be to highlight the areas in which the CF supply chain can improve and identify best practices to be incorporated therein based on Allied experiences.

Before proceeding with benchmarking, it is important to first clarify certain logistical and analytical concepts including an explanation of the SCOR model and performance measurement of the supply chain. Followed by a description of the 'as-is' CF supply chain to Afghanistan, the role of the Canadian Operational Support Command (CANOSCOM) and other stakeholders will be highlighted. Leveraging the work done by the Office of the Auditor General (OAG) in examining CF support to operations and

testimony given by the Department of National Defence (DND) and CF members to the Standing Committee on Public Accounts (SCOPA), an appreciation of the current level of effectiveness can be formed and the areas in which the supply chain can be improved will become apparent. It is at this point that the examination of Allied supply chains will become important in order to identify military best practices that can be leveraged to improve the CF operational supply chain. Although the nations to be analyzed do not share the same LoC, it is important to benchmark against military supply chains that share a common goal of supporting the warfighter vice against industry which is focused on profits. However, that does not preclude one from considering industry best practices for applicability to the military supply chain. Finally, reviewing the current CF supply chain transformation initiatives with respect to its allies will provide an informed assessment highlighting areas for improvement and making recommendation where necessary to align with Allied and industry best practices.

LOGISTIC CONCEPTS AND ANALYTICAL FRAMEWORKS

> In order to make assured conquests it is necessary always to proceed within the rules: to advance, to establish yourself solidly, to advance and establish yourself again, and always prepare to have within reach of your army your resources and your requirements.[19]
>
> Frederick the Great

Often admired for his tactical genius and operational successes, Frederick the Great's accomplishments during the War of Austrian Succession (1740-1748) and again during the Seven Years War (1756-1763) were as a result of his understanding and application of these rules. It can be argued that the course of European history may have

[19] Vego, *Operational Logistics*, VIII-75.

taken a different path had he not attached such importance to logistics. As has already been shown and emphasized yet again by this example, the significance of logistics to the outcome of military engagements has been a common theme throughout history. To understand this aspect of warfare and to continue with the proposed comparison of operational supply chains, it is critical to first gain a basic appreciation of key logistical concepts and analytical frameworks. Chief among these concepts is the evolution of logistics from the aforementioned mass-based approach to the more recent technology enabled sense and respond logistics (S&RL) approach as part of net-centric warfare (Figure 1). It is also essential to review the current and emerging automated identification technologies (AIT) and their significance to the supply chain to fully comprehend the revolutionary nature of S&RL and how it proposes to transform logistics in the battlespace. Finally, an overview of the methodology of benchmarking and the intent of performance measurement, specifically the Supply Council Operations Reference (SCOR) model, will be crucial to identifying areas for development in the CF operational supply chain.

Evolution of Logistics Approaches

Commensurate with the evolution of warfare, logistics has progressed over time to sustain forces in battle and overall military campaigns. From ancient to modern warfare, the solutions developed to support armies have focused on improving both parts of the supply chain, provisioning, which is the sourcing of commodities, and distribution, which are the methods employed to move supplies around the battlespace. Despite this period of advancement, the methods employed share one common attribute in that they were designed to build-up

Figure 1: Approaches to Logistics[20]

sufficient stocks to sustain the fight. The mass-based approach remained relatively constant throughout history up to and including the 1990-1991 Gulf War. Based on the observations of the U.S. Department of Defense (DoD) and the GAO regarding the significant logistical effort to prepare for Operation DESERT SHIELD and to drawdown Operation DESRET STORM (ODS), the war became a watershed moment for the approach to military logistics. Stockpiling 'iron mountains' of supplies was deemed rather inefficient and ineffective both in terms of the use of resources and timeliness of delivery. Leveraging the concept of 'lean thinking', which was developed by car

[20] United States. Department of Defense. Office of Force Transformation, "Sense and Respond Logistics: Co-Evolution of an Adaptive Enterprise Capability" October 23, 2003, , https://acc.dau.mil/adl/en-US/32752/file/54095/LL_BRIEFING_SARL-23Oct03_v3_.pdf (accessed March 3, 2012), slide 4.

manufacturer Toyota in the 1970s to use less in the areas of human resources, capital investment, facilities, spares, consumables, and time, the U.S. DoD began to identify processes in an effort to eliminate redundant steps and ensure processes flowed efficiently.[21] This began a period of transformation during which the military sought to streamline and synchronize processes in an effort to eliminate waste in the military supply chain. A RAND Corporation study conducted in the wake of ODS

> . . . concluded that commercial distribution processes used by FedEx and UPS appeared to be likely models for resolving the [U.S.] Army's distribution woes. These companies operated efficient distribution centers that routed and tracked a constant flow of parcels in a process termed 'velocity management.'[22]

Velocity management was a key part of the common concept employed throughout industry at the time known as Just-in-Time (JIT) delivery.

The JIT approach to logistics is the "process of synchronizing all elements of the logistic system to deliver the 'right things' to the 'right place' at the 'right time' . . ."[23] The principle behind this concept is to reduce the amount of commodities that an organization must physically hold by using consumption data to predict the rate at which the customer requires resupply and by maintaining a constant flow in the supply chain to meet the demand. Essentially, by moving commodities along the distribution chain from the supplier to the customer on various modes of transportation rather than stocking them

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[21] Commander D. G. Elford, *RTO-MP-AVT-144: The Evolution of Aircraft Support Concepts within the UK MoD's Defence Logistics Transformation Programme*NATO Research and Technology Organisation,[2011]), http://ftp.rta.nato.int/public/PubFullText/RTO%5CMP%5CRTO-MP-AVT-144///MP-AVT-144-06.pdf (accessed March 10,2012), 6-9.

[22] Daniels, *The Distribution Dilemma: That Last Tactical Mile*, 40.

[23] United States. Department of Defense, *Joint Publication 4-0: Joint Logistics* (Suffolk, VA: United States Joint Forces Command, 2008), GL-7, http://www.dtic.mil/doctrine/new_pubs/jp4_0.pdf (accessed March 30,2012).

on warehouse shelves, it would increase responsiveness and reduce the costs associated with the supply chain. While the approach works well for industry due to the permissive environment in which companies tend to operate, the unpredictability of combat and the volatility of a war zone create a non-permissive environment that can disrupt the effectiveness of a time-based supply chain as was noted during Operation IRAQI FREEDOM (OIF), the US-led invasion of Iraq in 2003.

> Approximately half of all I [Marine Expeditionary Force (MEF)] forces were committed to logistics operations, and . . . still could not provide timely and effective support across the full spectrum of logistics to the combat forces. . . . Combat forces were reduced to foraging for supplies (repair parts in particular) to sustain momentum.[24]

This was only one of the many examples of how JIT delivery was ineffective at sustaining the rapid advance of coalition forces in OIF. It had been said that, "[h]ad the coalition effort faced a stronger adversary . . . effects [of shortages] could have been catastrophic."[25] This was a point that did not go unnoticed, particularly by the U.S. who continued to search for the optimal means in which to support the warfighter.

The failure of JIT delivery in OIF and the emergence of the concept of network-centric warfare (NCW)[26] gave rise to Sense and Respond Logistics (S&RL), a new approach to logistics defined as;

> . . . a network-centric, knowledge-driven, knowledge-guided concept that sustains modular, reconfigurable force capabilities to execute Joint and Coalition effects-based operations and to provide precise, adaptable, agile support for

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[24] Love, *Operation IRAQI FREEDOM-Marine Corps Logistics at its Best?*, 49.

[25] Kallock and Williams, *DoD's SUPPLY CHAIN MANDATE: From Factory to Foxhole*, 46.

[26] Network-centric warfare, also called network-centric operations, is a military doctrine or theory of war pioneered by the United States Department of Defense in the 1990's that seeks to translate an information advantage, enabled in part by information technology, into a competitive advantage through the robust networking of well-informed geographically dispersed forces.

> achievement commander's intent. S&RL relies upon highly adaptive, self-synchronizing, and dynamic physical and functional processes, employing and enhancing operational cognitive knowledge development, sense-making, and decision support. It senses, predicts, anticipates and coordinates actions that provide competitive advantage spanning the full range of military operations across strategic, operational and tactical levels. . .[27]

Although primarily a U.S. DoD concept, S&RL has been embraced by American Allies such as the United Kingdom (UK) and Australia in similar concepts that leverage advancements in technology to provide an accurate picture of the logistic situation and allow decisions to be made in a timely manner to support the warfighter. While relatively new and yet to be fully realized, S&RL is designed to enable responsive and flexible support by anticipating requirements based on indicators and consumption data collected by a host of sensors across the battlespace. Had this and supporting concepts such as Condition Based Maintenance (CBM+)[28] been applied to OIF, the issues regarding the lack of repair parts experienced by I MEF during the operation could likely have been avoided. The ability to sense the consumption of parts by tactical level units would have triggered the network to conduct a search of units nearby to determine the best possible source based on a range of factors including distance, time, and mission priority. Not only would this have satisfied the requirement, it would automatically reorder the spare part through the various levels of the supply chain all the way back to the national source of supply. An ideal solution to compensate for the uncertainty of demand and supply experienced in previous wars, S&RL is far from being realized largely due to the high

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[27] United States. Department of Defense, *Logistics Transformation Strategy: Achieving Knowledge-Enabled Logistics*,[2004]), 7, https://acc.dau.mil/adl/en-US/32584/file/6183/Knowledge%20Enabled%20Logistics_Dec_04.pdf (accessed February 26, 2012).

[28] The aim of condition based maintenance is to detect wear within components, compare this to established safe operating parameters and replace them prior to failure.

reliance on technology which has yet to suitably evolve to a mature state capable of supporting the concept.

Automated Identification Technology

A fundamental component of S&RL is the ability to sense changes in the logistics environment. Highly dependent upon embedded sensors, these can be employed on vehicles to monitor the rate of expenditure of ammunition, the consumption of fuel, and the wear of parts to allow logisticians to predict requirements. This is precisely how CBM+ is able to determine the optimal time to change parts thereby reducing overall costs to maintain equipment through its life cycle. Similarly, sensors can be used to provide identity, location, and condition status (Figure 2) of commodities moving into and around the theatre of operations which aggregate to provide information commonly referred to as asset visibility (AV) and in-transit visibility (ITV). Visibility in general provides the logistician information pertaining to where, what, and how many commodities are in the supply chain whether that be in theatre, in the distribution pipeline or back in the home nation. "The most critical aspect of end-to-end distribution is the visibility of resources (i.e. quantity and location of supplies throughout a distribution system). . . [and] is key for building a time definite delivery system in theatre."[29] Ideally resourced with the appropriate information technology tools, the supporter or the S&RL network can monitor and influence the flow of supplies to ensure it meets the identified requirements. Although still evolving, many of the technologies required to provide AV

[29] Ahmed Ghanmi, Captain Gregory B. Campbell and Lieutentant-Colonel Thomas A. Gibbons, "Proceedings of the 2008 Winter Simulation Conference: Modeling and Simulation of Multinational Intra-Theatre Logistics Distribution" (Miami, FL, December 7-10, 2008, 1158 , http://www.informs-sim.org/wsc08papers/138.pdf (accessed March 24, 2012).

and ITV have developed to a level at which they can be employed in the supply chain, specifically automated identification technologies (AIT).

The range of AIT identified in Figure 2 is classified by the nature of the information provided. While most are in varying stages of development and fielding, radio frequency identification (RFID) and bar codes are two relatively well established and widely used technologies in industry and the military supply chain. RFID is defined as:

> . . . a data input system that consists of (1) a transponder, generally referred to as a tag; (2) a tag reader, also known as an interrogator, that reads the tag using a radio signal; (3) centralized data processing equipment; and (4) a method of communication between the reader and the computer.[30]

In layman terms, the tag contains information that is relayed to the reader when activated by the reader's radio signal. The information may contain the identity and the status of the asset which is passed through the network to a central computer along with the location of the reader. The fusing of the identity and status of the asset with the location of the reader and detailed information contained in the central computer provides a visibility of the asset. Readers are typically installed at important points along the supply chain to provide visibility of an asset as it moves through it. Using asset visibility to track the asset is referred to as in-transit visibility and together they deliver an accurate representation of the inventory throughout the supply chain.

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[30] United States. Government Accountability Office, *Defense Logistics: Lack of Information may Impede DOD's Ability to Improve Supply Chain Management GAO-09-150*,[2009]), 12, http://www.gao.gov/products/GAO-09-150 (accessed March 24, 2012).

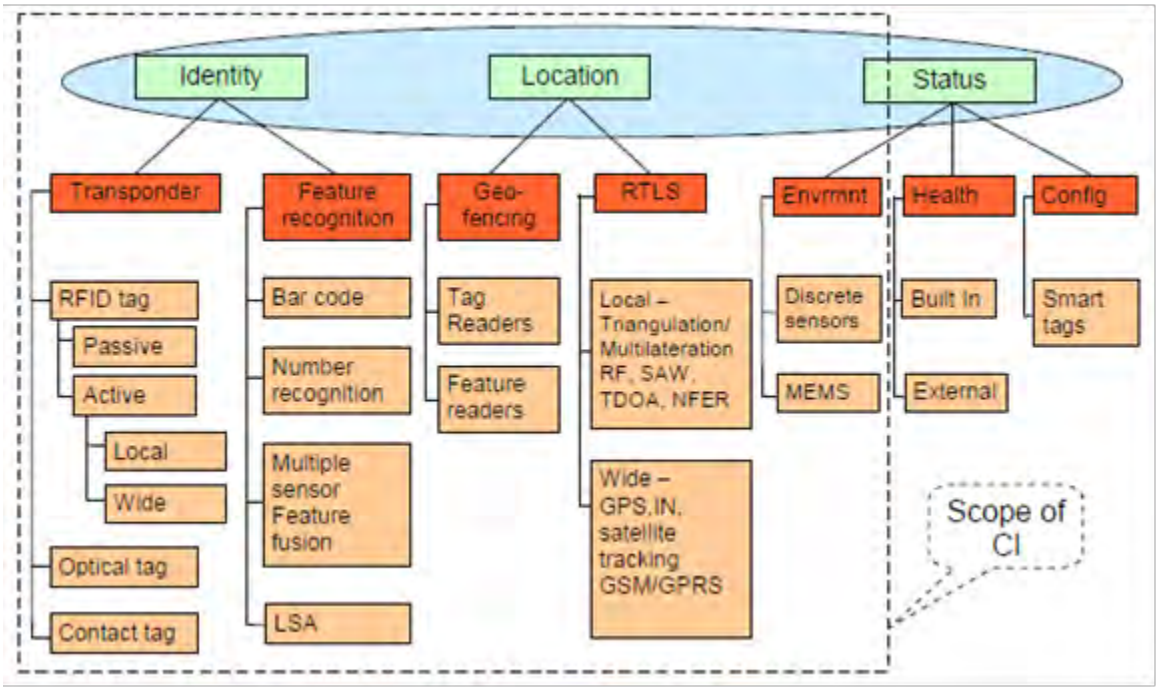

Figure 2: Asset Visibility Component technology assessment classification framework[31]

RFID tags have evolved along two distinct tracks. The description above is indicative of active RFID in which the tag actively broadcasts a signal containing the required information. Due to the power source incorporated into the tag, costs can be considerably higher than other forms of AIT. In light of this, recent development has focused on passive RFID tags that are:

> . . . an electronic identification device consisting of a chip and an antenna, usually embedded within a "smart" packaging label. Passive RFID tags have no battery; they draw power from the reader, which sends out electromagnetic waves that induce a current in the tag's antenna. Passive RFID readers transmit significant power to activate the passive tags and are not currently approved for use on ammunition, missiles, or other potentially explosive hazards.[32]

[31] Richard M. Devonshire and Richard Haynes, "Capability Investigation into Asset Visibility Final Report" QinetiQ, Hampshire, UK, 2008), 26.

[32] United States. Government Accountability Office, *Defense Logistics: Lack of Information may Impede DOD's Ability to Improve Supply Chain Management GAO-09-150*, 12.

As a result of efficiencies incorporated into passive RFID tags, the costs to produce the tags are generally lower per unit and can therefore be employed much wider across the supply chain. Passive RFID tags are already commonplace and have many applications in today's world although likely not recognized. For example, most libraries use passive RFID tags embedded within books to ensure that they are not taken without being checked out first. Similarly, they are used in clothing and other items sold in stores across the world for the purpose of loss prevention. In future, passive tags will become the standard and are likely to be affixed at the point of manufacture similar to bar codes today.

Bar codes are relatively old technology in relation to other AIT developments, but are still the most widely used due the relative minor costs associated with the system. Used extensively in the retail sector as a means of identifying an item cost, they are commonly referred to as a universal product code (UPC). Although limited strictly to the identity classification of AIT, bar codes only require a bar code reader to scan the label and transmit the information to the central computer system. Also known as automatic data capture (ADC) technology, bar code readers have evolved to read a range of bar codes developed for different applications including item unique identification (IUID). Extensively used by the U.S. DoD,

> IUID includes the application of a data matrix through direct inscription or placement of a permanent machine-readable label or data plate onto an item . . . [that] contains a set of data elements that form a unique item identifier . . . similar to the vehicle identification number on a car.[33]

[33] Ibid., 11.

While increasingly used in the DoD supply chain for high value and sensitive items such as weapon systems, IUID is not widely used in industry due to its relatively narrow application. It is still much easier and less expensive to print and affix a label to an item that to inscribe it with a laser particularly when companies are trying to reduce overhead costs to increase profit margins. Staying with the topic of increasing profits margins, another way in which companies can reduce costs is to conduct performance measurement of the supply chain and benchmark against similar businesses to highlight areas for improvement.

Performance Measurement and Benchmarking

Performance measurement is a method predominantly used by industry to gauge how well a company is performing relative to established goals or progressing towards a desired end state. Predicated on detailed knowledge of the processes employed, it is important to map the involved processes step by step and to collect data at each point for future analysis. The Aberdeen Group, a provider of fact-based business intelligence research, advocates that along with developing a strategy for global supply chain visibility,

> . . . the long-term goal should be to turn the visibility information into a competitive asset by analyzing it to uncover trends, root causes of the problems, understand how the costs accrue along the supply chain, and be able to timely respond to supply chain disruptions.[34]

A common practice in performance measurement is to establish key performance indicators (KPI) that identify the processes that are important to the organization and

[34] Viktoriya Sadlovska, *A View from Above: Global Supply Chain Visibility in a World Gone Flat* (Boston, MA: Aberdeen Group,[2007]), 8.

which are to be measured for compliance with established targets. There are many variations of KPI dependent upon the nature of the business being measured. The standard for the supply chain is based on the Supply Chain Operations Reference (SCOR) model, developed by the Supply Chain Council (SCC), an independent, global, non-profit corporation, that

> . . . provides a unique framework that links business process, metrics, best practices and technology features into a unified structure to support communication among supply chain partners and to improve the effectiveness of supply chain management and related supply chain improvement activities.[35]

The SCOR model identifies five performance attributes that allow for analysis and evaluation against other supply chains and are complimented by metrics (i.e. KPI) that measure the performance of an organizations supply chain (Table 1). Measuring a supply chain can show how well business processes are functioning and possibly identify areas for improvement. Organizations that adjust processes accordingly based on performance measurement results are likely to create efficiencies and improve the overall effectiveness of the supply chain. Critical to this task is the incorporation of analytical tools, referred to as business intelligence (BI) software. Standard in many of the enterprise resource planning (ERP) applications available today that encompass finance/accounting, manufacturing, and sales and service such as SAP and PeopleSoft, BI tools analyze information across an entire organization to provide an indication of performance for further benchmarking.

[35] Supply Chain Council, "What is SCOR?" http://supply-chain.org/scor (accessed March 28, 2012).

Performance Attributes and Associated Level 1 Metrics

Performance Attribute	Performance Attribute Definition	Level 1 Metric
Supply Chain Reliability	The performance of the supply chain in delivering: the correct product, to the correct place, at the correct time, in the correct condition and packaging, in the correct quantity, with the correct documentation, to the correct customer.	Perfect Order Fulfillment
Supply Chain Responsiveness	The speed at which a supply chain provides products to the customer.	Order Fulfillment Cycle Time
Supply Chain Flexibility	The agility of a supply chain in responding to marketplace changes to gain or maintain competitive advantage.	Upside Supply Chain Flexibility
		Upside Supply Chain Adaptability
		Downside Supply Chain Adaptability
Supply Chain Costs	The costs associated with operating the supply chain.	Supply Chain Management Cost
		Cost of Goods Sold
Supply Chain Asset Management	The effectiveness of an organization in managing assets to support demand satisfaction. This includes the management of all assets: fixed and working capital.	Cash-to-Cash Cycle Time
		Return on Supply Chain Fixed Assets
		Return on Working Capital

Table 1: SCOR model Performance Attributes and associated Level 1 Metrics[36]

Another way to improve the level of performance of a supply chain is through benchmarking. Comparing an organizations supply chain against others with similar characteristics that are regarded as 'best-in-class' is a useful approach to highlight best practices for adoption. The process reference model at Figure 3 identifies the basic approach to benchmarking. As seen with business process reengineering, it is important to understand the current 'as-is' state of the supply chain and the desired 'to-be' before proceeding with benchmarking, emphasizing the need to conduct process mapping and performance measurement as discussed earlier. Once the 'as-is' model is established, it is compared directly to the 'best-in-class' example to first highlight areas for improvement and then set targets based on the 'best-in-class' standards. After establishing targets, the exercise concludes with an analysis of the best practices used by the 'best-in-class' organization to uncover the changes required to achieve the new

[36] Supply Chain Council, "SCOR 8.0 Metrics Tables," http://supply-chain.org/f/SCOR%208.0%20Metrics%20tables.pdf (accessed March 30, 2012).

targets. It is this process reference model approach to benchmarking that will be used to compare the CF operational supply chain with that of its allies.

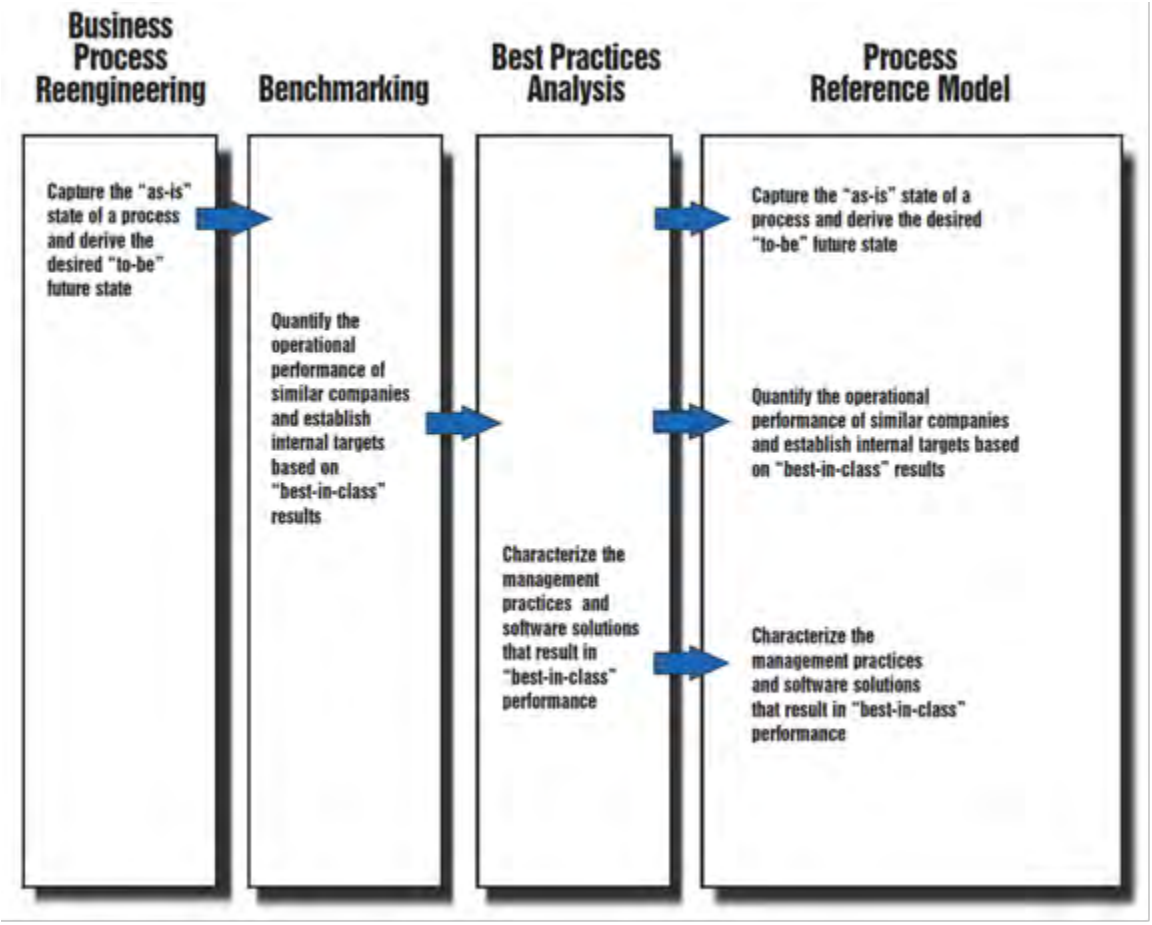

Figure 3: SCOR Process Reference Model[37]

Approaches to logistics have evolved significantly since the Gulf War. 'Iron-mountains' and just-in-time delivery are no longer viable options to support the warfighter that is now networked. Keeping pace with the advances in warfare and technology, sense and respond logistics now seeks to leverage the same network with well-placed sensors, automated identification technology, and analytical decision support

[37] Supply Chain Council, "SCOR 9.0 Overview Brochure" Supply Chain Council, 2008), http://supply-chain.org/f/SCOR%2090%20Overview%20Booklet.pdf (accessed March 30, 2012).

tools to become more reliable, responsive, and agile to meet the needs of the soldier engaged with the enemy. To realize this new approach, military support organizations from the strategic to tactical levels of war will have to evolve. One way to approach this evolution is to use performance measurement and benchmarking based on the Supply Chain Council's SCOR model to highlight areas for improvement in core business processes. In line with the SCOR model, the first step of this benchmarking effort is to define the 'as-is' model of the current CF operational supply chain and its level of performance which will be the focus of the next part.

THE 'AS-IS' CF OPERATIONAL SUPPLY CHAIN

> *Operational logistics* encompasses logistical organization in a formally declared or undeclared theater of operations. It links strategic logistics to tactical logistics. Its main purpose is to ensure that one's actions are continuous through all phases of a campaign or major operation. Thus, effective operational logistics should balance current consumption with the need to build up logistics support for subsequent operations. It should provide for lengthening the lines of communications and staging logistics support forward to maintain the desired operational tempo.[38]
>
> Dr. Milan Vego, *Joint Operational Warfare*

Dr. Vego's definition provides a clear description of the purpose of operational logistics, which is to link strategic logistics to tactical logistics to ensure operational actions are continuous and tempo is maintained. He further clarifies that it must strike a balance between current and future operations to be considered effective. While his description emphasizes the desired end state, it offers little in the way of an approach to achieve success. Alternatively, Lieutenant-Colonel John Conrad, the Commanding Officer of the Canadian National Support Element (NSE) in Joint Task Force-

[38] Vego, *Operational Logistics*, VIII-76.

Afghanistan (JTF-Afg) deployed to Kandahar, Afghanistan in 2006, characterized the critical nature of operational logistics when he aptly stated, "Losing the grip on your country's supply chain will get soldiers killed."[39] His pointed comments amplify the importance of getting it right in terms of supporting the warfighter and provide impetus for investigating the CF operational supply chain. To gain a full appreciation of the state of operational logistics in the CF, it is mandatory to consider the processes, technology, and performance measurement that form its core. Defining the 'as-is' version requires an explanation of the LoC between Canada and Afghanistan and the responsibilities of key players in the logistical effort. It also necessitates a review of the OAG report on support to deployed operations that will provide a synopsis of the performance of the supply chain and highlight the areas for development to be discussed in this study. To commence the assessment of the 'as-is' supply chain, it is appropriate to begin with a holistic description of the basics.

The CF Supply System

The CF supply system (CFSS) is based on the JIT delivery approach to logistics, using materiel priority codes (MPC) and required delivery dates (RDD) to identify how urgent and when the item is required. One of the unique characteristics of the Canadian approach is that it is a completely joint system. Unlike other nations that have supply systems that are stove piped along service lines (i.e. Navy, Army, and Air Force), there is a single supply system across the forces that supports the sailor at sea, the soldier in the

[39] Conrad, *What the Thunder Said: Reflections of a Canadian Officer in Kandahar*, 126.

field, and the airmen and women in the air. Using the example of Afghanistan, the CF supply chain follows the flow depicted in Figure 5 and described below:

> . . . the CF process flow starts with a Canadian combat unit requisitioning an item from the Canadian NSE. If the NSE has the item, then it is immediately issued to the unit; if not, then the demand is sought from other sources within theatre. If the item is not found in-theatre, then the requisition is entered on the CF Supply System [information technology (IT)] system and it is issued from the appropriate warehouse in Canada such as 25 CF Supply Depot (25 CFSD) in Montreal and transported to the NSE through the national stovepipe.[40]

Although the example above describes a requisition by an Army unit, notwithstanding the environmental differences in the execution of replenishment the process is essentially mirrored for each of the services. Additionally, the IT system used to generate the requisition is the same across the services and is used at every level of war. While this may sound ideal, there are issues with the current construct of the system.

> Inventory information currently exists in [three] applications, [Mincom Information Management System (MIMS)], [National Movement and Distribution System (NMDS)] and [Defence Resource Management Information System (DRMIS)]. As a result [materiel acquisition and support (MA&S)] users are required to access up to [three] systems to develop a cross enterprise view of inventory information for a specific item.[41]

This is in part due to the current migration from MIMS to DRMIS, both ERP applications that include inventory management, to be discussed later. NMDS on the other hand is the system of record for consignment tracking of shipments in the distribution pipeline and is not scheduled to be replaced by DRMIS. Consequently, there will remain two systems in the CFSS in order to provide AV and ITV of inventory in the supply chain which may require further investigation.

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[40] Ghanmi, Campbell and Gibbons, *Proceedings of the 2008 Winter Simulation Conference: Modeling and Simulation of Multinational Intra-Theatre Logistics Distribution*, 1160.

[41] Canada. Department of National Defence, *CFSS DRMIS Initiative - Blueprint for Supply Chain Information (SCI): Material Management and Inventory Reporting, Version 1.0F* (Ottawa: DND Canada,[2011]), 7.

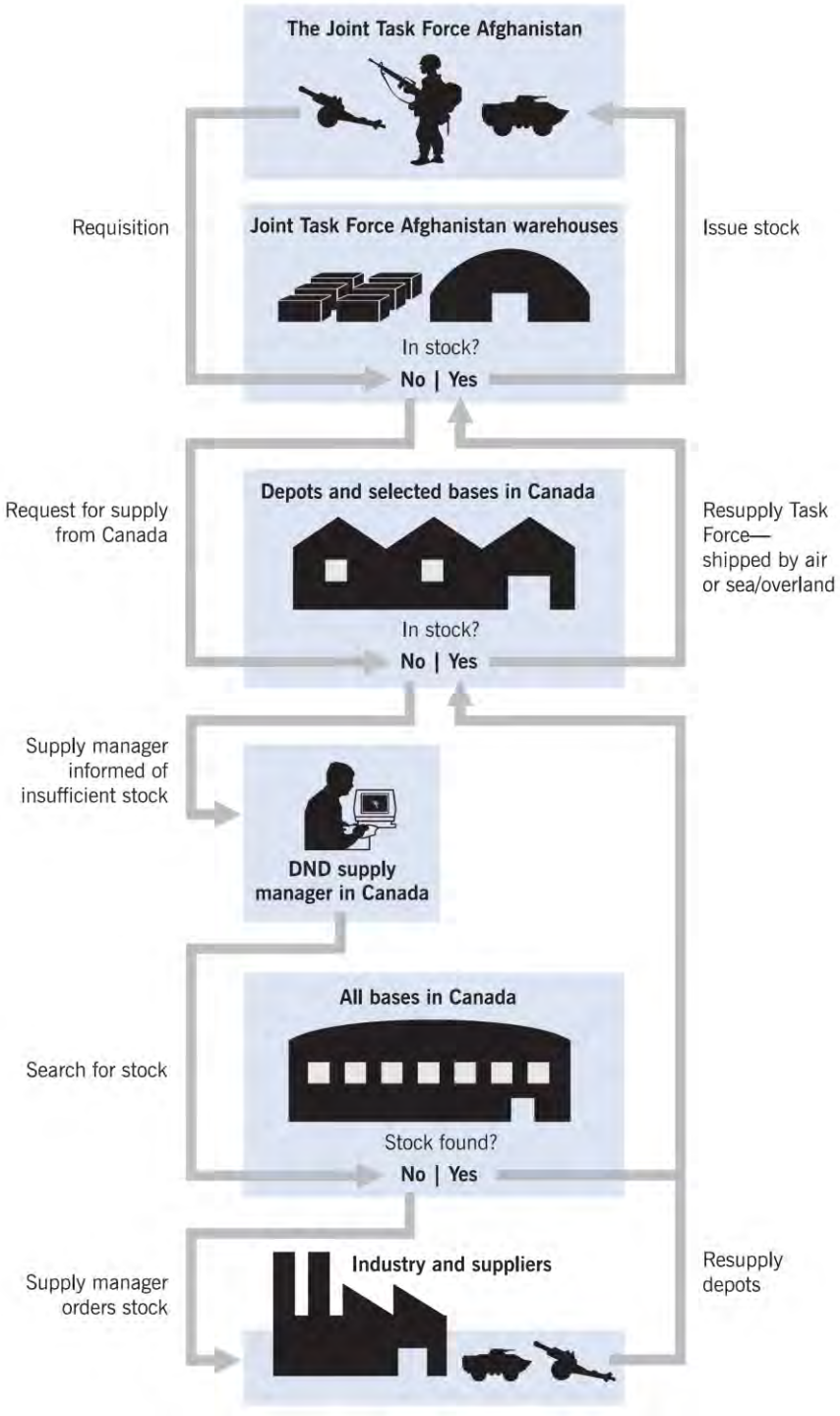

Figure 5: Simplified Supply Chain Operations[42]

[42] Canada. Office of the Auditor General of Canada, *Report of the Auditor General of Canada to the House of Commons: Chapter 2 Support for Overseas Deployments-National Defence* (Ottawa: Office of the Auditor General of Canada,[2008]), 7.

As discussed earlier, visibility of resources is critical to achieving a reliable and responsive supply chain. Early on in the combat mission to Kandahar, the NSE was entirely dependent upon visibility to maintain combat readiness due to the lack of resources available in theatre and the long LoC from Canada.[43] Although the CFSS was able to provide some measure of visibility for those items on shelves in warehouses or in sea containers, the process of achieving visibility was predominantly manual. The CF currently has visibility at different segments of the supply chain particularly when stock is static in warehouses. A supply technician can query the system to know when the item has left the depot, but until it arrives in theatre and it is manually receipted the technician lacks visibility. Due primarily to a lack of AIT incorporated into the process, from the recording of transactions to the receipting of consignments, manual data input is the standard across the entire supply chain. The CF has made efforts towards improving this situation. As the largest expeditionary mission for the CF, most of the development efforts have focused on Op ATHENA. Leveraging commercial off-the-shelf (COTS) technology, the CF has developed an interim RFID capability and deployed a hand-held bar code reading capability to increase visibility and automate processes in theatre.[44] While a step in the right direction, these capabilities are not yet mature nor do they address the entire issue of visibility. For example, the RFID capability will provide greater visibility along the LoC, but does not increase visibility of items once in theatre. Similarly, the bar code reader, known as a portable data entry terminal (PDET), does not

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[43] Conrad, *What the Thunder Said: Reflections of a Canadian Officer in Kandahar*, 126.

[44] Canada. Parliament. House of Commons. Standing Committee on Public Accounts., *Evidence*2nd Session, 39th Parliament, Meeting No. 40,[2008]), 4, http://www.parl.gc.ca/content/hoc/Committee/392/PACP/Evidence/EV3587434/PACPEV40-E.PDF (accessed March 24, 2012).

improve materiel asset visibility in the FOB.[45] As a result, the CF still lacks complete and accurate AV and ITV along LoC and throughout the supply chain which may have a negative impact on future operations. A sure way to gauge the impact is to quantify it in terms of the performance attributes used in the SCOR model through performance measurement.

Performance measurement is not merely a tool designed to improve the effectiveness of one's supply chain, it is also a key source of information to understand how well it is operating. Measuring KPI will demonstrate if the supply chain is operating effectively by virtue of whether or not it is meeting established targets. In line with this rationale, the Department has developed a performance measurement system focused on measuring upwards of fifteen KPI including average cycle time, depot stock reactivation, requisition volumes, and requisition satisfaction, all using data from the current CFSS IT system.[46] Most of the KPI developed measure velocity to determine how quickly it takes for an item from the moment it is requisitioned in theater to be delivered to the customer (i.e. the warfighter). The DND uses a BI application, Business Objects, to analyze the data captured throughout the supply chain. While it can measure the average cycle time (velocity), it lacks the ability to measure segments of the supply chain because the data is not captured. Similar to the supply technician, Business Objects cannot measure what it cannot see. The lack of AIT means that information is not captured as an item passes through critical points in the supply chain. Additionally, the reliance on manual inputs

[45] Canada. Department of National Defence. Canadian Operational Support Command, "Key Speaking Points Comd CANOSCOM" DND Canada, Ottawa, 2008), 5-6.

[46] Canada. Office of the Auditor General of Canada, *Report of the Auditor General of Canada to the House of Commons: Chapter 2 Support for Overseas Deployments-National Defence*, 13.

provides inaccurate and time-affected data. Therefore, the time it takes for the item to go from the supply depot in Montreal to the airport of embarkation (APOE) in Trenton or how long it takes to travel from the seaport of disembarkation (SPOD) in Karachi to Kandahar airfield cannot be measured at this point. This information is critical to monitoring the efficiency and effectiveness of the supply chain. Any potential issues that may be affecting the LoC will be missed. Moreover, it shows that the Department has yet to fully embrace a PM culture which will impact its ability to evolve in the right direction due to a lack of evidence. Lacking complete AV and the ability to measure the performance of the supply chain, the CF launched into Afghanistan.

The CF Operational Supply Chain to Afghanistan

Canada's involvement in Afghanistan began shortly after the terrorist attacks in the US on September 11th 2001. The CF has been committed to the operation for over a decade with varying troop levels and roles, missions, and tasks. At its height, the forces maintained roughly a 3000 member strong contingent focused on combat operations in Kandahar province situated in the southwestern part of the country. Operation ATHENA (Op ATHENA), the name given to the combat mission, was touted as the largest CF deployment since the Korean War and required a significant effort on Canada's part. Supporting the operation required a long LoC and a reliable supply chain to extend from Canada half way around the world to South-West Asia. The Deputy Minister for the DND, Mr. Robert Fronberg described the supply chain as follows:

> The military supply chain is a highly complex process with many components. Personnel located in Canada must acquire the supplies, transport them to users and manage inventory for the most demanding of operational environments. This currently involves shipments by air . . . two to three times a week to transport

> approximately 85 tonnes of equipment and supplies to a destination 12,000 kilometres away. At Kandahar airfield, the [CF] receives supplies and equipment from all over the world, including direct shipments from places like France and South Africa. A sea shipment may originate at the port of Montreal, transit in a place such as Pakistan, and then be driven overland into theatre. Once in Afghanistan, materiel and spare parts are moved from the base at Kandahar airfield to five different forward operating bases [FOB], as well as several remote sites, on a daily basis.[47]

Not unlike that of Allied nations, Canada's LoC to Afghanistan are characteristic of supporting expeditionary forces deployed around the world. To enable effective support of deployed forces requires a major effort and good coordination between the responsible organizations across all three levels of war. In Canada, this translates to the National Support Element (NSE) at the tactical level in theatre, the CANOSCOM at the operational level, and the Assistant Deputy Minister (Materiel) (ADM (Mat)) at the strategic or corporate level.

In its 2008 report, the OAG provided an overview of the roles in the CF supply chain to Afghanistan as follows:

> The operation is supported in-theatre by the [NSE] at Kandahar, which purchases locally and receives shipped goods, and by the [CANOSCOM], which is responsible for the supply depots, including local purchases of items in Canada, and coordinating the transportation of goods into Afghanistan. The [ADM (Mat)] organization is responsible for buying materiel and ensuring that stocks on hand can meet demands.[48]

At the tactical level, the NSE is responsible for providing the day to day support required by the warfighter also known as combat service support (CSS). Conducting both mobile and static operations in the field and on the base, the NSE bridges the 'last tactical mile' in the supply chain. At the opposite end of the spectrum is the ADM (Mat). At the

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[47] Canada. Parliament. House of Commons. Standing Committee on Public Accounts., *Evidence*, 3.

[48] Canada. Office of the Auditor General of Canada, *Report of the Auditor General of Canada to the House of Commons: Chapter 2 Support for Overseas Deployments-National Defence*, 6.

strategic level, "ADM (Mat) is the designated [DND] functional authority for [MA&S] and is responsible to develop all related policy, procedures, processes and training standards as well as ensuring compliance and oversight."[49] Essentially, the ADM (Mat) is responsible for the provisioning component of the supply chain, by acquiring equipment on behalf of the CF and filling the depots with the necessary stock to sustain it, and for the corporate level management function, to include the CFSS and performance management. Linking the tactical and strategic level logistic functions is CANSOCOM as the operational level organization responsible for this effort.

Part of the CF Transformation initiative, CANOSCOM was stood up in 2006 as an operational level command responsible to provide operational support to the expeditionary, domestic and special forces operational level commands, Canadian Expeditionary Force Command (CEFCOM), Canada Command (CANCOM), and Canadian Special Operations Forces Command (CANSOFCOM) respectively. Rather new in the CF order of battle, according to a former Chief of Defence Staff, CANOSCOM is the 'one dog to kick' with regard to supporting operations. As former Commander of CANOSCOM, Major General Benjamin, stated in his testimony to the SCOPA;

> Part of my task is to make sure that we understand the full supply chain from the manufacturer to the theatre, understand the level of stocks, and understand whether in time and space we can bring it into that theatre at the right time and at the right place to make sure we don't compromise operations.[50]

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[49] Canada. Department of National Defence. Associate Deputy Minister (Materiel)., *Materiel Acquisition & Support (MA&S) Business Transformation Program Charter Version 7.0* (Ottawa: DND Canada,[2011]), 2.

[50] Canada. Parliament. House of Commons. Standing Committee on Public Accounts., *Evidence*, 5.

As the link between strategic logistics and tactical logistics, CANOSCOM includes two formation level organizations, the Canadian Materiel Support Group (CMSG), which includes the supply depots, and the CF Joint Support Group (CFJSG), encompassing the force generation elements for theatre activation, deactivation and purchasing. Together with CANOSCOM headquarters, they play a significant role in sustaining the deployed forces. In order for CANOSCOM to accomplish its task, it relies heavily on the policies, procedures and processes that reside with the ADM (Mat) at the strategic level and the practitioners with the NSE at the tactical level. This was no more apparent than in the audit conducted by the OAG in 2007 which provided a snapshot of the performance of the CF operational supply chain.

OAG Report on Support to Deployed Operations

When the CF mission in Afghanistan evolved into a combat role and casualties were sustained, it was natural to question whether the soldiers were getting the best support possible. This question provided the impetus for the 2008 report by the OAG on the support to deployed operations in Afghanistan. Specifically, it examined the responsiveness, reliability, and agility of the Departmental supply chain,

> . . . to maintain adequate stocks for the repair and maintenance of military equipment, to track and control supplies as they move to Afghanistan through the supply chain, and to deliver items to those who need them when they are needed.[51]

While overall it was quite complimentary, lauding the CF for its efforts in achieving effective support of the mission, the report identified a number of areas for improvement

[51] Canada. Office of the Auditor General of Canada, *Report of the Auditor General of Canada to the House of Commons: Chapter 2 Support for Overseas Deployments-National Defence*, 1.

that unless addressed would have a negative impact on the ability to sustain operations in the future. Chief among these were issues with visibility, timeliness and shortages while noting a lack of quantifiable data to assess the performance of the supply chain. Each of these areas merit further discussion and will be amplified to provide a greater appreciation of the problem.

As already shown, the CF only has partial visibility of materiel as it moves through the supply chain. The lack of visibility was compounded on Op ATHENA which did not have the same level of capability as the supply chain in Canada, which was already sub-standard, particularly for tracking. The audit discovered that in many instances items were flagged as arriving late in theatre when they had in fact been received with the technicians unaware due to a lack of visibility. Citing a database that informed users when items were in transit, the report noted that it could not provide information on the expected arrival date. Coupled with the lack of visibility, the inability to predict the arrival date of materiel almost certainly had repercussions for impending operations. For example, when high priority requirements were identified in theatre, often a phone call was placed directly back to Canada circumventing the supply chain to ensure that the item was shipped promptly to avoid affecting the operation. While this worked well for the individual requesting the item, it often resulted in other similarly high priority requirements being bumped from aircraft likely causing them to miss their RDD potentially affecting other facets of the operation. Additionally, items shipped directly to theatre without going through the appropriate gateways inevitably meant that they were not tracked or accounted for properly resulting in a loss of AV. Such was the case in Afghanistan in 2007 when the CANOSCOM rotation staff assistance team

discovered that there were over $7 million worth of deficiencies, items that could not be located, and another $6.6 million in surpluses, items that were not accounted for in theatre.[52] Discrepancies of this magnitude often receive unwanted attention and in this case became the focus of the 2009 SCOPA hearing into the matter calling upon the Department's DM, the Vice Chief of Defence Staff, the ADM (Mat), the Deputy Commander of CEFCOM, and the Commander of CANOSCOM to testify. Beyond the obvious challenges for technicians operating without visibility and the pressure applied to senior defence bureaucrats and officers, it also put logisticians in a position to have their credibility questioned by commanders that placed significant trust in their abilities to provide support second to none in combat operations.

Trust between supported unit commanders and supporting logisticians is paramount. Soldiers engaged in combat usually find comfort in knowing that the resources required to fight are going to be available when required. The unpredictable nature of combat, however, results in irregular supply and demand which is why the mass-based approach remained relevant for so long. By following a JIT approach, the CF operational supply chain is forced to react to demands based on user defined priorities and delivery dates. For Op ATHENA, the audit discovered that the supply chain was able to deliver most of the goods requested, albeit rarely by the date required "including spare parts needed to keep equipment and weapons working."[53] Even more telling is the fact that approximately "one quarter of all requests were already late before being

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[52] Ibid., 11.

[53] Canada. Parliament. House of Commons. Standing Committee on Public Accounts., *Evidence*, 2.

shipped out of the main depot."[54] Surely the tardiness of spare parts arriving in theatre had an impact on the operational readiness of combat units. Indicative of shortages in national stock, it is symptomatic of a supply chain that is unable to accurately monitor and predict usage which can be attributed to a lack of visibility. As a minimum the life-cycle materiel manager (LCMM) should be able to track consumption data to determine the fluctuations in usage rates and source accordingly from industry to meet the new demand. Ideally, a predictive system enabled with a common operation picture (COP) would sense the fluctuations and prompt the decision makers in the supply chain to react. It also demonstrates a lack of awareness in just how well the supply chain is functioning suggesting that the CF is either incapable or unwilling to conduct the necessary performance measurement. Preferably, the system described above should incorporate a BI capability that would permit continuous monitoring of supply chain performance. Supplemented with a corresponding shift towards an environment in which PM is supported and encouraged should allow logisticians to maintain their credibility and the confidence of supported commanders.

While most would agree that the 'as-is' supply chain described by the OAG is not an ideal way to support forces engaged in combat and would expect some eroding in the confidence of supported unit commanders in the logisticians, this was not the case. When conducting the audit, the team seized the opportunity to interview commanders with regard to the support provided to the mission. Commanders expressed concerns over apparent shortcomings in the ability of the supply chain to provide timely support but

[54] Canada. Office of the Auditor General of Canada, *Report of the Auditor General of Canada to the House of Commons: Chapter 2 Support for Overseas Deployments-National Defence*, 10.

qualified these comments by stating that generally they were satisfied with the support.[55] Additionally, the team reported that there were no reports of operations being adversely affected by supply chain problems due to the outstanding efforts and dedication of logisticians to provide the required support despite the issues.[56] Lastly, it was noted in a review of audits performed in the US and UK that both countries had experienced similar issues to those afflicting the CF supply chain in supporting expeditionary missions.[57] Some would be content with this representation citing that if operations had not been significantly affected and commanders were satisfied then why fix it if it is not broken. Those same people may even refer to the fact that the Allies could not overcome similar issues as a reason to forego investment in the supply chain and divert funds to other capital purchases such as tanks, planes, and ships. While a rather naïve approach, the question of why invest a significant amount of time and money to address the issues identified by the OAG has to be answered. By examining the experiences of Canada's closest allies in supporting deployed forces in Afghanistan and their respective responses to the difficulties encountered should provide sufficient reasoning to evolve the CF operational supply chain into the 21st century.

ALLIED EXPERIENCES

In benchmarking it is important to compare one's supply chain against those that are considered the 'best-in-class' in order to distill what exactly makes them the best.

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[55] Ibid., 8.

[56] Canada. Parliament. House of Commons. Standing Committee on Public Accounts., *Evidence*, 2.

[57] Ibid., 2.

Equally important is that the comparison be done between organizations with similar lines of business. Applying these two factors to the range of potential supply chains to benchmark against quickly narrows the field; they must be military and a western nation. Given the context in which the CF has conducted operations recently, it is likely that Canada will continue to operate within a coalition in the future. Therefore, interoperability is another key factor to be considered when choosing potential candidates. This further narrows the range to allies that Canada will likely deploy with on future operations, principally the US, the UK, and Australia, all three of which are members of the American, British, Canadian, Australian (ABCA) Armies programme. For the purposes of benchmarking the CF operational supply chain, these three nations, each currently supporting forces deployed in Afghanistan, represent the 'best-in-class' for comparison purposes. Looking at their experiences in supporting the theatre, the observations of their respective national audit organizations, and their logistics transformation efforts, the intent is to highlight best practices employed by Canada's allies which can be adopted to improve the CF operational supply chain. As the lead nation in the most recent coalition effort in Afghanistan and likely to be the lead in future operations, it is fitting to begin by examining the US supply chain.

The United States Experience

> Most of the difficulties I can attribute to the fact that we fought a 21st century war with a mid-20th century logistics structure…[58]
>
> Lt. Gen Christianson, *senior US logistician during OIF*

[58] Kallock and Williams, *DoD's SUPPLY CHAIN MANDATE: From Factory to Foxhole*, 47.

The US has one of the largest armed forces in the world, certainly best equipped and the most engaged, which compliments it role as the only remaining global superpower. As such, it requires a robust logistics capability to support its deployed forces and in many cases its coalition partners that rely to varying degrees on their global reach. In the US DoD, responsibility for the supply chain is split between the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, which is focused on provisioning, and the US Transportation Command (USTRANSCOM), which is tasked with the distribution. The Under Secretary of Defense for Acquisition, Technology, and Logistics includes within its organization the Defense Logistics Agency (DLA), which as the US combat logistics support agency sources and provides virtually everything American forces require from the US industrial base with warfighter support being its number one priority.[59] In the Canadian context, DLA is a cross between ADM (Mat) and CANOSCOM functions, performing a full range of logistics, acquisition and technical services. Alternatively, USTRANSCOM, under the Unified Command Plan, is appointed as a combatant command with the primary role for coordinating the transportation of materiel and equipment into theatre. Under command are three service components, Air Mobility Command (Air Force), Military Sealift Command (Navy), and Surface Deployment and Distribution Command (Army), which execute the strategic movement plan. In addition to this role, it is also designated as the DoD distribution process owner (DPO), responsible for supply chain transformation initiatives to ameliorate issues encountered on operations in Iraq and Afghanistan.[60]

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[59] United States. Department of Defense, *Final Report on Defense Business Operations to the Congressional Defense Committees*,[2009]), 55-56, http://dcmo.defense.gov/documents/March_2009_Congressional_Report%20.pdf (accessed February 26, 2012).

The US has been a pioneer in the field of logistics as demonstrated while supporting its forces in Afghanistan under Operation Enduring Freedom (OEF). Whether proving new lines of communication or the use of new and emerging technology, DoD has shaped the way in which support is provided to the theatre with many of its Allies adopting similar approaches. While the primary means of support for most countries has been through an air bridge into Afghanistan, USTRANSCOM has made significant use of two surface modes through Pakistan and through western European and central Asian countries on which most of the equipment and supplies destined for theatre are shipped.[61] Not only is the use of surface modes far cheaper than air, but it preserves scare airlift for the deployment of troops and high priority equipment. To achieve this 'best practice' requires real-time visibility of assets and of consumption rates, two key pieces of information necessary for the supply chain to become predictive and to ensure the supplies and equipment are available when needed by the warfighter. As the DPO,

> USTRANSCOM's [new] mission is to synchronize the distribution system from "factory to foxhole" via improved processes and integrated real-time systems. . . . [to] facilitate collaboration up and down the supply chain through forecasting requirements, synchronizing sources of supply and modes of transportation, speedily responding to customer demand all the time, and constantly finding ways to improve everything from inventory visibility and transaction accuracy to communication systems.[62]

To accomplish its mission, USTRANSCOM has focused significantly on developing the capabilities to sense and respond to logistics requirements.

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[60] United States. Government Accountability Office, *Warfighter Support: Preliminary Observations on DoD's Progress and Challenges in Distributing Supplies and Equipment to Afghanistan GAO-10-842T*,[2010]), 5, http://www.gao.gov/products/GAO-10-842T (accessed March 24, 2012).

[61] United States. Government Accountability Office, *Warfighter Support: Preliminary Observations on DoD's Progress and Challenges in Distributing Supplies and Equipment to Afghanistan GAO-10-842T*, 6.

[62] Kallock and Williams, *DoD's SUPPLY CHAIN MANDATE: From Factory to Foxhole*, 47-48.

Transformation efforts in the US DoD have concentrated primarily on processes and technology to improve the supply chain based on lessons learned from Iraq and Afghanistan. It was discovered that during OIF senior commanders did not have the requisite information to be able to prioritize requirements or make decisions which adversely affected the transportation and distribution system. To resolve the issue, USTRANSCOM embedded the Central Command Deployment and Distribution Operations Center (CCDDOC) within the US Central Command to confirm the commander's priorities and synchronize the inflow with available theatre lift and handling capacity.[63] An example of an organizational change that has improved the distribution process, it precipitated the establishment of similar operations centres in each of the geographic combatant commands. Essentially a beefed up movement control centre (MCC) at the operational level, the embedding of operational level logistics functions within the supported command headquarters may be considered a 'best practice'.

In conjunction with process changes at the operational level, USTRANSCOM has also put a tremendous amount of effort towards implementing new technology to increase AV. Principally through the use of RFID and a network of interrogators deployed at critical points throughout the supply chain, the resulting increase in visibility has led to commensurate improvements in efficiency and effectiveness. According to the executive vice president of SAVI Technology, an industry leader in RFID technology, the US DoD is "using 30 percent fewer troops and 90 percent fewer containers to get materiel to the

[63] United States. Government Accountability Office, *Warfighter Support: Preliminary Observations on DoD's Progress and Challenges in Distributing Supplies and Equipment to Afghanistan GAO-10-842T*, 8.

front lines. . . [which] is attributed to improved visibility into the supply chain."[64] Although the predominant tool used for visibility of materiel, major end items such as vehicles require more persistent visibility than provided by RFID. During the American surge of forces into Afghanistan in 2009, "USTRANSCOM improved visibility of unit cargo deploying and redeploying through Pakistan by utilizing state-of-the-art satellite tracking technology to increase fidelity and accuracy of information."[65] Although integrating the global positioning system (GPS) with the supply chain can provide more accurate information such as is the case with the US Army's Movement Tracking System (MTS), the associated costs are more expensive and need to be weighed against the benefits of persistent visibility. Regardless of the costs, both technologies are commonplace in industry and are becoming more prevalent in advanced militaries and are therefore the standard against which others should benchmark.

Despite of the introduction of AIT and the subsequent improvements that resulted, supply chain distribution was still hampered by visibility problems attributed to issues with interoperability between the various systems. Consequently, it led to the requirement for additional staff in theatre and the use of ad hoc manpower intensive techniques to enable decision making.[66] It was a clear indication of the difficulties in achieving visibility and that technology was not a panacea for the issues associated with

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[64] Tom Andel, "THE MILITARY'S WAR ON Invisibility," *Material Handling Management* 59, no. 1 (Jan, 2004): 30, http://proquest.umi.com/pqdweb?did=536808001&Fmt=7&clientId=1711&RQT=309&VName=PQD.

[65] United States. Department of Defense, *Final Report on Defense Business Operations to the Congressional Defense Committees*, 63.

[66] United States. Department of Defense, *DoD Plan for Improvement in the GAO High Risk Area of Supply Chain Management with a Focus on Inventory Management and Distribution*,[2009]), 16-17, www.acq.osd.mil/log/sci/GAO_high_risk_update_Sept2009.pdf (accessed March 24, 2012).

the supply chain. While some contend that the issues experienced on operations by the US are a result of a lack of training that cannot be overcome with more and better technology,[67] others have concluded that improvements need to be made in the 'last tactical mile' to increase visibility.[68] Rather than arguments against the technological advances being pursued by the US DoD, these should be considered as focus areas for transformation initiatives as they go forward. Striving to address these concerns and overcome the systems interoperability issues, USTRANSCOM has developed the Theatre Enterprise Deployment and Distribution (TED2) concept which will attempt to evolve the deployment and distribution operations centre concept to support adaptive planning and agile execution. TED2 when realized will standardize joint theatre level organizations and their processes, business rules, tools, systems, and architecture to enable the planning and control of the pipeline and to create logistics situational awareness by contributing to a logistics COP (LCOP).[69] What may be the 'holy grail' of logistics, TED2 promises to provide the US logisticians with a significant capability that is intended to improve the efficiency of the supply chain and make it more effective in supporting the warfighter. While still being developed, the concept is appealing and one that merits consideration by others for incorporation into their respective supply chains.

The United Kingdom Experience

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[67] Daniels, *The Distribution Dilemma: That Last Tactical Mile*, 42.

[68] Robert S. Tripp and others, *Sense and Respond Logistics: Integrating Prediction, Responsiveness, and Control Capabilities. Report Prepared for the United States Air Force.* (Santa Monica, CA: RAND Corporation,[2006]), 39.

[69] United States. Department of Defense, *DoD Plan for Improvement in the GAO High Risk Area of Supply Chain Management with a Focus on Inventory Management and Distribution*, 33, 36, 38-39.

> Operations in Afghanistan are our top priority and the NAO notes the improvements in the supply chain, including to our armed forces on the front line. We are constantly working to improve our performance and we are currently implementing an GBP800 million contract with Boeing Defence for a more streamlined, agile and effective logistics support chain.[70]
>
> Peter Luff, *Minister for Defence Equipment, Support and Technology*

As a US ally in the Global War on Terror, the UK has been involved in Afghanistan from the outset. Similarly, the UK Ministry of Defence (MoD) has been challenged to provide effective support to expeditionary forces in foreign countries. Based on the experiences of earlier missions and the early days of the mission in Afghanistan, the UK MoD conducted a study on the supply chain with the assistance of McKinsey & Co. Released in 2003, it was dubbed the 'End-to-End (E2E) Study' for its examination of the supply chain from theatre to industry and is recognized as the turning point in MoD logistics from which recent UK transformation efforts trace their genesis. The study, which concluded that transformation could only be approached by looking at the entire supply chain, offered that a future logistics strategy should be joint, robust, rapidly-deployable, and focus on expeditionary operations that are short-notice in nature and conducted in far-off countries. Additionally, the strategy should be based on the commander's desired effects at the front and follow three key principles:

- Configure logistic support for the most likely operational scenarios (medium scale), but create sufficient flexibility to cope with the most demanding. . . .
- Concentrate support facilities at the 'logistic centre of gravity'. . . . [C]entralise stock holdings and support major training exercises and operations with 'Deployable Spares Packages' . . . , in line with Industry best practice. Hold only sufficient materiel for a unit, formation or squadron until the supply chain is established and where resources and materiel can deliver the required logistics support as effectively, flexibly and efficiently as possible.

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[70] Gerrard Cowan, "NAO Report Details Failings in UK Supply Chain," *Jane's Defence Weekly*, n.p., http://jdw.janes.com/subscribe/jdw/doc_view_print.jsp?K2DocKey=/content1/janesdata/mags/jdw/history/jdw2011/jdw45735.htm@current&Prod_Name=JDW&showUpdate=false& (accessed January 26, 2012).

- Streamline the supply chain and take a 'factory to foxhole' perspective to synchronise all logistic efforts with delivering the final output. By applying 'Lean' principles . . . to the end-to-end supply chain, excess capacity and duplication will be removed or reduced, defined organisational boundaries will be removed, and logistic support will flow more quickly, efficiently and effectively.[71]

A comprehensive examination of the MoD's supply chain, the E2E study highlights the importance of understanding one's current and future lines of business before proceeding with transformation and is an excellent example of a 'best practice' for other nations and organizations to emulate. In the case of the UK, what followed was a significant transformation by the MoD that resulted in an entirely new approach to support operations including the introduction of new organizations, processes, and technology.

Commanding the newly formed Defence Equipment and Support organization (DE&S), the Chief of Defence Materiel was appointed the logistics process owner (LPO), responsible for ensuring that logistics was delivered reliably and for gaining the confidence of operational commanders by providing information for decision making and greater flexibility.[72] Under DE&S, which manages the entire MoD supply chain, the Joint Support Chain (JSC) organization manages the daily operations of the strategic link between the UK and operational theatres with a number of organizations including Joint Support Chain Services (JSCS) and Defence Support Chain Operations and Movements (DSCOM). JSCS is responsible for the provisioning within the UK supply chain, running the depots and receipting materiel from industry into the military supply chain through

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[71] Elford, *RTO-MP-AVT-144: The Evolution of Aircraft Support Concepts within the UK MoD's Defence Logistics Transformation Programme*, 6-2.

[72] Christine Tipping, *Key Issues Affecting the Provision of Logistics Support to the UK Armed Forces in Expeditionary Operations* (London: The Royal United Services Institute, 2, http://www.rusi.org/downloads/assets/IBM_Logistics.pdf (accessed March 24, 2012).

the 'Purple Gate', a process to regulate materiel flow into the JSC. Conversely, DSCOM manages the distribution segment of the chain, responsible for the movement of personnel and materiel through the 'Coupling Bridge', which is a single supply chain to operational theatres. In addition to the management of daily operations, JSC also includes Support Chain Management, focused on procedures and processes, and the Logistics Network Enabled Capability Programme, which manages and improves logistics systems and BI tools.[73] The concentration of responsibilities within JSC under DE&S provides unity of command and of effect to achieve excellence in logistics. With its mandate, DE&S has the full complement of resources required to operate both an efficient and effective supply chain and should serve as a 'best in-class' organization for national level logistics organizations.

In an effort to provide efficient and effective support to expeditionary operations, the MoD makes use of operational sustainability statements. In essence, the statements identify priorities and performance targets using time for the delivery of materiel to theatre by priority code which determines the mode of transportation (Table 2). They state the expected rate of consumption of materiel for the operation and are then used to calculate the amount of stock to be held in order to meet the targets.[74] The statements are published by DSCOM for each operation and provide focus across the entire supply chain. Broken down by supply chain segment, it allows the organizations responsible for

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[73] United Kingdom. National Audit Office, *HC 827 Session 2010-2011 Ministry of Defence: The use of Information to Manage the Logistics Supply Chain* (Norwich, UK: The Stationary Office,[2011]), 10-11, http://www.nao.org.uk/publications/1011/logistics_supply_chain.aspx (accessed March 24, 2012).

[74] United Kingdom. National Audit Office, *HC 508 Session 2008-2009 Support to High Intensity Operations* (London: The Stationary Office,[2009]), 29, 32, http://www.nao.org.uk/publications/0809/high_intensity_operations.aspx (accessed March 24, 2012).

each segment to work towards a goal that aggregate to the total supply chain pipeline time for providing materiel to the warfighter. The statements are similarly important to performance measurement of the supply chain within the MoD. Within DSCOM is the Defence Logistics Operations Centre (DLOC), an organization that conducts performance measurement of the JSC as part of the management of the day-to-day operations. Currently measurement of JSC performance is velocity based, meaning it is based on time form the perspective of the customer (i.e. warfighter). The key metrics used by DLOC to indicate the performance of the JSC are reliability, responsiveness, and inventory availability, two of which correspond to the SCOR performance attributes that are considered 'best practice'.[75] More recently, however, DLOC planned to evolve from a velocity based performance measurement focus to one centred on readiness before eventually moving onto measuring effectiveness.[76] The rationale for the maturation of the metrics was that measuring the timeliness of materiel arriving in theatre no longer sufficed when the readiness of forces is the goal. Achieving readiness implies that the unit has the resources required for employment and is therefore a better measure of whether the JSC is effective. Between the use of operational sustainability statements and the focus on performance measurement, the UK MoD provides a tremendous example of focusing on performance to improve the supply chain.

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[75] Colonel Mark Dunn, "Performance Management - Supporting Operations and Changing Culture Presented to Canadian Department of National Defence" (Ottawa, November 7,2008), slide 17.

[76] Canada. Assistant Deputy Minister Materiel. "Coalition Benchmarking Seminar Working Group (CBSWG) Summary" 2008).

	Standard Priority Code	Demand Transmission Time to UK	Demand Processing Time	Materiel Handling Time	Time for Distribution to UK point of Embarkation	Time for Distribution to Theatre	Average Time for in Theatre Distribution	Total Supply Chain Pipeline Time	Mode of Distribution
IRAQ	01 Immediate	Within 1 hour		1 hour	22 hours	48 hours	24 hours	4 days	Air
	02 Priority	3 hours	3 hours	18 hours	24 hours	4-9 days	3-9 days	9-20 days	Air
	03/04 Routine	6 hours	18 hours	3 days	3 days	47 days	5 days KSF	59 days	Surface/Air
							8 days COB Basra	62 days	Surface/Air
							11 days Baghdad, MCC Bahrain ACC Al Udeid Seeb	65 days	Surface/Air
AFGHANISTAN	01 Immediate	Within 1 hour		1 hour	22 hours	3 days	24 hours	5 days	Air
	02 Priority	3 hours	3 hours	18 hours	24 hours	3-9 days	2-9 days	7-20 days	Air
	03/04 Routine	6 hours	18 hours	3 days	3 days	66 days	4 days Kandahar	77 days	Surface
							14 days Lashkar Gar	87 days	
							10 Days Camp Bastion and Kabul	83 days	

Table 2: UK MoD target times for the delivery of supplies to Iraq and Afghanistan[77]

[77] United Kingdom. National Audit Office, *HC 508 Session 2008-2009 Support to High Intensity Operations*, 30.

Despite this focus, the UK National Audit Office (NAO) in its 2011 report on The Use of Information to Manage the Logistics Supply Chain reported that the MoD was experienced difficulty in meeting its own targets published in the operational sustainability statements. Overall achieving targets just over 50% of the time, items flagged as high priority by theatre arrived on time in approximately a third of those examined.[78] While some would argue that the UK does not represent a nation to benchmark against given their dismal record, the simple fact that the MoD measures their performance is reason enough to continue to include them. By virtue of measuring the performance of the supply chain, the DLOC can identify whether an item was late due to a provisioning failure, when the item is unavailable, or a pipeline failure, when there are delays in transportation. In most cases the reason for failure was due to provisioning and has led to greater efforts to improve forecasting, which will allow the MoD to increase efficiency by reducing the amount of stock required in theatre and by using less expensive surface LoC.[79] To accomplish this, the MoD has concentrated its recent transformation efforts on improving systems integration within the supply chain. The Devonshire and Haynes Capability Investigation into AV within the JSC concluded that automation is essential and identified a number of areas to develop including the integration of information exploitation capabilities with sensing technologies to exploit AV information and the tracking of transportation assets from which the location of its contents can be inferred. Additionally, the report advocated following the US DoD research and development programmes as the leader in AV, something that was already

[78] United Kingdom. National Audit Office, *HC 827 Session 2010-2011 Ministry of Defence: The use of Information to Manage the Logistics Supply Chain*, 5.

[79] Ibid., 21,30.

being done by the North Atlantic Treaty Organization (NATO).[80] The report provided much of the impetus for the MoD Future Logistics Information System project as part of the Logistics Network Enabled Capability contract won by Boeing Defence which aims to create 'a more streamlined, agile and effective logistics support chain' as mentioned by Minister Luff. Although the project is far from being complete, it emphasizes the current focus of the UK and of many other nations on increasing efficiency as a means to improving the effectiveness of the supply chain.

The Australian Experience

> We've still got to move hard to bring automation into our logistics system and make sure that we can support troops at the end of a very long pipeline.[81]
>
> General Peter Cosgrove,
> *Australian Chief of Defence Force during OIF*

Similar to both the US and UK, Australia has fought both in Afghanistan and Iraq during the early years of the 21st century. While the two wars have emphasized the need for the Australian Defence Forces (ADF) to continue logistics transformation efforts, specifically visibility, much of the impetus for transformation stemmed from operations before the turn of the century. Unable to adequately track shipments of materiel and equipment in Australia or overseas, it was during the conduct of operations in East Timor in 1999 that the ADF learned the importance of visibility. Critical shipments of parts could not be located by forces on the ground using the existing information systems and

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[80] Devonshire and Haynes, *Capability Investigation into Asset Visibility Final Report*, 21, 44.

[81] Stephen Withers, "RFID in the War Zone," *Army Technology*, n.p., http://www.army-technology.com/features/feature1616/ (accessed March 4, 2012).

technology employed by the ADF.[82] At the time, the ADF relied on the Standard Defence Supply System (SDDS), an inventory management system based on MIMS, the same platform as DND. Although touted as capable of managing requirements determination and cargo tracking among other functions, there were performance issues associated with SDDS that proved unsuitable during operations in East Timor, Bougainville, and Cambodia. The inability to track items from industry to the ADF soldier prompted the Australian Department of Defence (AUS DoD) to initiate a series of visibility projects to correct the deficiency.[83] Essentially a description of the 'as-is' current state of the ADF supply chain in line with the SCOR process reference model, the AUS DoD embarked on a comprehensive review of logistics culminating in the ADF Future Joint Logistics Concept 2025 (FJLC 2025) and the Defence Logistics Transformation Programme (DLTP).

As described in the FJLC 2025 concept, the ADF identifies that future logistics will be as follows:

> The characteristics of future logistics will reflect a logistics system that is genuinely joint in nature, demonstrates comprehensive integration of the three networks within the system [control network, information network, and physical network], and has a distribution rather than stores holding focus. . . . [I]t will be agile and robust enough to maintain support to the operational force, and be capable of delivering precision effects within a joint and combined force structure. As a consequence, the FJLC 2025 can be described as a 'Networked and Distribution Based' concept.[84]

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[82] Ibid., n.p.

[83] Australia. Australian National Audit Office, *Audit Report no. 10 2006-07 Management of the Standard Defence Supply System Remediation Programme*,[2006]), 9-10, 25-26, http://www.anao.gov.au/Publications/Audit-Reports/2006-2007/SDSS-Get-Well-Program-(SDSS-Follow-up) (accessed March 24, 2012).

[84] Ibid., 20.

Logistics Principles	FJLC 2025 Characteristics	Joint Operations for the 21st Century Attributes
Simplicity	Interoperability / Networked	
Economy	Precision / Networked / Interoperability	
Flexibility	Agility / Networked / Deployable	Agile & Versatile
Responsiveness	Agility / Precision / Networked / Deployable	Deployable / Networked / Precise & Discriminating / Ready & Responsive
Balance	Agility / Precision	Balanced
Foresight	Precision	
Sustainability	Precision / Robustness / Agility	Persistence & Poised / Sustainable / Capable of Concurrency
Survivability	Robustness / Agility / Networked / Deployable	Survivable & Robust
Co-operation	Interoperability / Networked	Integrated & Interoperable

Table 3: Principles, Attributes and Characteristics[85]

Sharing many of the same characteristics that define S&RL in the US context, it focuses on six principle characteristics; agility, robustness, precision, networked, interoperability, and deployable. Mapped against the principles of logistics and the ADF defined attributes for joint operations in the 21st century (Table 3), the 'Network and Distribution Based' logistics concept as described appears to meet the requirements of the future operational environment while adhering to the traditional principles upon which logistics has been founded. Representing the desired 'to-be' future state using the SCOR process reference model, it serves as the driving force behind current ADF transformation efforts outlined in the DLTP and underscores the importance of following industry 'best practices' when seeking to improve the supply chain.

To achieve the 'to-be' future state, that is the 'Network and Distribution Based' logistics concept, the ADF outlined a comprehensive plan to transform the supply chain

[85] Australia. Australian Defence Force, "Future Joint Logistics Concept 2025: Supporting the Future Joint Force: Transforming Logistics Toward 2025 Version 10" 2007), 18.

within the DLTP. In it, the Chief of Joint Logistics (CJLOG) emphasized what he considered to be the four major issues that steered the direction of the programme:

- Ensuring End–to–End Asset visibility, particularly in support of operations;
- Reinvigorating logistics infrastructure in order to optimise the distribution function;
- Standardising and simplifying our processes in order to achieve efficiencies and improve data accuracy; and
- Establishing a networked logistics system in accordance with the aspirational Logistics concept of operations as articulated in Future Joint Logistics Concept 2025.[86]

Similar to lines of operation in a campaign plan, each issue provided focus for specific areas of transformation to be covered by the plan to move from the 'as-is' current state to the 'to-be' future state. The plan itself, laid out in a campaign design format (Figure 6), identifies how six conceptual themes applied across the three network systems, representing lines of development, will lead to a logistics system that demonstrates the six FJLC 2025 characteristics and achieve the transformation end state, which is the 'Network and Distribution Based' logistics concept, by the year 2025. Captured within the six conceptual themes are various priorities identified by senior logisticians in the ADF to reach the FJLC 2025 including the adoption of the latest advances in technology designed to achieve "a networked logistics system that balances supply, distribution, and risk."[87] A detailed and all-encompassing plan, the DLTP represents the future of logistics in the ADF and an example for others nations to follow in defining their own transformation efforts.

[86] Australia. Australian Defence Force, "Defence Logistics Transformation Plan Abridged Version 1" 2007), ii.

[87] Ibid., 2-3.

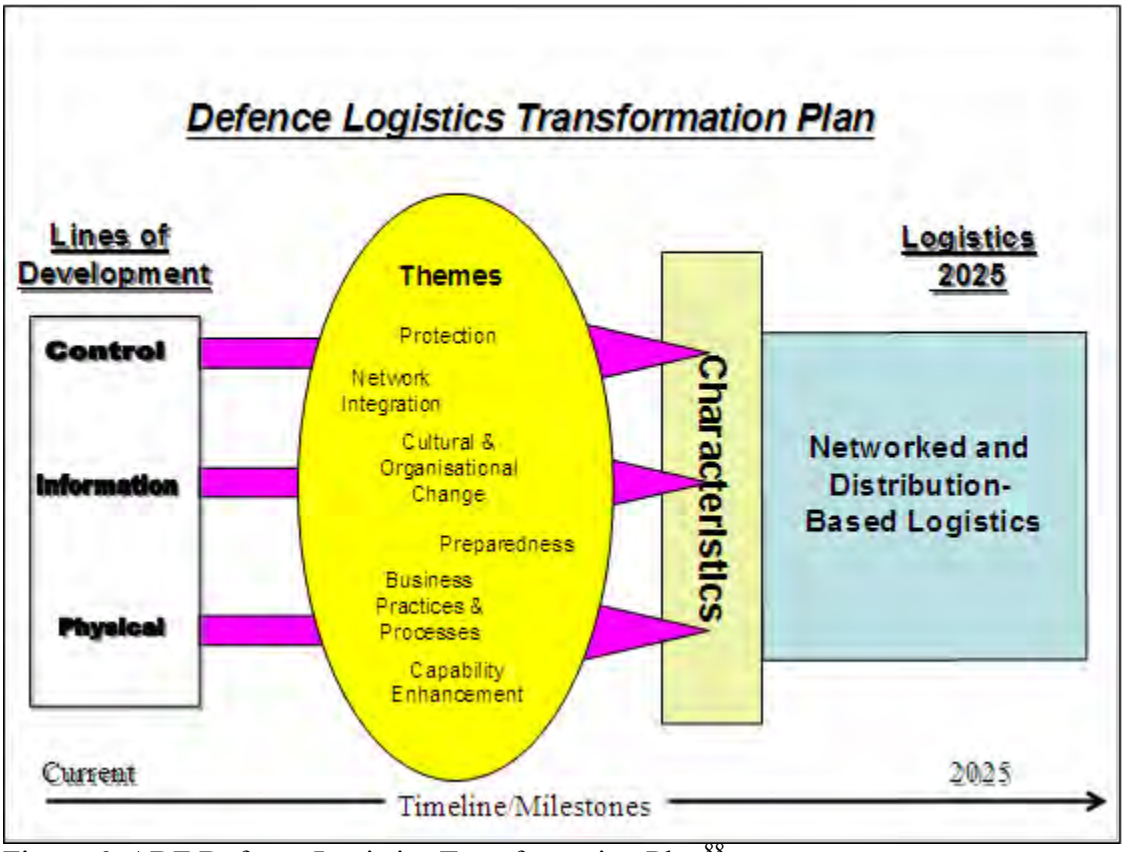

Figure 6: ADF Defence Logistics Transformation Plan[88]

As part of the DLTP, the ADF initiated a project to replace the SDDS with an information system capable of supporting the FJLC 2025. Joint project 2077 (JP 2077) aims to develop a modern, agile, and responsive military integrated logistics information system (MILIS) that is capable of providing the requisite information through automation. It is intended to be intuitive and predictive with decision support tools that enable accurate and timely decision making and planning during operations. Lastly, MILIS is expected to provide a significant improvement in the areas of ITV, deployable

[88] Australia. Australian Defence Force, *Future Joint Logistics Concept 2025: Supporting the Future Joint Force: Transforming Logistics Toward 2025 Version 10*, 26.

capability, and RFID capability.[89] The ten-year project, estimated to cost over A$650 million, will replace over 100 legacy systems with a single system that provides greater automation and visibility across the services based on a three-tier architecture; fixed, deployed, and mobile.[90] While projected to be a significant improvement over the current system, it does not appear to address all the issues identified by the CJLOG. To those familiar with the project, MILIS will remain an automated ordering and shipping system unable to contribute to the operational situational awareness as it does not track real-time consumption data or prognostic information of assets at the platform level, but instead relies on the input at forward supply points.[91] Despite appearing not to achieve a predictive capability that is required in the S&RL concept, the simplification of processes, the incorporation of visibility tools, and the deployable architecture expected from MILIS puts the ADF well on its way to achieving the end state in its DLTP and enables the support of Australian operations well into the 21st century. Moreover, it represents an advanced information system that is among the industry best and establishes a clear benchmark within the military realm.

Perhaps the most comparable to the CF in terms of total force size and structure, the ADF is a perfect force to benchmark. However, despite the similarities between the two armed forces, Australia currently out shines Canada in the field of logistics. Maybe

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[89] Australia. Australian National Audit Office, *Audit Report no. 10 2006-07 Management of the Standard Defence Supply System Remediation Programme*, 11.

[90] Withers, *RFID in the War Zone*, n.p.

[91] Maj Ray Hingst and Greg Gunter, "Land Warfare Conference 2008: Autonomic and Sense and Respond Logistics: The "Foxhole to Factory to Foxhole" Continuum of Combat Service Support" (Brisbane, Australia, October 2008, 90, http://eprints.usq.edu.au/4627/1/Hingst_Gunter.pdf (accessed March 24, 2012).

it is the fact that the ADF fought in Iraq, alongside the US and the UK, whereas the CF did not. The reality of supporting simultaneous operations in Iraq and in Afghanistan provided the opportunity for all three nations to stress test their respective supply chains, learning valuable lessons from their experiences which have shaped their transformation initiatives. As the clear front runner amongst the Allies, the US provides a 'best-in-class' example for the CF to follow. The identification of a DPO with clear transformation responsibilities, focused solely on providing the best support possible to the warfighter, is a clear benchmark to achieve. Similarly, developing a predictive supply system with visibility of assets achieved through automation and capable of providing a LCOP is considered a 'best practice' worth emulating. In the case of the UK, its E2E study showed the importance of conducting a comprehensive review to define the 'as-is' state of the supply chain to inform transformation initiatives. Additionally, the benefits provided by unifying both logistics command and effort in one organization are sufficient enough to warrant a serious examination of DND organization and structures. Moreover, the use of operational sustainability statements to set performance targets and the routine measurement of the supply chain are low hanging fruit that could offer short term gains. Lastly, as in the case of Australia, the development of a comprehensive future logistics concept and transformation plan such as the ADF FJLC 2025 and DLTP are definite milestones to be achieved by any organization hoping to improve its supply chain. Assessed to be the 'best in-class' amongst militaries, the incorporation of these military 'best practices' from the US, the UK, and Australia are necessary to realize gains in supply chain efficiency and effectiveness, to maintain the credibility of logisticians, and to boost the warfighter's confidence in operational support.

DND/CF LOGISTICS TRANSFORMATION INITIATIVES

The examination of the Allied experiences has established a number of benchmarks that inform a way ahead for the CFSS. Particularly in the area of transformation, the Allies as a whole have focused a tremendous amount of time and effort towards improving the business of supporting the warfighter. While still fresh in the reader's mind, perhaps now is the opportune moment to consider the DND/CF logistics transformation efforts in order to see how well they measure up against the efforts of the Allies. Logistics transformation in DND/CF, aside from the creation of CANOSCOM in 2006, has largely been focused on the introduction of new technology to improve supply chain performance. The three ongoing projects worth mentioning include the adoption of DRMIS as a single ERP, which is captured in the MA&S Business Transformation Program, the integration of AIT solutions, covered by the Data Collection System (DCS) Strategy and Guidance, and the development of a Recognized Operational Support Picture (ROSP), addressed in a CANOSCOM statement of capability deficiency. To assess the potential of these projects to improve the operational supply chain, there is merit in comparing them against industry 'best practices' employed by companies determined to be the 'best-in-class' in a 2007 study conducted by the Aberdeen Group. Consequently, by applying the same ranking used in the Aberdeen study, DND/CF logistics transformation will be judged as either being best-in-class, average or laggard. To begin the assessment, it is perhaps best to start at the heart of the CFSS by looking at the implementation of DRMIS as the primary IT system for the supply chain.

MA&S Business Transformation Program

> Best-in-Class companies are using more software tools to enable global supply chain visibility, ranging from in-house developed applications to advanced packaged commercial solutions.[92]
>
> Aberdeen Group, *A View from Above*

Approved by ADM (Mat) in the Fall of 2011, the MA&S Business Transformation Program represents the latest DND direction with respect to initiatives designed to transform the CFSS. Focused primarily on the adoption of the DRMIS ERP as the single IT system for materiel management, it also reviewed a number of legacy IT systems for potential migration of data and business processes to the ERP. The end state for the program is to "create an integrated MA&S environment with asset visibility, accountability, trained and committed practioners and credible world class support to operations."[93] To achieve this, DND conducted a series of blueprinting workshops designed to map processes, highlight requirements, and distill which legacy systems would be incorporated into the ERP. The outcome was a final CFSS-DRMIS planning and scoping report that highlighted the plan to consolidate materiel management business process in DRMIS. While a comprehensive plan to achieve 'an integrated MA&S environment' through the implementation of DRMIS, it does not address the wider CF supply chain transformation. Focused only on the corporate level, the plan falls short in providing a future concept of operational logistics support for the CF. Despite addressing

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[92] Sadlovska, *A View from Above: Global Supply Chain Visibility in a World Gone Flat*, 12.

[93] Canada. Department of National Defence. Associate Deputy Minister (Materiel)., *Materiel Acquisition & Support (MA&S) Business Transformation Program Charter Version 7.0*, 4, 8.

the systems requirement to realize the 'best practice' identified by the Aberdeen Group, it fails to show how MA&S transformation will achieve global supply chain visibility.

DCS Strategy and Guidance

> The Best-in-Class are already actively leveraging the visibility data and tools to conduct in-depth analysis to support both day-to-day activities and long-term strategic planning.[94]
>
> Aberdeen Group, *A View from Above*

As attested to by the Aberdeen Group, AIT plays an important role in industry such that it distinguishes the best companies from the others in the supply chain business. It is not surprising then to see the Allies put so much effort into adopting visibility technology when they are in the business of supporting soldiers whose lives depend on the availability of supplies. In the case of DND/CF, the DCS Strategy and Guidance document outlines a program focused on integrating COTS AIT capabilities, similar to those used in industry, to assist with materiel management, to contribute to visibility of MA&S inventory and assets, and to improve decision-making and sustainment planning. Covering the full range of AIT solutions, the program will initially focus on improving the legacy PDET capability, renamed the Defence Warehousing Information Management Solution for Operations (DWIMS-Ops), which will principally be used in the operational supply chain.[95] While DWIMS-Ops will address the automation of certain processes in theatre, it does not provide the complete solution required to improve the supply chain DND-wide. As with all projects, the DCS program is subject to funding.

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[94] Sadlovska, *A View from Above: Global Supply Chain Visibility in a World Gone Flat*, 12.

[95] Canada. Department of National Defence. Associate Deputy Minister (Materiel). Director General Materiel Systems and Supply Chain, *Data Collection System (DCS) Strategy and Guidance Version 0.5 (Draft)* (Ottawa: DND Canada,[2011]), 2,7,8.

Currently, there is $300 million earmarked for total asset visibility (TAV) in the investment plan between the fiscal years 2019/2020 and 2023/2024.[96] This means that additional enabling capabilities, including the full integration of RFID into the supply chain, are likely still upwards of ten years away from delivery and that the 'as-is' supply chain will remain 'as-is' for the foreseeable future. While it is recognized that these capabilities will not be online to support the Afghanistan mission before Canada completely withdrawals in 2014, it is highly probable that these enablers will still be unavailable for the next operation, potentially putting the welfare of the warfighter in jeopardy due to a lack of visibility.

CANOSCOM Statement of Capability Deficiency

> Best-in-Class companies are leveraging their enhanced visibility into supply chain processes to make their supply chains more agile.[97]
>
> Aberdeen Group, *A View from Above*

As previously mentioned, supply chain flexibility is one of the metrics used by the SCOR model to gauge the performance of business processes within the system. In other words, 'the agility of a supply chain in responding to marketplace changes to gain or maintain competitive advantage' as defined in Table 1. According to the Aberdeen Group, there is a correlation between agility and visibility. The ability to make accurate and timely decisions regarding supply chain operations is dependent upon AV and ITV. As noted during the Canadian withdrawal from Kandahar, Afghanistan in 2011, the

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[96] Cdr R. Hitesman, "Briefing Note for CFD: CANOSCOM Recognized Operational Support (ROSP) Capability" 2012), 1.

[97] Sadlovska, *A View from Above: Global Supply Chain Visibility in a World Gone Flat*, 11.

Mission Transition Task Force (MTTF) was largely reliant on logistics situational awareness to ensure the closure of Op ATHENA was completed on time given the political sensitivity of the issue.[98] Had the commander not had the ability to monitor the drawdown and make contingency plans based on the information presented in a purpose built COP tool, the strategic ramifications might have been severe. The requirement for the MTTF to develop a tool for theatre highlights a significant gap in the operational level logistics capabilities of the CF. Addressed by CANOSCOM in its statement of capability deficiency, the CF requires a ROSP defined as

> . . . a common representation of relevant support information that provides situational awareness (SA) to both supported and supporting Commanders and their staff at all levels and is shared with support organizations at all levels. This information is drawn from recognized, authoritative sources and sensors and provides temporal, spatial, condition, readiness, vulnerability and support process service delivery information.[99]

Similar to ongoing developments by Canada's allies in the US, UK, and Australia and even in NATO, the ROSP will be an integral part of the CF Battlespace Management Capability providing applications and tools that will automate operational support processes and improve decision-making for operational commanders. Most importantly, it will make the supply chain predictive through its ability to fuse information related to consumption, sources of supply, and transportation producing an estimated delivery date (EDD) of materiel to theatre.[100] It will allow the technician to provide the customer with a real answer when asked 'where is my stuff' or 'when will it arrive'. Although currently the focus of a Defence Research and Development Canada (DRDC) technology demonstration project (TDP), the ROSP is likely some time away

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[98] Canada. Department of National Defence, "Mission Transition Task Force Closure of Operation ATHENA - 2011 Version 1/Draft" 2012), 55.

[99] Canada. Department of National Defence. Canadian Operational Support Command, *Recognized Operational Support Picture Statement of Capability Deficiency Version 2.1* (Ottawa: DND Canada,[2011]), 1.

[100] Ibid., 3,7-8,B-4/5.

from being realized in large part due to the reliance on visibility, which will not be delivered until fiscal year 2023/2024.

The key to improving the efficiency and effectiveness of the CF operational supply chain is transformation. Unfortunately, the DND/CF lacks a coordinated and comprehensive plan identifying the future concept of the 'to-be' supply chain. Without this strategic vision and end state to guide transformation, the efforts of various stakeholders are destined to fail in its primary mission; supporting the warfighter. While DRMIS appears to be a very comprehensive IT system for the CFSS, it must be integrated with other technologies and coordinated with complimentary projects to achieve real benefits. With the full delivery of AIT solutions still over ten years away, visibility will continue to be an issue even after the introduction of DRMIS. Until visibility is achieved, a ROSP-like capability, the dream of every logistician, will remain just that, a dream. Whereas the Allies appear to be further ahead in the development process than Canada, DND has some significant work still to accomplish if it is to achieve a world class supply chain capable of providing effective and efficient support to the CF on operations. In accordance with the Aberdeen Group's ranking of companies in its study, the continuous, focused, and holistic logistics transformation efforts of the US, UK, and Australia make them the best-in-class of military supply chains. Conversely, Canada could easily be considered a laggard in comparison to its allies based on the current state of logistics transformation in DND and the amount of time until it will be addressed. Addressing this issue sooner rather than later is of vital importance to the credibility of CF logisticians and the focus of recommendations in the ensuing section.

RECOMMENDATIONS FOR THE 'TO-BE' CF OPERATIONAL SUPPLY CHAIN

The title of the paper proposes a Canadian revolution in military logistics, using benchmarking as a means to improve the operational supply chain. The idea of the revolution is taken from an IBM study prepared for the UK MoD based on logistics transformation within the US Army:

> The Revolution in Military Logistics (RML) represents the transformation of the [US] Army logistics system to a Distribution Based Logistics (DBL) system. DBL is a seamless logistics system that is integrated and synchronised to meet demand at the time of need. The RML is composed of five basic components:
>
> - A reduction in the demand that results from more supportable and reliable weapon systems
> - More accurate and timely visibility of demands
> - Quicker and more responsive processes
> - Increased support over longer [LoC]
> - A reduction of the CSS footprint on the battlefield.[101]

Although an army-centric study, these five components are universal across the services and are indicative of transformation efforts in each of the three allied military supply chains examined. Together, the components represent a shift in supply chain operations towards improving effectiveness at delivering materiel to the warfighter by creating efficiencies in the system with the additional benefit of contributing to a reduction in overall costs in terms of manpower and resources. The impetus for the revolution is rooted in the operational experiences of the Allies most notably in Afghanistan and Iraq. Similarly, the CF has experienced it fair share of problems in sustaining deployed forces during expeditionary operations. As was already noted, there were significant shortfalls of ammunition during the build-up to Operation MEDUSA in Afghanistan due to a lack of visibility and responsiveness. Another recent example was in 2010 when the CF

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[101] Rob Jones and others, *Delivering Comprehensive Situational Awareness* (Basingstoke, UK: IBM United Kingdom,[2008]), 21, http://www-304.ibm.com/easyaccess/fileserve?contentid=157576 (accessed March 24, 2012).

deployed to Haiti on Operation HESTIA, where for three weeks CF personnel were dangerously low on food, water, and supplies due to poor AV and ineffective operational support in theatre.[102] In light of these and the many other issues reported or not, a Canadian RML is both necessary and timely, and could contribute to real cost savings in an era of economic uncertainty and leaner defence budgets.

Formulate a DND/CF Logistics Transformation Plan

> National Defence will . . . [s]trengthen the overall state of the Forces' readiness to deploy, and their ability to sustain operations once deployed . . .[103]
>
> *Canada First Defence Strategy*

The CFDS spells out the federal government's expectations for the CF, which is to be a credible and capable force that can undertake six core missions including expeditionary operations. Key to meeting these expectations is the ability to project forces abroad and to sustain them for as long as the government dictates, both of which depend upon logistics. While the CF has been largely effective at living up to these expectations "due in significant measure to the dedication, hard work, and ingenuity of the troops on the ground,"[104] experiences in Afghanistan and Haiti have shown that it has not been without difficulty. To overcome these difficulties, the DND has embarked on a path of transformation. In comparison to its allies, however, Canada has lagged behind in its logistics transformation efforts principally due to the fragmented approach to projects,

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[102] Major D. Matsalla and Lieutenant-Colonel D. Rivière, "Sustainment of Hasty Deployments: Lessons Learned from Op HESTIA," *Canadian Army Journal* 13.3, no. Autumn 2010 (2010): 91.

[103] Canada. Department of National Defence, *Canada First Defence Strategy*, 4.

[104] Canada. Parliament. House of Commons. Standing Committee on Public Accounts., *Evidence*, 4.

the lack of strategic direction, and the lower priority relative to capital investments. Most notably missing in the DND is a clearly articulated future logistics concept and a comprehensive logistics transformation plan to achieve the desired end state. Without a roadmap to follow, it is unclear what transformation is supposed to achieve whether it be to save money, increase responsiveness or improve readiness. As the 2008 OAG report warned, there is a risk of failure on future missions unless DND resolves the issues plaguing the supply chain. Before committing additional funds to a disjointed transformation effort akin to reinforcing failure, it behooves the Department to step back and relook at what it intends to achieve.

In line with the SCOR process reference model (Figure 2), considered to be a 'best practice' by its allies, DND needs to capture the 'as-is' current state by carrying out a holistic examination of the entire supply chain from 'factory to foxhole' including the 'last tactical mile'. Similar to the UK E2E study, it is recommended that ADM (Mat) with key stakeholders from the environmental services, the operational commands, the other ADM, and industry conduct a comprehensive review of all business processes and technology with the intent of identifying issues and gaps for improvement. Without a fundamental understanding of how the business works from the strategic to the tactical level, DND will be unable to gauge the performance of the operational supply chain and target areas for improvement.

In conjunction with this work, DND needs to derive the 'to-be' future state (i.e. a future logistics concept) with which it will support future expeditionary operations. Predicated on the benchmarks set by the US, UK, and Australia, the three nations

alongside which Canada will likely conduct future operations, a future supply chain concept should be based on the S&RL and DBL concepts. Leveraging the experiences of its allies vice finding out the hard way, DND could avoid the unsuccessful steps in the logistics evolutionary process and adopt the preferred course of action with much less waste in terms of time and money. Such a move would enable to CF to potentially attain the future state in a shorter amount of time.

Ideally, the future CF operational supply chain would also include the integration of a robust performance measurement regime with the ability to provide commanders an accurate and timely picture of how well it is functioning. Although the migration to DRMIS includes a BI application that will provide the ability to measure, the use of performance measurement as a means to monitor processes and improve execution has to be cultivated and strictly reinforced. This would include implementing a disciplined reporting process that identifies issues in the supply chain and that allows commanders with the appropriate authorities to rectify those areas that are not meeting expectations. The use of operational sustainability statements much like that which is used by the UK MoD and Australian DoD is also key to reinforcing a performance measurement culture. Incorporating mutually agreed upon targets for delivery to theatre between the supported and supporting commanders, the statements would be a significant step forward for the CF in managing the expectations of theatre and potentially curbing the critical and time sensitive requisitions that more often than not result in a missed RDD or circumvention of the supply chain.

Most important in determining the 'to-be' future concept is the focus it will take going forward. While industry is focused on profits, soldiers' lives depend on the sustainment projected along LoC. Therefore, the provision of effective and efficient support to the warfighter must be the primary focus for all DND logistics transformation efforts. Although the MA&S Business Transformation Plan prepared by ADM (Mat) is aimed at providing 'world-class support to operations', it does not put enough emphasis on the needs of the warfighter as the ultimate customer. The title of the document itself conjures up more of a corporate level focus rather than one aimed at improving support to soldiers in theatre. Branding, which plays a significant part in successfully influencing leadership and gaining support for projects, must play to the needs of the warfighter in order to secure buy-in and funding for logistics transformation. By tying strategic and operational level transformation to tactical effects on operations, the CF will be able to advance the project within the investment plan and achieve the end state much earlier. Similarly, it may be the impetus for a migration from a system that is just good enough to one that is the best money can buy in support of operations abroad. Despite the fact that logistics has yet to affect operations according to commanders surveyed in the OAG report does not mean the supply chain is optimal. Conversely, it needs to improve before the CF deploys soldiers on the next mission.

As part of the proposed E2E study and resulting future logistics plan, there must be a discussion on the realignment of authorities within the logistics community, specifically between the strategic and operational levels. In comparison to the CF, the role of USTRANSCOM in coordinating the strategic movement is very similar to that of CANOSCOM with a very distinct difference; CANOSCOM does not own the movement

assets or the distribution process. Whereas USTRANSCOM has the authority to implement change and can have operational effect, CANOSCOM does not have the assets or the functional authority and therefore must rely on the Royal Canadian Air Force (RCAF) and ADM (Mat) respectively to support its operational mandate. Similarly, CANOSCOM does not have the same authorities as DLA. When Canada operationalized the depots under CANOSCOM, they essentially divorced acquisition from the depots. Unlike DLA which is responsible for both, the Department has created a situation whereby CANOSCOM owns the depots and ADM (Mat) controls the stock including the release authority and life-cycle management which may account for the shortfalls in materiel reported by the OAG. It underscores the issue with the current division of authorities and responsibilities within DND in which the functional authority for MA&S processes rests with ADM (Mat) while CANOSCOM is responsible for the operational support.

What works for the US DoD, however, may not function for DND given the large contrast in force size and structure. Another and perhaps more palatable option would be to look at the UK MoD construct whereby there is one overall authority with responsibility vested in the Chief of Defence Materiel. Although this would be somewhat of a reverse course from CF Transformation, there would be one distinct difference; it would be commanded by a general/flag officer and not a public servant. This would be a significant shift in the DND/CF construct, but perhaps one that is necessary given the disjointed approach to logistics transformation. The benefits of having military leadership responsible for operational support in the current CF construct are apparent in the support provided to Afghanistan since CANOSCOM's inception. Harmonizing

strategic and operational logistics authorities under military leadership would surely benefit from the focus and direction provided by a commander and would likely achieve the same level of success. Equally important is providing this new entity with the authority to develop and introduce the systems necessary to support the operational supply chain. Currently vested in ADM Information Management (ADM (IM)), aligning this authority within the logistics community would create a single process owner for logistics similar to USTRANSCOM and the UK's DE&S. If the division of roles and responsibilities in the US and UK can be considered 'best practice', then a review of the DND structure and authorities may be required to streamline the national supply chain in hopes of improving execution at the operational level.

While some would contend that the evidence is not strong enough to support the need for a multi-million dollar investment in logistics transformation based on the satisfaction of operational commanders and the lack of impact on operations expressed in the 2008 OAG report, this argument is misleading. The underlying messages contained in the OAG report point to a series of systemic problems, such as the lack of visibility, the lack of routine performance measurement, and materiel shortfalls to name a few, that if left uncorrected will have future ramifications. Although lacking a performance measurement culture, which in itself is reason enough for change, the figures presented by the OAG are indicative of flawed processes and poor system integration and should act as the catalyst for logistics transformation.

Integrate AIT Solutions into the Supply Chain

As suggested earlier, the 'as-is' CF operational supply chain can be considered a laggard in accordance with the Aberdeen Group's ranking of industry. Accompanying the ranking, the group offers three steps to success for laggards to achieve 'best-in-class' found below:

> - Move from the internal discussion stage to implementing at least the basic visibility tools. It is important to establish visibility into at least the most critical supply chain milestones. Select a set of metrics targeted for improvement and assign responsibility for each metric to a specific person / unit in the company. Build a business case by citing the benefits achieved by the early adopters.
> - Automate the main types of visibility data analysis. Begin using dashboards and scorecards built into the software as part of your everyday discussions with the team to support tactical decisions.
> - Increase use of forwarder / carrier, and 3PL-provided visibility systems. Some of these may be free of charge. Identify the biggest automation gaps between the events monitored manually and those monitored with the help of technology. This will help pinpoint the areas that automation efforts should target first.[105]

Commensurate with the adoption of a new concept, the 'to-be' model should also identify the necessary technologies to achieve this future state for integration into the supply chain. Following the steps identified above, the process owner, currently ADM (Mat), needs to determine whether the ongoing initiatives are in line with the 'to-be' future state. Based on the direction of 'best-in-class' organizations and in particular the three allied nations, the adoption of a single ERP is undoubtedly the way to go. Unfortunately, it appears as though NMDS will survive as a legacy system primarily responsible for the provision of movement visibility CF-wide. While visibility depends more on the data than system it resides in, the integration of systems to enable the passage of data is critical to its amalgamation and presentation as information to decision makers. The

[105] Sadlovska, *A View from Above: Global Supply Chain Visibility in a World Gone Flat*, 15.

continued use of NMDS is itself not an issue. It needs to, however, share visibility data with DRMIS as the system used by technicians to respond to customer's questions regarding the location and arrival of requisitions rather than having to manually fuse the data from both. Although the passage of data between the two systems to provide AV is addressed in the MA&S Business Transformation Plan, the incorporation of RFID and other AIT is not, making it a document of limited use for operational supply chain transformation.

Based on the current deployment of AIT in Afghanistan, there is much more work to be done to increase automation of functions and improve visibility if the CF supply chain is to become more efficient and effective, particularly in the 'last tactical mile'. Although there have been a number of AIT initiatives domestically with the PDET and RFID, they have not been fully integrated into the supply chain. The DCS strategy produced by ADM (Mat) seeks to correct this issue by delivering first on DWIMS-Ops as a barcode reading capability to facilitate the automatic capture of data and speed up the receipt and issue process on operations. Alternatively, it will be over ten years before RFID is fully integrated into the supply chain based on the current DND investment plan. While DWIMS-Ops will provide a measure of automation to the process, the lack of RFID will continue to plague visibility of materiel as its transits the LoC. Conversely, the three nations included in the benchmarking have focused significantly on the introduction of AIT solutions, specifically RFID and GPS tracking, to realize visibility. Considered a 'best practice' across industry according to the Aberdeen Group, automation and technology are integral to the future supply chain. Without these enablers, the CF operational supply chain is destined to remain a laggard unable to meet

the SCOR performance attributes or provide world-class support to its soldiers. To avoid this, DND must fully embrace current tools and prepare for emerging technology by advancing project timelines. Much like DWIMS-Ops is leveraging the work done previously on the PDET, DND should focus on reinvigorating the stalled interim RFID solution that was tested, proven, and used, albeit on an ad hoc basis, during Op ATHENA. In fact, much of the work has been done in terms of integrating tagging into NMDS and negotiating agreements for the passage of data between different nations. "Australia, the US, Canada and the UK have a memorandum of understanding regarding RFID interoperability, but at this stage only the US and Australia have compatible and interoperable RFID systems."[106] With such a head start already, it would seem disingenuous not to carry on with integration and use of a proven technology, especially when it is used extensively by ones allies.

In addition to the cooperation between the four allies on RFID, it is important to emphasize the need to remain interoperable when going forward with transformation. Taking into consideration that Canada's largest mission since the Korean War has been under NATO, of which Canada is a member and has obligations to, interoperability will be key to working with partners. There are definite benefits to remaining interoperable in the supply chain. When deploying to Afghanistan, Canada made use of the Integrated LoC (ILOC), a memorandum of understanding with the US that allows the CF to use American transport to move equipment and materiel. Similarly, the RFID interoperability agreement between the four allies permits each to leverage the others

[106] Withers, *RFID in the War Zone*, n.p.

network of interrogators to maintain AV thereby reducing redundancy and costs. Moreover, NATO has embarked on its own path of transformation with RFID standardization agreements and work on the Operational Logistics Chain Management concept for NATO combined and joint operations. Lieutenant-General James Soligan, the Deputy Chief of Staff of Transformation for NATO Headquarters Allied Command Transformation, summarized it best when he stated, "I don't want to own any hardware or software other than at the command headquarters or the joint force command . . . What I want to own is [sic] the databases. What I want to own is the data."[107] Highlighting the importance of data and of data sharing, the CF operational supply chain will need to keep pace technologically with that of the US, the UK, Australia, and NATO at large if it is to remain capable of working with it allies. Canada will undoubtedly work in a coalition or NATO environment on future operations, therefore, the operational supply chain will need to evolve significantly in order to remain a relevant and a credible ally. Canada's soldiers deserve it and its allies will demand it.

The visibility that IT systems and AIT solutions can provide, whether it be through a Canadian or allied networks, will be crucial to the maintenance of situational awareness and vital for operational support decision makers to remain ahead of the needs of the warfighter. Equally important is the presentation of this information in an easily digestible format with the appropriate decision support tools to automate processes and decision-making. The ROSP capability currently being pursued by CANOSCOM intends to provide a COP and the necessary tools to enable both the supported and the supporting

[107] Tony Skinner, "**Joined-Up Thinking: NATO C4ISR**," *Jane's Defence Weekly*, n.p., http://jdw.janes.com/subscribe/jdw/doc_view_print.jsp?K2DocKey=/content1/janesdata/mags/jdw/history/jdw2009/jdw40351.htm@current&Prod_Name=JDW&showUpdate=false& (accessed January 26, 2012).

commanders to make timely well-informed decisions based on accurate logistics information. Much like initiatives undertaken by its allies in the development of a LCOP or similar functionality, the work being done by CANOSCOM must be appropriately supported and funded given the importance of such a capability in providing 'world-class support to operations' as proven by the MTTF during the CF drawdown in southern Afghanistan. This will require the support of the strategic level, particularly by the Vice-Chief of Defence Staff, ADM (Mat), and ADM (IM), to advance the project within the investment plan. Alternatively, a command with the appropriate authorities as proposed earlier could pursue transformation unilaterally with the necessary funding.

The total cost of transformation is unknown because the plan has yet to be developed. Predicated on the costs associated with adopting DRMIS and those observed in other nations, it is safe to say that the cost will be fairly significant somewhere in the hundreds of millions of dollars. Some will contend, however, that "[i]ssues with asset visibility will not go away with more systems or radio frequency identification tags on the battlefield. . . Satellite systems track convoys . . . but do not facilitate the movement of commodities through the logistics pipeline."[108] While it is true that technology alone will not solve the issues with the supply chain, the enabling effect of AIT cannot be discounted. It is a critical element of transformation and but one piece of a larger range of initiatives designed to improve the efficiency and effectiveness of the operational supply chain. Coupled with improved realigned authorities, streamlined processes, and

[108] Daniels, *The Distribution Dilemma: That Last Tactical Mile*, 42-43.

performance measurement, technology completes the circle of initiatives that together formulate a transformation plan to move the CF from laggard to 'best-in-class'.

A Proposed DND Logistics Transformation Plan

To achieve the changes outlined above and improve the CF operational supply chain, the DND must pursue a holistic transformation plan. Although it is recommended that such a plan be preceded by a comprehensive E2E study of the entire supply chain to inform the correct approach, the following constitutes a benchmarking proposal for the way ahead. Using the ADF approach to its DLTP, the proposed transformation plan (Figure 7) uses a campaign design to outline a path to reach the desired end state, which is to provide effective and efficient support the warfighter and build commanders trust and confidence in operational logistics while reducing overall costs. Following three lines of development, named for the three networks in NCW, the plan will achieve a number of decisive points on the path to realizing transformation objectives in line with the SCOR performance attributes. The control line will emphasize agility though the integration of technology to increase the ability to predict requirements and to make timely and effective decisions in response to evolving operational situations. Reliability will be the focus of the information line, incorporating performance measurement as a means to consistently monitor KPI to meet organizational objectives and supply chain targets. The physical line will address responsiveness by improving the ability to project logistics globally and meet RDD of demands. The objectives when realized will bolster the warfighter's confidence in operational support and enhance the credibility of logisticians; the opposing and friendly centres of gravity respectively. Despite the lack of

a comprehensive study prior this plan, the benchmarks established by Canada's allies and represented therein are characteristic of the future operational supply chain. Commensurately, DND should strive to follow the same approach as its allies and incorporate the main points of this plan into a future logistics transformation plan if it is to achieve the end state earlier than, but certainly not later than fiscal year 2023/2024.

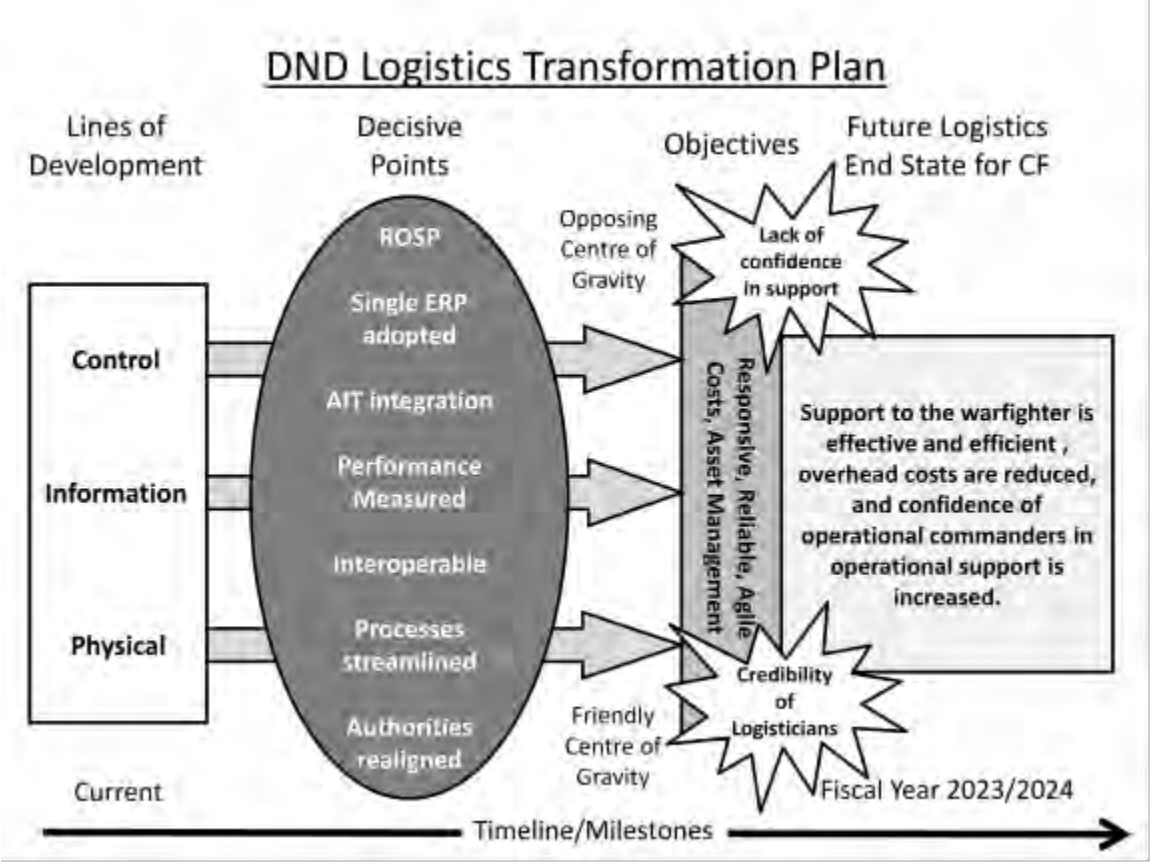

Figure 7: Proposed DND Logistics Transformation Plan

The RML by the US Army and comparable transformation initiatives across the Allies leaves one to question if and when the CF will experience its revolution. To achieve the mandate outlined in the CFDS, the CF operational supply chain will need to evolve to keep pace with the other arms. Using the SCOR process reference model as the

basis for transformation, the DND can formulate a plan by identifying the gaps in the current system and outlining the goals of the future one. Leveraging the 'best practices' of its allies that are deemed to be the 'best-in-class' in military logistics, the future logistics concept and resulting logistics transformation plan will dictate a path towards improvement of the expeditionary supply chain. The proposed way ahead, albeit not based on a full E2E study, comprises the suggested focus areas that will help the CF to realize its logistics end state and move from laggard to 'best-in-class' alongside its allies.

CONCLUSION

The Canadian experiences during the first decades of the 21st century, particularly in Afghanistan, have clearly shown a need for the CF to evolve its approach in support of expeditionary operations from reactionary to predictive. As witnessed since the end of the Cold War, the mass-based approach of creating 'iron-mountains' of supplies to counter the unpredictability of supply and demand is no longer cost effective nor efficient for supporting high tempo asymmetric operations. Similarly, the reliance on industry as a model for military supply chains particularly JIT logistics has proven ineffective at providing the right item in the right quantity at the right place and at the right time for armed forces in the western world. The recent developments in technology and net-centric concepts have sparked a RML towards similar concepts of S&RL and DBL that appear capable of making the supply chain more predictive. Coupled with a growing focus on performance measurement and benchmarking among industry leaders as a means to improving the efficiency and effectiveness of supply chains, the SCOR process

reference model developed by the Supply Chain Council serves as an example to be followed when embarking on transformation.

General Hillier, the former Chief of Defence Staff, who spoke so eloquently about having 'one dog to kick' in his reasoning for creating the operational commands, missed the mark with CANOSCOM. In reality the operational supply chain within the CF is much more complicated in terms of ownership and responsibility as evidenced by the OAG in its 2008 report. Try as it might to improve the support of expeditionary operations, CANOSCOM does not control the levers to logistics transformation within the CF. The levers of change reside at the corporate level within ADM (Mat) as the functional authority for the materiel domain. Unfortunately, ADM (Mat) has not developed a clear vision or a plan for logistics transformation within the DND, which has had a significant impact on the CF operational supply chain. Despite current corporate transformation initiatives focused on the ERP and AIT solutions, they do not appear to be harmonized towards achieving a well-defined end state nor do they translate well to the operational level in support of the warfighter.

The benchmarks set by Canada's allies act as a guide for the future transformation of the operational supply chain. Consistent with trends in industry, the 'best practices' employed by the US, the UK, and Australia have been shown to elevate companies to 'best-in-class' status by a leading industry researcher. Particularly, the affinity with technology has had a tremendous benefit in creating visibility of assets while static and in-transit. The visibility of assets not only provides the identity, location, and status of an item, but also the ability for decision makers to anticipate the support requirements of the

warfighter and ensure that a continuous uninterrupted stream of support is maintained. Achieving this milestone will inevitably boost the confidence of commanders in the support they receive and further expand the credibility of logisticians. Moreover, the warfighter will not have to look over his shoulder wondering if the combat supplies needed for the next action are going to be available, but rather can focus on the business of war fighting confident that support is only one bound behind.

Accordingly, DND must start its transformation effort from scratch by first mapping and assessing the 'as-is' current state of the supply chain. Completing a similar study to that of the UK, the DND should gain a sufficient understanding of the E2E supply chain before designing the 'to-be' future state. When deriving the 'to-be' model, it can leverage the capability gaps identified during the E2E study as well as the 'best practices' employed by its allies to establish a future logistics concept for the CF. The future concept for the CF supply chain should embrace the performance attributes expressed by the Supply Chain Council in its SCOR model and see a move towards the characteristics of S&RL and DBL concepts marking a significant change in its approach to logistics. Going forward, the concept will be used to map out a transformation plan to include the major milestones to be accomplished similar to the proposed DND logistics transformation plan. Although it is unlikely that the end state will be achieved before the next CF mission abroad, initiating well-focused and comprehensive transformation efforts today will pay huge dividends in the future as the CF approaches the armed forces of tomorrow. If one assumes that Rommel was correct when he said that the 'battle is fought and decided by the quartermasters before the shooting begins', then the CF need

to ensure that the battle for logistics transformation is ‘fought and decided’ before the next operation fails.

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