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# SENSE AND RESPOND: AN EMERGING DoD CONCEPT FOR NATIONAL DEFENSE

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Sense and respond is a concept that is emerging from the context of the network-centric environment. The relative unfamiliarity of this concept within much of the defense community suggests that its meaning and necessity are not completely understood. To help make sense and respond less a catchphrase and more a well understood concept, the text that follows will address: what the term sense and respond means, why it is important to our national security, and its relationship and application to the logistics community. The goals of this article are to provide the reader with a fundamental understanding of the sense-and-respond concept and promote greater dialogue among a larger group of interested parties on this concept.

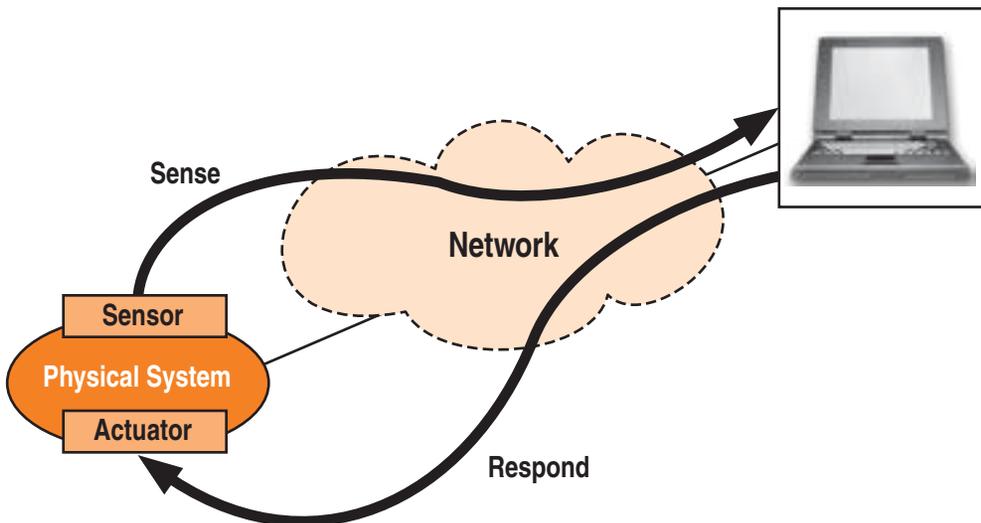
**S**ense and Respond (S&R) is a business strategy that is being incorporated for military use in a network-centric environment. The developer of S&R, Steve Haeckel, the director of Strategic Studies at IBM's Advanced Business Institute, adopted this system approach to meet the competitive challenges of the marketplace (Menotti, 2004). Business in the information age, he argues, must respond quickly as an adaptive system to ever-changing, unpredictable customer requests. *Knowing early* and *managing-by-wire* are the cornerstones of this business strategy. The former is getting the jump on the competition, while the latter is using advanced information technology to do so nearly instantaneously. Knowing what is next on the business horizon and having the ability to rapidly adapt a business strategy based upon lightning-speed information being received from the market environment, improves both responsiveness to customers and business performance in the competitive market place. According to now-retired Navy Captain Linda Lewandowski (2003), it is this managerial framework, established by IBM and now being adapted for military

application, that is at the heart of network-centric application and theory. According to Lewandowski, key ideas of S&R include:

1. Demand is ultimately unpredictable, so success depends on speed of pattern recognition and speed of response.
2. Organizations are prearranged in modular business units that can negotiate with one another over commitments.
3. Networks are self-synchronized via a common environment and shared set of objectives.
4. The supply chain is flexible.
5. Information Technology (IT) support enables data sharing, “knowing earlier,” commitment tracking, and role reconfiguration.

Authors Al-Hammouro, Liberatore, Al-Omari, and Phillips (2005) point out that “Networked S&R systems extend human reach beyond temporal and spatial barriers. Remote physical environments can then be monitored, controlled, and affected through communication networks.”

The two business tenets of S&R, knowing early on and managing-by-wire, can be adopted for use by the military. Similar to the commercial-business environment, the military is also increasingly confronted with a fast-changing, unpredictable, technologically sophisticated global threat. A military that can readily adapt, acquire,



**FIGURE 1. SIMPLEST EXAMPLE OF S&R SYSTEM (WITH A FEEDBACK LOOP BETWEEN SENSE AND RESPOND) (GARSTKA & ALBERTS, 2004)**

and assimilate information ahead of its adversaries will have the ability to control and dominate the enemy regardless of the type and location from which the threat is being received. The network-centric environment of the military provides the technical framework and resources to receive information early on and to manage that information electronically. This improved networking-communication system can lead to better information sharing and enhanced shared situational awareness (Army Business Transformation Knowledge Center, 2006). It can also improve the quality of decision making. Therefore, within the defense community, the concept of S&R has significance beyond the use of advanced technology. Its primary functions are leadership, decision making, and empowerment.

In a network-centric military environment that applies the S&R approach, the nature of leadership takes on a specific characteristic. Leadership does not effectively occur in a hierarchical structure, but rather occurs in a flatter organizational structure and is collaborative in nature. In networked structures, complex problems are solved by people from diverse organizations working together in ad hoc and sometimes virtual teams. Decision making is distributed throughout the organization. There are few formalized rules and procedures regulating behavior. As summarized by Garstka and Alberts (2004), “Individuals in these organizations come together to solve a particular problem or set of problems. Their interactions are guided by the nature of the problem, which determines the makeup of participants based on their different expertise.”

With respect to the type of decision-making authority mentioned above, Garstka and Alberts (2004) note that:

Rather than relying on rigid and formalized rules and regulations, these organizations will be characterized by a much more dynamic and evolving rule set. Individuals will need to be able to form appropriate bonds and identify with a variety of groups, from ad hoc co-located teams to virtual teams and networks of teams. Status will necessarily result from performance as very few roles will endure long enough to have institutionalized reputations. Importantly, these new organizational structures will require a synchronous perception of time; multitasking being the rule not the exception. Authority will be distributed rather than centralized and finally, the orientation toward the environment will shift from one based on control to one based on adaptation.

Furthermore, Al-Hammouro, et al. (2005) state that:

[The] S&R control environments can differ radically in complexity and in applications. Such environments can range from simple linear systems as in the case of a thermostat to very complex ones, which might include systems of subsystems, as in the case of unmanned autonomous vehicles (UAVs) and in the case of value-chains in manufacturing. Moreover, some systems may include different

hierarchical levels of complexity abstraction. For example in UAVs, there are several hierarchical levels. At the lowest level is the direct force level. At this level, the on-board controller issues tasks, such as rotating motors forward or reverse, based on feedback information supplied by sensors (this represents local S&R). At the highest level of abstraction are software agents. Software agents carry out high-level tasks, and are responsible for coordinating multiple UAVs into task-oriented teams, which can have impact on different applications, e.g., military transformation. On the other hand, an online auction S&R system would comprise only the software-agent level.

Agility is a prominent feature of the sense-and-respond concept, much as it is for network-centric warfare. By closely examining the definition of agility, we can quickly come to understand that there is a symbiotic relationship between agility and empowerment: “Agility provides the ability to be effective in changing, nonlinear, uncertain, and unpredictable environments. Agile organizations are the result of an organizational structure, command and control approach, concepts of operation, supporting systems, and personnel that have a synergistic mix of the right characteristics. The term agile can be used to describe each component of an organization’s capabilities and/or an organization that can instantiate many different mission types” (Garstka & Alberts, 2004, p. 21). A 2005 Rand study of network-centric operations provides many threads of discussion which suggest that the implementation of S&R in an operational environment is, to a high degree, predicated on empowering soldiers throughout the brigade with decision-making authority. The study notes that “the [situational awareness/situational understanding] afforded platoon leaders and commanders by the lower [Tactical Internet] and Force XXI Battle Command Brigade and Below (FBCB2) [gave them] the ability to maneuver their forces and close with and destroy the enemy during urban operations” (Gonzales, et al., 2005). The author goes on to state: “An important hypothesis captured by the NCO CF (conceptual framework) is that individual and shared sense-making are improved by the quality of interaction supported by the network.” This quotation suggests that command decisions are knowledge-based and demand-driven, and “depend on highly adaptive, self-synchronizing, and dynamic physical and functional processes, employing and enhancing operational cognitive decision support” (Office of Force Transformation, 2005). The type of speed and recognition required of S&R needs an empowering organization structure, a structure that is atypical of decision-making processes within most Department of Defense organizations.

## THE IMPORTANCE OF SENSE AND RESPOND

The reality of 21st century warfare is that it can occur at any place, anywhere, at anytime, and take many forms. The rules, norms, and expectations of warfare are highly unpredictable. The Office of Force Transformation (2003) states that there is an:

Emerging global security environment [that] represents a new set of challenges and threats, and fundamentally changes the rules of how America fights its wars. The new threats are broader and include global, regional, and local elements. They are non-state, multi-dimensional, flexible, distributed, information aware, and rapidly adapt to U.S. strategies and tactics. They are unconstrained by the values that guide America’s approach to warfare. Increasingly, these threats have at their disposal asymmetric, inexpensive, and competitive methods of creating large-scale effects.

This new global security environment is complex and highly unpredictable. Threats to U.S. security may be rooted in international organizations, nation states, rogue states, terror organizations, or any combination thereof (Office of Force Transformation, 2004a). Our survival depends, to a high degree, upon our ability to quickly adapt and appropriately respond to one or more of the changing challenges discussed above. The S&R system provides the technology, information, organizational structure, and cognitive speed and effectiveness to prevent minor threats from such entities turning into large-scale destructive action against the United States. Since the speed, intensity, and nature of the threat is highly unpredictable, our response capability has to be extremely agile. This agility requires “system” response at the Joint military level. “Sense and Respond is a transformational network-centric concept that enables Joint effect-based operations and provides precise, agile support” (Office of Force Transformation, 2004a, p. 3).

**TABLE 1. DISPLAY OF S&R LOGISTICS ATTRIBUTES**

<b>FOUNDATIONS FOR S&amp;R</b>	<b>GUIDING PRINCIPLES FOR JOINT LOGISTICS AND DYNAMIC ADAPTABLE OPERATIONS</b>
Dynamic adaptation of logistics support, using situation and commander’s intent-adapted business rules, risk thresholds, and multidimensional situation-relevant metrics	Emphasize achievement of commander’s intent with speed and quality effects
Integration of operations, intelligence, and logistics functions and activities	Enable and sustain effects-based operations, using reconfigurable joint/allied/coalition/treaty organization force capabilities as building blocks
Total situation awareness: dynamic knowledge of evolving commander’s intent, strategic, operational, and tactical situation, the global and local environment, and logistics and force capability status	Provide risk-mitigated situation-aware preparedness, readiness, deployment, employment, and sustainment options to the commander across the full range of military operations
Functions and activities governed by business rules that respond dynamically, in real time, to total situation awareness	Replace the cyclic nature of planning and execution with a continuous application of total situation awareness to current and future operations
Rule-based risk-assessed and mitigated dynamic adaptation of functions, activities, processes, organizations, supply, and support	Eliminated process lines, structural lines, organization overhead, and constraints

**TABLE 1. DISPLAY OF S&R LOGISTICS ATTRIBUTES (CONTINUED)**

<b>FOUNDATIONS FOR S&amp;R</b>	<b>GUIDING PRINCIPLES FOR JOINT LOGISTICS AND DYNAMIC ADAPTABLE OPERATIONS</b>
Cognitive decision support that is knowledge-guided, recognizes patterns and anomalies, and mines feedback and experience to adapt operations	Provide deterrence and alter initial conditions by developing kinetic and potential force capabilities relative to a potential adversary's courses of action to: deny benefits, impose costs, and induce restraints
Network-centric operations and warfare as an operational concept and as an infrastructure, including provisions for robust, secure, agile, and assured operations, and operations when network resources are scarce	Support expeditionary force projection and application for all military operations, emphasizing force-to-object maneuver
Coordination, collaboration, and coherence of operations through robust interfaces and shared knowledge across military domains, in multinational operations, and with government, civilian, and private organizations	Provide logistics for force capabilities from the point of effect to the source of support, using autonomous, peer-to-peer, and brokered demand and supply
Management of strategic, operational, and tactical envelopes of operations coordinated among the operations, intelligence, and logistics domains through common understanding of commander's intent and the situation	Embed evolutionary development of doctrines, tactics, techniques, procedures, and organization into the adaptation of functions and activities
Broadened asset visibility across: functions; services; multinational partners; government, non-government, and private agencies; the CONUS/OCONUS sustaining base; commercial and opportunistic sources of supply and services; and captured and confiscated resources	Dynamically adapt current and future operations to respond to evolving commander's intent and to the known and anticipated status of situation, environment, and force capabilities
Proactively sustain and support the force, using knowledge-guided adaptation, prediction, and anticipation to preemptively prepare and provide logistics resources	Defeat with modest forces (economy of power) and modest reinforcement (demassification)
Management of the mosaic of logistics resources and force capabilities and response to demand and events using advanced information technologies	Increase speed of command, accommodate dispersed, distributed forces, manage high rates of change, and respond to closely coupled events
Dynamic adaptive command and control, using business rule-adapted, coordinated, synchronized event processing, data/information/knowledge development, awareness, and sharing, and collaborative functions and activities	Accommodate the compression of (and simultaneous distributed response to) the strategic, operational, and tactical levels of war, including non-contiguous, non-linear operations
Tailored, precise logistics enabled through global situation awareness and knowledge of commander's intent, and local optimization of resource allocations, distribution, and employment	Support precision engagement/strike, decisive coercive operations, adaptive warfare, operational/tactical agility, and integration of offensive and defensive operations

Table 1 is a display of S&R logistics attributes. It indicates, among other things, that S&R is a concept that is applicable to all units and troops engaged in activity within the network-centric, joint battle space. Of equal importance, Table 1 underscores the fact that logistics is now an integral part of the warfighters' operational and tactical planning and execution (Office of Force Transformation, 2004b).

## APPLYING SENSE AND RESPOND APPLICATION TO THE LOGISTICS COMMUNITY

The logistics community must be prepared to meet the full range of military operations with the speed and agility that is expected from the warfighter. It must be able to distribute “guns, bullets, bread, and butter” and adapt its activities and support to quick, ever-changing threat environments. Lewandowski (2003) points out that “Hierarchical, stovepipe logistics chains cannot support distributed, adaptive operations.” The S&R for the logistician means that logistics support has to be push-and-pull in nature. Push requires anticipating where the forces will be and delivering the right configured package in the right place, at the right time, in the right amount. It is more than just-in-time, total asset visibility. It requires logistics to function as an integral part of a system. The very S&R system that jump-starts our military into action must be utilized by the logistician to support the commander's intent. As the fighting force becomes lighter and more agile, the effectiveness and efficiency of logistics should follow in kind. It must be flexible, agile, and fast. The logistics tail and footprint have to be significantly reduced in order to support and sustain the troops.

### SENSE-AND-RESPOND LOGISTICS

Sense-and-Respond Logistics (S&RL) is a transformational network-centric concept that enables joint effects-based operations and provides precise, agile support. The S&R Logistics relies upon highly adaptive, self-synchronizing, and dynamic physical and functional processes. It predicts, anticipates, and coordinates actions that provide a competitive advantage spanning the full range of military operations across the strategic, operational, and tactical levels of war. The SR Logistics promotes doctrinal and organizational transformation, and supports scalable coherence of command and control, operations, logistics, intelligence, surveillance, and reconnaissance.

Implemented as a cross-Service, cross-organizational capability, S&R Logistics provides an end-to-end, point of effect to source of support networks of logistics resources and capabilities. Within S&R Logistics, every entity, whether military, government, or commercial, is both a potential consumer and a potential provider of logistics. It delivers flexibility, robustness, and scalability for joint expeditionary warfare through adaptive, responsive, real-time, demand and support networks within U.S., allied, and coalition operations (Office of Force Transformation, 2004, p. 5).

As indicated by the Office of Force Transformation (2004c), “Sense and respond logistics will focus logistics support towards direct correlation to total situation awareness. It will anticipate and proactively support future operations, and predict future situations.” The ability to manage-by-wire will help fulfill the commander’s intent. By fully integrating logistics with operations and intelligence assets, logistics resources can be better exploited. These resources will be based on the commander’s intent, and will reduce risk and uncertainty of delivery and support as the redundant iron mountains of equipment and supplies give way to precisely tailored packages distributed by a transportation network that can transverse the full spectrum of the battle space.

The S&R Logistics Concept is based upon the power of the network (Office of Force Transformation, 2004a). It uses networks to support distributed, adaptive operations in a seamless and highly flexible manner. It is a transparent logistics system that the warfighter can depend upon and trust to deliver supplies and

**TABLE 2. LOGISTICS: PRE- AND POST-TRANSFORMATION**

<b>PRE-TRANSFORMATION</b>	<b>POST-TRANSFORMATION</b>
Linear	Nonlinear
Chains	Networked
Use-Based	Effects-Based
Service Stovepipes	Cross-Service Mutual Support
Functional Stovepipes	Cross-Enterprise
Title Ten-Driven	Joint Logistics
Pre-Planned	Dynamic Continuous Planning and Execution
Poor Ops/Log ISR Integration	Net Warrior Ethos
Reactive	Anticipatory
Parametric Analysis-Based	Collaborative
Hierarchical	Networked
Monolithic	Distributed, Modular
Poor Scalability	Dynamically Scalable
Not Flexible	Flexible
Consumption-Based	Adaptive, Cognitive
Mass	Speed of Effect
Attrition	Effects-Based
Service Perspective	Joint Coherence
Efficiency	Effectiveness
Highly Optimized	Effective
Brittle, Rigid Supply Chains	Robust, Flexible Demand Networks

munitions to project power and sustain their mission. Table 2 indicates how S&R Logistics will change the manner in which logistics will function for the greater part of the 21st century. In the post-transformation environment, stovepipes become a relic of the past. Logistics, as with warfighting, will become a joint endeavor. Networking will be the glue that will successfully implement cross-Service and cross-enterprise support.

The lightning speed at which this responsive, collaborative, anticipatory logistics system must function requires a network-centric communications system. This system must be extremely robust and highly tolerant of nonlinear, nonhierarchical communications for planning and logistics support for a broad range of missions anywhere in the world.

### THE FEASIBILITY OF IMPLEMENTING S&R

The feasibility of implementation of S&R is closely related to the necessity for implementation. The former Army Chief of Staff, General Eric Shinseki, recognized that the threat to U.S. national security is taking on a radically different form in the 21st century. Our forces have to be fast, agile, and highly mobile to respond to unpredictable sources of threat, regardless of their source. Network-centric technology, and in particular S&R operations, can enable such forces. Therefore, S&R feasibility is closely linked to force transformation and associated strategic, operational, and tactical operations in a joint warfighting environment.

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The S&R and the lighter, more agile force envisioned by General Shinseki are designed to work together. Both are complex to implement. The technical training associated with both is unprecedented. Both require a well educated workforce that has received extensive training in both warfare methodologies. In addition, the active and reserve components must be trained to the same degree and in the same manner. One important lesson-learned from our current military operations in Iraq is that the active force has been better trained to use advanced technology than their reserve component counterparts. The reserve forces often receive their first exposure to advanced technology shortly after their arrival into the theater. The S&R tactics and technology promise to be considerably more complex than much of the advanced technology currently being used in Iraq. The military op-tempo is expected to continue well into the future, suggesting that active and reserve forces will continue to be deployed together throughout the world.

The demographic and geopolitical backdrop of this situation is grounded in predications that indicate the global population will grow from 6 to 8 billion by 2025, which will help to accelerate international migration that will, in turn, contribute to global nation-state instability. Other issues are predicted to contribute to global instability. For example, the current National Security Strategy Plan and National Military Strategy are written to respond to the increased fragmentation of states along tribal, religious, and ethnic lines, as well as the proliferation of new states, and the loose alignment of regional political and economic associations, such as the Association of Southeast Asian Nations (ASEAN) and Gulf Coordination Council. If this trend continues, the demand on our military forces will be the same or greater than today. To cope with the sociopolitical challenges of the 21st century, it is imperative that S&R capability be adopted. The feasibility of implementation of S&R, however, is contingent upon ensuring that there is a cross leveling of training among the active and reserve component forces.

## CONCLUSION

What has been briefly demonstrated in this article is that S&R is a viable concept that needs to be rapidly adopted in response to the diverse military challenges of the 21st century. The U.S. military has to function as a *system* in order to properly implement S&R. The decision maker must realize that S&R is not a concept to be solely implemented at the point of the spear. Logistics and related *ilities* are just as integral to the system as the combat elements. The feasibility of successfully implementing S&R is highly dependent on appropriate education and training of the entire force, requiring a great deal of time and effort that cannot take place in the battle space during the fog of war. The U.S. capability to respond decisively to the military challenges of the 21st century requires the near-term implementation of S&R. With an understanding of S&R and its relationship to national security, the logistics community, and the necessity/feasibility of application, the defense community can come a step or two closer towards developing a S&R plan for implementation.



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