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Sustainment of Army Forces in Operation Iraqi Freedom

Battlefield Logistics and Effects on Operations

Eric Peltz, John M. Halliday, Marc L. Robbins, Kenneth J. Girardini

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Preface

This monograph describes how Army forces were sustained with materiel during Operation Iraqi Freedom, examines how well this support performed, and discusses the effects on operations, with an emphasis on the period from the start of ground combat to the fall of Baghdad. The findings should be of interest throughout the Army as well as the broader Department of Defense supply chain, deployment planning, and force development communities. The findings have implications for the design of the logistics system, logistics process improvement efforts, future force design and warfighting concepts, and the acquisition of end items such as vehicles, as well as logistics enablers such as information systems that provide logistics situational awareness.

The research documented in this monograph was conducted as part of a project called "Army Logistics in OIF: Key Issues for the Army." The project's goal was to produce an independent assessment of the Army's logistics experience in Operation Iraqi Freedom. It was sponsored by the Deputy Chief of Staff, G-4, Headquarters Department of the Army. Companion reports will address a wide variety of related topics, including end-to-end distribution from the continental United States (CONUS) to units in the field, spare parts demand characterization, tactical inventory effectiveness, Army Prepositioned Stock (APS) brigade set sustainment stock effectiveness, APS theater-level sustainment stocks and CONUS-based war reserves, the Army Working Capital Fund (AWCF) requirements and resourcing processes and the agility of the AWCF with respect to supporting contingency operations, and the deployment of Army forces for OIF.

This research has been conducted in RAND Arroyo Center's Military Logistics Program. RAND Arroyo Center, part of the RAND Corporation, is a federally funded research and development center sponsored by the United States Army.

Questions and comments regarding this research are welcome and should be directed to the leaders of the research team, Eric Peltz and Marc Robbins, at peltz@rand.org and robbins@rand.org.

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Summary

Introduction

By virtually every account, the major combat operations of Operation Iraqi Freedom (OIF) that toppled Saddam Hussein's regime were a remarkable success. However, there seems to be some belief within the Army and the broader defense community that this success was achieved despite severe logistics problems. Although legitimate issues did arise, the great success of major combat operations in Iraq could not have been achieved without historically noteworthy logistics support.

This seeming paradox may have resulted from several factors. Risk was accepted up front and did grow beyond what people are accustomed to, implying potential problems against a more effective adversary or in the event of major disruptions to logistics operations. Second, it is valuable to separate issues with logistics resources and processes themselves from issues with other facets of the planning for and the conduct of OIF, such as a concept of operations with unprotected supply lines, intelligence issues, or tactical communications difficulties, as they have markedly different implications for future force design and operational concepts.

There could be other cases, however, where the consequences of the types of sustainment issues encountered in OIF would have been more serious. To assess this, it is important to understand how logistics problems translate into operational effects; to drive improvement of future logistics capabilities, the underlying reasons for the problems or symptoms should be determined.

Distribution Based Logistics

OIF marked a de facto application of what has become known as distribution based logistics (DBL). DBL means limited inventory to cover small disruptions in distribution flow and enough supply to cover consumption between replenishments. The primary reliance is placed on frequent, reliable distribution rather than on large forward stockpiles. This is roughly how OIF combat operations were conducted. Except for small buffer stocks, such as one or two days of food and water at logistics support

areas, supplies stayed at an intermediate support base (ISB) (i.e., Kuwait) and were not pushed forward in large amounts. Even forward fuel supplies, while richer, were limited to a few days, but this was generally considered to represent a "healthy" situation. Further, the supply levels at the ISB remained limited in comparison to some past campaigns. For example, when ground operations began in Operation Desert Storm, forward logistics bases near the Iraqi border had 29 days of rations and 45 days of ammunition stockpiled to support operations, in addition to what was farther back at theater bases.[1] By contrast, in OIF, meals-ready-to-eat (MRE) stocks at the port and at the general support food warehouse were down to less than a day of supply early in combat operations, with as little as five days of supply contained in on-hand stocks within units, supply at logistics support areas (LSAs), and MREs in the distribution pipeline en route to units.[2]

But although inventory was reduced, many of the enablers of DBL were not in place, such as good in-transit visibility of supplies. Nor were many of the supporting processes, such as load building in the continental United States (CONUS), aligned with DBL concepts. In short, many of the critical elements of a DBL system were not in place or suffered problems, being overcome only by "superhuman" efforts and likely increasing risk.

The experience points to numerous issues, but several observations should be highlighted. Operating under the DBL paradigm may not always be comfortable for commanders and the troops, especially if this is not what they are used to, whether from training or from previous deployed operations. This is particularly true without complete, accurate, and real-time information about current and projected supply levels, which raises the perceived level of risk when relying on distribution rather than large stockpiles. And problems can develop quickly. To counter potential risk, commanders need to quickly know about and resolve any distribution flow issues. Thus, to reduce uncertainty and support operational decisionmaking and to control the system, DBL demands solid logistics situational awareness.

With a supply point model of support, the various portions of the supply chain can be somewhat disconnected for periods of time as units live off relatively large stockpiles. But if the stockpiles have the wrong things or do get drained, significant problems can result, as the system is relatively inflexible and unresponsive. In contrast, a DBL system may be at greater risk for spot shortages, but if well executed, it should be able to respond quickly to problems, minimizing their severity and duration. In such a system, planning and execution must be integrated across the entire

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[1] Army Materiel Command (AMC), *Theater Logistics in the Gulf War*, 1994. The goal was actually 60 days of fuel, food, and ammunition.

[2] From General Support (GS) supply daily status reports covering the theater distribution center, the food warehouse, and the seaport. It is possible that not all MRE inventory in the port was accounted for, but then again, if not accounted for, it could not be issued.

system from CONUS to consuming units, requiring adequate lift capacity balanced across distribution segments, seamless transfer of loads at distribution nodes, and load configuration aligned with distribution node capabilities. Without large stockpiles of items with high demand variability, such as spare parts, units need to always be connected physically and electronically so that they can order and "pull" such items when they use the few they have. Such items cannot be effectively "pushed" like items with low demand variability that are used at relatively predictable rates, such as food.

Finally, the desired levels of acceptable risk and associated buffers need to be carefully examined. The sandstorm that occurred a few days into ground combat provided an example of how a two- to three-day disruption can affect a force that is operating with limited supplies. The system was able to handle the disruption, but just barely. The ensuing separate discussions of fuel and dry cargo supply and distribution systems illustrate different levels of risk acceptance in the planning process, with different buffer sizes in the two systems. However, other factors, as will be described, also account for differences in fuel and dry cargo sustainment performance.

Fuel Supplies Stayed Robust

Actions and interviews across all levels make it clear that planners considered the need to get fuel right paramount for the success of the operation, which counted on a long, rapid advance. Unlike some other classes of supply, fuel shortages cannot be worked around without significantly changing the operational plan. Besides the greater emphasis that fuel received in planning and preparation than other classes of supply, other factors unique to fuel supply and distribution were important as well.

Starting in mid-2002, the theater planners proposed a number of preparatory tasks to set the conditions for force reception and rapid force buildup, primarily in terms of the infrastructure in Kuwait. An exception to the infrastructure or construction focus was the early approval for the mobilization and deployment of seven reserve component fuel truck companies. The early movement of fuel trucks combines with other preparatory tasks to suggest another focus beyond force reception: developing robust fuel supplies and distribution capabilities. Pipelines connected Kuwaiti refineries directly to the fuel farms and led virtually to the border with Iraq by the start of operations.[3]

Further evidence that fuel sustainment capability was believed to be critical can be seen in the results of the deployment planning process. In contrast to other types of distribution assets, fuel distribution assets have been generally acknowledged as

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[3] In COL (ret.) Gregory Fontenot, LTC E.J. Degen, and LTC David Tohn, *On Point: The United States Army in Operation Iraqi Freedom,* Fort Leavenworth, KS: Combat Studies Institute Press, 2004.

resourced at requested levels—all echelons received the assets they thought they needed to do the job. Additionally, as the force moved forward, large fuel farms were quickly put in place and filled.

Also in contrast to the classes of supply that had the most problems, determining what to send forward and how it should be consolidated across units is not an issue with fuel supply. The more complex and variable the demands for a given supply class are, the more critical this determination becomes, and there was a high correlation between class complexity and supply and distribution effectiveness in OIF.

Dry Cargo Distribution During Combat Operations

Dry cargo distribution performance during major combat operations did not meet expectations. Consumed materiel was not replenished to the expected and desired levels, and materiel ordered on demand (e.g., a specific spare part to correct a mission-critical equipment fault versus food that any unit could use) was difficult if not impossible to get via standard distribution channels during this period. Additionally, distribution inconsistency and the limited visibility of in-transit and on-hand supplies combined with the low stockage levels in units led to anxiousness among commanders in the force that may have affected decisionmaking and thus operations in ways that cannot be clearly documented. However, by most accounts and available data, distribution performance was at least minimally sufficient for subsistence, enabling the force to conduct operations as intended and as driven by other factors, such as weather and enemy actions.

Why did distribution performance fall short? First, it is widely believed that there was an insufficient number of trucks. Changes in the deployment plan are widely attributed as one of the reasons for the truck shortage. The nature of these changes may have been influenced by the lack of adequate theater distribution planning tools. There was no integrating tool to enable comprehensive, consistent planning across echelons. The consequence of this is difficult to determine, but at the very least the planners could not rapidly analyze how changes in the deployment plan and flow or changes in logistics policies would affect distribution capability, and thus quickly show their impacts. Additionally, no one had responsibility for looking across the theater and establishing a complete, detailed theater distribution plan and requirements down to the maneuver brigade level. What were, in a sense, separate plans were not treated as one capability package by the senior echelons of the chain of command. Additionally, this may have impeded seamless rebalancing of assets across echelons of distribution when the plan was not executed fully or needed to change because of unexpected conditions.

Reports indicate that distribution assets were deleted from the deployment plan or shifted in the deployment flow through a series of planning conferences and in the

request for forces process. Widespread interviews relate that units such as truck companies were often treated as individual elements in the deployment planning process. Without documentation of a comprehensive theater distribution plan and how each element fit within it, the reported result was cuts in these units.

Beyond what was in the force flow was the question of timing. A majority of combat service support units are in the reserve component, requiring about 90 to 120 days to mobilize and deploy.[4] Thus, in order to get ready by the start of combat operations they would have had to mobilize prior to the December 2002 holiday season. To avoid this, it was decided to delay some mobilizations.

Beyond whether the force had sufficient distribution assets to support the plan, there were a series of factors that changed distribution system requirements and available assets from planning estimates. Road conditions were not as good as expected, slowing movement rates. Convoy disruptions further reduced throughput. The *shamal* or sandstorm temporarily limited movement. Bottled water unexpectedly became the norm for the entire operation, consuming more distribution capacity than planned for.

The sum of these issues resulted in distribution limited to basic subsistence. Food, water, and ammunition were the priorities.[5] Choices had to be made, and there was room for little else except on an absolute emergency basis. This included spare parts. However, units were generally able to maintain combat power with on-hand spare part stocks and creative maintenance during combat operations.

Supply Levels During Combat Operations

The 3rd Infantry Division's plan was to start operations with five days of supply of food and water in all units, with an additional one to two days in the support battalions. The plan was to get the first resupply on G+2 at Objective RAMS near An Najaf (see Figure S.1), with distribution flowing from that point on, keeping the division basically at or close to the initial full load of supplies.[6] As a result of the factors affecting distribution throughput, the first replenishment of food and water, along with limited quantities of other materiel, did not arrive until G+6.[7] At this point, some units were down to a day or less of supplies.

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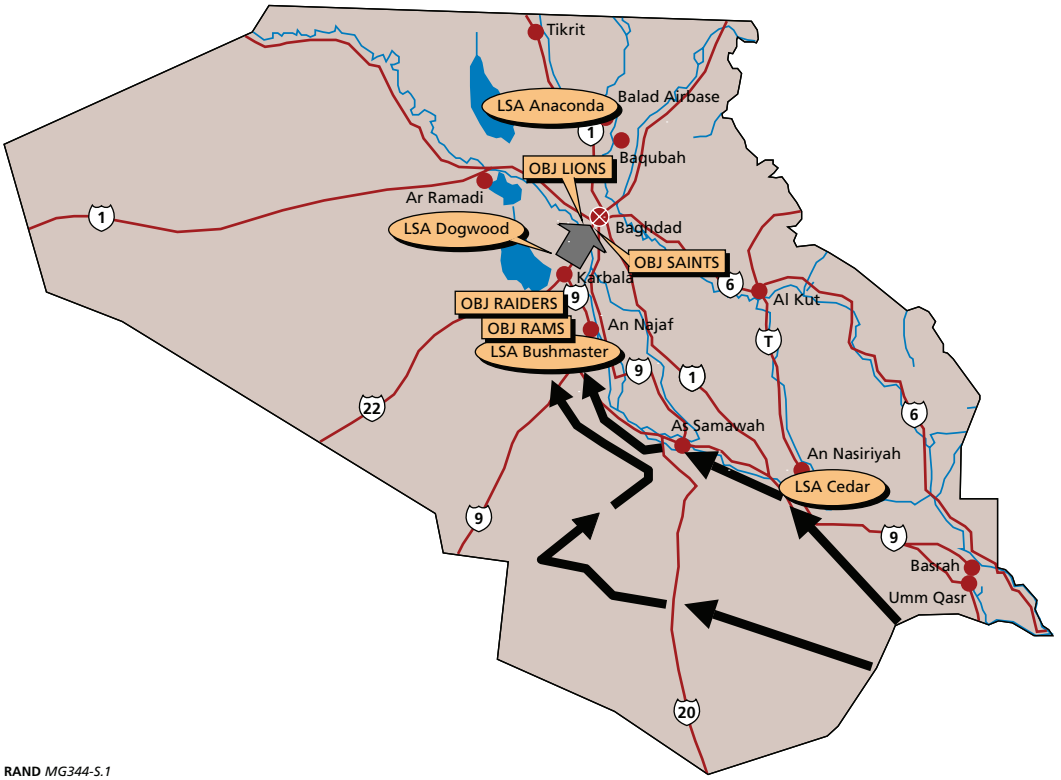
[4] Based upon actual times for OIF.

[5] Interview with BG Charles Fletcher, former commanding general of 3rd COSCOM, 22 October 2003.

[6] Interview with LTC Steve Lyons, former commander of 703rd MSB, 3rd ID, 28 October 2003.

[7] Ibid.

Figure S.1
Major V Corps Routes of Advance to Baghdad, Objectives, and Logistics Support Areas



RAND *MG344-S.1*

The plan was to launch the advance to cordon Baghdad with robust quantities of supplies available in units and at forward logistics support areas. The original concern was that from this point forward, supply lines would be at high risk, so immediate resupply could not be counted upon. It was the intent not to launch into the Karbala Gap toward Baghdad until LSA Bushmaster at Objective RAMS was established and it could support the advance.[8] However, many sources report the perception that distribution capacity was insufficient to rebuild supplies back to the five-day level. Instead, for example, maneuver units in the 3rd Infantry Division (ID) report beginning to get sustainment flows at barely sufficient levels to keep them going, let alone build their supplies back up, generally keeping them at 1+ days of supply. This is consistent with the flow of supplies, which appear sufficient for subsistence but not to replenish the initial on-hand levels. Additionally, it does not seem that the resupply pattern became immediately clear to 3rd ID personnel. With limited in-transit

[8] Interview with LTG William Wallace, former commanding general of V Corps, Fort Leavenworth, Kansas, 6 April 2004.

visibility at their level, supplies seemed to just show up, increasing the perceived level of risk.

Snapshots of the on-hand levels at LSA Bushmaster suggest that direct support (DS) food supply was built up to the target level of two days, but bottled water supplies were thin. We do note that the 3rd Corps Support Command's (COSCOM) daily briefings indicate different supply levels of food and water in 3rd ID than suggested by the 3rd Brigade Combat Team's supply status reports: 4 to 5 days of supply on 4 and 5 April in the 3rd COSCOM reports for the 3rd ID versus 1 to 2 days reported at the brigade level. This may reflect the amount of materiel at division level and/or en route to brigade combat teams as opposed to the brigade-level view, since corps throughput was to the division support area and not directly to brigades.

What is revealed by the combination of the limited situation reports, commander's update briefings, and brigade supply reports and interviews is that the intent was to build supplies in divisional and other major units back up to the original line-of-departure level, with two days of backup at LSA Bushmaster. In the case of food, it appears this was almost achieved, but limited distribution capability from the division support area forward to units did not make it look that way to front line maneuver units. Water remained scarcer.[9] The overall reports that reached corps commander level likely indicated a stabilizing and sufficient supply situation with respect to the commander's intent to advance forward through the Karbala Gap toward Baghdad, but these reports remained interspersed with reports of local shortages, as shown in Figure S.2.

Once units secured Objectives RAMS and RAIDERS and stopped advancing, their organic trucks became more flexible. The trucks, really mobile warehouses, could be unloaded and sent back to pick up supplies. This same approach was feasi-

Figure S.2
The MRE, Water, and Fuel Pipeline During Combat Operations from About 26 March Onward

		Estimated days of supply				
	"Strategic" pipeline	GS/ port	Distribution pipeline	DS/ LSA	Division LRP/transit	BCT
MRE	Ship	0–3	2(–)	1–2	0–2	1–2
Water	Local supplier/ship	4–15	2(–)	0–1	0–2	0–1
Fuel	Refinery and oil field	3+	Pipeline to Tallil	3		3–4

RAND *MG344-S.2*

[9] 1st BCT Orange supply status reports, 3rd COSCOM daily commander update briefings.

ble after the advance resumed, as support battalions did not initially cross the Euphrates River and because the advance was no longer continuous and rapid. Similarly, once Baghdad was cordoned, the limited movement requirements gave units the flexibility to use their organic trucks to pick up supplies. At times this divisional truck asset flexibility became important and probably helps explain why the distribution problems were surmountable. Organic division and brigade truck assets became an unplanned part of the theater distribution system.

Ammunition Supply During Combat Operations

Ammunition support during combat operations is more problematic in general, because consumption of ammunition is much more variable and unpredictable than that of food and water; moreover, resupply determination is more complex, depending upon the type of ammunition needed. This need is based on both what has been expended and what types of fights the unit expects to engage in. A term like "days of supply" has no relevance, since a full load of some types of ammunition could go in less than an hour or last more than a week, depending upon the situation. Additionally, the need for ammunition resupply can be absolutely immediate, without warning, and develop while in contact. Thus, critical spot shortages are more likely to develop for ammunition than for other supply classes, and they can develop in difficult resupply situations, which did occur. But a general, overall shortage did not develop, at least in terms of having some ammunition available, if not always the munitions of choice.[10]

The Pause in the Advance at Objective RAMS

By 23 March, the 3rd ID's 2nd Brigade Combat Team (BCT) had secured Objective RAMS just south of An Najaf, and 1st BCT moved north of RAMS to Objective RAIDERS. However, the 3rd BCT had to counter the unexpectedly heavy resistance in As Samawah that had been interdicting the main supply route and then remained there to protect the lines of communication (LOCs). Then on 24 March, the "Mother of All Storms" began, limiting offensive and other operations through the 26th. During this time, 1st BCT, 2nd BCT, and the divisional cavalry squadron (3-7 CAV) were engaged with enemy forces in the vicinity of An Najaf. Additionally, it became apparent that An Najaf could not be bypassed without incurring undue supply line risk. Similarly, the continued, unexpected resistance by *Fedayeen* along the supply lines led to a change in plans. The route from Kuwait to An Najaf could not be left unprotected. However, with the rolling start to the operation that limited

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[10] Interview with BG Charles Fletcher, and interview with MG Buford C. Blount, Commanding General, 3rd Infantry Division (Mechanized), 18 November 2003.

available forces when operations commenced, no combat forces had been following the 3rd ID to secure the rear areas; this was a risk that had been accepted. Thus, the 3rd BCT of the 3rd ID stayed back to secure critical areas near As Samawah. Plans had to be quickly developed for its relief to enable the 3rd ID to be at full strength for the assault toward Baghdad. Similarly, the *Fedayeen* operating from An Najaf posed too much of a threat for the 3rd ID to continue its advance without another force securing LSA Bushmaster and the supply lines in this area.

Plans were modified to relieve the 3rd ID as soon as possible given the available forces. The 2nd BCT of the 82nd Airborne Division was released to V Corps on 26 March, and it completed its relief of the 3rd BCT of 3rd ID on the 29th. Plans for the 101st Airborne Division (Air Assault) were changed, and it too was assigned to relieve the 3rd ID of LOC security roles. Responsibility for eliminating the threat from irregular forces in An Najaf was also given to the 101st, which completed its move to An Najaf by the 30th.[11] This series of actions enabled the 3rd BCT to move north, rejoining 1st and 2nd BCTs, enabling the entire division to prepare to restart the offensive before first light on 31 March. During this time, airpower worked to attrit Republican Guard units south of Baghdad and attacked command and control and intelligence targets in the Baghdad area, setting the conditions for the advance.[12]

Because of the limited distribution capacity and competing demands for the assets, the corps was not able to establish significant stockpiles at LSA Bushmaster. However, the pause in the advance still may have helped the logistics system become somewhat better prepared for further offensive operations. It likely enabled the distribution system to get untangled from the initial advance, and it kept the supply lines—and thus round-trip times—from getting even longer. Every day until the advance resumed was another day for trucks to become available for use as units continued to unload their equipment from ships and prepare for operations at camps in Kuwait. From 19 March to 1 April, the 3rd COSCOM's available trucks increased by 63 percent. So while the units and LSA Bushmaster did not fully achieve the desired level of days of supply for food and water, the pipeline from Kuwait north did begin to approach the desired levels of supply and could maintain a decent distribution flow by this time.

The pause was not caused by a wait to build up stockpiles, although it may have helped the distribution system to stabilize and improve its organization. This does not mean that the pause had nothing to do with logistics. One of the key proximate causes was the need to secure the supply lines in order to enable continued sustainment and even more extended LOCs. In this sense, beyond any shortfalls in combat service support units themselves, sustaining the force required much greater resources

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[11] Fontenot, Degen, and Tohn (2004).

[12] Ibid.

than anticipated: an entire division plus to secure the supply lines from Kuwait through An Najaf.

Spare Parts and Packaged POL Support

Spare parts support to the 3rd ID suffered from a chain of problems: poorly configured prepositioned spare part sets, an inability to order parts while on the move, insufficient distribution system capacity, distribution system problems unique to pull-type items such as Class IX, and later by expectations about redeployment.

Authorized Stockage Lists

The 1st and 3rd BCTs of the 3rd ID drew authorized stockage lists (ASLs) that were stored with prepositioned brigade set packages. The breadth of parts in these two ASLs produced little value for critical maintenance. An additional problem was that the parts were packed in the containers without separate dedicated bins and shelves for each part. Thus, the mobile warehouses had to be configured during the preparation for operations.[13] This would be particularly problematic in a rapid deployment and employment situation.

In this case the poor part mix was problematic because, with few exceptions, the only parts available through the fall of Baghdad were those that units carried with them.

Tactical stockage for units deploying with their ASLs from home station was generally better, at least during initial operations. These ASLs had broader and better mixes of parts. However, they were quickly depleted due to a complete gap in replenishment during combat operations and then very slow replenishment combined with high demand rates during stability operations.[14]

As soon as the supply support activities (SSAs) began moving, communications from the part-ordering system to the rest of the supply system ceased. Even when requests were submitted, the distribution time was too long for requests to the standard supply system to reach the 3rd ID during combat operations. In March and April, the distribution system was extremely turbulent, with parts often not making it to the ordering unit at all, regardless of the time. The primary driver of this turbulence was the fact that loads were shipped from CONUS in configurations poorly suited for the design of the theater distribution system and Army SSA capabilities.

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[13] See Kenneth J. Girardini and Eric Peltz, "Sustainment of Army Forces in Operation Iraqi Freedom: Prepositioned Authorized Stockage Lists," unpublished RAND research, August 2004, for an in-depth analysis of these two prepositioned ASLs.

[14] See Kenneth J. Girardini, Eric Peltz, Thomas Held, Art Lackey, and Candice Riley, *Sustainment of Army Forces in Operation Iraqi Freedom: Tactical Inventory,* Santa Monica, CA: RAND Corporation, forthcoming.

When shipments were made available for onward movement to the 3rd ID and other units in Iraq through the sorting process, spare parts and other items that came through the theater distribution center (TDC) were behind food, water, and ammunition in priority, limiting the frequency with which these items were shipped. Pushes of food and water would come through the TDC, and any available capacity was used to ship Class IX spare parts along with Class II, IIIP, and IV materiel. But such capacity was limited during major combat operations.[15]

As the operating tempo and scale of stability operations increased beyond expectations in the summer of 2003, the distribution time to the theater for CONUS-based supplies continued to worsen. The growing volume of spare parts and other requests outpaced the ability of Defense Distribution Depot Center Susquehanna, PA (DDSP), the primary distribution center for Army shipments from CONUS to the U.S. Central Command area of operations, to expand capacity. A backlog developed, and times worsened through the fall before finally recovering in February 2004 as capacity and demand became aligned and the backlog was eliminated. At the same time, the theater distribution system continued to struggle through November 2003 as a result of the load configuration issues.

The slow distribution times combined with high demand rates to limit the value of tactical stockage in Iraq in Army ASLs. The replenishment times were longer than the planning values, and the demand rates were higher than those used in planning, which in combination led to many empty shelves.[16]

The final factor was insufficient national inventories and production base response for items managed by Army Materiel Command (AMC). National war reserve secondary item requirements were missing many needed items or had too little depth, and only a small fraction of the requirements had been funded.[17] AMC could not respond in time by increasing procurements and repair to compensate, due to late authorizations to commit money for such actions. Before operations began, expectations about their scope and scale, along with limited awareness of war reserve shortfalls, led decisionmakers to discount requests to procure additional spare parts.[18] By the time the real demand rates were apparent, it was then too late to respond in time, owing to the long production lead times of many spare parts.

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[15] Interview with MAJ Thomas Murphree, TDC Commander (and previously CFLCC C-4 Battle Captain), interview with the author, 26 May 2004.

[16] See Girardini et al., *Sustainment of Army Forces in Operation Iraqi Freedom: Tactical Inventory.*

[17] See Kenneth J. Girardini, Eric Peltz, Art Lackey, Elvira Loredo, and Candice Riley, *Sustainment of Army Forces in Operation Iraqi Freedom: Army War Reserve Secondary Items*, Santa Monica, CA: RAND Corporation, forthcoming.

[18] Interviews at Tank Automotive and Armaments Command, feedback on briefing from Mr. Don Tison, Deputy to the G-8, Headquarters, Department of the Army, interview with Mr. Gary Motsek, Deputy G-3, Army Materiel Command.

Class IIIP (package petroleum, oil, and lubrication products) materiel also became a significant issue for 3rd ID and other units.[19] Stocks on hand to support rotational training and at the area support group in Kuwait were depleted during preparations for combat as training was conducted and the theater population grew in advance of combat operations. By 18 March, the general support (GS) on-hand levels of most IIIP items were zero for 64 of 77 items that were being tracked.[20]

Equipment Readiness

During combat operations, units were able to maintain equipment well enough to keep combat power high. The equipment readiness standard was "shoot-move-communicate" (SMC): could the weapon system shoot, could it move, and could it communicate? The only parts that absolutely had to be replaced during combat operations were those that contributed to this standard. Given this change in the maintenance standard, units did just enough in preparation combined with the cannibalization and controlled exchange they could do to get them through major combat operations. Most key combat equipment fared well for the first few weeks, to include M1A1 tanks, Bradley fighting vehicles, Paladin self-propelled howitzers, and multiple launch rocket systems (MLRS). During this period, aviation across the corps was generally kept above peacetime readiness standards with less of a difference in peacetime and combat reporting, because of safety-of-flight issues. However, some low-density and older fleets experienced problems.

However, the division's adaptations could work for only so long. Whatever extra parts they procured and placed in things like off-the-books ASL push packages were generally consumed by the fall of Baghdad. Deferred maintenance can only be deferred for so long before equipment becomes non-combat-capable. Across V Corps, deferred maintenance, continued problems with spare parts distribution, and a change in the standard to something closer to fully mission capable during stability operations resulted in all combat systems falling below 80 percent readiness by early July.[21] The very heavily worked distribution assets started showing signs of stress earlier, with many falling below 75 percent.[22]

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[19] Interviews with 1/3 ID, 2/3 ID, 3rd ID DISCOM, and 3rd ID DIVARTY.

[20] TDC status report, 18 March.

[21] 3rd COSCOM readiness briefing, 14 July.

[22] Ibid.

Effects During Stability Operations

Continued supply and distribution problems as stability operations became extended led to quality-of-life problems and affected morale. The sense conveyed by troops in interviews is that they understood issues with getting parts and not getting hot food during combat operations, but continued delays with things like spare parts and slow improvements in quality of life were disappointing and harder to understand. In particular, limited hot meals through June for some units has been highlighted. Soldier readiness fell as well in terms of having sufficient personal gear and supplies.

Beyond contributing to the equipment readiness degradation, national-level supply problems also led to increased costs due to the need for expedited deliveries and excessive use of strategic air to move supplies.[23]

Effects on Combat Operations

No direct operational consequences from a supply shortfall have been identified, in terms of either a mission failure or a changed course of action. However, the level of risk rose above the comfort level of combat commanders and the troops. Risk arose from relatively low on-hand supply levels in front line units, uncertainty as to actual supply status, and lack of information or logistics situational awareness. This risk likely weighed on commanders' minds, possibly affecting decisionmaking, although no specific examples have been cited. Similarly, it may have bounded the considered decision space.

There was a large logistics-related effect, but it was the result of the combination of the operational plan, the associated deployment flow, and an intelligence failure. The initial advance by the Army's V Corps to An Najaf was extremely rapid. However, the *Fedayeen* along the supply lines from Kuwait to An Najaf, particularly around the cities, posed an unanticipated threat to both supply line operation and the personnel in the convoys. 3rd ID became committed to fights against the *Fedayeen*, and then it was decided that the 3rd ID could not continue its offensive toward Baghdad without its rear area and the supply lines being secured. Combined with the severe *shamal* from 24 to 26 March, this held the 3d ID in place for about a week, although it was heavily engaged for much of this period. Since no combat forces were following immediately behind the 3rd ID, the delay resulted from the preparation and movement of units to relieve the 3rd ID, which was done by a brigade from the 82nd Airborne Division and the 101st Airborne Division (Air Assault).

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[23] For a discussion of shipping costs, see Marc L. Robbins and Eric Peltz, *Sustainment of Army Forces in Operation Iraqi Freedom: End to End Distribution*, Santa Monica, CA: RAND Corporation, forthcoming.

Spare parts shortfalls did lead to significant deferred maintenance during major combat operations and subsequent significant degradation in equipment capabilities. This did not produce documented adverse effects in OIF operations. However, the question has been frequently posed about how much longer 3rd ID could have been effective in high-intensity combat if the regime had not collapsed. As little as two weeks has been posited, but the answer depends very much on what 3rd ID might have been asked to do had combat operations continued. And had the 3rd ID remained the main effort in continued combat operations, it is likely that it would have received greater distribution priority, potentially providing the ability to correct some of the deferred maintenance deficiencies.

Implications for the Future

Perhaps more than the actual effects in OIF, logistics issues in OIF could have important implications for future force operational concepts. At a process level, there are tremendous numbers of lessons for joint doctrine, organization, policy, tactics, techniques, and procedures (TTPs), equipment, and information systems. There are at least three critical questions for the future force's design.

1. To what degree can support over noncontiguous lines of communications be counted on to sustain distributed operations?
2. What level of sustainment risk are commanders willing to accept in order to achieve mobile tactical formations and rapid deployment and employment?
3. How much will better logistics situational awareness change the risk dynamic?

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Glossary

AAR	After Action Report
ABN	Airborne Division
ACE	Armored Combat Earthmovers
AMC	Army Materiel Command
APS	Army Prepositioned Stock
ARCENT	U.S. Army Central Command
ASB	Aviation Support Battalion
ASL	Authorized Stockage List
AWCF	Army Working Capital Fund
BCT	Brigade Combat Team
BDE	Brigade
BN	Battalion
CAD	Computer-Aided Design
CASCOM	Combined Arms Support Command
CENTCOM	U.S. Central Command
CFLCC	Coalition Forces Land Component Command
CLS	Contractor Logistics Support
CONUS	Continental United States
COSCOM	Corps Support Command
CRSP	Central Receiving and Storage Point
CSB	Corps Support Battalion
CSC	Convoy Support Center

CSG	Corps Support Group
CSS	Combat Service Support
CTASC	Corps Theater Automatic Supply Computer
DBL	Distribution Based Logistics
DCUs	Desert Camouflage Uniforms
DDSP	Defense Distribution Depot Susquehanna, PA
DISCOM	Division Support Command
DIVARTY	Division Artillery
DLA	Defense Logistics Agency
DMMC	Division Materiel Management Center
DoD	Department of Defense
DODAAC	Department of Defense Activity Address Code
DS	Direct Support
DSS	Distribution Support System
DTRACS	Defense Transportation and Control System
FMC	Fully Mission Capable
FSB	Forward Support Battalion
GS	General Support
GSA	General Services Agency
HEMTT	Heavy Expanded Mobility Tactical Truck
HET	Heavy Equipment Transporter
ID	Infantry Division
ISB	Intermediate Support Base
JDLM	Joint Deployment and Logistics Model
LOC	Line of Communication
LRP	Logistics Release Point
LSA	Logistics Support Area
MLRS	Multiple Launch Rocket Systems
MRE	Meals Ready to Eat
MSB	Main Support Battalion

MSR	Main Supply Route
ODS	Operation Desert Storm
OIF	Operation Iraqi Freedom
PLL	Prescribed Load List
PLS	Palletized Load System
POL	Petroleum, Oil, and Lubricants
RFF	Request for Forces
RFID	Radio Frequency Identification
ROWPU	Reverse Osmosis Water Purification Units
RTFL	Rough Terrain Forklift
SAMS	Standard Army Maintenance System
SARSS	Standard Army Retail Supply System
SC	Support Center
SITREP	Situation Report
SMC	Shoot-Move-Communicate
SPO	Support Operations Officer
SSA	Supply Support Activity
TDC	Theater Distribution Center
TSC	Theater Support Command
TTP	Tactics, Techniques, and Procedures
ULLS	Unit Level Logistics System
USTRANSCOM	U.S. Transportation Command
VSAT	Very Small Aperture Terminal
WRSI	War Reserve Secondary Item

CHAPTER ONE

Setting the Stage

The Debate over Materiel Sustainment Performance

By virtually every account, the major combat operations of Operation Iraqi Freedom (OIF) that toppled Saddam Hussein's regime were a remarkable success. With what is generally regarded as a relatively small ground force and a lean logistics support force, Iraq's army was quickly beaten in the field and Baghdad secured, with few casualties. However, there seems to be some belief within the U.S. Army and the broader defense community that this success was achieved despite severe logistics problems. Articles written in the midst of combat operations cited fears that the forces would soon run dry of critical supplies or provided descriptions of isolated problems.[1] Later accounts cataloged lists of shortfalls, such as no spare parts delivered during combat operations, or described the sustainment system as one that was close to failure.[2] Other articles focused mostly on the effects of *Fedayeen* attacks and the resultant need to pause to secure supply lines.[3]

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[1] Seymour Hersh, "The Battle Between Donald Rumsfeld and the Pentagon," *The New Yorker*, 7 April 2003 (overextended supply lines, shortages of food, water, and ammunition, broken vehicles but focused on too small a force, unexpected nature of resistance, and a stalled operation as of early April). Colin Soloway, "Nuts and Bolts," *Newsweek (Web Exclusive),* 28 March 2003 (primarily a description of convoys, congested roads, sandstorm, general delays). Jack Kelly, "Conflict with Iraq: Logistics Expert Says Troop Flow Sufficient," *Pittsburgh Post-Gazette,* 7 April 2003 (suggests that general criticism of too lean a force by journalists and analysts is incorrect, citing military sources that say the supplies were held up by the sandstorm). Charlie Brennan, "Conflict with Iraq: Weather, Combat Create Resupply Nightmare," *Scripps Howard News Service,* 27 March 2003 (attributes food and water shortage to sandstorm and to a lesser degree supply line attacks, cites reports of units being out of food just before a "lost" convoy showed up). Yochi Dreazen, "Hey Solider, Can You Spare Some Ammo?" *The Wall Street Journal*, 14 April 2003 (shortages of supplies resulting from rapid operations outpacing the supply chain, discusses effort of a unit in Kuwait trying to get ammunition prior to moving into Iraq). Rick Atkinson, "General: A Longer War Likely; Logistics, Enemy Force Reevaluation," *The Washington Post*, 27 March 2003 (overextended supply lines and unexpected enemy tactics slow drive to Baghdad, cites pause to build a 10-day stockpile from depleted levels, discusses diversion of force to protect supply line, extensive discussion of unexpected amount and nature of resistance). "The Vulnerable Supply Lines," *The New York Times*, 28 March 2003 (some units low, potential problems on horizon, emphasis on attacks on supply lines).

[2] COL (ret.) Gregory Fontenot, LTC E.J. Degen, and LTC David Tohn, *On Point: The United States Army in Operation Iraqi Freedom,* Fort Leavenworth, KS: Combat Studies Institute Press, 2004 (describes a system barely able to stay above the subsistence level, complete failure of spare parts system, significant discussion of the delays associated with need to secure supply lines, attributes success to extremely hard work, discusses effects of deploy-

Despite legitimate issues, though, the great success of major combat operations in Iraq could not have been achieved without historically noteworthy logistics support, especially given relatively limited resources. The basic plan itself was predicated on bold operational concepts with long, rapid advances enabled by the application of a new paradigm of logistics support termed distribution based logistics (DBL) and a "running start" in which operations would begin prior to the full deployment of both combat and support forces in order to achieve tactical and operational surprise.[4] To achieve continuous pressure and maintain the desired rapidity of advance until reaching and cordoning Baghdad—taking it quickly was not an assumed part of the plan—the force would not have the luxury of stopping to build up large supply points between Kuwait and Baghdad during the initial phase of combat, thus demanding the reliance on DBL.

Operational commanders recognize that this plan led to some logistics risk, which arose from initial limited sustainment capacity, especially with respect to the critical distribution assets as the competing demands of the "running start" and achieving robust support collided, but they suggest that accepting the associated logistics stress was worth it because surprise was achieved, contributing to the quick

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ment sequence issues). Eric Schmitt, "Army Study of Iraq War Details a 'Morass' of Supply Shortages," *The New York Times,* 3 February 2004 (cites internal Army study saying Army logistics problems were severe, severe parts problems, ineffective distribution, improvisation kept the force going, insufficient logistics units). Matthew Cox, "Infantry Leaders Decry Woeful Supply Lines During Iraq Fight," *Army Times.com*, 11 September 2003 (no spare parts distribution, 3rd Infantry Division frustrated by logistics that could not keep pace). Roger W. Kallock and Lisa R. Williams, "DoD's Supply Chain Mandate: From Factory to Foxhole," *Supply Chain Management Review*, May/June 2004 (most units faced supply shortages that posed high risk, inability to support task organized units, information system problems).

[3] Monte Reel, "For 82nd, a Skirmish over Major Supply Route; Airborne Troops Clash with Militia Fighters," *The Washington Post*, 30 March 2003 (discusses move of 82nd to secure a supply route). "Army Beefs Up Its Logistics," *Engineering News-Record*, 7 April 2003 (supply route conditions, unexpected resistance, delay in advance to secure supply lines). Dexter Filkins, "Endless Supply Convoy Is Frustrated Endlessly," *The New York Times*, 28 March 2003 (delays from attacks on a Marine convoy, sandstorm, but no expectation of serious supply problems). Lance Gay, "Conflict with Iraq: History Lesson: Military Crushed by Broken Supply Lines," *Scripps Howard News Service*, 29 March 2003 (attacks on supply lines slow the advance, traces history of supply problems in military operations in the region). John Border, "Far Behind the Front, But Not Out of Danger," *The New York Times*, 26 March 2003 (talks about shift of emphasis to protecting supply lines, mentions slowing of advance from sandstorm). Mike Von Fremd, "Supplying the Front, Engineers Building Pipeline to Help Vulnerable Supply Convoys at Rear," ABCNEWS, 28 March 2003, http://www.abcnews.go.com/sections/world/Primetime/iraq_pipeline030328.html (unprecedented advance, diversion of troops to protect supply lines, building of fuel pipeline into Iraq). Thom Shanker, "Deployment of a Cavalry Contingent Is Speeded Up," *The New York Times*, 31 March 2003 (2nd Cavalry Regiment deployment moved up due to attacks on supply lines).

[4] Lt. Gen. James Conway, commander, First Marine Expeditionary Force, "Live Briefing from Iraq," 30 May 2003, http://www.defenselink.mil/transcripts/2003/tr20030530-0229.html (accepted some logistics risk for speed and it paid off). U.S. Department of Defense briefing on 23 April 2003, Operation Iraqi Freedom Briefing with Lt. Gen. David D. McKiernan, www.defenselink.mil/transcripts/2003/tr20030423-0122.html (logistics was sustained, continuous pressure applied—no operational pause, accepted some risk to achieve the operational concept and the risk was "overcome").

initial advance and rapid regime collapse.[5] It should also be noted that another risk inherent in the plan was unsecured supply lines, which would allow a long, fast, continuous advance with the limited forces that the running start would initially provide. Unexpected resistance dictated a change in this portion of the plan, which contributed to an interim pause of close to a week because there was a wait for units to secure urban areas in the rear that were astride supply lines. But even with this pause, operational commanders suggest that, combined with the surprise achieved by the running start, the advance was still fast enough to achieve their intent and probably minimized the length of major combat operations. Additionally, executing DBL concepts revealed, and in some cases reinforced, doctrinal, organizational, training, equipment, and other resource issues that need to be addressed, but the logistics system did not break in the face of a logistically demanding operation. Some articles and other sources do conclude that the tradeoffs imposed by the running or early start produced a net positive value during combat operations and that the change in support concepts was important to operational speed, describing logistics in OIF as a success even though there were many sustainment issues that need to be addressed.[6] A couple of sources assert or suggest that the logistics support that was needed and provided to execute the concept of operations could only have been achieved by the United States, going so far as to say that "Re-supply, quite as much as firepower or air support, was to be the secret of the coalition's overwhelming of Saddam's forces."[7]

On balance, though, the negative news on OIF logistics—both public and internal to the Army—outweighs the positive. However, problems in logistics and other support functions typically receive the most attention, while successes often

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[5] Fontenot, Degan, and Tohn (2004) concluded that the "tensions" from the running and early start "are a defining characteristic of the entire operation," a view supported by Conway, 30 May 2003, and McKiernan, 23 April 2003.

[6] John Keegan, *The Iraq War*, New York: Alfred A. Knopf, 2004 (describes strength of U.S logistics capabilities, speed of advance critical to the plan, also mentions supply shortages but states that after consideration it was decided to proceed much as planned). Kim Burger, "Just-In-Time Supplies for Iraq Conflict 'A Success,'" *Jane's Defence Weekly*, 18 June 2003 (fast-paced mission accomplished with small stockpiles and a lean structure, describes shortages and other problems but concludes the overall support did the job). Anthony Cordesman, *The Iraq War: Strategy, Tactics, and Military Lessons*, Washington D.C.: Center for Strategic and International Studies, 2003 (asserts the unique ability of the United States to sustain 24/7 operation and how logistics enabled unprecedented operational tempo, goes on to describe many "challenges" and problems overcome by improvisation). Steven Komarow, "General Recounts Key Moments in Baghdad's Fall," *USA Today*, 14 April 2003, p. 5 (LTG Wallace attributed speed of advance to get into position around An Najaf by the 3rd ID as one of the three keys to success). Hunter Keeter, "Top Marine Sees 'Margin' of Improvement in Maritime Pre-Positioned Force," *Defense Daily*, 2 June 2003 (no significant breaks in supply during combat operations). Lieutenant General Claude V. Christianson, "Testimony Before the House Armed Services Committee Subcommittee on Readiness, United States House of Representatives Regarding Logistics Readiness of the United States Army," 30 March 2004 (talks about the "spectacular" accomplishment of successfully supporting the unprecedented combat operations, personnel adapted organizations and processes not aligned with new operational concepts and overcame many acknowledged difficulties resulting from this misalignment). Also see McKiernan, 23 April 2003; and Conway, 30 May 2003.

[7] Keegan (direct citation) and Cordesman.

remain relatively unsung. So, is this what the news and reports reflect, or are they balanced? In this monograph and in the others in this series, it will be made clear there that were real problems, especially from the vantage point of the soldiers on the ground, even as adverse operational consequences appear limited in hindsight.[8] Generally, the news and published reports accurately detail the problems, but different conclusions can be drawn as to the overall success or failure of sustainment operations.

This seeming paradox may have resulted from several factors. Risk was accepted up front and grew beyond what people are accustomed to, which might imply potential problems against a more effective adversary or in the event of major disruptions to logistics operations. Both LTG McKiernan, Commanding General, Third U.S. Army and U.S. Army Forces Central Command and the Coalition Forces Land Component Command, and Lt. Gen. James Conway, Commanding General, First Marine Expeditionary Force, have stated that they accepted higher than typical logistics risk, and other senior leaders confirmed that this was known and reported to senior levels prior to commencing operations.[9] This high-level acceptance of risk, which does not appear to have been clear to the total force during the operation, may have combined with the application of new logistics concepts to generate some misalignment between expectations and logistics capabilities. Finally, it is valuable to separate issues with logistics resources and processes themselves from issues with the concept of operations, such as unprotected supply lines, or intelligence issues, since they have markedly different implications for future force design and operational concepts than do issues with logistics processes themselves.

Regardless, the success of the operation implies that the problems were not insurmountable in this particular case, limiting the consequences of logistics shortfalls. There could be other cases, however, where the consequences would have been more serious. To assess this, it is important to understand how logistics problems translate into operational effects, and to drive improvement of future logistics capabilities, the underlying reasons for the problems or symptoms should be determined. Thus, this

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[8] Eric Peltz, Marc L. Robbins, Kenneth J. Girardini, Rick Eden, John M. Halliday, and Jeffrey Angers, *Sustainment of Army Forces in Operation Iraqi Freedom: Major Findings and Recommendations*, Santa Monica, CA: RAND Corporation, MG-342-A, forthcoming. Marc L. Robbins and Eric Peltz, *Sustainment of Army Forces in Operation Iraqi Freedom: End to End Distribution*, Santa Monica, CA: RAND Corporation, forthcoming. Kenneth J. Girardini and Eric Peltz, "Sustainment of Army Forces in Operation Iraqi Freedom: Prepositioned Authorized Stockage Lists," unpublished RAND research, August 2004. Kenneth J. Girardini, Eric Peltz, Art Lackey, Elvira Loredo, and Candice Riley, *Sustainment of Army Forces in Operation Iraqi Freedom: Army War Reserve Secondary Items*, Santa Monica, CA: RAND Corporation, forthcoming. Eric Peltz and Jeffrey Angers, *Sustainment of Army Forces in Operation Iraqi Freedom: National Spares Support*, Santa Monica, CA: RAND Corporation, forthcoming. Kenneth J. Girardini, Eric Peltz, Thomas Held, Art Lackey, and Candice Riley, *Army Logistics in Operation Iraqi Freedom: Tactical Inventory*, Santa Monica, CA: RAND Corporation, forthcoming. John M. Halliday, John Bondanella, and Christine San, "*Sustainment of Army Forces in Operation Iraqi Freedom: Deployment Flow*," unpublished RAND research.

[9] In McKiernan, 23 April 2003; and Conway, 30 May 2003.

monograph tries to outline the logistics condition of the force to the extent possible through corroborating interviews and data, identify what effects logistics conditions had on operational execution, and determine how these conditions developed. It then concentrates on analyses of the major problems that could potentially impede operations to show, to the extent possible, why they occurred in OIF.[10] Further examination beyond this monograph will be necessary, though, to determine the root cause in many cases, which will often go back to factors such as training, funding, or force development.

The materiel sustainment of forces during combat operations is just one part of the story. Relatively soon after the fall of Baghdad, coalition forces spanned Iraq to conduct stability operations. Unlike major combat operations, stability operations have not been widely described as a success. But even had logistics problems continued, an inability to sustain the force is not generally blamed for the lack of operational success.[11] Instead, the cost of sustainment and troop quality of life became important issues, and the poor performance documented by business-type metrics clearly demands improvement. Thus, we focus much less on the operational effects of logistics on stability operations, shifting straight to an analysis of the logistics problems, again with an emphasis on drilling down as close to the root causes as possible. Most of this analysis can be found in the other reports emanating from our OIF research, in particular the report on distribution.[12]

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[10] Information sources: V Corps 19th Support Center daily situation reports, 3rd COSCOM twice-daily commander update briefings, theater distribution center and general supply support daily status report briefings, 1/3 ID supply status reports (20 February 2003 through 22 May 2003, with some gaps), email and planning archives from the theater distribution center, after action reports from 3rd Infantry Division, 4th Infantry Division, 82nd Airborne Division, 101st Division, 16th Corps Support Group, 7th Corps Support Group, Defense Logistics Agency distribution center and consolidation and containerization point data, U.S. Transportation Command (USTRANSCOM) shipping data, Army ordering and receipt data, weekly inventory snapshots for all Army organizations, Radio Frequency Identification (RFID) data, formal interviews (combat arms and logistics officers and warrant officers in a wide cross-section of 3rd ID units and functions, 377th Theater Support Command and Coalition Forces Land Component Command (CFLCC) C-4 staff members, 3rd COSCOM commanding general, theater distribution center commanders, 101st Division Support Command (DISCOM) commander, U.S. Army Forces Central Command (ARCENT) and CENTCOM logistics personnel, and general discussions with a wide cross-section of personnel involved in the planning and execution of OIF (not referenced in the report).

[11] The inability to more rapidly provide armored high mobility multipurpose wheeled vehicles (HMMWVs) and other trucks and body armor may have had operational effects. However, while some might include such problems in a broad definition of logistics, this monograph is concerned with sustaining the force rather than equipping it or providing "new" capabilities. We would classify these problems more in the realm of equipping the force, to include force planning and acquisition, as the quantities and timeframes in which these items have been needed were not recognized in the Army's requirements planning and resource programming efforts that determine force structure and fielding rates, and allocate resources.

[12] See Marc L. Robbins and Eric Peltz, *Sustainment of Army Forces in Operation Iraqi Freedom: End to End Distribution*, Santa Monica, CA: RAND Corporation, forthcoming.

The focus of this monograph is the materiel sustainment of Army forces conducting operations in Iraq.[13] As such, it includes the performance of both Army logistics organizations and other providers that support Army units. It does not encompass Army logistics support to forces from other services or coalition partners.

The Success of Major Combat Operations

The initial pace of advance of the Army's armored forces was extremely fast, with major elements of V Corps, led by the 3rd Infantry Division (ID), fighting three battles and advancing 220 miles in the first three days.[14] The 2nd Brigade Combat Team (BCT) of the 3rd ID (2/3 ID) covered this distance and reached Objective RAMS southwest of An Najaf just 34 hours after the division crossed the line of departure at 0300Z on 21 March, reporting RAMS secured about a day later (see Figure 1.1).[15] After 1/3 ID also secured Objective RAIDERS northwest of An Najaf on 23 March, the V Corps advance was interrupted from 24 to 30 March due to a severe *shamal* or sandstorm, attacks by Iraqi paramilitary forces or *Fedayeen*, the need to secure supply lines, and the need to relieve 3rd ID units from rear area and supply

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[13] The scope of this monograph does not include medical support. That will be covered in a separate RAND report.

[14] Briefing, "V Corps: The Road to 'Victory!' in Operation Iraqi Freedom . . ." The table below puts the rate and distance of advance in perspective. Other critical factors not in the table include enemy capabilities and force size.

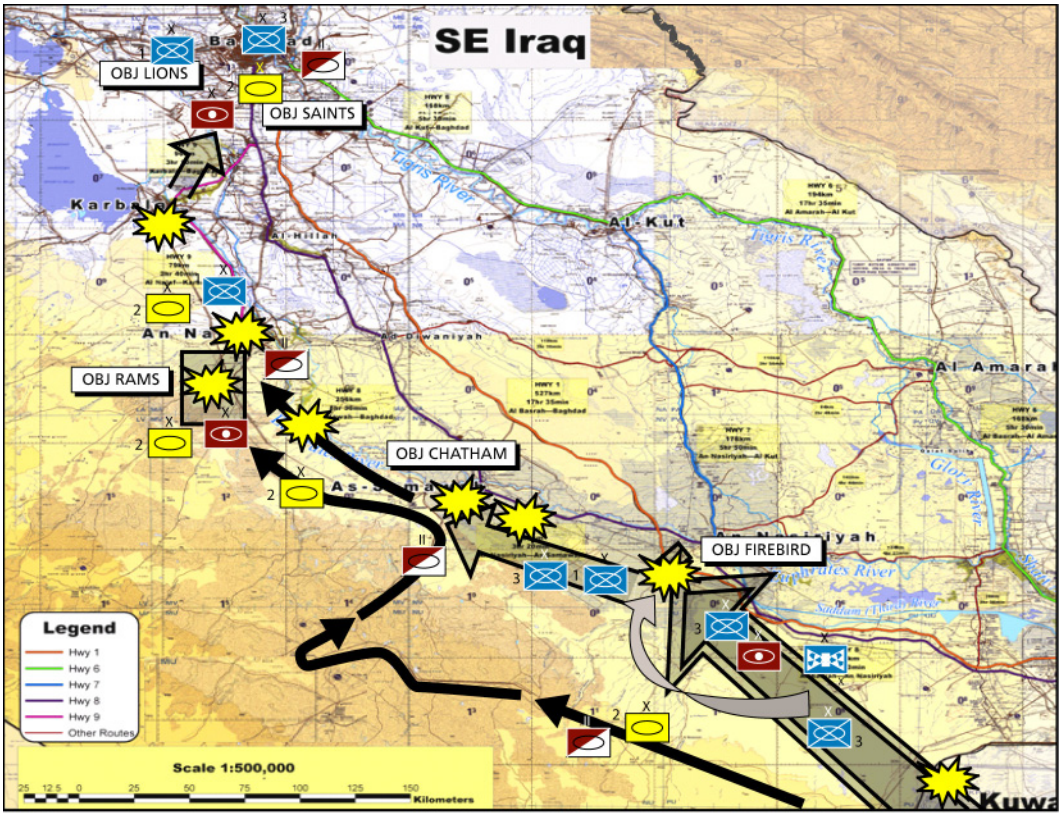
Rate and Distance of Advance: World War II Through Operation Iraqi Freedom

Commander, Organization	War	Start	Finish	Miles	Days	Miles/Day
Guderian, XIX Corps	WWII	Germany	Brest-Litovsk	325	14	23
Guderian, XIX Corps	WWII	Germany	Sedan	80	3	27
Guderian, XIX Corps	WWII	Germany	Dunkirk	144	11	13
Guderian, 2nd Panzer Group	WWII	Poland	Smolensk	413	25	17
Rommel, Africa Corps	WWII	El Agheila	Tobruk	1400	90	16
Montgomery, Eighth Army	WWII	El Alamein	Tunisia	248	16	16
Gavish, Southern Command	6 Day War	Israel	Suez	120	4	30
Yeosock, Third Army	ODS	Saudi Arabia	An Nasiriyah	210	4	53
Wallace, V Corps	OIF	Kuwait	An Najaf	220	3	73
Wallace, V Corps	OIF	Kuwait	Baghdad	350	14	25

SOURCES: Martin L. van Creveld, *Supplying War: Logistics from Wallenstein to Patton,* Cambridge, UK: Cambridge University Press, 1977. B.H. Liddell-Hart (ed.), *The Rommel Papers,* New York: Da Capo Press, Inc., 1935. Richard M. Swain, *"Lucky War": Third Army in Desert Storm,* Fort Leavenworth, KS: U.S. Army Command and General Staff College Press, 1991, http://cgsc.leavenworth.army.mil/carl/resources/csi/swain/swain.asp. Thomas T. Smith, "Blitzkrieg: The Myth of Blitz," *Infantry,* July–August 1990. http://www.israeli-weapons.com/history/six_day_war/SixDayWar.html.

[15] Briefing, "V Corps: The Road to 'Victory!' in Operation Iraqi Freedom . . ." and Headquarters, 3rd Infantry Division, Department of the Army, *Operation Iraqi Freedom: Third Infantry Division (Mechanized) "Rock of the Marne" After Action Report*, Final Draft, 12 May 2003.

Figure 1.1
Map of Major Combat Operations: Routes, Engagements, and Objectives



RAND *MG344-1.1*

Briefing, "Marne Thunder: 3rd ID (M) DIVARTY in Operation Iraqi Freedom."

line security roles to enable the full division attack toward Baghdad. This time was also employed to attrit Iraqi units south of Baghdad from the air, setting the conditions for further rapid advance.

With the operational conditions set, V Corps launched several simultaneous attacks on 31 March that combined with airpower to put the 3rd ID on the steps of Baghdad by the 4th of April. Then 3rd ID and the 1st Marine Expeditionary Force (MEF) cleared and secured Baghdad over the next week. Even with the infamous "pause" in the advance from 24 to 30 March, which will be discussed later in this monograph, Baghdad fell and the Iraqi army disappeared as fast as or even much faster than many anticipated. In short, when viewed from start to end, this campaign was a great operational success. It was done without the buildup of huge stockpiles near the line of departure, as was done before the start of ground operations in Operation Desert Storm (ODS), preserving some operational surprise and reducing pre-attack preparation requirements. The offensive was also executed without stopping to

build traditional, large supply bases as the "front" moved forward, as during the advance from Normandy to Germany in World War II, preserving operational momentum.

While heavily criticized, logistics was a crucial enabler of this success. Even though the supply points and distribution resources were kept lean and processes suffered from serious problems, it did not break in the face of operations that were closer to future force concepts than current force operating doctrine in terms of pace, distance, and freedom of movement. Perhaps surprisingly, analysis reveals that logistics problems do not even appear to have driven the pause.

Part of the logistics success from an outcome standpoint came from intensive management and incredibly hard work by the logisticians at all levels, including combat arms and combat support personnel performing logistics functions, as is often the case at company, battalion, and brigade level. In many cases, they found ways to work around insufficient resources or problematic processes. However, this will not always be enough, which is why it is important to examine what happened. In other cases, perceived risk became uncomfortable across the chain of command, and there were detrimental effects on quality of life and morale.

While logistics support of the 3rd ID is not the exclusive subject of this monograph, support to the 3rd ID is the focus of the portion on major combat operations. Telling the 3rd ID's support story enables the illustration and examination of most of the major logistics issues during combat operations.

Distribution Based Logistics

From an intent standpoint, OIF's major combat operations and phase IV stability operations marked a de facto application of what has become known as DBL.[16] In fact, the overall plan appears to have depended upon it. Accounts of the strategic planning for OIF and the decision to commence operations suggest sufficient confidence in the logistics system and the new DBL paradigm to craft and execute a plan heavily reliant on distribution over extended distances with somewhat limited theater stockpiles and very small direct support (DS) buffers between these theater stocks and forward units. While the confidence in DBL is lower now than before OIF, it is still the direction of future logistics concepts.

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[16] For a discussion of DBL, see Eric Peltz, John M. Halliday, and Steven L. Hartman, *Combat Service Support Transformation: Emerging Strategies for Making the Power Projection Army a Reality*, Santa Monica, CA: RAND Corporation, DB-425-A, 2003. Also see Office of the Deputy Chief of Staff for Logistics, Headquarters, Department of the Army, *Army Strategic Logistics Plan: Enabling Strategic Responsiveness Through a Revolution in Military Logistics*, 2000, and Combined Arms Support Command, *Distribution Based Logistics for the Objective Force,* prepared by Anteon Corporation for the CG, CASCOM and the DCS, ODCSLOG, 31 December 2001.

DBL does not mean zero inventories in forward units or even at DS supply points at logistics support areas (LSAs). Rather, it means limited inventory to cover small disruptions in distribution flow and enough supply to cover consumption between replenishments, with the primary reliance on frequent, reliable distribution from CONUS to the theater to units in the field. This is roughly how OIF combat operations were conducted. Except for small buffer stocks, such as one or two days of food and water at LSAs, supplies stayed at an intermediate support base (ISB) (i.e., Kuwait) and were not pushed forward in large amounts. Though more robust, even forward fuel supplies were limited to a few days. Further, the supply levels at the ISB remained limited in comparison to some past campaigns. For example, when Operation Desert Storm ground operations began, forward logistics bases near the Iraqi border had 29 days of rations and 45 days of ammunition stockpiled to support operations in addition to what was farther back at theater bases.[17] In contrast to ODS, stocks of meals ready to eat (MREs) both at the port and at the general support (GS) food warehouse were down to less than one day's supply early in OIF combat operations. In addition, the total inventory when combining on-hand supplies in maneuver units, in DS supply at LSAs, and in the distribution pipeline from the theater distribution center forward was as little as five days of supply.[18]

However, the DBL system led to significant consternation and post-OIF criticism, because while the approach was to use DBL, many of the factors that enable DBL, such as good in-transit visibility of supplies, were not in place. Nor were many of the supporting processes aligned with DBL concepts, such as load building and shipment consolidation. In short, many of the critical elements of a DBL system either were not in place or suffered problems, which will be evident in the coming pages. Instead, DBL was executed by brute force to some degree, such as by dramatically expanding the number of driving hours per day for drivers and by finding creative ways to work around problems.

The OIF experience points to numerous issues, but several observations should be highlighted. DBL, particularly when executed with relatively lean inventory buffers, may not always be comfortable for commanders and the troops, especially if this is not what they are used to either in training or in previous operations. More critically, not having full, accurate, and real-time information of current and projected supply levels at each inventory node and en route between nodes raises the perceived level of risk when relying on distribution rather than large stockpiles. Actual risk can also develop quickly. To counter potential risk, commanders need to quickly know

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[17] Army Materiel Command, *Theater Logistics in the Gulf War*, 1994. The goal was actually 60 days of fuel, food, and ammunition.

[18] GS supply daily status reports covering the theater distribution center, the food warehouse, and the seaport. It is possible that not all MRE inventory in the port was accounted for. However, if stock was there but truly not accounted for, it could not be issued.

about and resolve any distribution flow issues. Both to reduce uncertainty for effective planning and decisionmaking and to quickly resolve emerging problems, DBL demands solid logistics situational awareness.

With a supply point model of support, the various portions of the supply chain can be somewhat disconnected. In DBL, planning and execution must be integrated across the entire system from CONUS to consuming unit, requiring adequate lift capacity balanced across distribution segments, seamless transfer of loads at distribution nodes, and load configurations aligned with distribution node capabilities. Without large stockpiles of items with high demand variability, such as spare parts, units need to always be connected physically and electronically to order and "pull" such items when they use the few they have. They simply cannot be effectively pushed like materiel with low demand variability, such as food.

Finally, the desired levels of acceptable risk and associated buffers need to be carefully examined. The *shamal* generated an example of the effect of a two- to three-day disruption on a force that is operating with limited supplies. The system was able to handle the disruption, but just barely, leading to several questions:

- How close was this to the worst-case situation with regard to a disruption?
- How much risk is tolerable?
- How much will the full suite of DBL enablers reduce risk?

The ensuing separate discussions of fuel and dry cargo supply and distribution systems illustrate different levels of risk acceptance in the planning process, with different buffer sizes in the two systems. However, other factors, as will be described, also account for differences in fuel and dry cargo sustainment performance.

CHAPTER TWO

Fuel Sustainment

Fuel Supplies Remained Relatively Robust

Actions and interviews across all levels make it clear that the chain of command believed the need to get fuel supply and distribution right to be paramount for the success of the operation. The speed of advance was considered critical to the operational plan, and adequate fuel is essential to a relentless, rapid advance. Unlike some other classes of supply, fuel shortages cannot be temporarily worked around, and fuel cannot be rationed without impacting the operational plan. For short periods of time, food and even to a degree water can be rationed with few ill effects. Some maintenance can be deferred, and the lack of some spares can be worked around. One type of fires (either weapons or ammunition) may be substituted for another in many cases. None of these "workarounds" are ideal, but they do offer some additional protection against shortfalls. Perhaps, too, historical awareness drove the intense focus on fuel, as it has been the most frequent culprit when logistics has constrained mechanized operations.

A comparison between fuel and dry cargo supply and distribution preparation, deployment, and planning activities indicates that greater emphasis and priority was placed on producing robust fuel capabilities than on other supplies. This was reinforced during interviews with commanders at several echelons. Together, the comparison and interviews suggest that for OIF, the distribution of dry cargo was considered either less essential to success or easier to get right.[1] This appears to be one reason why fuel worked well and the supply and distribution of other materiel less so. LTG Wallace stated,

> We may have spent more time and energy on fuel at the expense of other commodities in hindsight that we might have anticipated being problems, but we just didn't have the same energy applied to it. . . . We knew we were going to have

[1] Interviews with personnel in several different 3rd ID units consistently related that operational planning left them with the impression that the operation would start with a quick dash to Baghdad against very limited resistance. Then the real fighting would begin. They speculated that this was why fuel support was emphasized to such a great degree. Other supplies could then be built up as they prepared to take Baghdad.

> fuel problems, and thus we spent a lot of time and energy trying to solve those problems . . . and . . . as a result we didn't have any fuel problems.[2]

However, beyond the recognized importance of getting the supply and distribution of fuel right, other factors unique to fuel supply and distribution were important as well.

Theater Preparatory Tasks

Starting in mid-2002, U.S. Central Command (CENTCOM) and Coalition Forces Land Component Command (CFLCC) proposed a number of preparatory tasks to set the conditions for sustainment, force reception, and rapid force buildup. The focus was on generating the ability to rapidly receive units and prepare them for combat—essentially developing the infrastructure in Kuwait from airfields to ports to buildings for warehouses and command and control. About half of the tasks were approved, including several related to fuel delivery. Most of the approved preparatory tasks had long lead times, particularly involving construction.[3]

A complement to the construction of a fuel delivery infrastructure was the early approval for the mobilization and deployment of seven reserve component fuel truck companies. Five of the seven were alerted on September 14, 2002,[4] and they all arrived between January and March 2003 and were ready when operations commenced. This contrasts with a lack of cargo truck assets and early reserve mobilization in the list of approved preparatory tasks.[5] The 3rd Corps Support Command (COSCOM) had requested the early flow of both fuel and cargo trucks assets, with only the movement of fuel assets approved.[6]

The early mobilization and deployment of reserve fuel truck units combines with other preparatory tasks to suggest another focus beyond force reception: devel-

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[2] Interview with LTG William Wallace, former commanding general of V Corps, Fort Leavenworth, KS, 6 April 2004.

[3] "CFLCC – 1003V Prep Tasks: Setting Theater Support Conditions," 15 February 2003. Tasks: prepositioning of watercraft, improvement of Kuwait Naval Base throughput capabilities, beddown capacity at Kuwait Naval Base, Ash Shuaybah port throughput and staging capacity, Arifjan beddown capacity and base operations, Udairi airfield construction for rotary wing beddown, construction for and startup of forward repair activities at Arifjan, establishment of theater stocks for critical items (authors' note: operational problems delayed use), unloading of theater war reserve sustainment stocks, aviation depot-level maintenance capability, fuel pipelines and bagfarms, seven fuel truck companies prepositioned, three medium ribbon bridge companies prepositioned, theater ammunition stocks (partial unload), construction and automation for theater support command center at Arifjan.

[4] Office of the Chief of Army Reserve, mobilization tracking spreadsheet.

[5] Interviews with MAJ Thomas Murphree, TDC Commander (and previously CFLCC C-4 Battle Captain), 26 May 2004; "CFLCC – 1003V Prep Tasks" briefing.

[6] Interview with BG Charles Fletcher, former commanding general of 3rd COSCOM, 22 October 2003.

oping robust fuel supplies and distribution capabilities. These included the early establishment of fuel farms in northern Kuwait and moving the Inland Petroleum Distribution System (IPDS) from Army Prepositioned Stock (APS) in Qatar by January 2003.[7] Between the IPDS and pipeline construction by the Kuwait National Oil Company, pipelines connected Kuwaiti refineries directly to the fuel farms and led virtually to the border with Iraq, with the fuel infrastructure complete by March 2003.[8] The total system could store 7.3 million gallons of fuel by the start of combat operations, and most storage sites had fuel stocks close to capacity. While critical to the establishment of robust fuel supply and distribution capability, the construction of fuel storage facilities and pipelines was also emblematic of most of the approved preparatory tasks, which primarily reflected long lead requirements that would be tough to work around, if possible at all.

Besides helping to provide the infrastructure, Kuwait provided the fuel, which had two benefits. One was that funds did not have to be approved or allocated from those already available to purchase fuel. Thus, funding was not a constraint on building up a fuel stockpile. The other was that the fuel did not have to be transported into Kuwait, which was constrained in its port capacity. Instead it could easily be moved from refinery to fuel storage farm by pipeline.

Planning and Resourcing Refuel Operations

Maneuver leadership emphasized rigorous fuel planning to a greater degree than for other supplies. Therefore, many in the chain of command were left with the impression that having enough fuel to get quickly to Baghdad was considered the key to initial operations, attributing this to expectations about the enemy and the potential rate of advance. Fuel support was intensively planned and rehearsed, with requests for fuel assets usually fully resourced. Planning laid out fuel stops down to the hour and even half-hour.[9] By the time operations commenced, confidence in the ability to keep the force fueled was high.[10] In several interviews from the battalion to corps commander level, leaders looked back and suggested they should have done the same level of detailed planning for other classes of supply—especially spare parts—walking the process step by step from communications to transportation.

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[7] Interview with MAJ Thomas Murphree.

[8] In Fontenot, Degan, and Tohn (2004).

[9] Interview with LTC Willie Williams, formerly Commander, 26th FSB, 3rd Infantry Division, 22 October 2003. Interview with MG Buford C. Blount, Commanding General, 3rd Infantry Division (Mechanized), 18 November 2003. Interview with COL William Grimsley, Commander, 1st Brigade, 3rd ID. 3rd COSCOM movement synchronization briefing.

[10] General discussions and interview with MG Buford C. Blount.

Generally, fuel distribution assets are acknowledged as resourced at requested levels. All echelons received the assets they thought they needed to do the job. Overall, 3rd ID received substantial augmentation of two petroleum, oil, and lubricant (POL) truck companies, giving the division a total of 170 fuel trucks.[11] To make the maneuver units self-sufficient and allow them to rapidly refuel on the move, these corps assets and main support battalion (MSB) fuel truck assets were pushed down to the brigades.[12] For example, the 2nd BCT reported a requirement of 60 fuel tankers and having 60 under its control when it crossed the line of departure.[13] As higher echelons had sufficient fuel assets as well, fuel supplies were often brought directly to BCTs, avoiding an intermediate stop and transshipment in the division support area. In contrast, the limited distribution capacity for dry cargo often led to supplies being dropped off at a centralized division location in the division support area or brigades sending trucks to LSAs to pick cargo up.[14] Based upon planning, 3rd ID had expected throughput of all supplies to the BCT level,[15] but the lack of cargo assets precluded this from happening.

Additionally, as the force moved forward, large fuel farms were quickly put in place and filled. By 28 March, capacity at both LSA Bushmaster and forward logistics base (FLB) Cedar at Tallil Air Base was 1.2 million gallons, with 250,000 and 975,000 gallons on hand, respectively. Two days later, Bushmaster was up to 803,000 gallons on hand, and Cedar's capacity had been expanded to 1.4 million gallons with 1.2 million on hand.[16] This compares favorably with V Corps' daily consumption, which averaged 402,000 gallons per day from 1 to 7 April, representing five days of supply, and these direct support (DS) supplies continued to be backed up by supplies at fuel farms in Kuwait.[17] Additionally, the maneuver forces

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[11] Headquarters, 3rd Infantry Division, Department of the Army, *Operation Iraqi Freedom: Third Infantry Division (Mechanized) "Rock of the Marne" After Action Report*, Final Draft, 12 May 2003.

[12] LTC Willie Williams, "FSB in Support of Offensive Operations: Personal Notes and After Action Report." Interview with MAJ Glenn Baca, formerly Division Transportation Officer (XO 703 MSB), 28 October 2003.

[13] Interview with LTC Willie Williams.

[14] Interview with COL James Rogers, Commander, Division Support Command, 101st Airborne Division (Air Assault), August 2003. 801st Main Support Battalion AAR. 101st Airborne Division (Air Assault) Memorandum for Record, Subject: Operation Iraqi Freedom AAR, 19 May 2003. Interviews at 3rd ID Division Support Command with LTC Bobby Towery (3rd FSB Cdr), LTC Michael Armstead (26th FSB Cdr), LTC Nate Glover (formerly 603rd ASB XO, then DISCOM S-3), LTC Suzanne Hickey (DMMC Chief), LTC Bill Gillespie (DMMC Chief), MAJ Mark Weinerth (26th FSB SPO), LTC Jack Haley (703rd MSB Cdr), and COL Brian Layer (DISCOM Cdr) on 29 October 2003.

[15] Interviews with 3rd ID DISCOM.

[16] 3rd COSCOM daily commander update briefings, 28 and 30 March.

[17] 3rd COSCOM daily commander update briefing, 8 April.

generally maintained fairly healthy levels. For example, from 29 March to 9 April, 1/3 ID supply status reports showed more than three days on hand on most days.[18]

There are several other contrasts to dry cargo, as summarized in Table 2.1. One factor frequently cited for fuel success is that there was effectively a single fuel supply and distribution owner, the commander of the 49th Quartermaster Group (Petroleum and Water).[19] He could coordinate and balance assets from Kuwait to Baghdad. A second factor is that determining what fuel to send forward, deciding how to package it, and ensuring that the right fuel gets to the right unit are not issues. The more complex and variable the demands for a given supply class are, the more critical such issues become. Table 2.2 illustrates how supply class complexity varies, with a high correlation between class complexity and supply and distribution effectiveness in OIF. There is great benefit to a single fuel on most of the battlefield. A third factor is that the demand for fuel was lower than expected. It was expected that 3rd ID would use 300,000 gallons per day, but it averaged 153,000 with a peak of 270,000.[20]

Table 2.1
A Comparison Between Fuel and Dry Cargo Supply and Distribution

Factor	Fuel	Dry Cargo
Truck requirement	Met	Not met
Division and brigade augmentation	Yes	No
Detailed planning	Yes	Less
Early deployment	Yes	No
Cost/financial risk	Free/None	Funding required
Load configuration	Single item	Critical for some classes
Demand: change in plan/other factors	Below expectations	Above expectations
DS inventory points	Large	Limited
Movement rates (road conditions)	Slow	Slow
Weather	Delay from *shamal*	Delay from *shamal*

[18] 1/3 ID Orange 1 supply status reports.

[19] In Fontenot, Degan, and Tohn (2004); OIF Distribution Rock Drill After Action Review held at Fort Lee, Virginia (discussion notes).

[20] Interviews with 3rd ID DISCOM.

Table 2.2
Criticality of Load Configuration/Ability to Push Supplies Depends Upon Supply Class Complexity and Demand Variability

Class of Supply	Number of Unique Items
IIIB, bulk fuel	1 (JP-8) for vehicles plus limited amounts of motor gasoline
Water	1 (bulk and bottled)
MREs	1
Unitized Group Rations (UGR)	4
IV, construction materiel	40 (combat maneuver brigade)
IIIP, packaged POL	81 (combat maneuver brigade)
V, ammunition	112 (combat maneuver brigade)
II, tools, general supplies, clothing, personal gear	1,155 (combat maneuver brigade)
IX, spare parts	10,000 (combat maneuver brigade during combat operations)

SOURCES: 1st BCT, 3rd ID Orange 1 supply status reports and Corps Theater Automatic Data Processing Service Center (CTASC) document history files.

CHAPTER THREE

Dry Cargo Sustainment

Dry Cargo Distribution During Combat Operations

Distribution performance during major combat operations did not meet expectations. Consumed materiel was not replenished to the expected and desired levels, and "special" materiel needed on demand (e.g., a specific spare part to correct a mission-critical equipment fault versus food that any unit could use) was difficult if not impossible to get via standard distribution channels during this period. Additionally, distribution inconsistency and the limited visibility of in-transit and on-hand supplies, combined with the low stockage levels in units, led to anxiousness among commanders in the force that may have affected decisionmaking and thus operations in ways that cannot be clearly documented. However, by most accounts and available data, distribution performance was at least minimally sufficient for subsistence, enabling the force to conduct operations as intended and as driven by other factors, such as weather and enemy actions. This conclusion is based upon interviews with combat and logistics commanders and staff officers from company to corps level.

A Shortfall in Trucks

Why did distribution performance fall short? First, it is widely believed that there were insufficient trucks. However, no clear documentation of the total cargo truck need has been found. Various organizations developed their own estimates, but we have been unable to document the total theater requirement for the dry cargo distribution system. These organizations included the 3rd ID and other combat units, the 3rd Corps Support Command (COSCOM), the 377th Theater Support Command (TSC), Coalition Forces Land Component Command (CFLCC), and probably others. The 377th TSC did report a requirement of 930 medium trucks when operations commenced, with just 298 total trucks and just 147 flatbeds and palletized load systems (PLS) available on hand at the start of major combat operations, including host nation support.[1] The 3rd COSCOM reported having 20 percent of its require-

[1] In an interview, COL James Lee, Support Operations Officer, 377th TSC, provided information about the TSC's truck requirement. TSC on-hand truck information is based upon a spreadsheet compiled by the 377th

ment at the start of combat operations, with a total of 290 trucks (191 cargo trucks) available at the start of combat operations (the 3rd COSCOM reached 2,451 trucks by 8 July supporting a larger force over a bigger area by that time).[2]

While not a clear benchmark, ODS serves as an interesting point of reference. Using a metric of Army personnel supported per truck, we provide a very rough comparison of relative echelon-above-division (EAD) truck capacity between ODS and OIF. The truck counts include COSCOM trucks in direct support of V Corps and theater support command trucks prorated based upon the relative proportion of supported personnel in Army versus Marine Corps units. When ground operations started, the approximate ODS ratio was 73 Army personnel per medium truck equivalent (MTE) versus an estimate of about 194 personnel per MTE when OIF ground operations began.[3] Additionally, in OIF the distance from the logistics base to support combat operations was greater—i.e., 285 miles to An Najaf/RAMS and 344 miles to Baghdad, versus 210 miles from logistics bases to the farthest advance in ODS.[4] As deployments of both trucks and overall forces continued, the ratio improved some by early April, but the support distances increased proportionately to the decrease in the ratio, limiting the effective gain in capacity. This trend continued through mid-April, with truck counts climbing (reaching an estimated ratio of 104 personnel per MTE by 19 April) along with support distance, which reached over 600 miles, and the spread of the force across Iraq. By the end of June, the ratio was roughly 50 to 1. Thus, in relative terms, the distribution capacity for OIF combat operations appears lean. Several issues appear to have contributed to this truck capacity problem.

Distribution Planning

Determining the units needed to establish and operate a surface distribution system in support of combat is a complex task. From the standpoint of operational support requirements, logistics planners must know the order of battle and the broad outline of the combat commander's plan, including

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TSC that lists daily truck counts by type and source. It was derived from filled transportation requests through 25 March and from distributed movement program daily data.

[2] Interview with BG Charles Fletcher; 3rd COSCOM weekly truck available spreadsheet archived by 3rd COSCOM Headquarters staff.

[3] Sources for the ratios: *Theater Logistics in the Gulf War*, Army Materiel Command, 1994; 3rd COSCOM daily commander update briefings; 3rd COSCOM, "Common User Lift Trucks" spreadsheet; OIF Rock Drill, briefing by LTC Dave Powell, RAND Army Fellow, on ODS Truck Deployments, 1992. Light trucks are counted as 0.33 medium trucks. Theater support command trucks are prorated by percentage of personnel being supported that are Army.

[4] In ODS, a logistics infrastructure had been established composed of forward log bases positioned such that the maximum travel distance was about 200 miles one way. Note that in establishing these forward bases, transits on the order of 500 miles one way were needed, but we are focusing on G-Day forward of the line of departure.

- estimated movement distances,
- time sequences,
- line of communication security factors, and
- the policies to be executed, such as whether bottled or bulk water will be used.

These operational factors are used to estimate consumption and gross lift requirements. The other side of the equation consists of distribution capabilities and the sustainment concepts to be executed. Planners must understand the geography of the theater to derive estimated movement rates. Throughput policies and transfer locations, such as delivery every day or every other day, and delivery to the division or the brigade combat team, must be determined. Combining this with gross lift requirements, planners can then estimate the unit requirements needed to accomplish the mission. Naturally, planners must also know the capabilities of the units available and what other echelons will provide. Policies and capabilities must be consistent across echelons. Clearly, this is a complex task that few staff officers get experience with in peacetime. It is a problem well suited to the capabilities of computer-based decision support tools.

In discussions with planners in the TSC, we found that they did not have a standard planning system that would take into account force structure across echelons, consumption factors, logistics policies, distribution unit capabilities, theater geography, and even theater climate patterns. As a consequence, planners used standard commercial software packages such as spreadsheets and computer-aided design (CAD) programs to accomplish their work. They recognized the need for a more comprehensive tool but did not have access to one.

This need had been recognized after ODS, and considerable effort was expended to develop the Knowledge Based Logistics Planning System (KBLPS), a very detailed graphical tool designed to aid distribution planning. KBLPS was to improve on the basic capabilities of a consumption-driven tool known as the Operational Logistics (OPLOG) Planner by adding such features as a map-driven geographic component. KBLPS reached a mature enough stage that it was used to assist in the planning for Bosnia with support from the development community. Eventually the tool was passed from organization to organization, lost its funding, and apparently survives only in pockets of the Department of Defense (DoD).

In the future, the evolving Joint Deployment and Logistics Model (JDLM) being incorporated in the Battle Command Sustainment Support System (BCS3) promises to provide the needed capability,[5] but it was developed initially for U.S.

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[5] "Operational Requirements Document for the Battle Command Sustainment Support System (BCS3) (Combat Service Support Control System (CSSCS))," Change Number 3.7, 5 November 2003. Army RDT&E Budget Justification (R2 Exhibit), Combat Service Support Control System (Project 091), February 2004. COL Tim Kleppinger, "LCOP Logistics Common Operating Picture Key to BCS3," briefing, February 2004.

Army Europe and only became available to CFLCC for the execution stage of OIF,[6] where it was used to provide logistics situational awareness and to do execution planning (e.g., convoy planning and management of on-hand assets). Thus, no integrating tool enabled comprehensive, consistent planning across echelons. The consequence of this is difficult to determine, but at the very least, the logistics planning community could not rapidly analyze the effects of changes in the deployment plan or changes in logistics policies on distribution capability. That is, there is nothing to suggest that the use of these ad hoc tools did not result in the development of good requirements. Rather, it appears the problem lay more in the ability to rapidly analyze the effects of changes in policies and deployment flow in order to support operational decisionmaking.

Because easy-to-use, standard distribution system design and capacity planning tools with rigorously developed planning factors were not available, planners had to rely on their own methods and tools. In fact, the support operations officer (SPO) for the 377th TSC developed a comprehensive plan for theater distribution using CAD and Microsoft® Excel, but CAD is not widely available and cannot be shared electronically with others in the Army and DoD.[7] Nor can it seamlessly integrate with other planning systems, such as those used for deployment. Additionally, personnel have to spend time during a very workload-intensive period of crisis action planning to research planning factors and create simple spreadsheet models. This does not engender consistency, potentially creates quality issues, and takes time away from other planning and job responsibilities.[8]

Theater Distribution System Ownership: Potential Deployment Effects

In addition to distribution planning issues, no one had responsibility for looking across the theater and establishing a complete, detailed theater distribution plan and requirements down to the maneuver brigade level. The divisions had their piece, the COSCOM its piece, and the TSC the theater-level portion. They each, in effect, based their plans upon assumptions about the other portions of the system. These are coordinated through the planning process, so there is some knowledge about the validity of the assumptions. However, what are in a sense separate plans are not treated as one capability package by the national chain of command. Additionally, this impedes seamless rebalancing of assets across echelons of distribution when the plan is not executed fully or needs to change because of unexpected conditions.

Without a fully integrated, comprehensive theater distribution plan, it can be difficult for overall operational planners and national-level decisionmakers and their

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[6] Email from LTC Charles Burke, 17 June 2004.

[7] Interview with COL James Lee.

[8] Ibid.

staffs to assess the needs for various distribution asset requests. And without a single organization and person responsible for distribution down to brigade or even small unit level, there is no single representation of distribution asset needs in the force planning process. This is a potential cause for widespread reports that the estimates of dry cargo distribution capacity that were developed were either removed from or moved back in the force flow during the deployment planning process.

Some requests were never approved, such as those submitted by 3rd ID units for augmentation, and thus were never part of a plan. This lack of within-division dry cargo distribution augmentation contrasts with Operation Desert Storm, in which the division had many 40-foot trailers from echelons above division.[9] As an example, 2/3 ID developed the following request for augmentation in OIF:

- 14 five-ton tractors with trailers to move spare parts, packaged petroleum, oil, and lubrication products, food, and bottled water,
- 12 palletized load systems (PLS) to move ammunition, and
- 5 3,000-gallon semi-trailer mounted fabric tanks (SMFT) to carry water.

Only the following was provided, which was in line with the expectation that had developed by January 2003:

- 5 five-ton cargo trucks (two of them arrived with cargo directed to be moved by division: one to carry humanitarian rations and one to carry joint service lightweight integrated suit technology (JSLIST) chemical protective suits).[10]

This and other similar unit requests were not included in the original deployment planning process, and thus they were not included in the theater's forecasted truck requirements. This factor, combined with the theater's shortage against the forecasted requirement, prevented the theater support command from accommodating them.[11]

In other cases, particularly those of the 377th TSC and the 3rd COSCOM, it is reported that distribution assets were deleted from the deployment plan or shifted in the deployment flow through a series of deployment planning conferences, especially when the time-phased force deployment list (TPFDL) was "thrown out" and deployment planning shifted to the request for forces (RFF) process at the end of November 2002.[12] Based upon the plan, the 3rd COSCOM estimated that it had only 20 percent of the needed dry cargo assets upon crossing the line of departure. As of

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[9] Interview with LTC Steve Lyons, formerly CDR 703 MSB (Division Deputy Chief of Staff, G-4), 28 October 2003.

[10] LTC Willie Williams, "FSB in Support of Offensive Operations: Personal Notes and After Action Report."

[11] Email from COL James Lee, Support Operations Officer, 377th Theater Support Command, 20 July 2004.

[12] Interview with BG Charles Fletcher. Email from COL James Lee.

19 March, the COSCOM had 91 PLS, 48 five-ton cargo trucks, and 60 medium trucks with 30-foot trailers available for use. Contrast this with its truck count on 15 April: 368 PLS, 125 medium trucks with 30-foot trailers, and 98 five-ton trucks. By 29 April, the count reached 445 PLS, 155 medium trucks with 30-foot trailers, 60 medium trucks with 40-foot trailers, and 255 five-ton trucks.[13]

Widespread interviews relate that units such as truck companies were often treated as individual elements in the deployment planning process. Without documentation of a comprehensive theater distribution plan and how each element fit within it, the reported result was cuts in these units. Such units are not easily individually justifiable; rather, they are part of a broader capability. Further, interviews suggest that various echelons did not have the information available to provide support in deployment planning conferences for the approval of logistics assets for other echelons. Each echelon was responsible for and focused on its piece of the system. The impression is left that logistics resources, especially supply and transportation assets as part of a fully integrated distribution system, were not well "defended" in these planning conferences (and there may have been no one with a comprehensive, integrated view of the distribution system requirements from theater to small unit level).

This impression comes across in numerous interviews and discussions, although an interview with LTG Wallace was particularly illuminating. Providing input to the RFF process became a major burden. For combat support and combat service support units, he and his V Corps staff had to justify individual units down to the company and even platoon level as they received questions about whether they really needed the trucks and people in those units. While these questions came directly from CFLCC with the rationale for each individual unit required in response, V Corps did not generally know the origination of the questions, only that they came from CENTCOM to CLFCC.[14] LTG Wallace and others have suggested that the entire process was made more difficult because the immediate "question askers" were generally combat arms officers. They had good knowledge of the composition, capa-

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[13] 3rd COSCOM, "Common User Lift Trucks" spreadsheet.

[14] This is consistent with a discussion in Bob Woodward's book *Plan of Attack*. When presented with the TPFDL in late November 2002, Secretary of Defense Donald Rumsfeld became concerned that "turning it on" would commit the United States to war. It would too clearly indicate U.S. plans and make it appear as though a final decision to attack Iraq had been made. Additionally, Woodward suggests that it was believed that implementing the formal deployment plan described by the time-phased force deployment data (TPFDD) would require commitment to and dissemination of the full plan. Thus it was decided to not use the TPFDD and slowly release deployment orders in order to preserve diplomatic flexibility. From this point on, the TPFDD was not used, with the process switching to the development and approval of many RFFs. Consistent with the description provided in discussion with many senior Army officials, Woodward states that Secretary Rumsfeld began to examine the TPFDD in some detail, finding the "pieces of units he wanted." What is not clear is why the TPFDD could not have been used if diplomacy was the only issue. It could conceivably have been kept behind the scenes with small pieces released in the form of deployment orders rather than releasing the entire TPFDD. Bob Woodward, *Plan of Attack,* New York: Simon & Schuster, 2004.

bilities, and need for an armor battalion, for example, but not a water purification unit. They had no sense of the size of such units and how they contributed to overall capabilities.[15]

Beyond what was in the force flow was the question of timing. A majority of combat service support units are in the reserve component, requiring about 90 to 120 days to mobilize and deploy given current mobilization policies and processes and the sailing time to Kuwait.[16] So to get ready by the start of combat operations, these units would have had to mobilize prior to the December 2002 holiday season. As a result, it was decided to delay some mobilizations. It has been reported that such types of shifts in the deployment flow were sometimes made without assessment of their impact on time-phased sustainment capabilities.[17] Mobilizations were delayed, but the desired theater arrival dates were not necessarily adjusted, creating an infeasible plan. In the longer term, the mobilization process might be changed and speeded up, but in the run up to OIF the process could not be adjusted sufficiently to accommodate the mobilization delays. Based on our analysis of deployment orders, we have determined that many units could not meet the required deployment date given the standard mobilization process and the Joint Chiefs of Staff deployment order approval dates. This is in addition to any postponement of the required theater arrival date from what was originally desired by logistics and operational commanders.[18]

The treatment of logistics units as individual pieces rather than as parts of larger capability packages may have had an impact on another widely reported problem. Logistics units were sometimes split over several ships, delaying unit preparation and thus mission readiness dates, particularly for theater-level transportation and supply units.[19] In addition, the coordination between the flow of unit personnel and their equipment became disrupted, leading to personnel in theater without equipment and vice versa.[20] This contrasts with the treatment of divisional "force packages," which include associated corps support groups. Maneuver brigade combat team packages, including task organized combat support and logistics elements, and division-level force packages were deployed as integrated packages, with each ship representing a usable step of capability.

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[15] Interview with LTG William Wallace.

[16] Based upon actual times for OIF.

[17] Email from COL James Lee.

[18] Interview with Lt Col Joseph (Joe) Gomes, USAF, CENTCOM, J-4, Plans (CCJ4-PL), August 2003. Woodward, *Plan of Attack.*

[19] CASCOM OIF Rock Drill discussion. Email from COL James Lee.

[20] Email from COL Joseph Walden, 17 September 2004. Interview with COL James Lee. CASCOM OIF Rock Drill discussion.

Changes in the Demand for Distribution Assets

Aside from the question of whether the force had sufficient distribution assets to support the plan, there was a series of factors that changed distribution system requirements and available assets from planning estimates. Planning assumed that units would cross the line of departure with bottled water, with a transition to bulk water production and five-gallon cans within five days.[21] Instead, after operations commenced, the decision was made to continuously rely on bottled water for hydration needs. This significantly added to cargo distribution demand, with reports of 60 percent of dry cargo line haul assets being devoted to bottled water. In fact, 3rd COSCOM daily briefings consistently show that 67 percent of the trucks used to move food and water were for water, and these two commodities consumed the bulk of dry cargo assets.[22] Another unplanned demand for distribution assets was the use of trucks for unit moves by the 101st Airborne Division (Air Assault) and the 82nd Airborne (ABN) Division's 2nd BCT.[23] One example is having to move the 2/82 ABN to As Samawah. Unexpected resistance and continued threats from *Fedayeen* fighters had tied down the 3/3 ID in the vicinity of As Samawah in part to secure the supply lines. The advance from An Najaf to Baghdad could not continue until the 3rd BCT could join the remainder of the division. The 2/82 ABN relieved the 3/3 ID, requiring truck assets to help complete the move. Finally, deployment delays and even some planned deployment flows required the use of trucks for force reception in Kuwait. It is not known to what degree, if any, trucks planned for distribution were used for this mission.

Environmental and Other Effects on Distribution Capacity

Early on, two factors reduced the effective distribution capacity. The first was road throughput. Expectations about the quality of the main supply route (MSR) that were derived primarily from photographic reconnaissance turned out to be wrong. The route had appeared to consist of standard paved, two-lane roads. In reality, the edges of the roads were falling apart, effectively making the route a one-lane road, and some stretches turned out to be improved dirt roads. Along much of the route there were limited road shoulders that could be used, and where there were shoulders, they consisted of talcum powder-type sand. As this sand was driven through by heavy trucks and equipment, it became hard to drive due to dust and the pulverization of the sand. Additionally, the unexpected resistance in As Samawah forced all traffic onto an alternative supply route to the west via an ad hoc bypass, which was

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[21] Email from COL James Lee.

[22] 3rd COSCOM daily commander update briefings.

[23] Email from COL James Lee. Additionally, this need is discussed in general terms in many descriptions of the operation, although they do not generally cite the fact that this requirement was not planned for and was met through the use of assets intended for sustainment.

not paved.[24] The result of these problems was much slower movement than the expected 30 kilometers per hour.[25] Even though the rate of movement was slow and a portion of the MSR was not usable, follow-on units and supplies were not held back in Kuwait. This resulted in heavy congestion on the roads, further slowing traffic to just a few miles per hour at times.[26] Finally, convoy disruptions resulted in some delays. Some convoys stopped due to enemy action, whether it was direct or in the general vicinity. At other times, drivers stopped when they saw fires or Iraqis under guard,[27] and there are reports of units simply stopping to take an uncoordinated break. There are also reports of drivers falling asleep after long periods of continuous operations and thus blocking traffic, with no one realizing why the convoy had stopped. Having only one driver per truck in some cases contributed to the lack of identification of sleep problems.[28]

The second factor that temporarily hindered distribution capacity—in fact, just about shut it off entirely—was the *shamal* or sandstorm pictured in Figure 3.1. It started in the afternoon of 24 March and ended about midnight on the 26th, with periods in which it became close to impossible to drive. Limited to literally inching along at about two miles per hour with drivers hanging their heads out the sides of vehicles to see the road, some convoys halted movement entirely.[29]

The supply of distribution capacity was also reduced below expectations due to contractor logistics support (CLS) issues. Reportedly, the contract with Kellogg Brown and Root called for a specified number of trucks in theater, but it did not specify an operational readiness requirement. It has been reported that at times their operational readiness rate was extremely low, reducing distribution capacity. And force protection issues limited the ability to send contractor trucks forward into Iraq. CFLCC expected to use CLS for the distribution of food and water into Iraq almost immediately, but as a result of the combination of issues, organic military transport had to be used instead.[30]

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[24] Interview with LTG William Wallace, 3rd ID AAR. Fontenot, Degan, and Tohn (2004).

[25] Interview with MAJ Glenn Baca. Combined Arms Support Command (CASCOM) OIF Rock Drill discussion.

[26] Fontenot, Degan, and Tohn (2004).

[27] LTC Katherine Cook, email discussion with the author, 2 June 2004.

[28] Interview with BG Charles Fletcher.

[29] Interview with MAJ Pacheco, 3rd COSCOM S-3 shop (now ERD), September 2003.

[30] Interview with LTC Swanke, Commander, Theater Distribution Center Camp Doha, September 2003.

Figure 3.1
Visibility Was Extremely Limited During the *Shamal*

RAND *MG344-3.1*

SOURCE: Briefing, "Marne Thunder: 3rd ID (M) DIVARTY in Operation Iraqi Freedom."

Limited Distribution Capacity

All of these factors led to distribution capacity problems at all levels. This resulted in organizations doing whatever they could to satisfy immediate needs, leading to widespread reports of units holding onto distribution assets that brought them supplies to meet local needs. The degree to which this affected total distribution system capacity has not been documented.

The sum of these issues resulted in reactive distribution limited to basic subsistence. Food, water, and ammunition were the priorities.[31] Choices had to be made, and there was room for little else except on an absolute emergency basis. This included spare parts. Units were generally able to maintain combat power with on-hand spare part stocks (whether officially accounted for or not) and creative mainte-

[31] Interview with BG Charles Fletcher.

nance. However, there was no way to work around not having food, water, and ammunition, which had to be provided to Army and Marine units from the theater base in Kuwait.

Keeping Distribution Running: Convoy Support Centers

Early in planning, the 3rd COSCOM understood that distribution and convoy control would be crucial. At least as early as 25 September 2002, detailed convoy support center templates had been developed describing the command and control element, requisite support units, types and amounts of supplies by class, service capabilities, automation requirements, signal needs, in-transit visibility system requirements, engineer support, and movement control needs.[32] Convoy support centers (CSCs) were developed to support convoys along supply routes and to serve as bases for transportation units as part of the "go fast option."[33]

Three levels of CSCs with a range of capabilities from least to most robust were used and termed pit stops, mini-marts, and truck stops. In many cases, the support at a location started as a pit stop as the operation hit specified trigger points and then grew as planned into a mini-mart and then a truck stop. As the operation progressed, a series of new stops were put in place.[34]

Pit stops consisted of a company or platoon of a rear corps support battalion (CSB) of a rear corps support group (CSG), which provided limited bulk fuel by tanker and could provide limited maintenance support. They would expand into larger CSCs or cease operations if the mission were completed. CSBs of rear CSGs established mini-marts, which provided fuel by tanker and started the development of a bulk fuel bag farm. They also provided bulk and bottled water, some trailer-transfer capability, and medical treatment teams. Generally, mini-marts were simply a phase in the development of a truck stop. Truck stops were part of LSAs, with trailer-transfer capabilities, a bulk fuel bag farm, direct support maintenance, and temporary beddown areas, and they served as home bases for transportation companies.[35]

To supplement CSCs, movement control teams (MCTs) were also placed at key intersections. These teams consisted of two vehicles and eight personnel to conduct 24-hour operations.[36] Further, the COSCOM recognized that a key to operations was keeping the limited trucks moving. Field grade officers and experienced captains were thus put to work during the initial movement at all key nodes and with large

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[32] 3rd COSCOM convoy support center matrix, 25 September 2002.

[33] Interview with BG Charles Fletcher.

[34] 3rd COSCOM convoy support center concept of operations.

[35] Ibid.

[36] Interview with MAJ Pacheco.

convoys to drive convoys forward. This became particularly important as the drivers got worn out from several days of continuous operations, with some having been awake for three straight days by the time they arrived at LSA Bushmaster.[37]

Situational Awareness and In-Transit Visibility

The 3rd COSCOM commanding general tried to stay close to the tactical operations center (TOC) of whatever unit currently had the main effort in order to monitor and understand its situation as effectively as possible. This was crucial, as he did not have Force XXI Battle Command, Brigade-and-Below (FBCB2) to track friendly forces and did not get a tactical satellite radio set (TACSAT) until about 30 March. However, because of the fluidity of the operation and the limited range of available line-of-sight communications equipment, he could not always stay close enough to monitor their radio nets. In contrast to other logistics units, though, the 3rd COSCOM's vehicles had movement tracking system (MTS) or Defense Transportation and Control System (DTRACS) capability in every convoy as the result of independent initiatives undertaken by U.S. Army Europe. The 3rd COSCOM commanding general also had the JDLM, enabling him to track convoy progress of MTS and DTRACS equipped trucks. This was invaluable in directing them to the right place at the right time.[38] By contrast, 3rd ID had no in-transit visibility of incoming supplies,[39] which made logistics and operational planning difficult.[40]

Supply Levels During Combat Operations

The 3rd ID's plan was to cross the line of departure with five days of supply of food and water in organizational trucks and trailers, with an additional one to two days of supply in support units. The MSB reported one day, and some forward support battalions (FSBs) reported two days, of backup supplies.[41] Many units within 3rd ID reported up to two additional days of supplies beyond the mandated five days at the organizational level, depending upon how much they could stuff into every nook and cranny of their vehicles.[42] And some commanders formally directed seven days of

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[37] Interview with BG Charles Fletcher.

[38] Interview with BG Charles Fletcher.

[39] 3rd Infantry Division AAR; interviews with MAJ Glenn Baca and LTC Steve Lyons.

[40] Interview with MAJ Glenn Baca and 1st Marine Division interviews.

[41] Interviews with LTC Steve Lyons and with LTC Willie Williams; 3rd Infantry Division AAR.

[42] Interviews at 3rd ID Division Artillery (DIVARTY) with LTC Craig Finley (CDR 1/39 FA BN MLRS), MAJ Phil Rice (Ops, 1/9), MAJ Jim Rooker (Asst S-3), MAJ Benigno (S-3, 1/39), SGT Pichardo, CPT Miguel Garcia (S-4), MAJ Barren (2 BDE Fire Support Officer), MAJ Ken Patterson (current XO), COL Thomas Torrance (CDR) on 28 October 2003. Interviews at 2/3 ID with CPT Jeff Sabatini (A/S-4 Maint and S&S), 1LT Adam

supply to be on hand.[43] The plan was to get the first resupply on G+2 from corps at Objective RAMS in the vicinity of An Najaf, with distribution flowing from that point on, keeping the division basically at or close to the initial full load of supplies.[44] As a result of the sandstorm, the congested roads, the two-day early start of the operation, and other factors discussed in the distribution section above, the first replenishment of food and water, along with limited quantities of other materiel, did not arrive until G+6.[45] At this point, some units were down to a day or less of supplies, reporting black on supply status (officially less than 50 percent). In particular, the 3rd Squadron, 7th Cavalry Regiment (3-7 CAV) was down to one day or less.[46] 1/3 ID was fairly low as well. But not all units were in this precarious shape. Again, some had taken more than the official planned level, and food was often consumed at less than the planning rate.[47] Some of the difference among units had to do with available preparation time. For example, soldiers of the 2/3 ID, which had been there for several months, had time to install additional racks on their vehicles to hold more supplies.[48] 2nd BCT reported between 2.5 and 4 days of food remaining at the time the first sustainment push arrived, with unofficial stowage and low MRE consumption the driving factors for the relatively healthy on-hand level.[49] Some Army units did report having to "officially" go to two meals per day for three to four days from about G+6 to G+10.[50]

Early on 26 March, the 19th Support Center (SC) reported a commander's assessment that 3rd ID was black on ammunition and red on food and water along with the 101st Airborne Division (Air Assault).[51] (This is a marked change from detailed 19th SC supply status reports on the 25th that show 3rd ID green in all areas of supply except packaged POL products—amber—and green for the 101st across the board.)[52] The 19th SC's situation report stated that supplies were en route but

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Points (Battle Captain), and focus group on 29 October 2003. Interviews at 3-7 CAV with CPT Patrick Shea, 1LT Keith Miller, and CPT David Muhlenkamp on 29 October 2003.

[43] Interview with SGT Pichardo.

[44] Interview with LTC Steve Lyons.

[45] Ibid.

[46] Interviews at 3-7 CAV and 3rd ID DISCOM.

[47] Interview with MAJ Glenn Baca.

[48] Interviews at 3rd ID DISCOM.

[49] Interviews at 2/3 ID.

[50] Interview with LTC Craig Finley.

[51] The 19th Support Center's supply status reports indicate green as no impact on operations, amber as potential minor impact, red as potential for major impact, and black as potential for mission failure. Its situation reports describe these levels as 85–100 percent of requirements, 70–84 percent, 50–69 percent, and less than 50 percent, respectively.

[52] 19th SC Class of Supply – ORG/DS Readiness Report, 251530ZMAR03.

delayed by the weather, with a 3rd BCT ammunition delivery three days late and 3-7 CAV ammunition on CH-47s awaiting weather clearance. They expected to see dramatic improvement as the storm lifted and en route supplies began reaching their destinations. Because of the storm and the other factors discussed, the first push of supplies that left on 23 March did not reach Objective RAMS until the 26th and then had to be distributed to the 3rd ID's BCTs and other units. At that time two more days were already en route, and another two days' worth was to depart on the following day.[53]

Interviews reveal that water was a bigger concern than food. In fact, both the 1st and 2nd BCTs of 3rd ID listed water and spare parts as the top two problems, with spare parts being worse in the 1st BCT.[54] The reasons for the difference in spare parts support will be covered in a later section.

The plan was to launch the advance to cordon Baghdad with robust quantities of food, water, and other supplies available in units and at forward LSAs. The original concern was that from that point forward, supply lines would be at high risk, so immediate resupply could not be counted upon. It was LTG Wallace's intent not to launch into the Karbala Gap toward Baghdad until they had established LSA Bushmaster at Objective RAMS and it could support the advance.[55] On 27 March, the 19th SC situation report stated that they were trying to meet the corps commander's guidance to build up five days supply of food and water in all units in Iraq, with two additional days at LSA Bushmaster.[56] However, many sources report the perception that distribution capacity was insufficient to rebuild supplies back to the five-day level. For example, maneuver units in the 3rd ID report beginning to get sustainment flows at barely sufficient levels to keep them going, let alone build their supplies back up, generally keeping them at 1+ days of supply. These reports are consistent with the days-of-supply status for food, water, and fuel for 1/3 ID shown in Table 3.1[57] and sustainer push reports from the 3rd COSCOM. The first push with two days worth of supplies arrived on 26 March (delayed two or three days by the storm and other factors limiting road throughput), but an additional two days of supply was en route for delivery on the 27th with another two days worth scheduled for departure

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[53] 19th Support Center SITREP, 261100ZMAR03.

[54] Interviews with LTC Willie Williams and COL William Grimsley.

[55] Interview with LTG William Wallace.

[56] 19th Support Center situation report (SITREP), 271100ZMAR03.

[57] Interviews at 1/3 ID with COL William Grimsley, CDR; LTC Ernest Marcone, CDR TF 3-69 AR; and focus group of Battalion XOs, Brigade XO, Battalion Motor Officers, BN S-4s, and Battalion Maintenance Technicians. 1st BCT daily Orange 1 supply status reports. All days for which the Orange 1 reports are available from 21 March to 10 April are shown.

Table 3.1
Days of Supply on Hand, 1st BCT Orange 1 Reports

	29 March	30 March	31 March	1 April	6 April	7 April	8 April	9 April
MREs	1.6	1.9	1.9	1.8	1.8	1.5	1.5	1.8
Water	0.8	1.0	1.2	1.0	1.0	0.9	0.9	0.8
JP 8 Fuel	1.0	4.3	4.7	3.9	3.1	4.1	3.6	2.3

NOTE: All available reports from 20 March to 10 April listed.

on the 27th for 29th delivery.[58] This pattern continued with two-day pushes departing every other day, except for the 29th, which had a four-day push.

However, most of the convoys were short some trucks, reducing the convoy loads from the full two days of supply.[59] Additionally, it does not seem that this resupply pattern became immediately clear to 3rd ID personnel. With limited in-transit visibility at their level, supplies seemed to just show up. This uncertainty dramatically increased the perceived level of risk.

Snapshots of the DS on-hand levels at LSA Bushmaster were archived for a small number of days. They suggest that DS food supply was built up to the target level of two days, but bottled water supplies were thin. Table 3.2 shows all snapshots available. These are from the 3rd COSCOM daily commander update briefings. The briefings themselves have been archived for each day during combat operations, but they include the information shown in the table for only a limited number of days.

We do note that the 3rd COSCOM's daily briefings indicate different supply levels of food and water in 3rd ID than suggested by 1/3 ID's supply status reports—four to five days of supply on 4 and 5 April in the 3rd COSCOM reports for the 3rd ID, as shown in Table 3.3, versus one to two days reported at the brigade

Table 3.2
Days of Supply on Hand at LSA Bushmaster DS Supply, 3rd COSCOM Daily Commander Update Briefings

	28 March 1140	29 March 0100	29 March 1130	30 March 0200	10 April XXXX
MREs	2.0	2.0	1.0	3.3	1.7
Bottled water	0.7	1.0	0.3	0.0	0.5

[58] 19th Support Center SITREP, 261100MAR03.

[59] 3rd COSCOM daily commander update briefings, 3 and 5 April 2004.

Table 3.3
Days of Supply on Hand as Reported in 3rd COSCOM Daily Commander Update Briefings

		4 April	5 April	10 April
3rd ID	MRE	4	5	1.8
	Bottled	4	5	1
	Bulk	1	1	1
	IIIB	G	G	G
	V	G	G	G
	Critical	Dextron III Turboshaft BATT (5590)	Dextron III Turboshaft BATT (5590)	
82nd	MRE	3	2	3
	Bottled	2	2	1.5
	Bulk	0	0	0
	IIIB	G	G	G
	V	G	G	G
	Critical	Dextron Turboshaft	Dextron Turboshaft 105mm HERA HELLFIREs	
101st	MRE	2.1	3.1	5
	Bottled	5	6	5
	Bulk	0	0	1
	IIIB	G	G	G
	V	G	G	G
	Critical	BATT (5590)	BATT (5590)	

level. This may reflect the amount of materiel at division level and/or en route to brigade combat teams as opposed to the brigade-level view reflected in the BCT supply status reports, since corps throughput was to the division support area and not directly to brigades. Again, a limited number of snapshots are available. Table 3.3 includes on-hand days of supply for MREs, bottled water, and bulk water along with bulk fuel and ammunition status and lists of critical Class II, IIIP, and IX supply items.

What the combination of the limited situation reports, commander's update briefings, and brigade supply reports and interviews shows is that the intent was to build supplies in divisional and other major units back up to the original line of departure level, with two days of DS backup at LSA Bushmaster. In the case of food, it appears this was almost achieved, but limited distribution capability from the DSA

forward to units did not make it appear thus to front line maneuver units. Even though the daily water requirement was reduced from six bottles per person to three after setting up LSA Bushmaster, based upon the ability to supplement bottled water with bulk water, water remained scarcer.[60] For example, 2/3 ID began the use of two reverse osmosis water purification units (ROWPU) at LSA Bushmaster, which were then used to fill empty water bottles.[61] The bottom line is that although the overall reports reaching corps commander level probably indicated a stabilizing and sufficient supply situation with respect to the commander's intent to advance forward through the Karbala Gap toward Baghdad, these reports remained interspersed with reports of local shortages. Figure 3.2 provides a picture of what the typical supply and distribution pipeline situation appears to have been from about 26 March until 10 April, although it does not seem that this complete picture was clear, especially to tactical units.

Once units secured Objectives RAMS and RAIDERS and stopped advancing, their organic truck assets became more flexible. The trucks, which are really mobile warehouses, could be unloaded if necessary and sent back to pick up supplies. This same approach was feasible even after the advance resumed, as support battalions did not initially cross the Euphrates River and because the advance was no longer continuous and as rapid. Similarly, once Baghdad was cordoned, the limited movement requirements provided the flexibility to use organic trucks.

At times this divisional truck asset flexibility became important and probably helps explain why distribution problems could be overcome after reaching Objectives RAMS and RAIDERS in the vicinity of An Najaf. COSCOM assets generally did not deliver directly to the brigade combat teams. Rather, supplies were often brought

Figure 3.2
The MRE, Bottled Water, and Fuel Pipeline During Combat Operations from About 26 March Onward

Estimated days of supply

	"Strategic" pipeline	GS/ port	Distribution pipeline	DS/ LSA	Division LRP/transit	BCT
MRE	Ship	0–3	2(–)	1–2	0–2	1–2
Water	Local supplier/ship	4–15	2(–)	0–1	0–2	0–1
Fuel	Refinery and oil field	3+	Pipeline to Tallil	3		3–4

RAND *MG344-3.2*

[60] 1st BCT Orange 1 reports, 3rd COSCOM daily commander update briefings.

[61] Interviews with LTC Willie Williams.

to a central point such as the main support battalion. But the main support battalions themselves (101st and 3rd ID) did not have sufficient transportation assets to deliver to the brigades. Therefore, the brigades sometimes had to find ways to go get their supplies.[62] For example, 1/3 ID would drive its trucks from RAIDERS to LSA Bushmaster to pick up supplies whenever the levels dropped to less than two days of water. 3/3 ID reports the use of its organic trucks to pick up supplies throughout operations.[63] The 101st and other units reported the use of this practice of unloading organic trucks and using them for distribution as well.[64] In a sense, organic division and brigade truck assets became an unplanned part of the theater distribution system. The requisite need to load and unload the trucks every time they are used to augment distribution capacity, though, creates additional workload during combat operations and is something the units clearly prefer to not have to do.

As theater transportation system capacity increased with continued deployments, the volume of distribution picked up. By mid-April, as the 3rd ID consolidated its positions and commenced stability operations in Baghdad, it began to get "inundated" with supplies. But these were still all sent to the logistics release point at Baghdad airport. No system for onward movement had yet been developed. Because they were now stationary, though, each BCT could use its own trucks to pick up the materiel.[65]

Transportation of Bottled Water

Packaging to support the movement of bottled water on flatbed trucks and in containers has not been developed for battlefield distribution. Poor bracing and blocking could result in half the bottles in a container coming loose and spilling out of their packaging. When this happens, materiel-handling equipment cannot be used to unload the container.[66] Typical tie-down techniques did not work well in Iraq for loads of bottled water. Tie-down straps for pallets might come loose over the very rough roads, requiring further tightening. The extra tightening (or even initial tightening) might crush some bottles, getting cardboard boxes wet and causing them to break down, leading to additional loosening of the load. The load would be tightened yet again at the next CSC, leading to another round of load disintegration.[67]

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[62] Interviews with LTC Willie Williams.

[63] Email from LTC Katherine Cook.

[64] Interview with COL James Rogers.

[65] Interview with LTC Steve Lyons and with MAJ Glenn Baca.

[66] 4th ID Materiel Management Center interviews, September 2003.

[67] Interview with COL Terry Clemons.

One advantage of bottled water, though, once the support units get it, is speeding up resupply operations during offensive combat operations.[68] Additionally, the standard 5-gallon water cans were typically stowed outside of combat vehicles, where they often got punctured. In contrast, vehicle crews could store the individual water bottles inside their vehicles where they were protected and could be accessed even in combat. The distribution of water from sources of production and the Army's large storage containers to individual vehicles and personnel remains difficult.

The Supply of Food to the Theater

The transition to hot food dramatically illustrates issues with supply and theater distribution development. 3rd COSCOM reports that some units were eating MREs for over 90 days.[69] 3rd ID reports the start of one hot meal per day on a consistent basis in June, with three to four per week before that.[70]

Early supply problems with MREs present an example of a coping strategy that generated its own issues. Records indicate that from 23 to 29 March, the on-hand balance covering the theater distribution center (TDC), the general support food warehouse (PWC), and the Ash Shuwaykh port was less than half a day's worth for the Marines and Army personnel in Iraq. Supplies were as low as 2,256 cases, or enough to feed 10,104 people for a day.[71] As a result, the theater staff ensured that everyone in Kuwait ate only hot meals or at least had them available three times a day in order to preserve MREs for shipment into Iraq.[72] Personnel in Iraq were understandably bitter that they were eating MREs while hot food was being served in Kuwait.[73] The reason for this disparity was not made known to the troops in Iraq; they might merely observe the hot food on a trip back to Kuwait. This is actually representative of many issues. Time and again, our research has found that forward units had little awareness of why something was happening—only that it was. Improved information flow to forward units would help them better understand the total picture and the reasons for problems. Being informed would not have helped their actual situation when there was a problem, but it could have reduced uncertainty and potentially benefited morale by preventing people from assuming the worst.

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[68] 3rd ID AAR.

[69] Interview with BG Charles Fletcher.

[70] Interviews at 1st BCT, 3rd ID.

[71] Theater distribution center and general support SSA daily status reports. It is possible that not all of the inventory in the port was accounted for (and thus still not available).

[72] Interview with COL Terry Clemons, CFLCC C-4 staff.

[73] Interview with BG Charles Fletcher.

Food shortfalls likely resulted from expectations about the scale and duration of stability operations and reports of delayed planning for stability operations.[74] Shortfalls in food resulted in production coming virtually straight to the theater. A problem was that this generated containers full of one meal type, such as breakfast, that troops would have to eat for days on end, three times per day.[75]

Ammunition Supply During Combat Operations

While a general, overall ammunition shortage did not develop in combat units, at least in terms of having some available, if not the munition of choice, ammunition sustainment presents a challenge akin to medical support, with short-duration, spot shortages having potentially dire consequences.[76] Ammunition support during combat operations is more challenging than many other classes of supply, because consumption of ammunition is relatively unpredictable, resupply determination is complex (depending upon the type of ammunition needed), and replenishment may have to be done very quickly. The need for resupply is based upon both what has been expended and the types of fights the unit expects to find itself in. A term such as "days of supply" has no relevance, as a full load of some types of ammunition could be consumed in less than an hour or last more than a week, depending on the situation. Additionally, the need for ammunition resupply can be absolutely immediate, happen without warning, and develop while still in contact. Thus critical, spot shortages requiring immediate, emergency resupply are more likely to develop for ammunition than for other supply classes, and they can develop in difficult resupply situations, as occurred in OIF. As a consequence, there is a clear need for real-time information about ammunition supply and distribution pipeline status.

3-7 CAV's intense fight outside of An Najaf on 25 March provides a good example. With a high rate of fire, the unit ran low on small arms ammunition as the sandstorm made resupply and external fire support (e.g., close air support) difficult. A 26 March situation report from the 19th SC states that munitions had been loaded aboard CH-47s, but they were still awaiting a break in the weather to head out to the 3-7 CAV.[77] The 3-7 CAV also ran low earlier in fighting around As Samawah. Similarly, 1-64 Armor ran low on small arms in a fight in the vicinity of An Najaf. Although the unit supplies officially remained at green, that is, "ok," the 1-64th wanted to top off prior to continuing to Baghdad but was unable to do so because the sandstorm prevented the planned CH-47 resupply and then later the CH-47s were ap-

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[74] T. Christian Miller, "Pentagon Waste in Iraq May Total Billions, Investigators Say," *Los Angeles Times*, 16 June 2004.

[75] OIF Distribution Rock Drill discussion and notes.

[76] Interviews with MG Buford C. Blount and BG Charles Fletcher.

[77] 19th SC Situation Report 26100ZMAR03.

parently not available for this mission. Eventually, the FSB delivered the ammunition from RAMS sometime after commencement of attacks north of An Najaf on 30 March.[78]

The 3rd ID took one and a half days of a unit basic load across the border for large-caliber direct-fire weapons. This represents a turret load in each combat vehicle and half a turret load on trucks. Limiting the amount of ammunition on trucks and at the support battalions enabled the brigades to bulk up on loads of other supplies such as water.[79] From this perspective, it was recognized that some risk had been taken with ammunition, although this seems to be based upon an expectation of limited combat from the border to Baghdad.[80] However, multiple units did report shortages of mortar rounds that could potentially have created problems. For example, 1/3 ID reported cases where it would have liked to use mortars for suppressive fire but did not do so in order to conserve rounds for what was believed would be more critical fights south of Baghdad. In consonance with the anticipated need for mortar fire, it used its mortars in a fight east of Baghdad International Airport.[81]

The division artillery (DIVARTY) struggled at times, but invariably found ways to get resupplied. However, it often did not have the types of fuses and munitions that were deemed optimal. It is possible that this could create problems in some situations. However, the DIVARTY commander and staff reported that there were no cases where they could not achieve the desired combat effects.[82] Still, there were times that shortages produced collateral, undesirable effects such as when they would have preferred to use high-explosive munitions to cut down on duds but had no choice other than to use dual-purpose improved conventional munitions (DPICM) instead of conventional high-explosive shells.[83] Deliveries were made in bulk, requiring the DIVARTY to break bulk for distribution of combat-configured loads to units.

Similarly, the 101st reported having to make do with the types of munitions available, but things worked out—again, this might be solely due to the specific enemy. The division's intended ammunition basic loads were not there in time, but it was able to use ammunition intended for the 1st Armored Division. It also had only a limited number of radio frequency (RF)-guided Hellfire missiles, the latest and most capable variant, having to rely instead on the more basic missile.[84]

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[78] Interviews with LTC Willie Williams.

[79] Interviews with LTC Steve Lyons and LTC Willie Williams.

[80] Interview with MG Buford C. Blount.

[81] Interviews at 1/3 ID.

[82] Interviews at 3rd ID DIVARTY.

[83] Interview with COL Thomas Torrance.

[84] Interview with COL James Rogers.

Spare Parts Support

Spare parts support to the 3rd ID suffered from a chain of problems:

- poorly configured prepositioned spare parts packages in the brigade sets,
- an inability to send transactions from the Standard Army Retail Supply System (SARSS) while on the move,
- insufficient distribution system capacity,
- distribution system problems unique to "on-demand" items, and later by
- expectations about redeployment.

Authorized Stockage Lists

Through March 2002, various battalion task forces on training rotations had used a rotational authorized stockage list (ASL) in Kuwait for training. However, that month the entire 3/3 ID deployed. During the six-month deployment, this BCT worked to expand the ASL to better match the needs of a full brigade rather than a battalion task force. The 2/3 ID deployed in September 2002 on what was ostensibly another training rotation in Kuwait and took over this ASL.[85]

Besides supporting training, this ASL was designated for a prepositioned brigade set of equipment.[86] Upon examination, 2/3 ID's 26th FSB realized that even with the improvements made by the 3/3 ID's 203rd FSB, the ASL was not as broad in the number of different parts authorized for stockage and thus not as effective as their home station ASL, and so developed a plan for further augmentation. After some initial delays in approval by the staff, the CFLCC C-4 approved expansion of their stockage, to include the depth or the quantity of some authorized parts as well. The brigade's maintenance experts identified critical parts for their key combat equipment, which they used to build ASL push packages split out among the brigade's task forces in two trailers each. Similarly, they expanded the prescribed load lists (PLLs) held by the maneuver units that they were given in theater.[87] In particular, they used training exercises in late 2002 in Kuwait to identify parts they could quickly replace during offensive operations and that affected their ability to shoot, move, and communicate.[88]

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[85] Email from LTC Katherine Cook, 203rd FSB Commander in OIF, 20 June 2004.

[86] ASLs comprise the list of items a supply support activity is authorized to hold. Within a division, the forward support battalion (FSB) has an ASL to support its brigade, the main support battalion (MSB) has separate spare parts and Class II/IIIP/IV ASLs to support divisional troops, and the aviation support battalion (ASB) has one to support the aviation or 4th brigade, with the designation depending upon the division.

[87] The PLL is the name given to the inventory owned by each company-level organization.

[88] Interview with LTC Willie Williams.

Since the rotational ASL had been intended for support of a prepositioned brigade set of equipment and rotations had continually used it, why were the problems not noticed and corrected prior to the start of OIF preparations? There appear to be several reasons. First, it does not seem that the wartime purpose of the ASL—the complete ASL to support a prepositioned brigade set of equipment rather than just an ASL for rotational training—was clear to the rotational training units.[89] Second, most rotations consisted of only a battalion task force, not a brigade, producing less demanding support requirements. Third, rotational units were always in close proximity to the main warehouse in Kuwait, which was richly endowed with parts. As with other "field" warehouses without mobility constraints in the U.S. Army, it had a high part fill rate.[90] In particular, it was like the situation at the National Training Center, where maneuver brigades always have the broadly and deeply stocked main warehouse one day away during their two weeks of force-on-force and live-fire maneuver training.[91] Finally, when parts were not available in Kuwait, strategic distribution to the theater was excellent, with times from order to delivery from CONUS sources of supply averaging 9 to 10 days in 2001 and 2002, with relatively little variability, including delivery to rotational units.[92] Thus, prior to OIF, units received excellent parts support in Kuwait despite the rotational ASL's problems.

The 1st and 3rd BCTs deployed in January and February 2003 and thus had much less preparatory time than the 2nd BCT. They drew ASLs that were stored with prepositioned brigade set packages. The breadth of parts in these two ASLs produced little value for critical maintenance. Most parts that were needed were not part of the ASLs, a problem of exclusion, and many of the parts in the ASLs were not needed, a problem of inclusion. While the equipment they drew was similar to what they had at home, the compositions of the prepositioned ASLs were almost completely different from the ASLs they had at home. An additional problem was that the parts were packed in the containers without separate dedicated bins and shelves for each part. Thus, the mobile warehouses had to be configured during the preparation for operations.[93] The containers simply appeared to be a hodgepodge of parts, and it was not clear to the two FSBs that received them that they were designed to be maneuver brigade ASLs.[94] This would be particularly problematic in a rapid deployment and employment situation.

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[89] Email from LTC Katherine Cook.

[90] Fill rate is defined as the percentage of requisitions immediately filled from on-hand stocks.

[91] Author's past research and interview with LTC Willie Williams.

[92] USTRANSCOM and DLA monthly strategic distribution reports.

[93] For an in-depth analysis of these two prepositioned ASLs, see Kenneth J. Girardini and Eric Peltz, "Sustainment of Army Forces in Operation Iraqi Freedom: Prepositioned Authorized Stockage Lists," unpublished RAND research, August 2004.

[94] Email from LTC Katherine Cook.

Both the 1st and 3rd BCTs quickly realized there were severe problems with their ASLs, but they did not have enough time to completely reconfigure them and order a whole new set of parts. Instead, both brigades selectively had some parts sent from home and ordered what they could. 1st BCT was able to have its home station PLLs shipped, and it purposely left most of the APS ASL in Kuwait, not officially bringing most of the parts into its supply records.[95] A noncommissioned officer in the 3rd BCT put together four air pallets worth of shop stock line replaceable units (LRUs) and all of the Class IIIP they had, which got to the FSB prior to the commencement of operations.[96] The DIVARTY also reports sending their home station PLLs and augmenting them based upon experience, but stated they still did not do so to the degree they should have. One innovation they used was to have replacement personnel bring batteries with them.[97]

The MSB had a different story. There was not a prepositioned MSB ASL designed specifically to support the divisional units, such as the signal and military intelligence battalions, which is doctrinally the role of the MSB ASL. Rather, it was given the main ASL designed to back up rotational units and to support Kuwait tenant units. In some respects, it was like the main warehouse at the National Training Center. With a great variety of parts, the ASL had many of the parts needed by the divisional units, but also many parts they did not need. And at 60+ trailers, it was not a mobile ASL. Instead, the MSB took a few trailers up to Objective RAMS and planned to bring up other needed parts by airlift. This never materialized. Many of the remaining trailers were brought up to LSA Dogwood between Karbala and Baghdad after 5 April.

The aviation support battalion (ASB) deployed its home station ASL because the Army does not preposition helicopters and associated spare parts. It performed about the same as it had at home, although a small drop-off was seen.

Since the BCT ASLs were poorly configured from the start, they most likely had few parts to support low-density systems from divisional assets that were task organized or sliced to the BCTs. In addition, from interviews conducted, it does not seem that such slices received the same attention when addressing shortfalls in stockage during preparatory time in Kuwait—especially since they are not typically supported by the FSBs at home station and thus would not automatically have parts in the home station FSB ASLs and shop stock. So unless the divisional unit augmented its PLL on its own, it was likely to get even worse support than the remainder of the BCT when placed under the control of a BCT through task organization.

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[95] Interviews with 1/3 ID focus group, LTC Ernest Marcone, and COL William Grimsley.

[96] Email from CPT Petrosky, MATO, 203d FSB, 3rd BCT, 14 June 2004, and from LTC Katherine Cook.

[97] Interviews at 3rd ID DIVARTY.

This poor stockage for the 3rd ID became particularly problematic because, with few exceptions, the only parts available through the fall of Baghdad were those it carried with it. The next section discusses how well the division was able to maintain its equipment—or in effect, how well it was able to compensate for the spare part inventory and distribution problems.

During initial operations, tactical stockage for units deploying with their ASLs from home station was generally better. They had broader and better mixes of parts. However, these ASLs were quickly depleted due to a complete gap in replenishment during combat operations and then very slow replenishment combined with high demand rates during stability operations.[98]

There were also cases where ASLs that deployed from home station with a unit were not well configured to support assigned customers as the result of task organization. For example, the 82nd Airborne Division's 407th FSB had to support the 1-41st Mechanized Infantry Battalion, which brought valuable firepower to the 2/82 ABN. However, the FSB's ASL was not configured to support a heavy unit, and Army ASLs are not designed to seamlessly carve out a section to send with a cross-attached battalion.[99]

This could be a particular problem for nondivisional support, as the maintenance support structure above division level frequently changed. Maintenance units might lose customers and not know it for a significant period of time. This was exacerbated by the use of two Corps Theater Automatic Supply Computers (CTASC). The 548th Maintenance, for example, was under the 19th SC and its CTASC, and its customers would sometimes fall under the 321st and its CTASC, with some customers unwilling to switch.[100] In other cases, it would have been appropriate for customers to change their supporting maintenance unit, but they did not, because they did not want to switch CTASC (and lose outstanding requests). Instead, they accepted the time and distance penalty.[101] In the short term, this raises an issue as to whether two CTASC computers should be used for one operation.

On the Move Supply and Maintenance System Signal Connectivity

Up through the beginning of movement toward the border in preparation for the start of combat operations, regular, normal ordering and transmission activity flowed

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[98] See Kenneth J. Girardini, Eric Peltz, Thomas Held, Art Lackey, and Candice Riley, *Army Logistics in Operation Iraqi Freedom: Tactical Inventory*, Santa Monica, CA: RAND Corporation, forthcoming.

[99] Headquarters, 82nd Airborne Division, Department of the Army, Memorandum for Commander, V Corps (Attn: G3 COL Hicks), Subject: Lessons Learned by the 82nd Airborne Division during Operation Iraqi Freedom, 1 May 2003.

[100] Interviews with CW2 Small, SSA tech, and CPT Berg, CDR, 588th Maintenance Company, 548th CSB, September 2003.

[101] Interviews with MAJ Abrams, SPO, 548th CSB, Rear CSB for 101st CSG, September 2003.

through all six SARSS-1 computers in the division's support battalions.[102] As soon as the supply support activities (SSAs) began moving, communications from SARSS-1 to the rest of the supply system ceased. It was very briefly reestablished during the stop at Objective RAMS for two of the SARSS-1 computers and then shut off again through the fall of Baghdad when the SSAs essentially became stationary again. What happened?

Parts ordering starts at organizational and direct support maintenance through the unit level logistics system (ULLS) and the standard Army maintenance system (SAMS), respectively. In the field, parts clerks can use hand-carried disks to transfer the order data to SARSS, or it can be transmitted over the air through FM radio or wireless local area network (LAN) technology. However, the technology available to units for wireless ULLS and SAMS transmission requires line-of-sight communications. While ULLS and SAMS orders were lower than we might have expected for the period of combat operations, there were still a substantial number of orders created that were transferred to SARSS-1 at the SSAs by 3rd ID divisional troops, 1/3 ID maintainers, and 4/3 ID maintainers. 1/3 ID reported some success with FM transmission when distances permitted. Floppy disks for disk transmission did not work well in the harsh environment due to problems with the disk drives.[103] 2nd BCT had planned to rely on FM transmission, but the ranges were too great and retransmission corrupts data. Consequently, they relied primarily on manually generated call-in requests, as verbal transmissions could be retransmitted.[104] 3-7 CAV did not use ULLS until after the fall of Baghdad.[105] However, getting orders from ULLS or SAMS to SARSS-1 is just the first step. The SARSS-1 at each SSA had to transmit its order data to the division's SARSS-2AD computer, which in turn had to transmit to the SARSS-2AC computer. Initially, the SARSS-2AD was in Kuwait, which was out of line-of-sight range of all the SARSS-1 (but it could connect via wired network capability to the SARSS-2AC) and was not conducive to driving disks back and forth. Once the SARSS-2AD came forward, it lost this wired network capability.

The plan was to use mobile subscriber equipment (MSE) for SARSS-1 to SARSS-2AD transmissions. MSE enables non-line-of-sight wireless transmission capability from central battlefield nodes. However, MSE nodes must be stationary for operation, requiring setup each time, and remote terminals must be within line-of-

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[102] Each of the three FSBs has a combined Class II, IIIP, IV, and IX SSA, as does the ASB. The MSB has two separate SSAs and SARSS computers: one for Class II, IIIP, and IV and one for Class IX.

[103] Interviews at 1/3 ID. Problems with drives were also reported by the 4th ID and 3rd COSCOM units in interviews (September 2003); in fixed locations, some units were able to use email from ULLS locations to SARSS locations. The receiving organization would format the requests for transmission to SARSS. This technique was used at times by the 3rd ACR. At other times they had to drive their ULLS disks up to 238 miles from a forward operating base to the SSA. 3rd ACR interviews, September 2003.

[104] Interview with LTC Willie Williams.

[105] Interviews at 3-7 CAV.

sight of node centers with the satellite access. Distances among division elements were often too great for the required line-of-sight communication between nodes, and the division was rarely stationary long enough until the fall of Baghdad for a network setup to be feasible. In fact, once each unit began moving from its assembly area in Kuwait until Baghdad was secured, SARSS data show successful requests placed via supply automation for the 3rd FSB on only one day and the 703rd MSB on a couple of days, with none from the other support battalions. For about three weeks, the standard spare parts request system was basically out of action.

In the absence of standard SARSS connectivity, the SSAs used Iridium phones to place orders. They would call back to the division rear, which would either call in the request or enter the order in the SARSS computer left there.[106] Due to the time-consuming nature of this process and the difficulties with staying connected on the Iridium phones (20-second bursts), this was naturally limited to a small fraction of standard field volume. Only the most critical requests could be transmitted. As a result, there was just a trickle of shipments from CONUS supply sources to units operating in Iraq until the units became relatively stationary, with just 1 or 2 for an entire brigade on some days.[107]

Later, many SSAs were provided with VSAT terminals, which provided mobile satellite communication capability for SSAs. This is the near-term solution for the Army's SSAs and other key logistics and medical nodes that is being pursued by the Army's Deputy Chief of Staff, G-4, with VSATs already in place at key nodes in Iraq.

Effects of CONUS Spare Parts Packaging on Distribution

This leads to the next problem. Even when requests were submitted by SARSS or by phone, the distribution time was too long for requests to the standard supply system to reach the 3rd ID during combat operations, and transportation capacity was generally focused on other classes of supply. However, units did receive a small number of parts. These had to come from shipments already in the pipeline prior to the start of operations or as the result of calls back to their rear party in Kuwait where they left some containers with parts. The rear party would then find the part either in left-behind 3rd ID stocks or through any other means possible.

In March and April, the distribution system was extremely turbulent, with parts often not making it to the ordering unit at all, regardless of the time. The primary driver of this was having loads shipped from CONUS in consolidation configurations poorly suited for the design of the theater distribution system and Army SSA capabilities. Most small items for Army units shipped from Defense Logistics Agency

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[106] Interviews at 3rd ID DISCOM.

[107] Analysis of DLA distribution support system (DSS) data.

(DLA) distribution centers—the primary source from which "on demand" and ASL replenishment orders are filled—are combined in boxes typically addressed to one SSA. That is, all of the orders sourced from one distribution center for a given SSA and its supported units are combined in one or more large boxes, called multipacks. Typically, these boxes contain dozens of (if not 100-plus) shipments. This is the standard practice for DLA.

For shipments to most overseas locations, most of these multipack boxes from the various DLA distribution centers, shipments from the General Services Agency (GSA), lateral shipments from other Army locations, and direct vendor delivery items are further consolidated on pallets for air shipment or in containers for ocean shipment. Prior to OIF, most divisional SSAs and some nondivisional SSAs received air pallets built exclusively for them—one SSA per pallet (again including materiel for the SSA itself and its supported units). ARCENT/CFLCC personnel requested that DLA continue this practice for OIF in logistics planning sessions at least as early as September 2002. From their vantage point, it appeared that this request was approved, and they assumed that this ad hoc arrangement of SSA-pure pallets that had evolved over the last few years would be the standard for shipments to OIF units.[108]

A number of factors—the Army's decision to require all deploying units and SSAs to use new unit address codes (called Department of Defense Activity Address Codes or DODAACs) rather than their home station DODAACs; a series of communication and coordination problems between CFLCC/ARCENT, other Army organizations, and DLA; and inefficient processes for changing the DLA "sortation" logic as DODAACs changed—all combined to create misalignment between the DLA sortation logic and the deployed force structure composition. As a result, both the large cardboard boxes and the pallets sent from distribution centers in CONUS typically contained materiel destined for multiple SSAs. Gradually, the mixed-SSA box problem was resolved, but not in time to help major combat operations. For the most part, shipments to the 1st, 3rd, and 4th brigades of the 3rd ID were mixed in with 703rd MSB shipments, which directly supported the divisional units and not the brigades, up until the start of operations.[109] These shipments had to be sorted by the MSB and then delivered to the appropriate brigade, which is not a function they are manned and prepared to execute. Thus, prior to the start of combat operations, the other support battalions had some of their personnel help the MSB sort through mixed multipacks and pallets as well as pick up parts and other supplies.[110] The 2/3 ID also had multipacks addressed to it, but these multipacks also included materiel

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[108] Interview with LTC Forrest Burke. Email from COL James Lee. Emails from James Blalock and Gordon Kennedy.

[109] See Marc L. Robbins and Eric Peltz, *Sustainment of Army Forces in Operation Iraqi Freedom: End to End Distribution*, Santa Monica, CA: RAND Corporation, forthcoming.

[110] Email from LTC Katherine Cook.

for other units in theater (beyond other 3rd ID units). The 3rd ID's SSAs did start getting "pure" SSA-level multipacks at the start of combat operations, but at about the same time their flow of orders dropped significantly due to the connectivity problems and the pace of operations. Other SSAs in Iraq still had mixed multipacks. In addition, beyond the mixed multipacks, most pallets, including those sent with 3rd ID materiel, were still mixed across SSAs.[111]

Making matters worse, it was sometimes not clear to distribution personnel in theater whether a box or a pallet had materiel for multiple SSAs or single SSAs. In fact, when boxes were addressed to a single SSA and not a central destination in Kuwait (e.g., the theater distribution center), they were assumed based upon past experience to only have materiel for the SSA on the address. So often these were sent forward. Similarly, mixed-SSA pallets were sometimes sent forward. Materiel in the boxes and pallets intended for other SSAs, as opposed to the SSA that the boxes and pallets were addressed to, often did not get to the ordering SSA, especially if it was in another division. In effect, these became lost shipments, although we know some of the materiel was used by the SSAs that mistakenly received it. There are no records to track such usage, though, as these were off-the-books transactions or free to the gaining unit.

In other cases, boxes were addressed directly to the TDC, thus automatically signaling a need for unpacking, sorting, and repacking. Similarly, some mixed multipacks and pallets addressed to specific SSAs were identified and set aside to be "broken" apart in order to resort and repackage the materiel. Such break bulk operations, particularly for mixed multipacks and pallets together are orders of magnitude more workload intensive than transloading pallets or, in other words, moving them from one trailer to another for onward movement. Additionally, without good automation, it is difficult to sort accurately. The TDC did not have the capacity at the time (and probably never did) to handle a high-volume break bulk and load-building operation, nor did it have supporting automation. With its initial very lean manning, the TDC sent mixed multipacks to the central receiving and storage point (CRSP) to be sorted and then returned. As TDC manning increased, the mission reverted to the TDC.[112] Regardless, throughout the operation, shipments in mixed multipacks took substantially longer to reach the ordering unit than shipments in single-SSA multipacks.

The TDC tried to identify SSA-pure versus mixed pallets by using radio frequency identification (RFID) data, but in February and March many pallets did not have such data. When data were available, a manual check of the addresses for the individual shipments on the pallets was made. Some pallets started getting broken

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[111] DLA DSS data.

[112] Email from COL Joseph Walden, 17 September 2004.

down immediately, although the data suggest that many mixed pallets were sent forward unbroken to the lead consignee. Division expeditors helped the pure/mixed identification process and identified critical items after sorting was complete.[113]

Theater Distribution Center Startup

Before OIF planning commenced, there was a contractor-run CRSP operation in Kuwait to support rotational training and tenant activities. As units began arriving, materiel ordered from CONUS continued to flow through the CRSP for these units. Its capacity was overwhelmed, and the contractual provisions did not call for capacity to support a major warfight. Thus a significant backlog of materiel sitting on air pallets started developing. At the same time, containers with prepositioned materiel and stocks sent from CONUS started arriving and getting backlogged at a general support (GS) supply point.

Plans had been made to establish a centralized theater distribution transloading, packaging, and routing capability. It was originally planned to be a function for a general support supply company of a corps support battalion (CSB) as part of its mission to establish and operate the GS supply base to include the food and water warehouse, the spare parts warehouse, and the Class II, IIIP, and IV warehouse.[114] The intended GS supply company arrived later than required,[115] and it also seems that volume started ramping up earlier than anticipated.[116] Additionally, a freight forward detachment that was planned to augment the company to sort and repackage materiel as necessary was shifted to later in the deployment flow. In terms of location, the TSC planned to use a warehouse at Camp Arifjan. However, the needed buildings ended up being used to house soldiers during the reception, staging, onward movement, and integration (RSOI) process.[117] Consequently, in January, a new but bare site in Camp Doha, Kuwait was found, and when the unit arrived in theater, it started setting up operations. Containers from prepositioned sustainment materiel on ships and some other materiel began to come into the unit to deliver to the appropriate location. However, most CONUS flow was still going into the CRSP, and the GS supply unit was not manned and configured to break and redistribute loads on the large-scale basis required by the fact that during this time most multipacks and pallets were not packed for a single SSA. Compounding the workload problem for the CSB was the fact that the thousands of Army Prepositioned Stock (APS) containers of theater sustainment materiel had to be unpacked and the materiel completely

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[113] Ibid. Interview with MAJ Thomas Murphree. Analysis of RFID data.

[114] Interview and email from COL James Lee.

[115] Interviews with COL James Lee and COL Terry Clemons.

[116] Interview with COL Terry Clemons.

[117] Interview and email from COL James Lee.

reconfigured to establish usable warehouses. One supply company could not handle the volume and types of demands placed upon it, much of which was rightly not anticipated, such as the mixed loads.

Recognizing the growing problem, the CLFCC C-4 directed the immediate startup of a formal theater distribution center (TDC) with more robust capabilities in the second week of February. A commander was selected, and he was notified and went to work the same day, after receiving general instructions on the concept of operations from the CFLCC C-4. The 227th GS supply company that was operating on site remained as part of the TDC along with other units in an ad hoc organization. These units included a platoon from a cargo transfer battalion and two movement control teams. The TDC itself consisted of open, unprepared desert ground, a newly constructed berm around the area, and two containers to serve as office space. By this time, a backlog of 2,500 containers and 3,000 air pallets was already present. Consequently, the TDC already had a backlog of undelivered and unsorted shipments to handle as it opened operations. In addition, long before construction was completed and with inadequate manpower and other resources, it began immediately receiving materiel. Making matters more difficult, the 5,000 or so pallet backlog at the CRSP was moved to the TDC as the CRSP was turned off as a theater transshipment point.[118]

The TDC was given the mission to receive all theater inbound cargo and send it on to the right organization, transship materiel stored in theater, and organize convoys for the distribution of materiel.[119] A TDC plan was completed and a $15 million construction project began on 25 February, with completion on 8 June. Also at about this time, the CFLCC C-4 released a formal policy for all materiel to go through the TDC. Much materiel had already been coming into the TDC, but this was arranged through ad hoc, informal means. On 21 March, an ad hoc organizational design was officially stood up as the 3079th Cargo Distribution Company (provisional) to operate the TDC. Initially there were only about 200 personnel, growing to about 700 at the end of April, before reaching 965 at the end of May.[120]

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[118] Interviews with MAJ Thomas Murphree, COL Terry Clemons, and COL Joseph Walden, CFLCC C-4 Staff.

[119] This included forward and reverse flows, with responsibilities including providing in-transit visibility. The TDC also received, processed, and stored HAZMAT. "Operation Iraqi Freedom Theater Distribution Center (3079th Cargo Distribution Company) (Provisional) Tactics, Techniques and Procedures (TTP)," briefing.

[120] Interviews with LTC Swanke and MAJ Thomas Murphree. Early on, the 3079th CDC included three movement control teams, most of one cargo transfer company and platoons from two others, two trailer transfer detachments, a GS supply company, and a small detachment of riggers from a quartermaster company. Briefing on "Operation Iraqi Freedom Theater Distribution Center (3079th Cargo Distribution Company) (Provisional): Tactics, Techniques, and Procedures (TTP)," provided by MAJ Thomas Murphree.

Priority Was Given to Food, Water, and Ammunition

However, even when shipments were made available for onward movement to the 3rd ID and other units in Iraq through the sorting process, spare parts and other items that came through the TDC were behind food, water, and ammunition in priority, limiting the frequency with which these items were shipped. Pushes of food and water would come through the TDC, and any available capacity was used to ship Class IX spare parts along with Class II, IIIP, and IV materiel. Such capacity was limited during major combat operations, preventing complete distribution of even the critical items on a daily basis.[121] Already somewhat high in early March, TDC delay and awaiting-shipment times for spare parts began climbing when operations commenced and stayed relatively high through mid-April.[122] To compensate for the emerging cutoff of parts flow, virtually every organization stationed personnel at the TDC to expedite and find its parts. The 3rd ID had a party of eleven personnel who sorted multipacks, among their other functions.[123] It was also widely reported in site visits and interviews with both TDC personnel and units that due to the extreme problems in distribution, pilferage became common. People started to fend for themselves as best they could.

By late April, TDC operations had improved as manpower increased, effective procedures were developed, and transportation started becoming more available. However, after temporarily improving, mixed multipacks again increased in frequency as new units (with new DODAACs) commenced operations, preventing distribution improvement. Multipacks improved once again by July, but this was then counteracted by a new problem, especially since mixed pallets remained. Delay times started to climb further in July as the result of capacity shortfalls in CONUS operations that are discussed in a companion report along with a more in-depth examination of mixed multipack boxes and pallets.

Use of Intratheater Air

The use of intratheater air sustainment, particularly for spare parts support and medical supplies, was below expectations from both 3rd COSCOM and 3rd ID perspectives. 3rd ID expected greater rotary-wing support, and 3rd COSCOM had counted on C-130 delivery of supplies. In fact, V Corps quickly secured the airfield at Tallil Air Base, which engineers rapidly repaired and prepared for operations with the expectation of immediate air resupply. It opened on 23 March at 1700 hours.[124] However, significant airflow never developed during major combat operations, with

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[121] Interview with MAJ Thomas Murphree.

[122] Analysis of distribution data.

[123] Interviews with personnel in the 101st Airborne, 3rd Infantry Division, 3rd COSCOM, and 3079th CDC.

[124] "V Corps: The Road to 'Victory!' in Operation Iraqi Freedom . . ."

just eight pallets of supplies arriving by air. Engineers also prepared an airfield at LSA Bushmaster, and it too had limited utilization.[125]

The Effect of Changes in the Redeployment Plan

After Baghdad was secured, the combat mission appeared accomplished and original plans for the 3rd ID to soon return home remained in place. After an initial requirement for the 3rd ID to return its equipment to good working order before turning it back in for prepositioning, it was decided that the division could turn in its equipment as is. Accordingly, two events occurred. First, the 3rd ID generally stopped ordering parts. The 1st BCT, 2nd BCT, divisional units, and 4th brigade drastically slashed ordering volume between 26 April and 3 May. 3rd BCT stopped ordering parts on 21 May. Second, shipments on their way to the 3rd ID were redirected to other units.

On 26 May, 1st and 2nd BCT orders abruptly restarted. 1st BCT orders quickly fell off again over about a two-week period, and during this time units supported by the MSB and the ASB ordered parts for about a week. This happened because a portion of the division got extended to assist with stability operations as conditions began deteriorating. Basically, a consolidated brigade—nominally 2nd BCT—moved to Falloujah to conduct stability operations. Due to the poor condition of its equipment at the time, it had to pull equipment from across the division, which may be why other units temporarily ordered parts as well. 3-7 CAV also remained, but it was no longer directly supported by a 3rd ID SSA. Rather, the 3-7 CAV was assigned support from different SSAs outside of 3rd ID on several occasions, making parts order and delivery almost impossible.[126]

Spare Parts Support During Stability Operations

As the operating tempo and scale of stability operations increased beyond expectations in the summer of 2003, the distribution time to the theater for CONUS-based supplies continued to worsen. The growing volume of spare parts and other requests outpaced the ability of Defense Distribution Depot Susquehanna, PA (DDSP), the primary distribution center for Army shipments from CONUS to the CENTCOM area of operations, to expand capacity. A backlog developed, and times within CONUS worsened through the fall before finally recovering in February 2004 as capacity and demand became aligned and the backlog was eliminated. Capacity was increased by a series of actions at DDSP as well as other adaptations designed to relieve DDSP of some of the workload.[127]

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[125] Interview with BG Charles Fletcher; various 3rd ID interviews.

[126] Interviews at 3-7 CAV.

[127] See Marc L. Robbins and Eric Peltz, *Sustainment of Army Forces in Operation Iraqi Freedom: End to End Distribution*, Santa Monica, CA: RAND Corporation, forthcoming.

At the same time, the theater distribution system continued to struggle through about November 2003. The mixed box problem was resolved, the theater distribution center's capacity expanded and its processes improved, and theater transportation capacity had expanded significantly. The problem of mixed pallets remained, though, continuing to hamstring operations. Starting in November 2003, a plan to build pallets for the region for each SSA and its supported units was worked out between CFLCC and DLA. In March 2004 this practice was extended to Air Mobility Command, which also builds pallets with cargo for Army units for certain types of materiel such as oversized or hazardous.[128]

The slow distribution times combined with high demand rates to limit the value of tactical stockage in Iraq in Army ASLs. The depth of an ASL or the amount of each item held in stockage is based upon replenishment time and demand patterns. The replenishment times were longer and the demand rates were higher than the planning values, which in combination led to many empty shelves.[129]

The final factor was insufficient national inventories and production base response for Army Materiel Command managed items. National war reserve secondary item requirements have been found to be lacking, and some valid requirements were underfunded.[130] AMC could not respond in time by increasing procurements and repair to compensate, due to late authorizations to commit money for such actions. Prior to operations, expectations about their scope and scale led decisionmakers to discount requests to procure additional spare parts.[131] By the time the real demand rates were apparent, it was then too late to respond in time, because many weapon system items have long production lead times. Lead times of three months to two years must be accommodated.

Packaged Petroleum, Oil, and Lubrication Products

Class IIIP (packaged petroleum, oil, and lubrication products) materiel does not often receive much attention. They are fairly standard products often easy to get in peacetime operations. Thus, it may be easy to forget how critical they are to maintaining equipment. One can continue to run equipment with limited oil or lubrica-

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[128] Ibid.

[129] See Kenneth J. Girardini, Eric Peltz, Thomas Held, Art Lackey, and Candice Riley, *Army Logistics in Operation Iraqi Freedom: Tactical Inventory*, Santa Monica, CA: RAND Corporation, forthcoming.

[130] See Kenneth J. Girardini, Eric Peltz, Art Lackey, Elvira Loredo, and Candice Riley, *Sustainment of Army Forces in Operation Iraqi Freedom: Army War Reserve Secondary Items*, Santa Monica, CA: RAND Corporation, forthcoming.

[131] Interviews at Tank Automotive and Armaments Command. Feedback on briefing from Mr. Don Tison, Deputy to the G-8, Headquarters, Department of the Army. Interview with Mr. Gary Motsek, Deputy G-3, Army Materiel Command.

tion, but down the road this will have detrimental effects on maintaining equipment in proper working order.

This class of supply became a significant issue for 3rd ID and other units.[132] Stocks on hand to support rotational training and at the area support group in Kuwait were depleted during preparations for combat as training was conducted and the theater population grew in advance of combat operations. The GS supply base was not yet set up to provide these items. Thus new orders from CONUS had to be placed prior to operations. It has been reported that funds to purchase preparatory stocks were constrained, limiting stocks on hand.[133] According to theater status reports, by 18 March the GS on-hand levels for 64 of 77 Class IIIP items that were being tracked were at zero.[134] Units did ameliorate the problem somewhat by shipping materiel from home and through some local purchase.

Another problem developed during combat operations. Class IIIP materiel sometimes came in, but it was often delivered in large containers, such as 55-gallon drums. This became very difficult to distribute on the battlefield to small units and individual vehicles.[135] With short and poorly configured supplies, equipment sometimes had to go without IIIP or inappropriate IIIP was used. Units got as creative as they could, even cross-leveling transmission oil from within one vehicle to another in order to give each vehicle at least a low level of fluid rather than have one full and one practically empty.[136]

Equipment Readiness

The question becomes: How did equipment perform given these severe Class IX and IIIP problems? The short answer is that during combat operations, units were able to maintain equipment well enough to keep combat power high. Particularly in the 3rd ID, combat power measurement with respect to equipment was based upon a combat standard and not the peacetime standard of technical manual–based "fully mission capable." The combat standard, instead, was "shoot-move-communicate" (SMC): could the weapon system shoot, could it move, and could it communicate? With this standard, the demand for parts was lower. The only parts that absolutely had to be replaced during combat operations were those that completely prevented the ability to fire, move, or communicate. A tank with a heavy leak or roadwheels

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[132] Interviews at 1/3 ID, 2/3 ID, 3rd ID DISCOM, and 3rd ID DIVARTY.

[133] CASCOM OIF logistics Rock Drill discussion, 3rd ID AAR.

[134] TDC status report, 18 March.

[135] Interviews with LTC Ernest Marcone, LTC Steve Lyons, and 3rd ID DIVARTY.

[136] Interviews at 1/3 ID.

without rubber could continue to move. So too could a wheeled Fox Nuclear, Biological, and Chemical Reconnaissance System missing two of six tires. However, some interviews did suggest that even the SMC standard was stretched at times. Some 2/3 ID personnel suggested it was more a shoot-move standard, while some 1/3 ID personnel emphasized that "shoot" meant that at least one weapon on a platform could shoot—not all (e.g., a 25mm chain gun or a machine gun on a Bradley fighting vehicle).[137] On the supply side, it seems that given this change in the maintenance standard, units did just enough in preparation combined with the cannibalization and controlled exchange they could do to get themselves through major combat operations.

2/3 ID reports that, overall, its equipment was in fairly good shape when Baghdad fell and would not have been an impediment to further operations, at least for a short period.[138] Similarly, 1/3 ID's commander reported being 90 percent combat capable or better through combat operations, while emphasizing that the unit quickly learned the difference between combat capable and fully mission capable (FMC).[139] The DIVARTY reported generally always being able to shoot, move, and communicate with heavy use of controlled exchange.[140] Other units report creative workarounds, such as cross-leveling tires from 203rd FSB vehicles to trucks in other 3/3 ID units[141] or using parts from Iraqi commercial vehicles. The result was that across the board, relatively few vehicles had to be left behind.[142] Daily briefings, interviews, readiness reports, and after action reports (AARs) all suggest that most key combat equipment fared well for the first few weeks, including M1A1 tanks, Bradley fighting vehicles, Paladin self-propelled howitzers, and multiple launch rocket systems (MLRS). During this period, aviation across the corps was generally kept above peacetime readiness standards with less of a difference in peacetime and combat reporting, owing to safety-of-flight issues.

Within units, certain specialty and low-density equipment did experience more problems. Most likely due to their age and heavy use, M88s were a widespread issue, with only 50 percent operational readiness in 2/3 ID.[143] M88s are limited in density in units to begin with, and a low readiness rate compounds this factor. This resulted in significant levels of like-vehicle recovery, which can magnify effects on combat

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[137] Interviews at 1/3 ID and 2/3 ID.

[138] Interview with LTC Willie Williams.

[139] Interview with COL William Grimsley and 1/3 ID focus group.

[140] Interview with SGT Pichardo. He reported 17 circle X vehicles at the fall of Baghdad, which are technically not mission capable but deemed to be usable or unofficially partially mission capable.

[141] Email from LTC Katherine Cook.

[142] Widespread 3rd ID interviews and 1st Marine Division interviews, which also reported similar spare part supply and distribution results as described here for the Army.

[143] Interview with LTC Willie Williams.

power—i.e., two vehicles out of action as the result of one breakdown—and result in additional breakdowns due to stresses on tow vehicles.[144] The old armored vehicle launched bridge (AVLB) fleet did extremely poorly, reaching just 28 percent operational readiness at the reduced maintenance standard over three weeks of combat in the 3rd ID. Armored combat earthmovers (ACE) struggled as well, reaching 70 percent readiness by the fall of Baghdad, but dropping lower at some points. Older M113 armor personnel carriers and M113-based platform variants drawn from APS were also reported to have some problems, especially with their powertrains.[145] Another equipment readiness issue was Q37 counterbattery radars. Three operational radars were needed to keep a continuous fan across a brigade front as it moved forward. This is typically accomplished by leapfrogging the radars. However, brigades often had one of three down, indicating the need for a more reliable system or an additional radar or even two per brigade.[146]

But the division's adaptations could only work for so long. Whatever extra parts it procured and placed in things like off-the-books ASL push packages were generally consumed by the fall of Baghdad. And maintenance can be deferred for only so long before equipment becomes truly non-combat-capable. For example, the inability to replace worn track and roadwheels led to second-order problems as movement generated additional heat and vibration. Uncorrected leaks and failure to replace oil and other lubricants likely led to more severe problems as equipment was run without sufficient lubrication.[147] Across V Corps, deferred maintenance, continued spare parts distribution problems, and change in the standard to something closer to FMC during stability operations resulted in all combat systems falling below 80 percent readiness by early July, with only the MLRS, the Black Hawk UH-60L, and the Apache AH-64A above 70 percent. M1 tanks and M2 Bradleys were considered at less than 60 percent readiness. In 3rd ID, M1 tanks, M2 Bradleys, and MLRS were reported at less than 30 percent readiness.[148]

The very heavily worked distribution assets started showing signs of stress earlier, with many of the key combat service support (CSS) fleets dropping below 90 percent readiness even in March. By June, the continued high-intensity usage of these systems during stability operations and the spare part problems led to a signifi-

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[144] Interviews at 3-7 CAV and 1/3 ID.

[145] 3rd Infantry Division AAR.

[146] Interview with MAJ Benigno.

[147] Interviews at 1/3 ID.

[148] 3rd COSCOM readiness briefing, 14 July.

cant drop, with all CSS systems below 85 percent and most below 75 percent in the 3rd COSCOM.[149]

Soldier Readiness

Chillers for water were not available until after combat operations, and then they often had maintenance problems.[150] As stability operations commenced, supply problems developed with replacement desert camouflage uniforms (DCUs) and odd-sized boots.[151] After six months in theater, some soldiers were down to one pair of DCUs and one set of boots, and in some cases had to borrow such items.[152] Problems with Class II supplies—ranging from insufficient supplies of toilet paper to difficulty getting replacements for personal load-bearing equipment that was destroyed in combat—became emotional issues.[153]

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[149] 3rd COSCOM readiness briefing, 14 July. Below 75 percent: M88A1 tracked recovery vehicle, M1000 heavy equipment transporter (HET) trailer, M923/925 5-ton cargo trucks, rough terrain forklift (RTFL) 4k (at just 42 percent), M1070 HET (at 57 percent), ROWPU 600 gallons per hour, RTFL 6k, M984A1 HEMTT wrecker, forklift (FL) 10k. 79 to 85 percent: M1074/1075 PLS truck, M978 HEMTT fuel tanker, and M977/M985 HEMTT cargo trucks. The ACE and small emplacement excavator (SEE) were also reported below 80 percent at this time.

[150] Interviews with COL Terry Clemons and with LTC Willie Williams.

[151] Interview with LTC Willie Williams.

[152] Interviews with LTC Ernest Marcone and 2/3 ID.

[153] Interviews at 1/3 ID and 2/3 ID.

CHAPTER FOUR

The Pause in the Advance at An Najaf

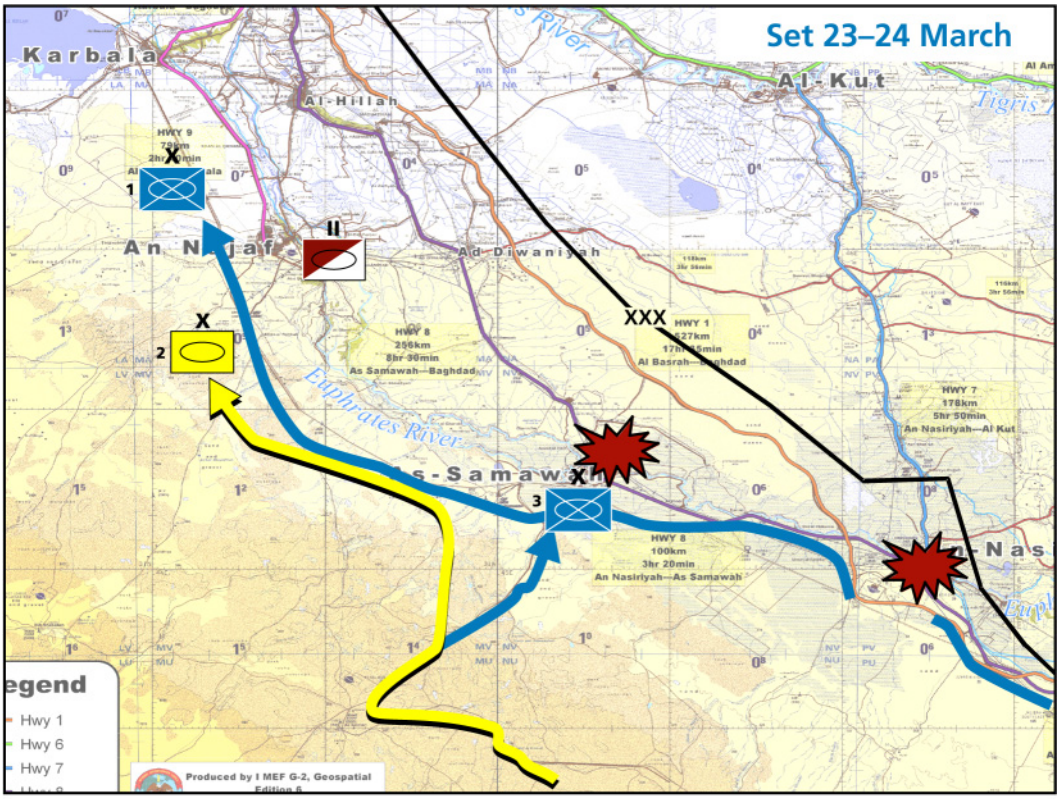
By 23 March, 2nd BCT had secured Objective RAMS just south of An Najaf and the intended site of LSA Bushmaster, and 1st BCT moved north of RAMS to Objective RAIDERS. While 1st BCT led the advance on the western route, bypassing the major southern cities to rapidly secure Objective RAMS, 3rd BCT led the attack on the eastern route. 3rd BCT quickly secured Tallil Air Base and bridges over the Euphrates River near An Nasiriyah, opening the initial line of communication. After being relieved by Task Force Tarawa, the 3rd BCT moved north to counter the unexpectedly heavy resistance in As Samawah (see Figure 4.1) that had been interdicting the main supply route and then remained there to protect the lines of communication (LOCs). This contrasts with V Corps' plan, which was to keep 3rd ID moving north without getting tied down to clear the supply routes and cities.[1] Then on the 24th, the "Mother of All Storms" began, limiting offensive and other operations through the 26th. During this time, 1st BCT, 2nd BCT, and 3-7 CAV were engaged with enemy forces in the vicinity of An Najaf.

Recognizing that the *Fedayeen* would continue to be a threat to LOCs in close proximity to An Najaf and would pose a risk to LSA Bushmaster and thus to the advance to Baghdad, the 3rd ID moved the 1st BCT to establish a blocking position north of An Najaf on 24 March and secure a bridge over the Euphrates. 3-7 CAV attacked to secure a bridge to the east of An Najaf and then move north on the 25th. The intent was to cordon off the city to protect supply routes and LSA Bushmaster and to prevent reinforcements from flowing into An Najaf. A series of intense fights erupted and continued through the 27th, with the mission of isolating the city ending up requiring 1st and 2nd BCTs along with 3-7 CAV. Figure 4.2 shows a snapshot of unit positions during this period.

Additionally, the continued, unexpected resistance by *Fedayeen* along the supply lines led to a change in plans. The route from Kuwait to An Najaf could not be left totally unprotected, leaving convoys open to attack. However, with the rolling start

[1] Fontenot, Degan, and Tohn (2004).

Figure 4.1
Map of Operations to An Najaf and 3rd ID Positions on 24 March



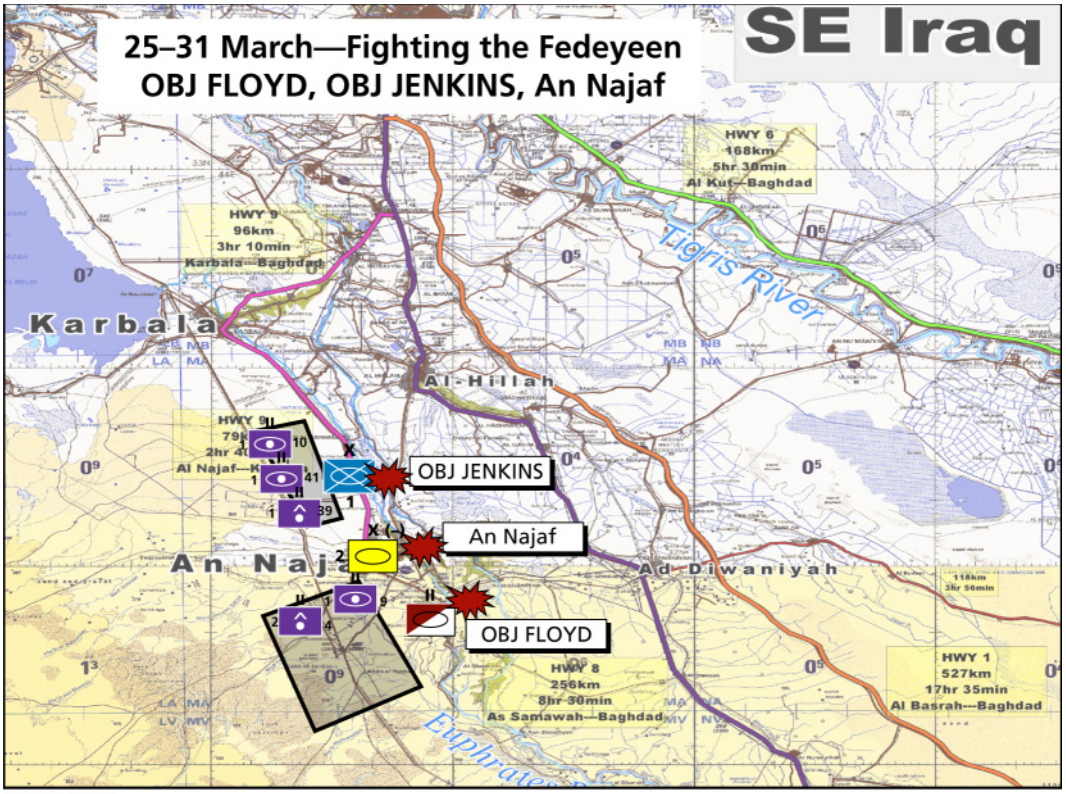
RAND *MG344-4.1*

SOURCE: Briefing, "Marne Thunder: 3rd ID (M) DIVARTY in Operation Iraqi Freedom."

to the operation that limited available forces when operations commenced, no combat forces had been following the 3rd ID to secure the rear areas; this was a risk that had been accepted. Thus, the 3/3 ID stayed back to secure critical areas near As Samawah. Plans had to be quickly developed for its relief so as to enable the 3rd ID to be at full strength for the assault toward Baghdad. Similarly, the *Fedayeen* operating from An Najaf posed too much of a threat for the 3rd ID to continue its advance without another force securing LSA Bushmaster and the supply lines in this area.

Plans were modified as quickly as possible to effect the relief of 3rd ID as soon as possible given the available forces. The 2nd BCT of the 82nd Airborne Division was released to V Corps on 26 March, and it completed its relief of 3/3 ID on the 29th. Plans for the 101st Airborne Division (Air Assault) were changed, and it too was assigned to relieve the 3rd ID of LOC security roles. Responsibility for eliminating the threat from irregular forces in An Najaf was also given to the 101st, and it

Figure 4.2
3rd ID Positions and Engagements Around An Najaf



RAND *MG344-4.2*

SOURCE: Briefing, "Marne Thunder: 3rd ID (M) DIVARTY in Operation Iraqi Freedom."

started moving into the area on 28 March, with its units and attached organizations completing their moves to An Najaf by the 30th.[2] This series of actions enabled the 3rd BCT to move north, rejoining 1st and 2nd BCTs and enabling the entire division to prepare to restart the offensive before first light on 31 March. During this time, airpower worked to attrit the Medina Republican Guard division and other forces south of Baghdad, setting the conditions for the advance.[3]

Because of the limited distribution capacity and competing demands for the assets, V Corps was not able to establish significant stockpiles at LSA Bushmaster. However, the pause in the advance still may have helped the logistics system become somewhat better prepared for further offensive operations. It most likely enabled the distribution system to get untangled from the initial advance, and it kept the supply

[2] In Fontenot, Degan, and Tohn (2004).

[3] 3rd Infantry Division AAR.

lines and thus round-trip times from getting even longer. Every day until the advance resumed was another day for trucks to become available for use as units continued to unload their equipment from ships and prepare for operations at camps in Kuwait. From 19 March to 1 April, the 3rd COSCOM's available trucks increased by 63 percent. So while the units and Bushmaster did not fully achieve the desired level of days of supply for food and water, the pipeline from Kuwait north did begin to approach the desired levels of supply and could maintain a relatively reliable distribution flow by this time. As discussed earlier, 1/3 ID reported receiving sustainment of about two days of supply every day from its arrival at RAIDERS forward but no significant pushes to replenish depleted stocks.[4] This is consistent with 3rd COSCOM daily reports.

The pause also enabled 3rd ID units to do some maintenance using whatever parts they had on hand, cannibalization, controlled exchange, and very limited supply from Kuwait. Until this point, units did what little maintenance they could do very quickly while on the move, or they towed vehicles.[5] But at RAMS and RAIDERS they could do critical, deferred maintenance for items that could not be changed on the move, and they got handfuls of parts. 2nd BCT reported a valuable period of close to 24 hours of a true pause that enabled it to do the first "hard maintenance" of the operation.[6] 3-7 CAV received three critical tank engines.[7]

We conclude that although it may have helped the distribution system to stabilize and improve its organization, this pause was not caused by a wait to build up stockpiles. MG Blount, commanding general of the 3rd ID, commented that logistics never held him back. The pause did not do much in terms of allowing a rebuild of supplies; food and water continued to be consumed at about the same rate, and ammunition was being consumed during this period as well (sometimes at a high rate).[8] Only fuel consumption became lower, and fuel supply was not a problem, as discussed earlier.

This does not mean that the pause was totally unrelated to logistics. One of the key proximate causes was the need to secure the supply lines to enable continued sustainment and even more extended LOCs beyond An Najaf to Baghdad. In this sense, beyond any shortfalls in combat service support units themselves, sustaining the force required much greater resources than originally anticipated: an entire division plus to secure the supply lines from Kuwait through An Najaf.

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[4] Interviews at 1/3 ID.

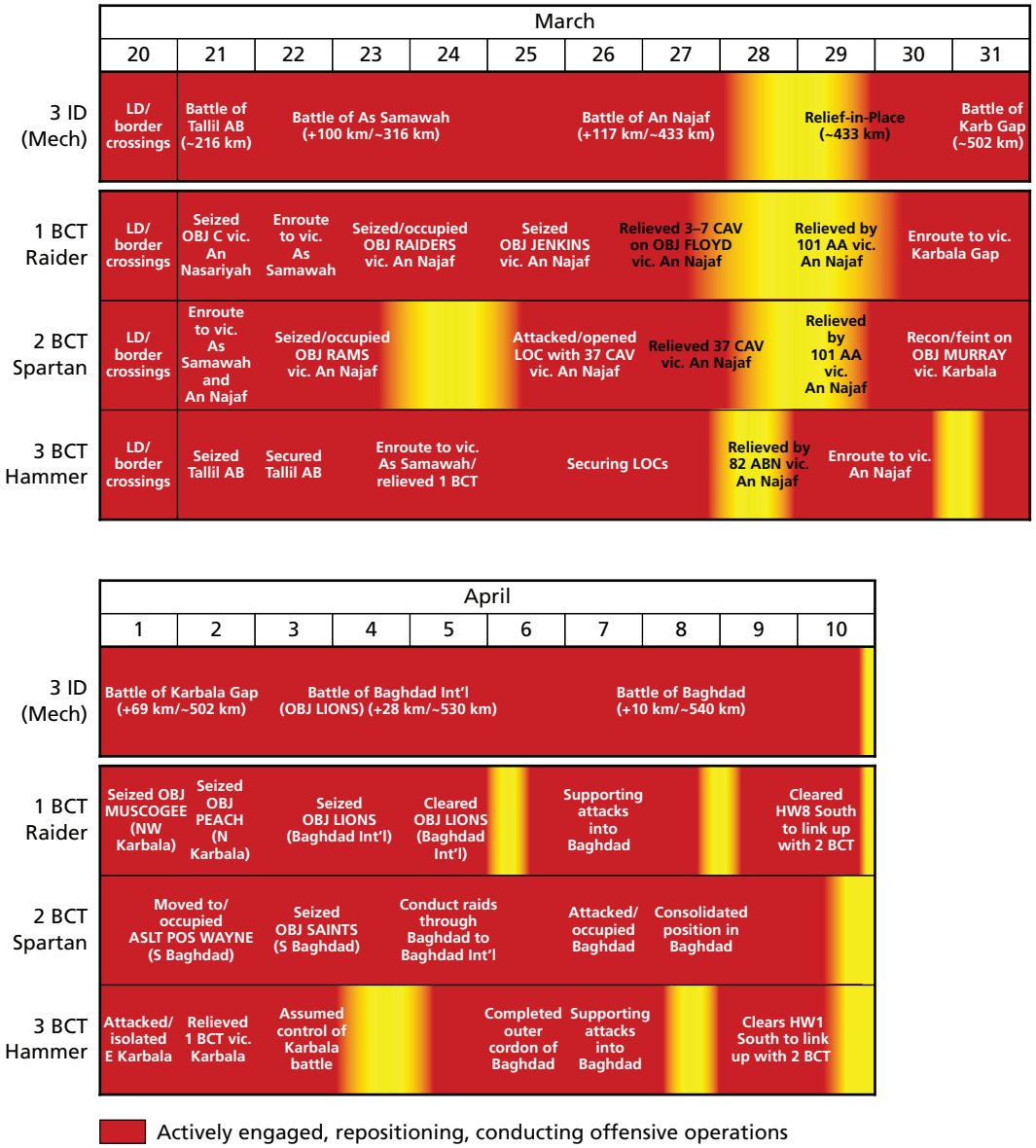
[5] Interviews at 1/3 ID and with LTC Willie Williams.

[6] Interview with LTC Willie Williams.

[7] Interview with LTC Willie Williams.

[8] Interview with MG Buford C. Blount.

Figure 4.3
3rd ID Operational Timeline During Major Combat Operations



RAND *MG344-4.3*

SOURCE: 3rd ID AAR, "V Corps: The Road to 'Victory!' in Operation Iraqi Freedom . . ."

Additionally, this was certainly not a pause in combat, as should be clear from the descriptions of the operation from 24 to 27 March and as depicted in Figure 4.3, which is an operational timeline for the 3rd ID. LTG McKiernan, the CFLCC

commanding general, strongly stated: "I would refute any notion that there was any kind of operational pause in this campaign. There was never a day, there was never a moment where there was not continuous pressure put on the regime of Saddam."[9]

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[9] In McKiernan, 23 April 2003.

CHAPTER FIVE

Effects and Implications of Sustainment Performance During OIF

While it is clear that there were sustainment performance problems, whether or not there were direct effects is less so. There are not clear metrics to gauge combat effectiveness or operational results strictly from a military effectiveness standpoint. Additionally, the "can do" attitude of soldiers provides significant "slack" in the system that can help cope with many situations. Finally, a strategic plan is generally based upon an assessment of national logistics capabilities to support it. This bounds what is considered possible. While some view the bounds to have been pushed to the edge or stretched for OIF, it may be that setting of operational bounds during planning is where logistics, including sustainment, has the biggest effect. This aside, we now explore the effects of sustainment performance on operations in OIF, and perhaps more importantly, the implications of OIF sustainment performance for operations in general.

Combat Operations

In OIF it has been widely reported by logisticians, operational commanders, and the soldiers that sustainment performance fell short, except for fuel support. To a great degree, this is backed up by process analysis. However, in the same reports that discuss problems, the effects are often unstated or unclear. So what were the effects? This is a difficult question, subject to judgment, and not simply a matter of looking at somewhat measurable effects, such as execution delays. Rather, it also includes whether potentially more effective operational courses of action were precluded.

Also, the effects from the unexpected need to protect supply lines should be separated from the effects of logistics performance. The actions of the chain of command directly demonstrate that the danger posed to the LOCs by the *Fedayeen* was unacceptable, due to either the risk to the soldiers in the convoys or the risk of the supply lines being disrupted or—more likely—both. Thus, the delays in providing units to secure the supply lines contributed directly to a pause in the advance, and supporting the force required greater resources than initially deemed necessary.

However, with respect to whether planned actions were prevented or made less effective than they should have been, interviews, after action reports, and the data available from unit and personal computer archives provided by several logistics leaders in OIF do not reveal any specific, large-scale operational effects from logistics performance shortfalls. From these sources, we cannot document supply shortfall–driven delays in the advance from Kuwait to Baghdad or an inability to accomplish a mission resulting from a logistics problem. Nor have we been able to document any cases where operational decisions were specifically dictated by the logistics situation differing from expectations. Logistics problems did not force a change in the plan or prevent courses of action that were being considered. This is not to say that there were no logistics shortfalls that had to be considered. There were. In some cases they were substantial. But in OIF, for a variety of reasons, Army forces were always able to overcome and cope with these shortfalls. The effects (or apparent lack thereof) of these shortfalls should not be generalized beyond the specific conditions of OIF. Instead, we should consider how the performance problems could affect operations, depending upon the situation. Similarly, it is important to consider whether such problems could occur in future operations, even with expected improvements in logistics capabilities.

What is difficult to assess are what potential courses of action were not considered either in planning or execution because of general knowledge about logistics capabilities that bounded thinking. While looking back with 20/20 hindsight does not reveal specific operational effects, it is important to try to place oneself in the time and setting of the action, to the limited degree possible, and think about the view from various perspectives within the force. In other words, when trying to assess the question of whether there may have been broader operational effects, the frame of reference is critical.

On-hand supplies in maneuver and supporting units did become low, sometimes down to one day of water, food, and even fuel in very isolated circumstances. While in most such cases supplies were in the pipeline from Kuwait to the units, this was often not visible to the units facing the supply shortages. Consider the case of a maneuver brigade down to one day of supplies and with no to little visibility of incoming supplies in the pipeline back to Kuwait. Regardless of the supplies on the way to them, what can they report other than what they have visibility over? How do they make decisions? The only information they have to base their decisions on is their inventory of what they have on hand. Even if they know supplies are on the way, this will not help in many fast-paced battlefield situations if they do not have a good estimate of when the supplies will arrive. For example, if an attack is planned for 0500, it is not enough to know that supplies will be there sometime that day or even that morning. The effects of uncertainty can be nuanced as well, with hard-to-measure effects. Are less aggressive options considered? How aggressively does each level of command press the fight? If commanders are confident the system can come

through, no matter the situation, their decisions may be different than if they have some doubts.

On the Army's four-tier supply reporting scale, there were scattered reports of black (i.e., high risk/potential for mission failure) on ammunition or technically 50 percent or less of the basic load. Commanders up and down the chain of command knew this. The collective impression from interviews is that this created a sense of doubt about logistics robustness that could have affected thought processes when examining the battlefield to develop courses of action and when making decisions.

What we will never know are the potential courses of action not considered, because an effective commander will not sit back and try to consider every possible option. First, some options will never enter discussion, as expert military judgment will rule them out as infeasible or very high risk, negating any need for explicit analysis. Second, there simply will not be time to come up with every option. Particularly during combat, it is often considered more important to take action with a good enough plan than to delay for a perfect solution.

The consideration of options becomes limited when conditions preclude the luxury of leisurely bouncing ideas around. In essence, the marginal value of developing and considering more options begins to outweigh the value of the time investment. This type of situation is epitomized by combat operations, in which time becomes a precious resource. Thus, the focus of decisionmaking tends to be on the marginal cases. That is, the consideration of options is limited to those cases in which the force might have to stretch a little, perhaps creating some risk but generally not extreme levels of risk. A commander may consider a situation that is high risk, depending upon a series of events to break in the right direction, but these can be separated from those courses of action that are clearly physically infeasible. What one considers doing is bounded by one's perception of the situation, which springs from the information being received and the lens through which it is processed.

A related effect is what LTG William Wallace, commanding general of V Corps, described as the psychological or mental effect on decisionmaking and planning. Key components of decisionmaking are risk assessments (determining the level of risk) and risk tolerance (determining the level of risk one is willing to expose oneself to). The information you have and the confidence you have in that information affect your risk analysis. During the *shamal*, supplies were starting to run low as the storm and other factors delayed replenishment. At the same time, there was heavy contact, driving ammunition consumption. The combination resulted in spot shortages with some units black on ammunition, and there were reports of some units rationing MREs. (Black on supply is intended to communicate high risk.) On the other hand, while supplies were getting somewhat low overall, they generally were still being reported as green (low risk/no mission impact) or amber (medium

risk/potential for minor impact) in most formal reports.[1] The isolated reports of problems had to be weighed against the overall reports. Which were more reflective of the true situation? Or did the isolated reports reflect an impending change in the overall situation? Would continued delays create serious problems? In hindsight (e.g., knowing precisely when the storm would end or what weapons the Iraqis had available) and with good knowledge of what was happening everywhere (i.e., perfect information), the danger may not appear as high as it did from within the blowing sands of Iraq on 25–26 March or thereabouts as the *shamal* was still raging. But this is irrelevant, other than for analyzing the potential benefit of future improvements in logistics situational awareness. Although convoys were on their way and the storm would soon abate, logistics commanders and staffs had very imprecise information (the storm impeded not only distribution but situational awareness about distribution as well) to provide to operational commanders, and they could not know with certainty when the storm's effects would lessen. They did not know when convoys would arrive, and not surprisingly, precise forecasts of when the *shamal* would end changed several times. This is the frame of reference in which decisions had to be made.

People knew reports were not good and often had poor visibility of incoming shipments.[2] So in this environment, knowledge that there is uncertainty in reporting, as well as uncertainty about such things as whether a convoy will have a problem, combine with scattered reports to generate a perception of risk and doubt about the overall situation, regardless of the overall status reports. This perception is the decisionmaker's assessment of risk. Maybe the shortages are really spot shortages, but maybe they are signs of impending, larger problems.

Thus, LTG Wallace suggested that this general perception of logistics risk probably affected his thinking; it was something there in the back of his mind. Still, he could not cite specific effects associated with this. Rather, the sense is that it may have affected how he judged the risk associated with different courses of action. LTG Wallace's words about this period capture the situation best. "Perception is reality. . . [Do the spot shortages] work psychologically on your ability to make broad, sweeping, risk-taking decisions associated with the entire formation? You damned betcha."[3] It is clear that he did not want to move forward from the vicinity of An Najaf until logistics capabilities reached a desired level. However, it does not appear that logistics delayed the move forward. In the end, it appears that it was decided to accept at least a little higher level of risk than was desired. In part, given the total control of the air and the total joint force combat power that could be brought to

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[1] 3rd COSCOM daily commander update briefings.

[2] 3rd ID AAR and interviews with LTC Steve Lyons and MAJ Glenn Baca.

[3] Interview with LTG William Wallace.

bear, this may been due to reasonable confidence that the U.S. military could control events on the ground well enough to prevent severe problems. Major Iraqi ground units had little chance of mounting a major, disruptive attack on supply lines (as opposed to still dangerous but more isolated small-scale attacks). But this may not always be the case. The same supply levels and distribution capability in a "risk equation" may prompt a different decision if other variables (e.g., control of the air) in the equation are different.

There were some important tactical-level effects that likely contributed to the mental effects described in the preceding paragraphs. First, leaders in the 1/3 ID stated that they sometimes conserved mortar shells in cases where they might have liked to use them for just-in-case suppressive fire because they knew it would be difficult to quickly replenish the shells. Instead, they decided to conserve their mortar shells for higher-risk situations, such as already being in actual contact. From a combat arms perspective, though, they would rather initiate action than wait to first be fired upon.[4] Second, field artillery often did not have the optimal munitions for fire missions. However, the DIVARTY commander and key staff stated that there were no times that they could not achieve the desired effects.[5] This is a case where the results could be different with a different enemy or situation. Third, there were tactical spot shortages of direct-fire ammunition such as during 3-7 CAV's defense against *Fedayeen* in the vicinity of An Najaf.[6] This resulted from a sustained high rate of expenditure and conditions that made immediate battlefield resupply difficult. The *shamal* prevented aerial resupply, and ground convoys were slow at the time. Instead, the unit was reinforced, relieved where possible, and resupplied by maneuver battalions initially from 1/3 ID and then by 2/3 ID.[7]

Another effect of logistics shortfalls was morale. Not getting parts for vehicles not only degraded their performance over time, it led to anger. The thought becomes, why can't they take care of me well enough to ensure I have ready equipment? Why am I eating MREs for the 90th day in a row? Why is my water so hot?

Finally, the question that is frequently posed is, "How much longer could intense combat operations have continued?" By 9 April, equipment in the 3rd ID was getting run down, and its ability to execute intense maneuver warfare certainly would have been degraded at some point if the pace of operations had continued. Estimates from interviews range from as little as two weeks to more than four. It will be impossible to ever know for sure, because there are many what-ifs:

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[4] Interviews at 1/3 ID.

[5] Interviews at 3rd ID DIVARTY.

[6] Interviews at 3-7 CAV.

[7] 3rd ID AAR.

- Under what conditions, if any, would it have been necessary for the 3rd ID to drive north (as opposed to using other units to accomplish the mission)?
- Would continued fighting in Baghdad have required the same type of equipment capabilities as that needed for the advance to Baghdad or placed different types of stresses on equipment (e.g., less mileage-related wear)?
- Would part flows have improved to the 3rd ID if fighting had continued and the expectation that they were soon going home had not developed? For example, their parts were actually rerouted to other units soon after the fall of Baghdad. So when the division was needed again in Falloujah for stability operations, the equipment was in very rough shape.

If major offensive operations had needed to continue aggressively north of Baghdad in the early April timeframe, it is possible this would not have been doable without a pause to build logistics capabilities. The distribution system was stretched very thin, and it has been suggested that major supply points first would have to have been established in the area to support such operations.[8]

Earlier, the fact that only logistically feasible options were considered during combat execution was discussed. This can be extended to long-term planning as well. Logistics considerations were included as an embedded part of the planning cycle. The process did not simply generate an operational plan and then throw it over the wall to the logisticians. This is akin to platform design teams that consider manufacturing from the start rather than the old sequential process of throwing a design over the wall and then determining if it can be made. So again, it is hard to say whether there were things that commanders wanted to do that could not be done logistically.[9] However, a crucial caveat must be added to this discussion. This concurrent logistics and operational planning was conducted in the development of the "deliberate" plan. Then the deployment plan associated with the operational plan was discarded, with final deployment decisions somewhat dissociated from the operational plan. It was then up to commanders and soldiers to make things work.

The conclusion drawn is that logistics performance enabled the execution of the plan and desired branches or options during combat operations. Logistics problems did affect risk assessments during decisionmaking processes, but not enough in this operation to produce clear, definitive alterations in courses of action. Rather, commanders judged that sometimes they were out on a limb. In other situations, such as against a more capable military force, the effects on operational decisionmaking could be greater.

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[8] Interview with LTC Willie Williams.

[9] Interview with Lt Col Joseph (Joe) Gomes.

Even if no specific operational consequences can be identified, questions do remain about the ability to drive a heavy force further north or sustain high-intensity combat operations if the Iraqi military had not collapsed. One might also ask whether there were any courses of action that were prevented. What if the Iraqis had more effectively attacked the supply lines? Or is this a moot point, because then the advance might have been executed differently? What if the *shamal* had lasted two more days or the supply lines been shut down by chemical attacks? What if there had been a second *shamal* a few days later?

Stability Operations

As stability operations became extended, continued supply and distribution problems led to quality-of-life problems and affected morale. The sense conveyed by troops in interviews is that although they readily understood issues with getting parts and not getting hot food during combat operations, the continued delays with things like spare parts and slow improvements in quality of life were disappointing and harder to understand. In particular, limited hot meals through June for some units has been highlighted.[10]

National-level supply problems also led to increased costs due to the need for expedited deliveries and excessive use of strategic air to move supplies.[11] These national supply problems and theater distribution issues led to significant equipment readiness degradation. However, evidence of adverse effects on stability operations has not been uncovered.[12] As during combat operations, units adapted, finding ways to make things work and continuing to perform at high levels.

Implications for the Future

The questions raised by an examination of sustainment during major combat operations lead to a key issue for the design of future forces and the development of operational concepts: How robust should the sustainment system be against disruption, in terms of both the length of delayed replenishments and the ability to counter disruptions?

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[10] Interviews at 1/3 and 2/3 ID. Rowan Scarborough, "Troops Complain of Conditions in Iraq," *Washington Times*, 17 June 2003.

[11] See Marc L. Robbins and Eric Peltz, *Sustainment of Army Forces in Operation Iraqi Freedom: End to End Distribution*, Santa Monica, CA: RAND Corporation, forthcoming, for a discussion of shipping costs.

[12] A seemingly important exception is the shortage of the latest generation of body armor. This was definitely a problem. We classify this, though, as an Army peacetime requirements and resourcing priority issue rather than a sustainment issue.

Requirements of Distributed Operations with Long LOCs

Once the nature of the enemy was understood, providing rear area and LOC security consumed as many forces as the advance to Baghdad in the V Corps sector. However, it should be noted that different types of forces could be and were used to do the job than could be used to conduct offensive operations and take Baghdad. Relatively light, mobile forces were determined to be ideal for the mission, with immobile light infantry employed as an expedient, capable backup. Similar issues have recently been identified in Army future force war games. Resulting questions include:

- What are the minimum requirements for logistics units, in particular transportation units, in terms of communications equipment, combat training, weapons, equipment survivability, and personnel, i.e., what is the force protection and internal convoy security need?
- Under what conditions can distributed forces be supported with unsecured LOCs? How does this vary with changes in the capabilities of logistics units?
- What are the logistics unit force protection and LOC security requirements across a range of potential threat, friendly, and environmental conditions?
- What are the right types of forces for LOC security missions, and how, if at all, should this affect the mix of different future force unit types?

It should be noted that during major combat operations, other than a small number of missions to deliver ammunition and other emergency supplies, little use was made of aviation assets to deliver supplies. This continued until late in 2004. Our research did not delve into the reasons for the dearth of C-130s and other aircraft to support Army forces. Understanding the factors that led to this situation should be researched to determine if this was a planning, interservice coordination, or resource constraint issue or even a combination of all of these factors.

Low Supply Levels in Maneuver Brigades Produced a Strong Sense of Risk

Maneuver brigades in OIF were often down to one or two days of supply of food and water and did not always have as much ammunition they would have liked. Of note, units reached this level despite taking three to four more days of supply than they were expected to consume before the first planned replenishment. Critically, these extra supplies did enable them to make it through disruptions to the supply chain such as that caused by the *shamal* and the unexpectedly poor road conditions. Future force operational concepts envision "pulsed" combat operations in which units of action have enough supplies to get through a pulse and are then replenished. By definition, this will result in low supply levels toward the end of pulses. However, one big difference is expected: much better logistics situational awareness. When looking at OIF through the lens of future force operational concepts, several questions come to the fore:

- How would the calculation of risk have changed if the maneuver brigades and the entire chain of command had had a good picture of the sustainment flow and the rest of the supply chain?
- How would the level of risk have been viewed if actual conditions had been in line with expectations?
- Are the logistics implications of future force operational concepts—operating on the supply edge by the end of combat pulses—in line with soldier expectations?
  - If not, can training bring expectations into alignment?
- What length and types of disruptions should be protected against?
  - What is an acceptable level of supply risk, measured in terms of potential disruptions?
  - How many days of supply should a unit of action carry when it plans to conduct three-day high-intensity pulses or X-day pulses?

The Criticality of Logistics Situational Awareness

This discussion highlights the value of good information. Logistically, it has long been recognized as valuable for the management of processes and resources. Beyond this, OIF demonstrates that good logistics situational awareness is also a critical factor in operational decisionmaking. Poor logistics information adds to the uncertainty facing a force in an environment where there are many external factors that already create a high level of uncertainty. The technology exists today to largely eliminate logistics situational awareness as one of the major sources of battlefield uncertainty. Enemy actions and responses and battlefield conditions are beyond the U.S. military's control. Many experts also suggest that perfect awareness of enemy actions is likely to remain an illusion as well, even with the best of current technology. However, at this point, resource decisions will be the primary determinant of the timeliness and accuracy of logistics situational awareness, with the exception of potential countermeasures that a highly capable enemy might develop.

This discussion may also serve to add to the rationale for good logistics situational awareness. Oftentimes, good in-transit visibility and logistics situational awareness is justified in order to improve logistics command and control, that is, to improve the effectiveness and efficiency of logistics support. Logistics situational awareness is also a key component of overall situational awareness for commanders from platoon and company level to combatant command when faced with battlefield decisions, whether "reactive" or at branch decision points, and planning further operations. What may differ among the levels of command is the acceptable level of latency and fidelity. At the tactical level, exact counts of each item may be critical, and hours, minutes, or even seconds can be vital. At higher levels of command, the overall readiness of a unit to execute different missions may be sufficient. This assessment, which should be automated, should rest upon the high-fidelity information

needed at the tactical level. With manual supply status reporting, this will continue to have significant latency (e.g., up to a full day). The more automated that detailed supply accounting becomes, the more current high-level logistics situational awareness will be.

This leads to one additional issue with regard to logistics situational awareness. How should sustainment readiness be measured on the battlefield? Should it be a constant standard, or does it depend upon the situation? There appear to be three components: At any given moment, are the people and equipment in a unit able to execute the necessary tasks to accomplish the potential mission set? Is a unit likely to be able to conduct operations at this level of readiness until the next expected replenishment cycle, with a desired level of "safety"? Will the distribution pipeline be able to deliver the next replenishment cycle? Certainly the parameters for the second and third questions depend upon the situation. For example, an acceptable level of days of supply of water might depend upon the enemy's perceived ability to interdict and disrupt distribution, potential weather conditions, and the level and type of buffer distribution resources in the theater available to conduct emergency missions. If ground distribution gets cut off, will aviation assets be available? Will the air threat permit aerial resupply by landing? Is airdrop available? In this light, the commander and staff might set parameters for readiness in the logistics situational awareness system that can change for different operations or over the phases of an operation as conditions and missions change.

Units Employed a Combat Readiness Standard

During major combat operations, the readiness standard became "shoot-move-communicate": could a weapon system fire one of its weapons, could it move, and could the soldiers communicate as needed? The parts needed to correct these types of faults and keep a platform in the action were the only ones crews and mechanics absolutely wanted during combat operations. Everything else could wait until an appropriate break in offensive operations, at which time they would conduct deferred maintenance. However, the shoot-move-communicate standard is an unofficial, undefined standard.

- To what degree does the system abort standard used in the current requirements and acquisition processes reflect the shoot-move-communicate standard? Should it?
  - What difference might this make in terms of unit spare part requirements?

Preparing for Uncertainty

Despite dramatic advances in technology providing unprecedented sensor coverage, complete control of the skies, the ability to dictate the start of action, and tremendous levels of training in the U.S. military, the unpredictable nature of conflict was

pervasive in OIF from the tactical to the strategic level, from weather to the enemy's intentions. A system resourced to the precise level of the estimated requirement based upon the expected conditions will be efficient, operating at high capacity utilization. But it will probably have great difficulty with less likely conditions that stress the system. This appears to be the case for OIF. This said, given the number of conditions that developed that were different from the planning assumptions, sustainment performed remarkably well. This suggests a greater robustness of resources than assumed in planning as well as some elasticity of demand. Examples of "uncounted capacity" include the use of maneuver brigade trucks to augment theater distribution and extended operating hours of people and equipment. Still, operational planning can and should explicitly consider the sources of uncertainty and determine which they want to be ready to handle immediately, which can be handled with moderate responsiveness, and which are all right to handle with deferred response. How much uncertainty should be all right to absorb through the extraordinary effort of soldiers, and how much should be absorbable through redundant or buffer resources?

In this report we have tried to lay out how well the sustainment system supported Army units in OIF and the questions this performance raises. In companion reports we examine the performance and the causes of issues in more depth and provide detailed recommendations. With respect to implications for the future, the answers are less clear. Rather, this review of sustainment performance in OIF and the discussion of effects and implications should be valuable as the Army and the DoD continue their efforts to transform.

APPENDIX

Truck Availability

3rd COSCOM

	HET	PLS	MDM 30	MDM 40	5 T
19 March 2003	91	91	60	0	48
28 March 2003	96	142	120	0	48
1 April 2003	96	189	125	0	64
8 April 2003	96	236	125	0	64
15 April 2003	296	368	125	0	98
22 April 2003	276	445	143	47	150
29 April 2003	330	445	155	60	255
2 May 2003	330	457	246	60	261
9 May 2003	365	486	266	95	283
16 May 2003	363	486	253	120	281
23 May 2003	372	487	253	120	281
30 May 2003	468	495	246	120	296
7 June 2003	465	498	252	120	387
14 June 2003	465	594	274	120	483
21 June2003	404	565	379	120	577
28 June 2003	404	655	379	416	577
8 July 2003	463	657	346	416	569

SOURCE: 3rd COSCOM, "Common User Lift Trucks" spreadsheet.

NOTE: MDMs are 30- and 40-foot medium flatbed trucks. 5 T is a five-ton cargo truck.

377th TSC

	Lowboy		HET					Flatbed					PLS	626		Bus		BAG
	ITO	HN	ITO	HN	KBR	32D	7TH	ITO	HN	KBR	32D	7TH		ITO	HN	ITO	HN	TRK
1 March		15					10		11			40	20			30	3	10
2 March		21					52		37			33	43			30		18
3 March		28		26			57	20	43			64	43			30	17	6
4 March		24					46		75			39	43			30	17	6
5 March		20					58		54			30	21			30	33	9
6 March		10					49		25			46	31			30	10	18
7 March		5					45		53			45	21			30	24	3
8 March		11		6			24		42			43	14			30	23	5
9 March		10					87		63			50	18			30	23	11
10 March		11		6			46		20			30	18			30	15	5
11 March		9					25		28			30	23			30	10	9
12 March		15					83		30			73	40			30	29	2
13 March		2					52		54			60	48			30	26	15
14 March		9					61		23			47	43			30	33	4
15 March		15					37		55			69	35			30	28	8
16 March		13					28		44			110	43			30	36	2
17 March		18					25		48			55	48			30	37	11
18 March		10					68		38			80	51			30	26	9
19 March		9					59		52			73	21			30	32	10
20 March		19					53		40			65	45			30	35	7
21 March		15					65		46			43	58			30	28	13
22 March		10					43		31			56	23			30	38	11
23 March		9					48		44			48	48			30	46	5
24 March		15					35		70			62	32			30	54	9
25 March		21					61		89			23	51			30	60	6

Data taken from filled transportation requests

377th TSC (continued)

	Lowboy		HET					Flatbed					PLS	626		Bus		BAG
	ITO	HN	ITO	HN	KBR	32D	7TH	ITO	HN	KBR	32D	7TH		ITO	HN	ITO	HN	TRK
26 March		10		30			41	0	165			30	36			30	95	25
27 March		10		30			33	14	205			21	40			30	95	25
28 March		10		30			28		205			52	43			30	95	25
29 March		10		30			17		165			60	55			30	95	25
30 March		10		30			36		205			35	43			30	95	25
31 March		10		30			22		205			41	51			30	95	25
1 April		10		30	10		10		95	57		54	15			30	22	35
2 April		10		30	0		40		110	47		60	15			30	10	20
3 April		10		27	10		25		105	47		59	15				95	25
4 April		5		15	10		18		61	47		50	15				63	10
5 April		7		15	10		5		105	13		50	17				95	25
6 April		10		31	11		28		107	23		33	34				95	25
7 April		7		15	10		17		103	31		50	17				95	25
8 April		37		29	7		11		105	21		50	15				95	25
9 April				15	8		0		105	21		50	14				95	25
10 April				15	8		0		145	16		98	15				95	25
11 April		7		15	10		0		119	49		50	18	20			95	18
12 April		7		15	10		0		119	32		50	18	20			95	18

377th TSC (continued)

		Lowboy		HET					Flatbed					PLS	626		Bus		BAG
		ITO	HN	ITO	HN	KBR	32D	7TH	ITO	HN	KBR	32D	7TH		ITO	HN	ITO	HN	TRK
13 April	Data taken from distributed movement program		7		15	10		12		145	10		50	14				95	18
14 April			7		15	0		11		139	3		18	15	20			95	18
15 April		30	7	30	15	0		2	90	165	0		50	17	40	50	20	95	18
16 April		30	7	30	15	8		50	40	130	17		2	53	0	50	0	95	18
17 April		15	7	15	15	18		50	39	185	42		21	0	40	30	20	95	18
18 April		20	7	20	15	18		36	20	158	52		14	35	40	30	15	95	25
19 April		20	7	20	15	0		36	32	167	23		8	52	40	30	15	95	18
20 April		20	7	20	30	12		30	40	175	20		9	52	40	50	15	95	18
21 April		30	7	30	30	3			30	175	0		1	50	40	50	15	95	18
22 April		30	7	30	30	0		0	30	155	6		8	40	40	50	15	95	18
23 April		30	7	30	30	7		59	30	152	11		24	41	40	50	15	95	18
24 April		30	10	30	17	17	90	0	30	175	72	25	50	0	40	0	20	95	18
25 April		10	10	30	30	17	92	0	30	175	72	25	51	0	40	0	20	95	18
26 April		30	10	30	30	17	90	0	30	175	72	35	50	0	40	0	20	95	18
27 April		30	10	30	17	17	90	0	30	175	72	50	35	0	40	0	20	95	18
28 April		30	7	30	17	17	7	0	30	175	72	20	30	0	40	0	20	95	18
29 April		30	10	30	17	17	30	0	30	175	72	16	30	0	40	0	20	95	18
30 April		30	10	30	17	15	50	0	30	175	72	40	30	0	40	0	20	95	18

NOTES:
1. Installation Transportation Office (ITO) trucks were from the contract administered by ITO office at Camp Doha from the Kuwait and Gulf Link Transport Company.
2. Host nation (HN) trucks were from the Heavy Lift Contracts administered by the 3rd Army Principal Assistant Responsible for Contracting (LTC Cintron).
3. KBR (Kellogg Brown and Root) were trucks provided by the Logistics Civil Augmentation Program (LOGCAP).
4. Lowboy: commercial trailers designed to carry heavy vehicles.
5. HET: heavy equipment transporter (military).
6. 626: a truck that has passed a "626."
7. Baggage (BAG) truck: commercial 18-wheel tractor-trailers and their military equivalent M915s.

SOURCE: 377th TSC, spreadsheet with trucks by type and source derived from filled transportation requests from 1 through 25 March 2003 and distributed movement program daily data from 26 March to 30 April.

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