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SPACE APPLICATIONS IN THE LOGISTICS ARENA

AN ANALYSIS OF COMBAT TRACK

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by

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Disclaimer

The views expressed in this academic research paper are those of the author and do not reflect the official policy or position of the US government or the Department of Defense.

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Acknowledgments

This research project actually began three years ago during an after work discussion with Lieutenant Colonel Barb Duink. Colonel Duink had been tasked to track aircraft for Air Mobility Command (AMC). As a career transporter, I casually told her that AMC couldn't track the "stuff" on those planes either. Why not track both the aircraft and the "stuff" at the same time, serving both the operations and the transportation communities simultaneously? Colonel Duink took the question to heart and arranged several meetings with AMC and an extremely talented individual from McDonnell Douglas-Aerospace named Col. Al Brown USAF,Retired. Together, Colonel Brown and Colonel Duink developed a plan to bring COMBAT TRACK to life. Despite numerous setbacks, COMBAT TRACK is now operating daily on missions in USAFE. It is, therefore, to Colonel Duink that I owe the largest debt of gratitude. Without her dedication, perseverance, and continued professionalism, COMBAT TRACK would not exist.

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Abstract

Operation Desert Shield was plagued by deficiencies in the transportation command and control (C^2) network. Although numerous systems attempt to alleviate those C^2 deficiencies, none exploit the near real-time capability of space assets. Further, those systems require extensive manual data input, impeding accuracy and timeliness.

COMBAT TRACK is a prototype system developed by the Space Warfare Center, Falcon Air Force Base (AFB), Colorado. Using space assets and evolutionary software, it provides near real-time, secure visibility of aircraft, cargo, and passengers worldwide. It also allows an almost complete hands-off approach to data collection and data transfer.

COMBAT TRACK is but one use of space-based assets, though it is among the first logistics applications within the Air Force. Unfortunately, it has not been tested during deployments on the scale of Desert Shield. As a result, questions concerning the utility of COMBAT TRACK and of space-based assets in the logistics arena remain.

Can systems employing space assets handle the enormous amount data logisticians require to forecast materiel and lift requirements? Can space-based assets improve the timeliness of data transfer, enhancing logistics C^2? Can the use of space assets in the logistics arena reduce transportation C^2 problems similar to those encountered in the Gulf War? Using historical analyses and expert interviews, this paper answers those questions, reviews COMBAT TRACK's successes and limitations, and provides a synopsis of potential applications of space assets in the logistics arena.

Chapter 1

Introduction

> *The deployment to the Persian Gulf was the fastest buildup of conventional airpower in history.*
>
> —Eliot A. Cohen,
> *Gulf War Air Power Survey*

Most analysts agree that U.S. military action in the Gulf War was a success. As such, it would be incorrect to say that the logistics system in the Gulf War was *not* a success. In fact, after-action reports reveal logistics considerations did not limit decision-making by commanders at either the tactical or strategic level.[1] The logistics system was effective. Nevertheless, logistics efficiency was not achieved.[2] Although numerous lessons learned studies were conducted following the Gulf War, little was done to correct the inefficiencies they uncovered. Six years after the end of the Gulf War redeployment, those logistical deficiencies remain in the system. In fact, the same problems were prevalent during The 1996-1997 US troop deployments to Bosnia in support of Operation Joint Endeavor.

Although problems occurred within each of the logistics disciplines (including but not limited to supply, maintenance, and transportation), this analysis reveals several commonalties. These include lack of communication and connectivity between automated systems, poor source automation, and lack of near real-time access to information. Had the U.S. not been given 6 months to deploy its forces and establish its infrastructure, and had we deployed to a region not equipped to support traditional communication (e.g., land lines), success in the Gulf might not have occurred with such relative ease. The reality is, as military budgets are cut and forces are down-sized, we must begin exploiting available technology as a means of achieving efficiency.[3]

Examination of currently available technology reveals the solutions to these problems are now within reach "but they involve radical departures from our current ways of doing business."[4]To rectify the logistics problems encountered during the Gulf War, logisticians must solicit joint solutions and cast aside inter-service rivalries. The logistics infrastructure must be modified by standardizing data requirements and providing instantaneous connectivity between logistics disciplines and between services. Source automation must be integrated into the logistics network to provide the initial link in the asset visibility chain.

This paper is divided into four parts. The first provides a brief description of some of the logistics command and control (C^2) problems encountered during the Gulf War and the ramifications of those problems. The second analyzes COMBAT TRACK, an Air Force Tactical Exploitation of National Capabilities (AFTENCAP) initiative designed to help solve those problems. The third section highlights areas conducive to incorporation of space technology into future logistics efforts. This paper closes with answers to questions remaining about the utility of space-based assets in the logistics arena and also provides concluding remarks.

Notes

[1]Taylor, William H. "Logstics C^2 and Its Application During Desert Shield/Storm." ii

Notes

[2]Vandermarliere, Constance A., Lt. Col., USAF. Telephone interview and electronic mail. In fact, some commanders would argue that even logistical effectiveness was not achieved. For example, Lt. Col. Vandermarliere, a previous Transportation Squadron Commander at Nellis AFB, Nevada states "I disagree. If I'm forced to divert a bus and forklift and two operators to meet every flight - or if I don't know what's in a container, and I have to expend resources doing an inventory - my decision making has just been limited by the logistics system. If I need those soldiers bearing weapons to keep the bad guys at bay - the logistics system has just compromised my mission in a big way."

[3]Ibid., Col. Vandermarliere states that "Good management is exploiting available technology to achieve efficiency regardless of budget cuts and down-sizing." While this is true, this author believes that "good management" is often the exception, not the rule.

[4]Bucher, John R. "System Synergism for 21st Century Logistics." 12

Chapter 2

Logistics Command And Control In The Gulf War

> *…it sometimes appears that the logistics aspect of war is nothing but an endless series of difficulties succeeding each other. Problems constantly appear, grow, merge, are handed forward and backward, are solved and dissolved only to reappear in a different guise.*
>
> —Martin Van Creveld
> *Supplying War*

Although several logistics command and control (C^2) difficulties were encountered during the Gulf War, this paper focuses on three that are interrelated and can be corrected through the application of existing technology. Those three are communication and connectivity; source automation; and near real-time access.

Communication and Connectivity

Logisticians must concentrate on developing an automated network of systems to allow near-real time visibility and control of cargo from depot to foxhole. During the Gulf War, numerous systems at both the joint and service level were used to provide oversight of cargo from point of origin to point of destination. Those systems ranged from the Global Decision Support System (GDSS) and the Joint Operation Planning and Execution

System (JOPES) used at command level, to rudimentary spreadsheets developed by logisticians in theater to track vehicle and personnel assets. Estimates of the number of automated logistics systems used during Desert Shield/Desert Storm ranged from 29 (within the Army alone) to 55.[1] A January 1996 site survey of the aerial port terminal at Hickam AFB, Hawaii revealed four separate automated systems used for the load planning function.[2] Interestingly, none of these systems could talk to the other, yet each held information vital to creating an aircraft load plan.

Perhaps John Bucher, in his paper entitled "System Synergism for 21st Century Logistics" states it best: "Today's logistics is a highly segmented, linear architecture. Each node of the system focuses on increasing its own efficiencies without regard to overall system performance…Not only have individual services fielded redundant systems, there remain unique systems for individual classes of supply within the services themselves."[3] Examining the aircraft load planning function provides an excellent example. The Army created the Automated Load Planning System (ALPS), while the Air Force created the Computer Automated Load Manifest System (CALM). Both allow automated load planning at the unit level; yet neither can talk to the other. As a result, automated transfer of aircraft load plans was not possible During Desert Shield/Desert Storm. In effect, load plans created using ALPS were recreated using CALM if the cargo moved through an Air Force aerial port.

Turning to the logistics disciplines within a given service (e.g., supply and transportation in the Army, or transportation and supply in the Air Force), we see similar communication and connectivity problems. The Gulf War Airpower Survey (GWAPS) found that "Air Force customers were forced to manually track items moving through the

Air Force pipeline using two separate and distinct sets of status numbers. The supply system tracks items through the requisition process against a unique requisition number."[4] The transportation community, on the other hand, uses a unique transportation control number (TCN) to track that same item once it enters the transportation system. Further complicating the matter, supply documentation is not decipherable by transportation systems. As a result, the requisitioner must retain both the supply and transportation tracking numbers to monitor status of an item in the distribution cycle. Additionally, transporters have to manually enter pertinent bits of data from supply documentation into transportation systems. These inefficiencies were a prime source of error and customer dissatisfaction during the Gulf War and a leading cause of the Air Force's inability to provide visibility of an item as it moved from supply to transportation. In fact, when items were lost during the transfer from supply to transportation, they were frequently never found. All too often, customers merely reordered the item needed.

Despite the findings in some after action reports, it is apparent that the lack of communication and connectivity did impact operational efficiency during the Gulf War. C^2 systems used at the headquarters level were often not available to field units. JOPES was a prime example of this. Though used extensively by headquarters planners, most field units simply did not have access to JOPES terminals.[5] To provide units some visibility over time phased force deployment data (TPFDD), reports were often faxed or sent electronically by modem to unit planning cells. Because units could not access JOPES directly, they could not keep the time phased force deployment data list (TPFDDL) up to date. As the GWAPS found, the result was that "MAC sometimes arrived at an installation only to find the cargo had already been moved."[6] In the end, it became impossible to automatically track what cargo had actually deployed, where it deployed to, when it deployed.

Underlying the problem of communication and connectivity is the lack of joint and intraservice direction mandating data and system requirements. This lack of direction was evident during the Gulf War and many would argue that in spite of the recent publication of Joint Publication 4-0, "Doctrine for Logistic Support of Joint Operations," specific guidance concerning primary interoperable systems still does not exist. To correct this, we must develop a few interoperable systems to comprise the distribution network—any attempt to link current systems is merely a Band-Aid; not a permanent fix. Additionally, we must reduce the possibility of human error by exploiting technologies that reduce or eliminate the need for manual data input.

Source Automation

Source data automation is a necessity on today's fluid battlefield because people make mistakes and cannot always perform data input fast enough to meet operational requirements. As highlighted in the previous section, insufficient or incorrect data provided on the shipping end affects lift allocation—often at an extraordinary cost. It also Affects the allocation of manpower and equipment (e.g., busses, drivers, and materials handling equipment, MHE) on the receiving end. Because the automated planning and execution systems used in the Gulf War could not keep up with changes to the TPFDD and airlift flow, there was no reliable means to determine exactly what was arriving on an aircraft as it landed in theater. An Army commander interviewed in 1994 stated that his unit met every aircraft with a bus and a forklift because they didn't know if the plane carried cargo or passengers.[7]

Incorrect or insufficient information about specific cargo created additional challenges to aerial port of debarkation personnel. Lt. Cols. Clark Hall and Bernhard Vincent noted in their paper entitled "Container Management during Desert Shield/Storm. An Analysis and Critique of Lessons Learned," "In the early portions of Desert Shield, destination codes were not provided to the field…As a result, hundreds of pallets sat in the aerial port facility at Dhahran; no one knew their intended destination or priority."[8] Users often intentionally duplicated high priority requisitions to ensure the item would eventually be received.[9] This created an additional strain on already heavily tasked lift assets.

During the Gulf War, human error often precipitated incorrect or incomplete source data. "As a result of the President's decision to rapidly redeploy from Southwest Asia, many units did not inventory their material before packing it and did not prepare the documents necessary to identify container contents or efficiently move packed containers back to the United States."[10] Had a source automated system been in place before Desert Shield/Storm began, units could have prepared documentation in time to meet redeployment requirements.

Automating data collection at the source saves time and increases accuracy. Manual data input is both unreliable and inefficient. Each time information is manually entered into an automated system, the chance for error increases. Because of that error, visibility over the item decreases. Because intra-service logistics systems (i.e., supply and transportation) do not use common data elements and inter-service logistics systems (e.g., load planning) cannot talk to each other, operational efficiency is severely degraded.

Lack of source automation also inhibits a commander's ability to rapidly make educated decisions. Logistics systems must be flexible and reliable, providing commanders the information they need to make operational decisions. Commanders must be able to quickly locate items that have entered the logistics pipeline. This provides them the information necessary to divert essential equipment and personnel as the situation dictates.

Each of the services has identified the need for automated source data. Air Mobility Command (then Military Airlift Command) began efforts in the late 1980s to use bar-code technology to help eliminate the need for manually capturing data required for cargo manifests and load plans. Unfortunately, due to a lack of appropriate equipment, non-existent service-wide procedures, and insufficient personnel training, a reliable bar-code system is still not used consistently throughout the Command.

Following the Gulf War, the Army began concerted efforts to use radio frequency (RF) tags developed by the Savi corporation to capture the data normally included with pallet and container documentation. RF tags were used effectively by the Army during numerous deployments, including Operations Uphold Democracy in 1994 and Joint Endeavor in 1996. However, serious effort to integrate bar-coding and RF technology has not occurred within or between services. As a result, effective and consistent source automation throughout the services is not a reality.

Near real-time Access

In "Operation Desert Shield/Desert Storm Logistics Lessons Learned," the Naval Supply systems Command states that "Operation Desert Shield/Storm underscored the need for a mobile system of real-time, on-line access to logistics communication via electronic networking."[11] Though real-time (instantaneous) access is not yet technologically possible, near real-time (micro-seconds) access is possible. Systems used during the Gulf War and systems currently being developed rely on slow, antiquated batch-processing technology. In a batch processing system, new data accumulates until a computer operator updates the data base (usually every 12 hours) and makes the information available to all system users. As such, it can only be accessed following processing. This technique is both ineffective and, at least from the user's point of view, inefficient.

The lack of near real-time information intensified customer dissatisfaction during the Gulf War and, more recently during Operation Joint Endeavor. Frustrated customers frequently used other means to collect and transfer data (message, facsimile, and telephone). This resulted in an inordinate amount of off-line requisitioning, further congesting the logistics pipeline.

Planners on MAC's Crisis Action Team were also frustrated by the lack of accurate, near real-time data. So much so that they established a requirements augmentee cell to contact deploying units by telephone, to verify TPFDD requirements before scheduling lift. Planners and airlift schedulers found this data much more accurate and timely than data available through JOPES.[12]

Customers and planners were not the only ones lacking near real-time visibility. According to GWAPS, "MAC did not have the capability to determine where aircraft were on a real-time basis."[13] The Global Decision Support System (GDSS) was designed to provide this information but units in the field could not access the database. Thus, GDSS served as an after-the-fact source of data, of little value to decision makers.[14]

Commanders frequently did not have the logistics information necessary to respond to changing priorities and battlefield requirements.

With the end of the Cold War, U.S. military forces are being tasked to support a variety of missions world wide with smaller supply reserves. We must be cognizant that the logistical feasibility of a plan can, and does, impact plan development and execution. Logisticians must, therefore, develop a flexible, responsive logistics architecture. Traditional methods of connectivity may not be available in areas of future conflict. Further, these methods are no longer responsive enough to keep pace with the modern battlefield. If logisticians are to be successful, they must develop systems capable of operating in the joint arena; service-unique systems using traditional land-line communications simply do not meet the needs of commanders, planners, or customers. This architecture must incorporate space-based assets and allow for the rapid integration of future technology. The next chapter reviews COMBAT TRACK, a prototype system employing space-based assets to track military aircraft, cargo, and passengers worldwide.

Notes

[1]Bucher, 6.

[2]This was the author's observation while on a COMBAT TRACK site survey.

[3]Bucher, 8.

[4]Cohen, Eliot A. *Gulf War Air Power Survey, Volume 3, Logistics and Support.* 127-128.

[5]Ibid., 127-128.

[6]Ibid., 127-128.

[7]During the fact finding phase of COMBAT TRACK, numerous commanders from both the Army and the Air Force were briefed on the COMBAT TRACK concept. All commanders, including an Army major general at Fort Monroe made similar comments.

[8]Cohen, 102.

[9]Hall, 20.

[10]U.S. General Accounting Office. "OPERATION DESERT STORM: Lack of Accountability over Material During Redeployment." 3.

Notes

[11]Naval Supply Systems Command. "Operation Desert Shield/Desert Storm Logistics Lessons Learned." II-24.

[12]Cohen, p90.

[13]Ibid., 102.

[14]Ibid., 103.

Chapter 3

Combat Track: A Potential Solution

> *…We are determined to give the warfighters the kind of space support they need…the Air Force is committed to maintaining relevant space-based assets to support the joint team.*
>
> —General Ronald Fogleman
> Air Force Chief of Staff

Five years ago, logistics C^2 problems like those occurring during the Gulf War may not have had an easy solution. Today, however, using existing space-based assets and current technology, solutions are at hand. COMBAT TRACK, conceptualized and developed through a joint Air Mobility Command (AMC)/Air Force Space Command (AFSPC)/Space Warfare Center (SWC) effort, is one example of the effective application of space-based assets in the logistics arena. As previously stated, problems encountered within the logistics system during Operation Desert Shield/Storm included communication and connectivity, source automation, and near real-time access to information. The previous chapter provided a detailed description of those problems. This chapter provides a brief description of COMBAT TRACK—a system that could solve many of those problems.

Background

COMBAT TRACK began as TALON TRACK, a combined AMC-SWC initiative to provide near real-time location reports for AMC aircraft. An AFTENCAP flight-following system (the Multi-Source Tactical System, MSTS) proved that, using space-based assets and evolutionary software, national and tactical intelligence data could be received, processed, and overlaid onto digitized moving map displays to provide near real-time threat data in the cockpit. Following discussions with aircrew using the MSTS on operational missions, SWC action officers and the contractor (McDonnell Douglas) soon realized that by using Global Positioning System (GPS) data, another layer could be added to the MSTS. This additional layer would allow near real-time location reports for aircraft equipped with the MSTS.

While in the requirements definition phase of TALON TRACK, SWC personnel learned that visibility of cargo and passengers on board AMC aircraft was also a stated AMC deficiency.[1] Simply put, AMC could not always locate, let alone communicate in near real-time with, their aircraft. Even when they knew aircraft location, they rarely knew who or what was on board. The subsequent aircraft position and logistics layer added to the MSTS was dubbed COMBAT TRACK.

System Description

COMBAT TRACK is available in two related but distinct configurations. These include the full-up system and the logistics-only work station. The full-up system includes both MSTS and COMBAT TRACK hardware and software and provides the complete air picture, including aircraft location, threat data, and logistics information. The logistics-only work station includes only COMBAT TRACK hardware and software. It is designed for the user in the field and includes only logistics data.

COMBAT TRACK was originally designed to be part of the MSTS. An important design characteristic of the MSTS is its layered approach to data display. The first six layers comprise the MSTS. The seventh layer incorporates COMBAT TRACK data and displays. Each level overlays the previous levels, providing one integrated picture with MSTS and/or COMBAT TRACK levels as requested by the user. Though this paper has a logistics focus, each layer is briefly described below, as each provides a distinct piece of the C^2 picture. A graphic depiction of the layers is at Figure 1.[2]

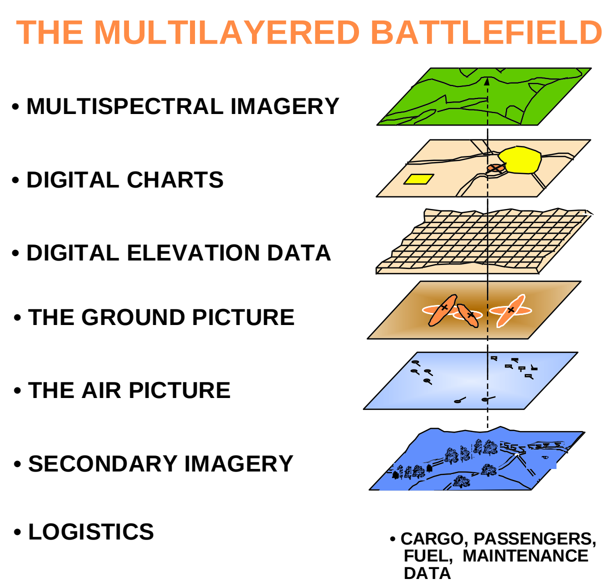

Figure 1. The Multilayered Battlefield

The first layer provides Multi-Spectral Imagery. It incorporates data from LANDSAT and Satellite Pour l' Observation de la Terre (SPOT) satellite systems, and provides the aircrew with current images of a designated geographical location. This data is loaded onto the MSTS prior to installation on the aircraft.

The second layer provides a refined, focused picture of a defined geographical area. Several charts (in varying degrees of definition) are loaded into the MSTS data bank prior to installing the MSTS on the aircraft. These include Joint Navigational Charts (JNC), Operational Navigation Charts (ONC), Joint Operations Graphics (JOG), and Tactical Line Maps (TLM). Aircrew members can choose which chart to use (via a toggle function), depending upon the level of detail required.

The third layer provides digital terrain data which can be combined with imagery of charts to provide three-dimensional views. It is based upon the Defense Mapping Agency's level one (100 meter) Digital Elevation Terrain Data (DTED). As with the first two layers, this information is loaded into the MSTS data bank prior to installation on the aircraft.

Layer four provides an overlay of the ground threat picture using world-wide, over-the-horizon intelligence data from RC-135 Rivet Joint (RJ), and National sources. This data is fed live to the aircraft, providing near real-time information about the ground threat.

The theater air picture is provided in layer five. Here, Airborne Warning and Control System (AWACS) and RJ data are fed live to the aircraft, providing near real-time information regarding actual air threats.

Secondary imagery is incorporated into layer six. Both national and tactical satellite and aircraft sources are used to provide near real-time images for this layer. Images include, but are not limited to, drop zones and airstrips.[3] These data augment the air and ground pictures provided by other layers and are fed live to the MSTS aboard the aircraft.

COMBAT TRACK data is the seventh and newest level of information. In this level, Global Positioning System (GPS) position reports and logistics data from a variety of potential sources are overlaid onto the other six levels of data. This layer is the subject of this paper and is described in greater detail throughout the remainder of this chapter.

COMBAT TRACK incorporates data relayed from military satellites worldwide. Data processed and broadcast by software and hardware includes GPS position, two-way message text, load plan, and cargo manifest information. Additionally, "The prototype, proof of concept system is compatible with the Army's Battlefield Distribution System (BDS)."[4] COMBAT TRACK can read and interpret radio frequency tags and/or bar codes placed on cargo (either by item or by pallet). Further, data can be manually input to the system, allowing greater flexibility and in-flight corrections or modifications. A more detailed description of specific COMBAT TRACK capabilities is included in the next section.

Combat Track Advantages

In its current version, COMBAT TRACK addresses three stated AMC deficiencies. First, it allows near real-time flight following of aircraft (i.e., aircraft tracking). Second, it allows secure, near real-time communication with the aircraft (much like secure electronic mail). Third, it provides visibility of cargo and passengers on board the aircraft. We must note, however, that though COMBAT TRACK was initially developed for use on aircraft, it can be installed on any mode of transportation (trucks, trains, and ships, for example).

Several features make COMBAT TRACK a unique and promising system. Recall from the previous chapter that this paper focuses on three logistics C^2 problems: communications and connectivity; source automation; and near real-time access. By design, COMBAT TRACK addresses each of these problems with a multitude of solutions. Those solutions are highlighted below.

Communication and Connectivity

COMBAT TRACK uses a time-division-multiple-access (TDMA) data burst scheme to allow multiple users on the same satellite channel. The user defines the burst interval, from every 10 seconds to several hours. Using 10 second burst intervals, a single channel can support 30 users. Changing the burst interval to every 5 minutes, 900 users can be accommodated on one channel.[5]

The COMBAT TRACK system uses satellite channels owned by the military (Satellite Communications, SATCOM), rather than commercially owned and operated systems. This keeps the cost down (commercial INMARSAT costs up to $2 per minute, while the use of military SATCOM channels costs the user nothing).[6] Additionally, commercially-owned satellites are subject to the priorities of the owner. If the system owner doesn't support an operation, he can merely deny use of the system; an unacceptable alternative for military operations.

COMBAT TRACK also provides secure data transmission. This protects both the aircraft and its contents from inadvertent discovery by potential adversaries. Thus, even if the aircraft position is not considered sensitive, data transmitted about the contents of the aircraft is still secure. Conversely, broadcasting cargo and/or passenger data does not put the aircraft at risk by revealing aircraft position, speed, flight path, etc.

Additionally, McDonnell-Aerospace personnel designed the COMBAT TRACK software giving priority to connectivity with other systems. Given the appropriate software interface, the contractors believe they could connect to any system currently used, or planned for use, in the Defense Transportation System.[7]

Source Automation

COMBAT TRACK provides for source automation by combining bar-code and radio frequency tag technology to identify cargo. It then transmits that information to an existing Air Force transportation system (e.g., the Consolidated Aerial Port System, CAPS) for consolidation into a cargo manifest. Eliminating the need to manually input data into other automated systems reduces the potential for human error. Additionally, it increases flexibility in the entire logistics system because it is not confined to data gathering via just bar-codes or just RF tags.

Near Real-Time Access

COMBAT TRACK affords all users near real-time access to cargo location once that cargo is in the system. COMBAT TRACK components identify cargo as it is loaded onto an aircraft (or truck, train, or ship). For example, as the aircraft departs a station, the aircraft position and cargo data are automatically broadcast. If a CALM loadplan is available on disk, COMBAT TRACK can read and transmit loadplan data to downline stations. If a loadplan disk is not available, the loadmaster can use COMBAT TRACK to manually sketch and transmit the load plan or passenger manifest to downline stations.[8]

Using the COMBAT TRACK system eliminates the need uncovered during Desert Shield, to meet every aircraft with a forklift and a bus. Personnel at downline stations know exactly where an aircraft is and when it will arrive on station. Further, port personnel know what type of cargo is on board and its corresponding pallet position. Thus, if cargo requires special handling (mail, refrigeration, etc.) the appropriate personnel can meet the aircraft with the right equipment. This allows materials handling equipment (MHE) and personnel to be in place as the aircraft is parked, potentially reducing ground time and ramp saturation, and maximizing the use of personnel and equipment.

The end user also benefits from COMBAT TRACK. When fully implemented, COMBAT TRACK allows the requisitioning unit complete visibility once the item enters the system. This eliminates duplicate requisitions and allows the user to plan for the item's arrival. Thus, if a unit is awaiting the arrival of a high priority item, they can be at the port when the item arrives.

Miscellaneous Advantageous Features

Another advantage of COMBAT TRACK is its Snap-On design. This means systems do not have to be permanently installed—anywhere. Instead, they are rugged, portable, and self-contained. The Snap-On feature allows COMBAT TRACK units to be quickly removed and reinstalled where needed.[9] This potentially reduces the number of systems needed by a unit to maintain maximum operational efficiency. Hypothetically, if a unit has 12 primary assigned aircraft but only an average of 9 fly at any given time, only 9 systems would be needed.

Another feature of COMBAT TRACK is its evolutionary design. Each time the system is demonstrated, a detailed wish list is compiled by the user and subsequently passed to SWC action officers and the contractor. The list is prioritized and the contractor adds new capabilities to the software (as in the case of the electronic link to CALM) as funding permits. Although the time it takes to modify the software varies according to the task, all software changes to date have been accomplished within one month of funding allocation.[10]

Combat Track Limitations

Although COMBAT TRACK has great promise, serious shortfalls remain. Interestingly, those shortfalls are generally a result of conscious decisions rather than design flaws within the COMBAT TRACK system. This section summarizes the shortfalls and provides suggested corrective actions.

Perhaps the greatest limitation of COMBAT TRACK is satellite availability. Though this system takes advantage of TDMA and data-burst technology, finding a channel to dedicate to logistics endeavors is difficult. There are, however, work-arounds to the problem. During Operation Joint Endeavor, a SATCOM voice channel dedicated to medical evacuation was used for COMBAT TRACK data transmissions without limiting medical evacuation capability.[11] A test channel was also used to accomplish several of the demonstrations. Unfortunately, no permanent logistics channel has been assigned. The procedures exist to correct this limitation. As such, the logistics community should lobby for at least one dedicated logistics channel in each satellite footprint.

Lack of coverage over certain areas of the world is another limitation. Because of satellite locations and capabilities, several blind spots exist. Aircraft traveling through these blind spots lose satellite connectivity. To correct this problem, increased funding should be allocated to support the military satellite program. Specifically, more military communications satellites should be procured, built, and launched.[12]

COMBAT TRACK does not currently interface with the Global Transportation Network (GTN), nor is it a USTRANSCOM-sanctioned system. The limitation created by this oversight is obvious. GTN is the USTRANSCOM-designated automated data processing and communication platform for in-transit visibility. As such, it is designed to provide the "centralized capability to gather and maintain timely/accurate movement data."[13] GTN is essentially the data bank for all cargo moving through the variety of systems encompassing the DOD network of transportation automated information systems. Unfortunately, GTN is not yet fielded, nor does it provide near real-time information or source automation. Because COMBAT TRACK is not recognized by USTRANSCOM as a feeder system, data input to, and transmitted through, COMBAT TRACK is not fed into the data bank. As a result, COMBAT TRACK users can not track their cargo via GTN. This creates the need to maintain yet another system in the quest for in-transit visibility.

Unfortunately, no system other than COMBAT TRACK can provide the vital near real-time information requested by USTRANSCOM customers. To alleviate this deficiency, COMBAT TRACK should be recognized as a feeder system and used at all major ports and depots (if not at all units). Before this can be done, however, COMBAT TRACK must be recognized as part of the DOD migration plan. This comprehensive plan identifies current automated transportation systems that will either be eliminated or designated as core systems. Though the plan has merit, it does not allow for incorporation of systems using new, or cutting edge, technology. Thus, though we will have fewer systems operating, we in the DOD will still be behind commercial industries (e.g., United

Parcel Service (UPS) and Federal Express (FEDEX) who regularly update their systems to incorporate new technology.

A fourth limitation of COMBAT TRACK is that it does not provide a data base for storage and retrieval of data. To date, only data entered into COMBAT TRACK and actually on a moving platform are tracked. Consequently, anyone wanting information about cargo or passengers awaiting movement, received at an in-transit location, or received at final destination, must rely on other automated data systems or telephone inquiry. Systems currently planned or in use do not, as pointed out earlier, provide the timeliness or level of accuracy required.

As stated earlier, including COMBAT TRACK as part of the GTN network of feeder systems would correct this problem. GTN could then serve as the data base, allowing storage and retrieval of information. COMBAT TRACK provides the missing link caused by GTN's inability to track cargo while it is actually in transit. Further, COMBAT TRACK reduces reliance on manual data input; a problem common among all other GTN feeder systems.

This chapter has provided a brief summary of the capabilities, advantages and limitations of COMBAT TRACK. The next chapter highlights logistics areas conducive to incorporation of space-based assets.

Notes

[1]Duink, Barbara A., Lt. Col., USAF. "SWC/DOB Trip Report." Paragraph C(1) states "USTRANSCOM and AMC's goals are the capability to identify and track the movement of Defense mobility assets, cargo, passengers, medical patients, and personal property from origin to final destination during peace and war." For more information, suggest interested readers review the "1994 Year of In-Transit Visibility Action Plan," 11 January 1994.

[2]Brown, Alan A., Col., USAF (Retired.) "COMBAT TRACK Flyer." This figure is part of the COMBAT TRACK flyer, available from the SWC or McDonnell Douglas

Notes

Aerospace-Information Systems and Support, 11242 Waples Mill Road, Suite 300 Fairfax, Virginia 22030.

[3]Those interested in more specific detail on available images should contact personnel at the SWC, Falcon AFB, Co. or the nearest Joint Intelligence Center.

[4]COMBAT TRACK Flyer.

[5]Though the number of stated users allowable is mathematically possible, it has not been demonstrated.

[6]Blanton, James P. "Talking Paper on AERO-C INMARSAT and COMBAT TRACK."

[7]Brown, Alan A., Col., USAF (Retired.) Telephone interviews, September 1996 through February 1997.

[8]As a result of use during Operation Joint Endeavor Redeployment, the contractor is developing connectivity with the Computer Automated Load Manifesting (CALM) system This will eliminate the need to manually develop a load plan on board the aircraft. Because cargo is identified as it is loaded on the aircraft, the CALM load plan will automatically be verified and updated, reflecting what cargo is actually on board, its off load point, and the ultimate destination.

[9]For example, installation on a C-130 takes approximately 30 minutes.

[10]Duink, Barbara A., Lt. Col., USAF. Telephone interview. 13 November 1996.

[11]Ibid.

[12]Ibid.

[13]United States Transportation Command, "1994 Year of In-Transit Visibility Action Plan."

Chapter 4

Potential Logistics Applications Of Space-Based Assets

The previous chapter highlighted the advantages of space-based assets in the logistics arena based on knowledge gained through COMBAT TRACK testing and deployment. Among the most obvious advantages are the increased communication and connectivity resulting from near real-time access to information and reduction of manual data input via source automation. COMBAT TRACK has opened the door to increased innovation and application of space-based assets in non-traditional roles.[1] The applicability of space in all facets of the military is limited only by imagination. This point was solidified during the course of interviews conducted for this research endeavor. This chapter summarizes several potential uses of, and a prototype system inspired by, the technology demonstrated by COMBAT TRACK. These findings are by no means all inclusive; indeed astute readers will discover that one idea merely spawns another.

Self-Contained Navigation System (Scns) Data

Air Force Reserve C-130 aircraft assigned to the 302nd Airlift Wing (AW) at Peterson AFB, Colorado are currently equipped with an SCNS unit to automatically record malfunctions occurring within the aircraft's navigational system. Following aircraft arrival and aircrew debrief, maintenance personnel manually connect to the SCNS 1533 data bus to retrieve malfunction codes. Once the codes are retrieved, maintenance crews analyze the data, identify the specific problem, and order replacement parts as necessary.

MSgt Jeff Wendling, a Communications-Navigation supervisor at the 302nd AW has suggested that the entire process could be streamlined if data were automatically fed to ground maintenance crews from the aircraft during flight.[2] This would involve connecting a unit similar to COMBAT TRACK to the 1533 data bus to gather and transmit SCNS data. Maintenance crews on the ground would then have on-line access to the information. This would reduce debrief time and allow critical parts to be requisitioned before the aircraft arrives on station. The result more efficient use of manpower, reduced aircraft down time and significantly shorter debrief times.

Engine Performance Data

Commercial airlines currently monitor engine performance data while the aircraft is in flight. Similar data are also available for the Air Force's C-17, however those data are not available to personnel on the ground until the aircraft has landed. Currently Air Force engine performance information is fed to the aircraft's flight data recorder. Maintenance personnel interviewed believe the utility of the data would increase exponentially if ground maintenance crews had on-line access.[3] This would allow in-flight troubleshooting (to facilitate functional flight checks) and provide valuable information during aircraft emergency situations.

Data sent via space-based assets could include (but not necessarily be limited to) fuel use rates, oil pressure, engine temperature, and throttle positions. Data would also serve as an historical data base and could potentially warn of an impending problem, such as propeller failure. The safety implications in this situation are obvious. As with SCNS data, both the supply and maintenance functionality could benefit from this information.

Aircraft Maintenance Debrief

Immediately following landing, the aircrew provide a thorough debrief of the aircraft's performance and maintenance data to aircraft maintenance personnel. In many cases, this briefing is the maintenance team's first notification of a maintenance problem. Following the debrief, maintenance crews of various Air Force specialties equipped with a myriad of equipment, are dispatched to the aircraft to download data (e.g., from the SCNS) and perform a variety of diagnostic tests. Once the problem is identified, maintenance crews repair the aircraft and order replacement parts as required.

This process could be expedited using space-based assets to transmit both aircraft performance data and an automated debrief accomplished by the aircrew (especially, but not exclusively, if a crew chief is part of the aircrew).[4] Maintenance personnel could order replacements, request in-flight tests, and have the right maintenance specialties available to meet the aircraft upon landing. This would reduce debrief time, minimize aircraft down time, and save many hours of on-ground tests, thereby maximizing one of our most critical resources—manpower.

Fuel Tracking: The In-Flight Receiver Identification System

During a COMBAT TRACK in-process review at AMC, one of the attendees mentioned that AMC was unable to accurately bill all customers who received fuel during in-flight refueling. This deficiency results in thousands of dollars of erroneous billing annually. Could COMBAT TRACK be adapted to track fuel as it is passed from tanker to receiver, regardless of visibility (day or night) or communication status (i.e., during communication-out conditions)? The COMBAT TRACK team (the SWC and McDonnell Douglas Aerospace) believed the answer was yes. They located a small company experimenting with two dimensional bar-code technology; affixed one of those bar-codes to the nose of an F-16A; mounted a prototype Snap-On camera (to read the bar-code) in the boom operator's window of a KC-135R; and successfully demonstrated the ability to identify an aircraft (in this case, the F-16A) as it flew into position for refueling.

The San Antonio Air Logistics Center is reviewing the system, called the In-Flight Receiver Identification System (IRIS), in an effort to provide a direct link to the Fuels Automated Management System (FAMS).[5] Though still in prototype phase, IRIS has the potential to provide seamless, automated billing of fuel passed by tankers. IRIS also provides commanders on the ground visibility over the amount of fuel remaining on a tanker, thereby enhancing command and control.

Coupled with the transportation and operations capabilities, IRIS (which serves the Supply discipline) further demonstrates the utility and flexibility of COMBAT TRACK across numerous functional lines. AMC personnel have repeatedly stated their desire to eliminate stove-piped systems (i.e., those systems that serve only one segment of the Air Force community). COMBAT TRACK is clearly not a stove-piped system. Indeed, COMBAT TRACK is proof that stove-piped systems should be eliminated in favor of systems that provide valuable services and information to a multitude of DOD specialties.

Although analysis and limited operational employment of COMBAT TRACK appear to prove that space-based assets improve logistics C^2, some questions do remain about COMBAT TRACK and other potential space-based systems. The questions include the following: Can systems employing space-based assets process the enormous amount of data logisticians require to forecast materiel and lift requirements? Can space-based assets improve the timeliness of data transfer, enhancing logistics C^2? Can the use of space-based assets in the logistics arena reduce transportation C^2 problems similar to those we encountered in the Gulf War? The next and final chapter answers these questions and provides concluding remarks.

Notes

[1]For the purposes of this paper, traditional roles include Intelligence and direct support to aircraft operators. The author realizes that systemic classification changes are currently being made to include aircraft maintenance in the "operational" category, however at the time of this writing, those changes have not been solidified. Thus, aircraft maintenance and other logistics applications of space-based assets are considered non-traditional.

[2]Interview with MSgt Jeff Wendling , a Communications/Navigation Supervisor assigned to the 302nd Maintenance Squadron/LGMV, 302nd Airlift Wing, Peterson AFB, Colo. Commercial telephone (719) 556-4604. As of this interview, his experience in the Communications-Navigation field exceeds 20 years.

[3]Ibid.

[4]Ibid.

[5]Those interested in more information about IRIS should contact the SWC/DO, Falcon AFB CO., or the contractor, McDonnell Douglas Aerospace-Information Systems and Support, 11242 Waples Mill Road, Suite 300 Fairfax, Virginia 22030.

Chapter 5

Conclusion

This paper has focused on the logistics C^2 problems encountered during the Gulf War and the recent use of space-based assets to alleviate those problems. Despite the apparent success of COMBAT TRACK, the system has still not been integrated into the DOD's network of transportation systems. As a result, questions concerning the utility of space-based assets in the logistics arena remain. Throughout the course of this paper, several of those questions have been answered; however, a brief synopsis is provided in this section to ensure clarity. This chapter closes with a summary of findings concerning the current and potential utility of space-based assets in the logistics arena.

Revisiting The Research Questions

Can COMBAT TRACK process the enormous amount of data logisticians require to forecast materiel and lift requirements? To answer this question, we must examine COMBAT TRACK from both a stand-alone and a network (i.e., if connected to other automated systems) perspective. Though COMBAT TRACK can operate as a stand-alone system, in reality it is a conduit, rather than repository of information. It was not designed to be a data base. Because it is not a data base, it provides only information relevant to items (and/or passengers) currently in the logistics pipeline. Additionally, it does not offer search capability. As such, users cannot forecast requirements based on what has already moved.

COMBAT TRACK's real utility is as a conduit of information. It was designed to receive and deliver information in a secure, near real-time mode, to existing automated transportation systems. This capability has been repeatedly demonstrated. COMBAT TRACK's timeliness, accuracy, security, and user friendliness far surpass any other operational system. Additionally, it was designed to track at least 900 platforms (i.e., trucks, trains, aircraft, and ships) at one time. Although this capacity has not been operationally demonstrated, tests indicate that it can indeed simultaneously transmit all position and logistics data.[1] The bottom line—COMBAT TRACK can provide secure, time-critical validation of cargo and passengers in the logistics network. This will eliminate redundant requisitions, providing a more accurate picture of materiel and lift requirements.

Can space-based assets improve the timeliness of data, thereby enhancing logistics C^2? This question is much easier to answer—yes. COMBAT TRACK was designed to provide information in near real-time. As such, it is more timely that traditional methods of communication. Further, because it is not dependent upon land-line connectivity, it can be used even under the most austere conditions. Personnel on the receiving end know exactly what cargo and passengers are inbound on a lift platform, eliminating the need to open every crate or meet every aircraft with a forklift and a bus. COMBAT TRACK also affords commanders the ability to redirect aircraft en route if the situation dictates.

Can the use of space-based assets in the logistics arena reduce the transportation C^2 problems similar to those encountered in the Gulf War? COMBAT TRACK is not the only answer to current logistics C^2 difficulties. It is, however, a technologically feasible, currently available system that provides more timely and accurate logistics tracking than any system currently fielded. If tied to a database, the joint services arena would undoubtedly achieve increased logistics C^2 and enhanced in-transit visibility. Unfortunately, COMBAT TRACK is not included in the DOD's migration plan, which identifies core systems to be used throughout the transportation network. This could ultimately prove to be a costly mistake, holding the Defense Transportation System back as the rest of the world moves into the twenty first century. Further, those who believe COMBAT TRACK is a stove-piped system are simply incorrect. This paper has shown just the opposite: COMBAT TRACK can provide much of the data needed by the transportation, maintenance, supply, operations, and command post communities.

Summary

As highlighted in previous chapters of this paper, COMBAT TRACK has opened the door for other uses of space-based assets in the logistics arena. This paper highlighted a few potential logistics applications noted during a brainstorming session with experts in the field. With a decreased budget and a downsized force, imagination, innovation, and accountability are vital to the military's success across the spectrum of conflict. If the Air Force is to continue being the most respected space and air force in the world, she must lead the way in space.

Notes

[1]More specific and detailed information on COMBAT TRACK's capacity is available through the contractor, McDonnell Douglas Aerospace-Information Systems and Support, 11242 Waples Mill Road, Suite 300 Fairfax, Virginia 22030.

Glossary

AFSPC	Air Force Space Command
AFTENCAP	Air Force Tactical Exploitation of National Capabilities
ALPS	Automated Load Planning System
AMC	Air Mobility Command
AW	Airlift Wing
AWACS	Airborne Warning and Control System
BDS	Battlefield Distribution System
C^2	Command and Control
CALM	Computer Automated Load Manifest
CAPS	Consolidated Aerial Port System
CAT	Crisis Action Team
DMA	Defense Mapping Agency
DOD	Department of Defense
DTED	Digital Terrain Elevation Data
FAMS	Fuels Automated Management System
GAO	Government Accounting Office
GDSS	Global Decision Support System
GOSG	General Officer Steering Group
GPS	Global Positioning System
GTN	Global Transportation System
GWAPS	Gulf War Airpower Survey
INMARSAT	International Maritime Satellite
IR	Infrared
IRIS	In-flight Receiver Identification System
JNC	Joint Navigation Chart
JOG	Joint Operations Graphic
JOPES	Joint Operation Planning and Execution System

MAC	Military Airlift Command
MHE	Material Handling Equipment
MSTS	Multiforce-Source Tactical System
ONC	Operational Navigation Chart
RF	Radio Frequency
RJ	Rivet Joint
SATCOM	Satellite Communications
SCNS	Self-Contained Navigation Data
SPOT	Satellite Pour l' Observation de la Terre
SWC	Space Warfare Center
TCN	Transportation Control Number
TDMA	Time Division Multiple Access
TLM	Tactical Line Map
TPFDD	Time Phased Force Deployment Data
US	United States
USAFE	United States Air Forces, Europe
USTRANSCOM	United States Transportation Command
WWMCCS	Worldwide Military Command and Control System

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