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ACHIEVING IN-TRANSIT VISIBILITY (ITV): A STUDY OF TECHNOLOGY ON ITV IN THE DEPARTMENT OF DEFENSE

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ABSTRACT

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As the Office of the Secretary of Defense (OSD) leads a revolutionary transformation effort across the Department of Defense (DoD) and the Army studies and applies what it has learned from the force projection operations to meet the requirements of the War on Terrorism, the time is right to institute the technologies necessary to achieve near real time knowledge of units and assets as they move through the Defense Transportation System (DTS). With assured communications systems, ITV of forces and materiel from Home Station or industrial base, into a Theater of Operations can be provided. This paper will describe the technologies and military applications necessary for Joint integration of ITV and the Army's application of ITV technology to achieve necessary changes resulting from lessons learned during Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF).

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ACHIEVING IN-TRANSIT VISIBILITY (ITV): A STUDY OF TECHNOLOGY ON ITV IN THE DEPARTMENT OF DEFENSE

A year after the invasion of Iraq for Operation Iraqi Freedom (OIF), 1,400 trucks operate daily to provide supplies to the troops conducting peace enforcement missions and fighting the insurgents in Iraq.[1] What is on all of them? What are the priorities of movement? Where are they delivering, and when do they move on what routes?

No one knows the answers to all of these questions. Yet, it is just as important for a logistician to "see the battlefield" as it is for a tactician. The difference is what must be seen. In considering the answers to the questions posed above, and why they are important to know, there is a quick appreciation for the need for centralized knowledge management. There are information sets of data elements that define the materiel required to sustain the force. There is also a location associated with all materiel at any particular time. When this knowledge is managed simultaneously, these data sets define what the logistician must see. This logistician's sight picture must extend beyond the immediate battlefield, and include the arrival of supplies in the strategic flow. What is entering the theater, or what was expected to enter but hasn't, can effect tactical operations just as severely as the internal logistics operation within the Regional Combatant Commander's Area of Responsibility (AOR).

Despite attempts over the years by many leaders at various local levels to capture the data and manage the knowledge of supplies and materiel movement, the military forces have failed to create the automated systems and operational controls to successfully manage the vast data necessary to command and control large scale military logistics operations. The speed and volume of U.S. military operations in the Information Age has added another level of complexity to this already challenging task.

This paper addresses the impact that the most recent United States military logistics experiences in supporting OIF and Operation Enduring Freedom (OEF) has on the future of logistics. The specific focus is on achieving In-Transit Visibility (ITV) as a means of knowledge management. ITV is the term used to define the reporting and management of what is moving within the Defense Transportation System (DTS) and the Defense Department's geographic operational theaters. It is the ability to track the identity, status, and location of unit equipment, and non-unit cargo, from origin to destination.[2] This is not only physical management, but knowledge management; the ability to plan and predict requirements based on the information at hand. ITV is a component of Total Asset Visibility (TAV), which is the capability to provide users with timely and accurate information on the location, movement, status, and identity of units, personnel, equipment, materiel, and supplies. It also includes the capability to act upon

that information to improve overall performance of logistics practices.[3] Relegating management of materiel to the physical actions as it flows is inefficient. It leads to lost time and resources and places unacceptable sustainment risk on our fighting forces. Improve ITV, and through that, an ability to see and decide on support requirements in a theater of war, and the result is a savings in money, time, resources, and materiel handling. Streamline the supply chain, and proper support to forward tactical forces will follow. It is not sufficient to be able to manage the handling and movement of the materiel itself, but to also be able to manage the data that defines what is moving. "Lack of visibility hides bottlenecks, precludes accurate asset accounting, and forces unnecessary procurement at the national level."[4] It is the data flow that arms the decision-making process.

"Sustaining and increasing the qualitative military advantages the United States enjoys today will require transformation - a transformation achieved by combining technology, intellect and cultural changes across the joint community. The goal is Full Spectrum Dominance - the ability to control any situation or defeat any adversary across the range of military operations."[5] Such dominance must include the procedures for deployment and sustainment. Services have a responsibility to change doctrine and practice to meet future operating goals, but the key is to achieve joint interdependency of forces. Thus, integration of logistics operations at the strategic level is the ultimate goal, and this must be driven by policy formulation at the highest level. Policy will enable Unified Commanders to create the structures and functions necessary to establish systems reaching to the tactical level. Services, then must train and equip the force so the necessary skills and equipment are available at the unit level for tactical execution and close the circle from the strategic to the tactical level of war.

Despite an obvious profitability recognizable by any novice accountant or businessman, the fact is, the Department of Defense (DoD) failed to establish feasible ITV policy, even after the benefits were experienced as a result of supply chain management and distribution failures from Operation Desert Shield/Storm (ODS) over a dozen years ago. At some command levels, minor implementation of identification technologies was accomplished. These efforts were far from system-wide implementation and contributed more to “stove-pipe” Service or command processes rather than efficient handling. Services learned again, through a major finding from OIF, that there was a lack of knowledge and decision capability over what was flowing into the theater through the strategic pipeline. Complicating a holistic view of resources, Services failed to manage what was stored or moving within the AOR. Twice is enough. It is time to fix the problem.

The solution is not simple. It is not improvement of old techniques. The character of warfare changed with the execution of OEF/OIF. The pace is rapid. The advance across Iraq was the quickest of any attacking army in history. Distances are great. OIF was the deepest advance of land forces in such a short period of time. The battlespace is noncontiguous. Forces bypassed congested/contested areas and left other open spaces virtually unassailed, while operating across hundreds of miles in both Iraq and Afghanistan. All of these traits of recent land warfare had an impact on U.S. logistics planning and execution. The view of these changes upon warfare in the information age reinforces the need to infuse a higher discipline into the supply chain through DoD network centric operations and new policy requirements. These implications cannot be ignored if the U.S. military is to achieve what they desire in the future, which is to "rapidly build momentum and close the gaps between the decision to employ force and the deployment of initial entry and follow-on forces in order to rapidly achieve objectives."[6]

BACKGROUND

Historically, Army combat service support formations have not been constructed to operate within such fast-paced, dynamic, nonlinear warfare as was recently experienced. Army logistics communications systems are weak and ineffectual when measured against the demands of the OIF experience. Not only were systems inefficient for lateral and vertical communications, but logistical units were generally ineffective when on the move during the brief but intense offensive phase of the operation. The few units that were equipped with satellite communications capability still had to halt their supporting advance to place the communications systems into operation. There was virtually no time to accomplish this as ground combat forces reinforced success through rapid and continuous maneuver. Units discovered they had no way to update demand and status files to accomplish supply chain management and respond to their customers' needs.

There was no systemic communications capability while on the move. Transportation units were particularly incapable of maintaining near real time status of movements because they were not authorized to maintain the equipment necessary to conduct the scanning and reporting of materiel and manage theater movements. Transportation Movement Control battalions had great difficulty even transmitting daily tracking and movement data to maintain visibility and conduct movement planning over MSRs because of a lack of systemic capability. Legacy systems could not meet the demands of today's fast paced operational requirements.

The Cold War programs were not fit to fight the War on Terrorism in the contemporary operating environment.

As a result of the U.S. experience, the need to update supply chain management procedures through application of commercially ubiquitous radio frequency technologies to provide near real time knowledge was evident. Though minor progress was made in recent years, primarily at Service, or individual command level, any advancement was wholly lacking in overarching policy that integrated and prescribed capabilities to create a seamless end-to-end process.

Tens of thousands of shipping containers had to be opened in Saudi Arabia during ODS. There was no other way to determine what was in them. Though the experience during OIF was an improvement, many similar deficiencies were glaring. Where the necessary instrumentation and knowledge management of cargo through the application of radio frequency tags and Military Shipping Labels (MSLs) was possible, military commands and supporting agencies maintained a suitable level of knowledge. Where instrumentation, communications, or unit capability could not be applied – mostly at the far end of the pipeline in the tactical area, there was failure. In this failure, the ability to manage the support necessary to sustain the warfighter was lost to the logistics system and warfighting command.

It was clear. Millions had been spent by the U.S. over the last decade on ensuring the ability to rapidly deploy forces. Now, the need is to "focus on improving the reception and integration of personnel and materiel in the theater."[7] Deployment of forces for OIF was almost a third faster than a similar force flow during ODS. U.S. strategic lift fleets have been restructured, military forces are better able to flow through strategic US ports, and redesigned prepositioned stocks allow forces to fall in on readily available combat systems and sustainment stocks. Lagging behind this ability to rapidly deploy, is the ability to maintain ITV as materiel moves along the pipeline.

Successful ITV is the result of managing two sets of information; one for deployments (unit moves) and one for sustainment (strategic base). Both requirements compete for the same lift assets and must be prioritized for movement. Likewise, they can conflict based on the operational environment and commander's requirements. Adjustments, both during planning and execution, are necessary in order to synchronize strategic flows and deliver the right goods at the right time.

The logistics support during OIF was clearly unsuitable for the U.S. Army of the twenty-first century. Major improvements in network management of sustainment and deployment data from the strategic to the tactical level was warranted. The level of effort experienced by the

United States Army in Europe (USAREUR), based in Germany, far exceeded system capability. "During the original buildup of forces for OIF, the 21st TSC [Theater Support Command] pushed out, in a little over six weeks, approximately 18,000 vehicles and cargo for V Corps Headquarters and separate brigades. 3rd Corps Support Command, and the 1st Armored Division - an average of about 3,000 pieces per week. To support the USAREUR rotation for OIF II, the 21st TSC was called upon to move an average of 4,000 pieces per week."[8]

In October of 2003, DoD saw fledgling policy guidance from the Under Secretary of Defense.[9] The first, in a series of policy letters, established Radio Frequency Identification (RFID) implementation policy and outlined a plan to integrate identification technologies from end to end – suppliers to users. The policy letter required proper tagging of cargo and prescribed infrastructure responsibilities for ensuring instrumentation was on hand to scan identification data as it passed by designated locations. The defense community now had the first key points and could develop a way ahead with unity of effort.

Within the AOR, military leadership experienced the first wide-spread use of automated tracking systems for controlling the force on the ground. Maneuver commanders maintained visibility over what was where on the battlefield through a new system called Blue Force Tracker (BFT). BFT provided a digital rendering of unit locations in real time. It was a great advancement in situational awareness that provided the tactical commander a physical representation of the battlefield arrangement of forces. A similar system for the logistician is the Movement Tracking System (MTS). It was the first step in providing the future tracking capability for movements and sustainment management within the theater. Logistic information can be embedded within MTS to identify what materiel is in a convoy, where that convoy is located, and the final destination. Updates can be made and transmitted by the stroke of a key.

OIF saw the first application of these systems, along with experiencing the early characteristics of those being described for the future force, "an adaptive joint force will be capable of conducting rapidly executable, globally and operationally distributed, simultaneous and sequential operations."[10] This is a force where integration of sustainment and deployment is critical. "This calls for a shift from supply-based logistics and regionally focused, service-centric planning to a sustainment system that is precise, flexible and responsive to sustaining tailored forces operating in a dynamic environment."[11] In practical application, there are a set of characteristics necessary for successful implementation of this process.

Supply based logistics fundamentally meant that available materiel would have been stored in theater stocks to draw from when the force needed it. Everything possible was shipped under a prioritized timeline regardless if it was actually needed by the supported

commander. The selection process took place on the far side, after shipment occurred. Today, "supply based" means managing materiel by need, through network centric operations that provide the knowledge of supplies moving in the DTS. This supports timely decision-making regarding moving only where and when needed. This reduces handling, storage, and wasteful use of strategic lift assets. It is also significant to reducing the level of risk to support forces on the ground since it reduces the need for those forces to establish, operate, and secure overly abundant theater stockage sites.

The result from OIF was a recognition of the need to create an integrated logistics information network. By enabling an integrated system through ITV to create positive control over the supply chain, a responsive system of real-time data for decision-making becomes available to the warfighter, and economies of scale are achieved. U.S. forces suffered a discrepancy of $1.2 billion in materiel shipped versus materiel acknowledged as received[12] because of old procedures and systems.

"The speed of operations in Iraq and the distances across which we operated were unprecedented, "[13] that won't be an anomaly in the future. Through a distribution based logistic system, and an intelligence system to maintain ITV, it becomes possible to target the flow of materiel based on the warfighter's needs, reduce handling, and deliver faster. The redesign of the logistic system, combined with integration of sustainment and deployment, requires a second process change – deployment.

This paper previously addressed that a number of physical improvements to deployment were adopted over the last decade, ranging from new strategic lift assets to home station processing. The next requirement is to establish ITV over the deployment process. It took 12 different automation systems to conduct movement tracking within the DTS and provide even a rudimentary level of predictive analysis of the flow during OIF. Obviously, there is a better way to track nearly 60,000 passengers and 180,000 tons and 6.5 million square feet of cargo over four months.[14] As the U.S. integrates the Services' deployment and sustainment supply movement through the use of prescribed signatures, end-to-end tracking, with positive control techniques, the information management process will streamline into a manageable tool for commanders and staffs.

CURRENT ACTIONS THAT MITIGATE THE PROBLEM

"Army transformation depends on logistics transformation."[15] The Army Deputy Chief of Staff, G-4 has a plan to correct OIF logistic shortfalls and prepare logistical forces and processes for the future. These actions are his highest priority to correct.[16] The G-4 has a

campaign to achieve network centric deployment, employment, and sustainment operations. In his campaign, the G-4 describes the following requirements. First, connect the logistician. This means that the logistical chain in theater can see supply requirements as demands are established in the system. Second, modernize theater distribution. This will be done through the establishment of the distribution based logistics concept focusing on timely, accurate and predictable delivery combined with status visibility. Third, improve theater reception by establishing theater opening units that are equipped and linked systemically, to transition materiel and associated ITV from strategic deployment assets into the theater. Finally, integrate the supply chain through a lean end-to-end process. The core to each of these is real-time knowledge management. The key is ITV, networking the data operationally, and using ITV data to manage strategic movement and battlefield distribution.

The G-4's plan is keenly supported by two additional Office of the Secretary of Defense (OSD) policy letters that followed the Under Secretary's initial note to the field. On 20 February, 2004, Mr Wynne published an update to the original letter.[17] His update provided the business rules for RFID use. Instructions were provided for both unit deployment use and supply chain management. The memo further established a 1 January 2005 implementation date and recognized DLA's implementation at the strategic distribution centers. It stated the requirement to finalize staffing and policy formulation and assigned lead agency responsibility to the DoD Logistics Automation Identification Technologies (LOG-AIT) Office as the action agent. His final policy letter was published on 30 July 2004. It superseded the first two letters as an inclusive document. The policy required internal implementation strategies for the Service components and demanded supporting implementation plans for radio frequency identification technologies. The policy letter further specified that the final step would be Joint and Service regulations and doctrine revisions.

Finally, stabilizing, prescriptive procedures had come together at the top of the command chain. These will serve to integrate Service developments within a joint architecture necessary for mutually supporting operations and the Army G-4's requirement that "Army logisticians will become an integral part of the joint battlefield network with satellite-based communications (SATCOM) providing 24/7 connectivity."[18] The Army has currently programmed $160 million to provide SATCOM to support forces to provide the necessary network. This will create the backbone for BCS3, the Battle Command Support System, will be the future tactical level integration tool for the logisticians.[19] The United States Marine Corps is undergoing a similar change. Their "sense and respond" logistics concept ties into modernizing theater logistics and the Joint concept, as does the Army's. It will enable the interdependence and integration of

systems necessary for the Army to keep the Marines sufficiently supplied as part of the ground force.[20]

The DoD's overall policy is required for the Joint community to resource and implement changes. "To enable end-to-end control of our distribution system, we must integrate Automatic Identification Technology (AIT) as an enabling function."[21] Though limited work occurred over the last several years to incorporate AIT capability into military distribution functions, there had been no driving force to integrate standard commercial applications, like management functions, interchangeable data operability, and common programs across all Services, with DoD's current actions spearheading efforts.

U.S. Joint Forces Command (USJFCOM) and U.S. Transportation Command (USTRANSCOM) are the leaders in Joint deployment and distribution process development and application. DoD policy now provides the guidance necessary to design and implement an end-to-end system. This will serve to integrate both unit deployment and sustainment ITV policies and re-engineer the entire pipeline from individual suppliers, through the Defense Logistics Agency (DLA) regional distribution centers and TRANSCOM shipment nodes into an area of operations. It is then a Service responsibility to train and equip field forces to complete the sustainment pipeline to the units in forward locations.

Early in 2003, U.S. Central Command's Combined Force Land Component Command (CFLCC) attempted to procure and implement a battlefield system of ITV tracking stations to help solve what was recognized as a long term problem. Hard work and ingenuity brought some success but lack of policy and standards doomed CFLCC to overall failure, since integrated systems, data input management, and reporting conventions were not used by all Services, nor was all the material entering the theater through supply channels electronically tagged.

"A networked Joint Force can maintain a more accurate presentation of the battlespace built on the ability to integrate intelligence, surveillance and reconnaissance, information and total asset visibility." [22] Total Asset Visibility (TAV) is a more encompassing level of data management than ITV. TAV includes all resources everywhere (storage, operational stocks, pipeline). ITV will help achieve TAV. Knowledge will be a trait for the interoperable Joint force of the future. " The Joint Force must sustain itself in austere global regions by becoming less dependent on existing infrastructure and using globally integrated and synchronized end-to-end logistics and self-sustainment systems."[23]

Baseline procedures and guidance for conducting ITV are currently available in several regulatory and procedural manuals. Part III, Mobility, of the Defense Transportation Regulation

(DTR) dated April 2004[24] identifies a baseline RFID policy for the DTS consistent with the USD, AT&L policy memorandum, and provides a synopsis for marking requirements on containers, pallets, and major organizational equipment. It states that these items will have RFID tags burned with data necessary for identification. Three regional ITV servers are in operation to maintain global visibility – CONUS, Korea, and Europe. These servers identify cargo shipments and unit deployments as they enter and move through the DTS.

USTRANSCOM was assigned duties as the Distribution Process Office in September 2003. One of the first actions undertaken was establishment of a deployable element that would locate within the supported commander's AOR and serve as the single end-to-end visibility point of contact to the Combatant Commander. The CENTCOM Deployment and Distribution Operations Center (CDDOC) established operations early in 2004 in the CFLCC C-4's location at Arifjan, Kuwait. The C-4 mission was to assume strategic level ITV and transition necessary ITV data into the theater for management within the AOR. This integration process was lacking in previous Joint organizations and system interfaces.

CFLCC had undertaken several early actions in an attempt to achieve ITV prior to the execution of hostilities in Iraq and achieved some success. Two primary locations within the CFLCC C-4 had responsibility for these actions. One was focused on DTS status for strategic movement in the ITV section of the Joint Movement Center. The other was focused on supply chain management within the logistic automation section of the C-4. Separately, this knowledge had to be compared and deconflicted manually, causing unnecessary staff meetings and troubleshooting to compose an accurate picture of the situation.

Another major action on the part of USTRANSCOM to assess and develop new ITV processes was the establishment of a Distribution Transportation Task Force (DTTF). The DTTF functionally had four areas to assess – distribution and deployment, end-to-end architecture, direct vendor delivery, and finally, RFID.[25] This focus group continues to conduct analysis and implementation of ITV concepts and procedures to improve the end-to-end application of the system.

An Army Major Command, the Army Materiel Command (AMC), manages supply lines that stretch 13,000 miles.[26] AMC is focused on two improvements, infusing agility into management of the supply chain by working at the source – the commercial supplier, and the need to improve our theater opening capability. [27] AMC recognized the need for doctrine and process change to enable Transformation by "eliminating barriers between customers in the field and the wholesale supply system" and combining "separate supply and transportation systems into a unified distribution network."[28] The Commanding General of AMC's first effort is

to replace current automated systems. Once the current systems are replaced with the required system capability, then together with TRANSCOM, they will merge the systems into an integrated end-to-end program.[29]

CONTINUING ACTIONS TO SET THE CONDITIONS FOR ITV

The nation's military Services are busy. DoD is not only focusing on the War on Terrorism, but also on a campaign for Transformation. These efforts must set the conditions for success for the Future Force. Two concepts are definite. First, no single Service will operate unilaterally. Second, logistics must achieve a set of capabilities necessary to support the Joint and expeditionary Army and all the Services. Again, the key is achieving ITV. OIF reinforced the experience of failed logistics during ODS, over a decade earlier. Without positive control over what is moving in the defense pipeline, control of the routing and arrival of goods becomes problematic. The effects are felt in the attempt to manage the ground transportation assets it takes to move them, and on the decisions necessary to deploy and operate viable military operations in a highly fluid and dynamic world. Infusing a level of shared situational awareness leading to achieving decision-making based on real time knowledge portends an achievement that translates into the desirable U.S. Future Force characteristics. The military must continue to develop and implement actions through the Combatant Commanders and Service departments if the U.S. is to achieve the necessary level of ITV that provides actionable information to make deployment and sustainment decisions.

The Global Transportation Network (GTN)[30] is the backbone information system. It will hold the key to ITV by integrating systems to seek, track and manage data for identification, status, and location of materiel on commercial and military transportation assets around the globe. USTRANSCOM as the end-to-end process owner of the Defense Transportation System, and deploying units that must produce and provide the source data necessary for accurate tracking, are critical to success of the GTN.

Within the combatant commands, ITV actions need to be enforced and exercised. The Eighth U.S. Army (EUSA) in Korea began establishing an RFAIT infrastructure in 1996.[31] EUSA currently uses RF tags for Class IX and ammunition movements. EUSA established interrogators at key logistic nodes on the Korean peninsula to annotate materiel arrival and delivery to Corps Support Areas and Ammunition Supply Points. The regional server is accessible from the internet and all units need to become aware of the system and benefits.

EUCOM has a policy for managing Theater level ITV.[32] The theater policy designates responsibilities from the EUCOM J-4, down to supporting organizations and subordinate

component commanders. The ITV policy establishes minimum requirements for identification, how RF tags should be marked, and how the regional server will be maintained.

RFID technologies and systems within the commercial industry are expanding rapidly as private companies employ them to gain efficiencies in the storage, shipping and handling requirements of products. Industry recognizes the cost saving associated with ITV system use and eagerly employ their benefits in order to realize them on the company's bottom line. The radio frequency technology industry is projected to go from $1 billion last year to an anticipated $3 billion operation by 2007. The DoD is a part of this effort, and has not limited the infusion of AIT capability into military units and supporting logistics agencies, but also required commercial suppliers of military goods to begin using smart tags by this year.[33] This source data capture will provide the opportunity for inclusive application from the initial shipping point, into cargo consolidation points, and ultimately, all the way to the farthest end of the distribution pipeline.

This final step is currently the most deficient part of the system. To date, there has been a "seam" at the transition point from the operational level of war to the tactical level. JFCOM and TRANSCOM will need to work hard in their new roles to reduce this seam and provide for a systemic process to enable the proper information flow – the management of knowledge – as well as we can manage the materiel from the CONUS base, into the Unified Command, and to the service or subunified commands. At the tactical level, services must design, equip, and field the ground units with the ability to network until delivery to forward units. In some case this will require unit structural changes, adding network enabling equipment into their authorizations, and updating doctrine to include new techniques and procedures.

"The joint logistics system must include a responsive logistics infrastructure with simultaneous deployment, employment, and sustainment capabilities and a single, integrated, responsive end-to end distribution system."[34] DoD can adopt existing commercial radio frequency applications in existence for use in tactical units. Products are available and in use across industry with all major distribution and transportation companies. Industry leaders such as FEDEX, the LANDSTAR trucking group, and WALMART all employ this technology to manage shipment data or keep stockages to cost effective minimums. The commercial application is proven. DoD's initial, limited use of similar technology proves that Commercial Off the Shelf (COTS) products are sufficient for military use. No new design or different production requirements are necessary to meet the DoD ITV goals.

CONCLUSIONS

The important first steps to achieving ITV have been realized. DoD organizations recognize ITV as a necessary enabler. The U.S. military transformation effort cannot deliver Future Force capabilities without the ability to achieve ITV over the distribution system. Full spectrum dominance entails an agile logistics structure to support an agile force. The strategic logistic system must support and enable the tactical level systems to provide capability throughout the entire pipeline. Policy formulation from DoD has established the operating guidance necessary for joint commands and military agencies to establish and operate viable ITV programs, including prescriptive format for uniform data compliance by the service departments. This foundation provides the integrating policy at the national level.

Success starts with proper policy formulation. By all evidence, U.S. forces have that today and it defines the desirable ends. Following the new OSD guidance are implementation strategies across the Unified Commands and Services. These actions have been initiated and are steadily progressing in JFCOM and TRANSCOM as deployment and distribution process owners at the joint level, and must permeate into the Regional Combatant Commands logistic operations and deployment programs. The Army implemented these in the Korean and European theaters, and with them, has accomplished the first step in implementing the ways. Significant actions remain in establishing the means necessary to achieve the change demanded by OSD policy.

To create a network centric, end-to-end capability for ITV requires very deliberate actions to accomplish two advancements. First, is the necessary integration of the two separate functions of unit deployment and sustainment operations. The second is the institutional determination and sourcing of tracking technologies to create ITV at the far end of the pipeline, the operational theater. These plans have not yet been formulated. The roadmap to follow is based on the descriptive capabilities outlined in the Joint Operational Concepts for the Future Force, and the military's own experience in recent and current operations as a result of experimentation with various commercial tracking systems.

Once the Services arrive at the implementation strategy of the OSD policy, in 2005, they will be able to close the link between the prescribed capabilities of an end-to-end system, and what the tactical units need to operate a successful sensing and reporting system, managed by a control structure at Joint or operational JTF headquarters. This will change the entire execution of logistics operations in the Future Force, realize significant cost savings, reduce the logistics infrastructure required in the operational theater, and reduce the risk of sustainment to engaged forces.

First, strategic deployment and sustainment systems must be integrated in the theater. The logistics pipeline flow originates in CONUS and flows into the main battle area. All military services and supporting agencies must apply consistent capability from the beginning to the end. This will happen only when the theater level control and management systems are fed by strategic systems, and by joint integration of system capability to integrate the logistics network so that any origin location and source data is sufficient to populate all ITV requirements.

Management of knowledge must be the focus. Through Joint and Service transformation efforts the communications and decision support systems necessary to enable continuous real-time knowledge management will be achieved. The tactical level equipping and training requirement is the weakest point in the solution. Until the field units that provide the transportation and quartermaster functions in order to enable distribution and supply management functions at the tactical level, no amount of strategic architecture will provide a solution. Additionally, unless the same data used by all sources and commands has the same functional qualities and populate the same information systems, ITV of materiel will continue to be lost at the tactical level, which will equate to lack of supply support to the warfighter.

This leads to the second requirement, which is to resource the far end of the pipeline properly. Systemic integration of data for tracking storage, supply, and movement data, as resident in JOPES, or processed through supply and deployment information systems for execution,[35] or as originated by commercial sources, or in prepositioned stocks, must be interchangeable. All necessary technology is available. It is used throughout commercial enterprise. The Army's use of systems such as Blue Force Tracker and Movement Tracking System demonstrate the possible integration of these decision support templates into contemporary warfare. The complete solution will come with data integration and transmission capability.

A recommendation is necessary to address several outstanding issues. Based on the research for this paper and professional experience, the question of resourcing for a large quantity of RF tags remains undetermined. There are two likely scenarios which appear to be most feasible for assigning responsibility to source and provide tags to units and wholesale supply agencies alike. These are either USTRANSCOM as the Joint level headquarters responsible for distribution and transportation support or the Installation Management Agency, which owns the deployment and shipment functions at the Army installation level.

A companion to the issue of initial resourcing of RFID tags is the recycling and return of assets for recurring use. Historically, forces in combat succumb quickly to possession rules or feel anything they don't need is a throw-away product. History has illustrated a gross deficiency

in recycling RF tags during deployment exercises and operations. The accumulation of millions of dollars in rental and delinquency charges on shipping containers and the "Bogarting" of 463L air pallet systems causing shortages in the airlift cycle are indications that the systemic return of a device that can fit in a soldiers hand or be quickly dropped to the ground will never make it back into the transportation network.

Finally, compliance checks must be considered. The policy from USD (AT&L) lacks an assessment tool to determine compliance. Proper enforcement and reinforcement of the procedures is necessary. Assessment metrics concerning source data quality, use and tracking factors, and return of tags into the transportation system will indicate how well the warfighter is supported.

In conclusion, ITV can be achieved. DoD policy and industrial technologies exist to deliver the capabilities needed throughout DoD agencies and units. Though some additional actions are needed to "close the loop" in tactics, techniques, and procedures, the value of ITV acknowledged by commanders, combined with the actions pursued in force transformation into the Information Age, will drive the process through integration at the tactical level.

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