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On the move

Advancing military
logistics toward
sense-and-respond

Government



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On the move

Advancing military logistics toward sense-and-respond

By Dr. Alberto Castano-Pardo, Dr. Grace Y. Lin and Thomas Williams

Movement is something military organizations understand very well. Worldwide, militaries move many millions of people, machines and packages every day. But we believe these organizations have another equally important move to make – moving their logistics operations to a more advanced level of sense-and-respond.


In most developed nations, the military moves far more people, equipment and supplies than the average commercial enterprise. The very nature of military operations makes logistics a defining capability. To accomplish missions – whether military or humanitarian – the delivery of troops, machines, supplies and more must be synchronized to arrive in the right quantities at the right place at the right time.

Speed and accuracy are paramount. Defense organizations today are being asked to respond to multiple operations – such as military, peace-keeping, nation-building or disaster relief efforts – at any given time. Unexpected events can upset standing plans at any second. Logistics must somehow keep pace with ever-faster operational execution.

For many years, the U.S. Department of Defense required its combat units to be capable of deploying forces anywhere in the

world within several days. These deployment expectations have grown increasingly shorter, particularly in recent years, with the wars in Iraq and Afghanistan.¹ Even after troops are deployed, their ultimate effectiveness is tied to the logistics capabilities that sustain them.

For most defense organizations in the world today, logistical complexity has become overwhelming. The U.S. Department of Defense is a case in point. Its logistics agency receives some 54,000 requisitions per day, does business with some 24,000 suppliers and handles over 5.2 million stock-keeping units (SKUs).² (As a point of reference, the typical supermarket carries just 45,000 SKUs.³) This kind of complexity is not isolated to the United States; the United Kingdom's Royal Air Force stocks approximately 2 million items – including hundreds of different engine versions for the Tornado aircraft, one of the RAF's most common combat fighter jets.⁴



Military agencies worldwide have found it increasingly difficult to meet these challenges with traditional logistics operations; as a result, many have launched initiatives to develop sense-and-respond capabilities. By that, we mean the ability to sense events or situational changes in realtime and respond rapidly and effectively.

But are defense agencies focused on the most important dimensions of logistical change? And how far have logistics operations progressed toward sense-and-respond objectives? We believe that emerging technologies and techniques currently being vetted in the commercial arena open a new realm of possibility for military logistics. These advances allow defense organizations to move their logistics operations much closer to a true sense-and-respond environment.

On the move

Advancing military logistics toward sense-and-respond

Realtime visibility provides the foundation for sense-and-respond; without it, waste and inefficiency are common consequences.

What does the journey involve?

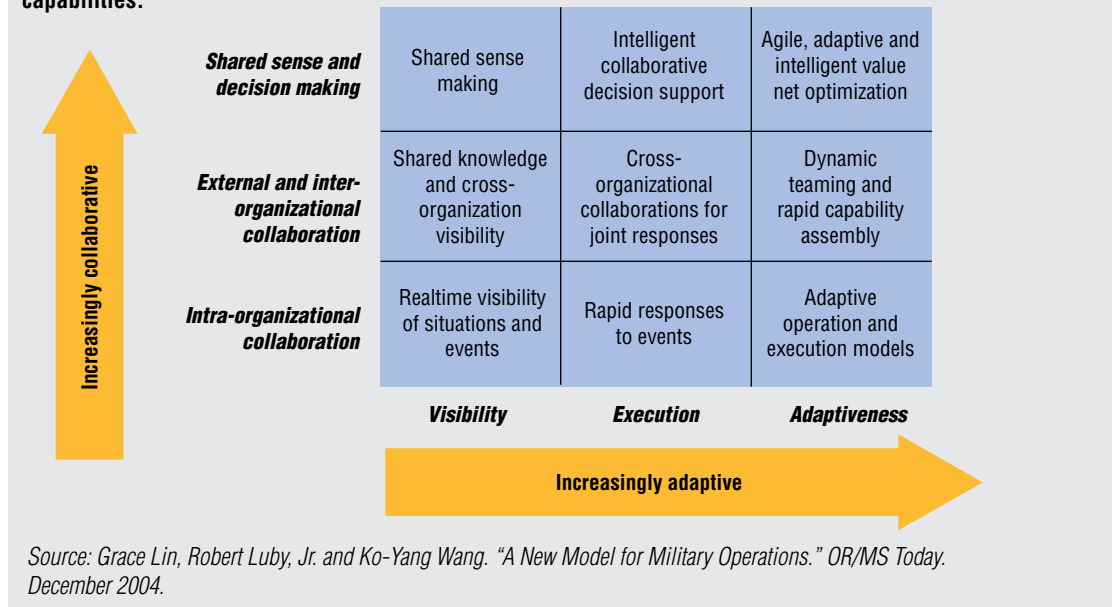
The transition to sense-and-respond is evolutionary – but it is also urgent. To be most successful, we believe militaries must evolve along two trajectories at once – becoming increasingly collaborative and increasingly adaptive (see Figure 1).

Improvements in logistics begin with having realtime visibility into what is happening across the entire organization: where inventory sits at any given moment, what equipment is working and what is not, what is being consumed and what is sitting idle. When a common shared logistical picture is not available, organizations waste time and money trying to compensate.

For instance, let's say a military unit in the field needs a part to repair a vehicle. The supply sergeant submits a requisition for the specific part. Then she waits (and waits) to hear back from the inventory control point. Meanwhile, the urgency of the request rises because two more of the unit's vehicles have been irreparably damaged. The sergeant submits another requisition with a higher priority, hoping to drive a quicker response. As the urgency of the request escalates, the sergeant resorts to informal methods, such as contacting all adjoining units in search of the badly needed part. One nearby unit has a spare, which it sends to the sergeant's unit and then submits a requisition for a backfill. Now, we have three requests – two of which are being shipped to a unit that no longer needs the part.

FIGURE 1.

A maturity model provides logistics organizations with a roadmap for building improved sense-and-respond capabilities.



In this kind of low-visibility environment, informal swapping and hoarding are common consequences. A sense-and-respond system, on the other hand, would have known – because of realtime visibility – that an extra part was close by, transferred it right away and issued the appropriate restocking requisition, without all the costly chaos.

With a realtime visibility foundation in place, defense organizations can begin to move horizontally across the maturity model – responding rapidly to what they see, and eventually adapting their operations in realtime based on what they are learning. For example, imagine a brigade task force has been sent on a two-part military mission. After taking the main objective, the commander only has a few minutes to decide whether to continue with the follow-on objective.

As it turns out, in accomplishing the main objective, the unit has consumed more resources than originally planned. Rain brought muddy terrain, causing vehicles to use greater amounts of fuel; and because the battle was more ferocious than expected, significantly more rounds of ammunition were expended. However, because the commander is operating in a sense-and-respond environment, complete with sensors that detect ammunition expenditure and fuel consumption, he knows precisely what resources remain. Since he's working with adaptive systems that have recalibrated to account for his current situation – muddy terrain and different enemy fighting tactics – he also knows what it will likely take to accomplish his follow-on objective. Through sense-and-respond, this commander is able to make a more accurate go/no-go decision.

Turning aspiration into reality: Onboard information systems

IBM, in partnership with the National Automotive Center, has created an in-vehicle data management system that informs a variety of management systems used by commanders and logistics managers. Simply put, the onboard information system (OBIS) enables moving platforms, such as trucks, aircraft or combat vehicles, to “report in” to operations centers, motor pools or other locations in realtime. Many of its features are direct enablers of sense-and-respond logistics, including:

- **In transit visibility of cargo and personnel** through self-interrogating radio frequency identification (RFID) capabilities
- **Simultaneous transmission of platform condition and logistics data** to multiple systems and echelons of command
- **Predictive maintenance through embedded module** that reads vehicle sensors
- **Remote diagnostics** that allow combat repair teams to analyze problems and equip themselves with the right parts and tools before deploying on repair missions.

Returning to our maturity model, organizations should also be simultaneously maturing along the vertical axis. At the outset, realtime visibility allows collaboration within the bounds of a particular organization. Then, organizations begin to share information and coordinate activities with other organizations. Eventually, this collaboration deepens to the point that information is interpreted with a collective mindset and decisions are made jointly.

Think about the type of response to catastrophic natural disasters, such as Hurricane Katrina or the South Asian Tsunami, that could be orchestrated if the major organizations

Moving toward sense-and-respond involves a dual challenge: becoming more collaborative and more adaptive.

involved had integrated sense-and-respond capabilities. To begin with, a Joint Task Force Commander might identify and dispatch scarce reconnaissance assets to gain an accurate assessment of the magnitude of damage. Because communications systems are linked, all responder organizations have simultaneous access to this information – each for their own purposes. The commander has visibility to thousands of deployable troops across various chains of command – and even volunteers.

Despite separate procurement systems, the commander sees a unified view and can coordinate ordering, transportation and distribution of supplies through the most efficient and expedient means possible, regardless of organization. The collective resources of the suppliers that provide products to each branch of the military can all contribute to the disaster response. As first responders arrive, they know the precise location of food, water, clothing, vehicles, doctors and even hotel rooms.

Search and rescue operations – although performed by different teams – are synchronized to avoid any omission or unnecessary duplication. Deployments are optimized so that units with special capabilities are sent where those skills or equipment – for instance, military police, divers with deep-water expertise or heavy-lifting equipment – are needed most. The coordinated response is swift and complete. But most importantly, it saves lives and reduces the suffering of those that have been devastated by the disaster.

As logistics organizations reach the upper right cell of the maturity model, interrelated organizations are all optimized and adapted collectively as an integrated network of operations. Here's how that might look in action: A marine – deep in enemy territory – lases an enemy tank, providing its exact location coordinates to the joint task force commander hundreds of miles away. At his fingertips, the commander has up-to-date status information on *all* firing platforms within his area of responsibility, regardless of which branch of the military “owns” each asset. He knows their location, condition, historical accuracy and more, and he also knows the logistical and operational impact on other units should he choose to use a particular platform.

Thanks to his sense-and-respond environment, the joint forces commander can easily identify the best resource available for immediate engagement. The system presents him with a prioritized list of available weapon systems that could service that particular target; the prioritization considers many factors, including the realtime status of weapon systems across all branches of the military, as well as historical patterns of successful engagements in similar circumstances. With ready access to accurate information across his entire span of control, the commander can respond rapidly to a momentarily available strategic strike opportunity.

For the military, this is the heart of sense-and-respond logistics. It is the point where logistics operations, as a whole, are fully optimized and adaptable – and can contribute most significantly to successful missions.

What characteristics define sense-and-respond logistics?

Once a military logistics organization matures into a sense-and-respond organization, what does it look like? How does it function differently? How does sense-and-respond affect everyday activities?

We believe sense-and-respond manifests itself in several key ways:

Shared situation awareness – In a mature sense-and-respond environment, all leadership levels – from joint command to mobile bases to field commanders – see the same set of information (in keeping with authorized clearances). This shared view provides total visibility of the location and state of all resources – from troops to trucks to tissue boxes. Though it may seem far-fetched, technology exists that can track vehicle fuel levels, meals in stock, bullets fired and even the life left in a battery. The kind of visibility we're discussing is not an isolated snapshot within a particular silo; it's an integrated, constantly updated perspective that spans all branches of the military. The view also extends to the "last mile," from in-theater distribution centers to the war-fighter. Though sense-and-respond provides the ability to track shipments for their entire journey from factory to foxhole, it may have its greatest impact in the last leg. Here in the shifting operational environment, the unexpected is more likely to occur, and realtime visibility is sorely needed to make sure the right shipments arrive at the right unit at the right time. Realtime visibility also allows realtime adjustments. This means a high-priority requisition could be fulfilled by shipments already en route from in-theater distribution centers.

Better decision support – With a realtime, holistic view, commanders can make more accurate decisions. Sense-and-respond is about reducing uncertainty, and thereby reducing risk. No longer are commanders left to search out answers manually or, worse, guess; they have the information they need at their disposal.

More effective collaboration and coordination – Shared awareness allows logistics support to be far more effective, particularly in joint operation situations. Why send separate deliveries to air and ground forces when both are situated in the same location? Since decisions are made based on a complete picture, the military's collective war-fighting capability can be optimized. As collaboration increases, it also prompts process standardization and shared administration across military silos, thereby reducing costs for all.

Self-synchronization capabilities – Unlike most commercial logistics organizations, which operate in a relatively static supply network, military logistics organizations are shipping to units that change composition and location frequently. Therefore, in a sense-and-respond logistics organization, information and actions must be recalibrated as the environment changes. For instance, if a field unit places an order and is redeployed before it arrives, the system recognizes that fact and automatically adjusts. This kind of mid-stream adjustment is not simple; it could involve redirecting a shipment that is already in transit, changing a ground shipment to an air drop or modifying how an order is packaged or combined with other deliveries.

A sense-and-respond organization has a shared view of any situation, collaborates effectively, synchronizes in realtime, moves faster and adjusts dynamically to the inevitability of unexpected changes.

Faster speed of execution – Sense-and-respond facilitates horizontal collaboration among organizations, which helps the military avoid costly delays that often result from the numerous decision layers inherent in its command-and-control systems. Routine decisions are automated. Even complex decisions are accelerated because officers – at all levels – have a realtime, consolidated view of the information they need.



Dynamism – Sense-and-respond logistics allows for rapid reconfiguration of business rules, process flows and decision-making models based on realtime events in an extremely dynamic environment. Take inventory restocking levels as an example. If the system detects a higher than normal frequency of requisitions for a particular item, it could update deployment planning models and recommend a higher level of on-hand inventory for that item. In effect, sense-and-respond capabilities act as a trigger, causing realtime changes in demand to be integrated into demand plans as they occur. All participants in the supply chain are able to update their demand plans at the same time. Thanks to end-to-end visibility, out-of-threshold imbalances are detected before it is too late and a steady supply of vital materials can be maintained. This realtime demand data, when coupled with historical information and future indicators, allows organizations to make forecasting algorithms more accurate on a continuous basis.

Progress is possible despite complexity

Because militaries are among the world's largest and most complex organizations, leaders are often daunted by the idea of change on such a massive scale. But progress is possible – even for large, complicated organizations.

Consider the case of IBM. Although it is not as large as the entire U.S. Department of Defense, it is bigger than most countries' defense organizations and is roughly the same size as the individual branches of the U.S. military. For instance, IBM is comparable in size to the U.S. Navy (see Figure 2).

FIGURE 2.
IBM is similar in size to the U.S. Navy.

		
Where it ranked/would rank in 2006 Fortune 500	10th	8th
2005 revenue/budget	US\$91.1B	US\$131B
2005 supply chain budget	US\$38B	US\$31B

Sources: "Fortune 500: Our annual ranking of America's largest corporations." *Fortune*. April 17, 2006; U.S. Department of Defense annual budget reports, 2001-2006; IBM analysis.

Despite its mass, IBM has steadily become more nimble, flexible and adaptive over the last decade. In the logistics area, its improvements have been extensive. The company's 1990s cost structure, which was predominantly fixed, has migrated to one that is significantly more variable. For instance, fixed spending for high-volume systems manufacturing was reduced by 33 percent over 3 years, and logistic warehousing went from wholly owned to 100-percent vendor managed. As of 2005, inventories were at historic 30-year lows.

From a procurement perspective, IBM has reduced its overall number of suppliers by half – and decreased non-strategic suppliers by some 80 percent. Maverick buying is down from a high of 35 percent to less than 0.2 percent.

Equally important, the changes that generated all of this business value also benefited clients. By 2004, the company was processing orders 32 percent faster. The supply chain improvements are also allowing IBM sales teams to be more productive. In 2003, sales teams reported spending 20 percent of their time on supply chain activities – for instance, checking the status of orders or investigating billing questions. By 2004, that figure had been reduced to 15 percent – giving teams more time to spend with clients.

“We started on this road early, not necessarily because we had great vision or insight but because we had a great need.”

– Gary Smith, Vice President, Global Logistics, IBM Integrated Supply Chair⁵

Some could argue that the nature of IBM's business is less complex than that of the world's military powerhouses. However, there are parallels. Based on sheer size, IBM serves as an interesting case that provides evidence of sense-and-respond logistics feasibility.

Making your move

The current challenge to military leaders is to move aggressively toward an integrated supply chain that is synchronized and effectively leveraging the tools and techniques of sense-and-respond logistics. So, where should you start? What are the risks? What is the most practical way to proceed?

Based on IBM's own experience and that of our clients, we recommend that military leaders consider the following ten actions as they move into a more integrated environment and apply the tools of sense-and-respond:

- *Start with procurement.* Analyze spending across the organization. Look for ways to centralize procurement efforts and leverage your full organizational buying power. Optimize the whole instead of separate branches of the service. For an organization the size of the U.S. Department of Defense, even a conservative estimate of savings can be substantial (a 2-percent procurement savings at the DOD would equate to US\$150 million in 2005 and US\$2.3 billion by 2009). For many organizations, successful initial results in procurement provide an immediate “win” and can often fund further investment in efficiency.
- *Make global logistics a state-of-the-art process.* The entire logistics infrastructure should be scrutinized from the standpoint of performance, integration with suppliers and customers, and return on assets.

**As militaries
contemplate their next
move toward sense-
and-respond, we offer
ten possible actions for
consideration.**

- *Develop a deep understanding of demand.* Many private-sector companies have clearly demonstrated that a deep understanding of demand is the foundation for greatly improved performance. Implementing an aggressive “on demand” strategy positions an organization to respond with speed to shifting customer demand and emerging threats.
- *Tap talented leaders.* Creating an integrated supply chain, conducting serious demand planning analyses, significantly changing the logistics structure are all difficult and complex efforts. Aggressive and talented leaders are required to develop and deliver this challenging agenda. Such an approach requires new skills and different experiences as supply chains are managed in a more interactive fashion.
- *Build momentum.* Take advantage of the initial gains in procurement, the improved logistics infrastructure and the deeper understanding of demand to establish organizational buy-in and create the momentum necessary to develop a more comprehensive agenda. Success comes with continuous evolution in the processes you implement.
- *Exploit pockets of excellence.* Search out supply chain best practices in individual units and apply them globally across the organization. This identification process should be a regular reconnaissance mission – not a one-time effort.
- *Examine processes closely.* Identify the core supply chain processes and the strategic goals associated with each process. Begin the conversation regarding which processes are strategic and which are candidates for possible outsourcing, teaming or external collaboration.
- *Establish metrics and measure results.* Supply chain metrics should be derived based on the strategic plan. Every part of the organization must clearly understand how the metrics are derived and interpreted. Use a structured approach to identify the goals and metrics and cascade throughout the organization.
- *Make the organization match the strategy.* Consider any organizational best practices identified as a “pocket of excellence” above. Discuss with the leadership team the issues regarding centralization versus decentralization. Force the team to view the supply chain from an end-to-end, network centric operations perspective and make the necessary organizational changes to enable updated processes and achieve established measurement targets.
- *Think globally.* Identify opportunities presented by the global environment. For instance, evaluate the possibility of joint procurement programs that span multiple nations’ military organizations. Or, investigate how you might bring allies into a common sense-and-respond network.

After you have achieved some early success in the procurement arena, most of the remaining activities in this list can, and should, be pursued in parallel. These actions should also be considered iterative – repeated on a regular basis to continuously refine your strategy for moving toward sense-and-respond logistics.

Conclusion

For defense organizations today, logistics is, quite literally, a mission-critical function. Military missions simply cannot be effective without adequate logistical support. Unfortunately, for many organizations, lagging logistics capabilities hamstring operational execution.

We believe that emerging technologies and techniques hold great promise for military logistics. These advances can help defense logistics organizations become increasingly collaborative and adaptive, and ultimately

reach a state where they can take action as soon as conditions change. In turn, these new sense-and-respond logistics capabilities can offer military leaders the information and decision-making superiority that they sorely want to accomplish their missions efficiently and effectively. Given the nature of modern warfare, it becomes imperative to address logistical and procurement issues with an enormous sense of urgency. The good news is that the insights needed to accomplish that task are understood and feasible.

About the authors

Dr. Alberto Castano-Pardo has many years of experience as a consultant in the IBM Supply Chain Practice focused on application of Operation-Research principles to the enhancement of capabilities in performance management, collaboration, forecasting and scheduling. Prior to joining IBM, he produced patented work for the semiconductor industry through the implementation of advanced intelligent systems in production facilities. In the public sector, he has contributed to studies on spare-parts management, network-centric-operation models, economic models for the evaluation of highway construction and improvement, and game-theoretic models for highway cost allocation. Dr. Castano-Pardo can be contacted at acastano@us.ibm.com.

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