# Dynamic Response Logistics:
# Changing Environments, Technologies, And Processes

A Research Paper
Presented To

Air Force ***2025***

by

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## Disclaimer

***2025*** is a study designed to comply with a directive from the chief of staff of the Air Force to examine the concepts, capabilities, and technologies the United States will require to remain the dominant air and space force in the future. Presented on 17 June 1996, this report was produced in the Department of Defense school environment of academic freedom and in the interest of advancing concepts related to national defense. The views expressed in this report are those of the authors and do not reflect the official policy or position of the United States Air Force, Department of Defense, or the United States government.

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*Logistics management* is the integrated management of the functions required to acquire, store, transport, and maintain the materiel necessary to support combat forces. The task of the military logistician is to establish the appropriate balance among these functions to achieve the required level of operational support while consuming the least amount of resources. Future logistics concepts will evolve primarily from recognition of new **environments**, **technologies**, and **processes**.

The use of self-repairing and self-reporting parts will greatly reduce both the proverbial logistics "footprint" and decrease the logistics "tail." Multiuse packaging, in which packaging combined with a catalyst produces either a fuel or food product, will reduce additional shipments of items into the theater of operations. The Battlefield Delivery System (BDS) with a standard shipping container will provide a seamless transportation system from the commercial vendor to the theater of operations.

The concept of a container aircraft will increase the flexibility of the BDS concept and become an integral part of the agile base concept, where the container aircraft's cockpit becomes a command and control center with its engines providing electrical power to the base. The Mobile Asset Repair Station (MARS) will support the remanufacture and repair of avionics and components in the theater of operations using a mobile facility with fully integrated flexible manufacturing systems and robotics systems linked to commercial manufacturers.

Logistics operations of the future will operate under an integrated, flexible, and seamless system from vendor to battlefield which will govern logistics decisions and operational strategy—a system called **dynamic response logistics**.

# Chapter 1

## Introduction

Logistics, combined with strategy and tactics, will continue to shape command planning and decisions into the future. Commanders will continue to have "the responsibility to create, to support, and to employ combat forces."[1] Logistics will play a major role in the command of aerospace forces through "the creation and sustained support of weapons and forces to be tactically employed to attain strategic objectives."[2] As Douglas Menarchik states,

> Logistics affects military strategy, military strategy affects grand strategy, and grand strategy affects political outcomes. It raises important issues for America's security policy in the post-Cold War era and is worthy of leadership interest to ensure America's logistics is in order. America and the international community need to pay more attention to logistics infrastructure, doctrine and its effects on strategy, tactics and military-political outcomes.[3]

A task at hand is to reduce the logistics "footprint" and decrease the size of the logistics "tail." This statement is easy to articulate but challenging to achieve. The paramount goal for the military logistician in 2025 is to provide a responsive, agile logistics system to support military operations in an effective and efficient manner—**dynamic response logistics**. A critical requirement for any logistics system in 2025 is that it operate similarly in both wartime and peacetime environments.

Logistics management is the integrated management of the functions required to acquire, store, transport, and maintain the materiel necessary to support combat forces. The task of the military logistician is to establish the appropriate balance among these functions to achieve the required level of operational support while consuming the least amount of resources. B. S. Blanchard states,

> The requirement to increase overall productivity in a resource-constrained environment has placed emphasis on all aspects of the system/product life cycle, and logistics has assumed a major role comparable to research, design, production, and system performance during operational use.[4]

Air and space missions and the requirement for specific types of logistics support will undoubtedly change over the next 30 years. While the future remains uncertain, a number of trends appear likely to affect the mission and logistics support areas:

- more varied, regional operations;
- potential for multiple simultaneous operations;
- increased privatization and outsourcing;
- more tightly integrated operations among the Air Force, Army, Navy, and Marine Corps.

The military logistician will respond by altering and implementing evolutionary and revolutionary logistics processes to achieve the required level of support.

**Environment**, **technology**, and **process** changes have enabled military and business logisticians to significantly increase support while achieving dramatic reductions in total cost. For example, deregulation of transportation modes in the 1970s and 1980s allowed organizations to achieve higher levels of customer service through the trade-offs of inventory and safety stocks for faster, less expensive, and more reliable transportation. Changes in technology and information management have resulted in logisticians trading "inventory for information" and using more timely information to anticipate customer requirements. Process changes have also significantly affected logistics support by reducing cycle and repair times, reducing nonvalue-added interfaces and transactions occurring among logistical functions, and more clearly focusing on those activities that provide the greatest value to the customer.

The environment, technology, and process innovation will continue to act as the major agents of change within military logistics. The environment will shape logistics practice through changes in air and space missions, resource availability, and business logistics practice. Technological changes and improved information management will allow the logistician to bring state-of-the-art decision making and hardware to bear on logistical problems. Process changes will streamline the flow of materiel from source of supply to the ultimate customer. The future logistics structure will be dominated by a "pull" process rather than the predominate "push" process in use today.

These change agents will radically alter the activities employed by the logistician to support the core competencies necessary for attaining the war-fighting commander's strategic and tactical objectives. As James Huston states in his 1966 classic *The Sinews of War*, "it is no use engaging in a dream world strategy divorced from logistical feasibility."[5] Dr. Paul G. Kaminski, undersecretary of defense for acquisition and technology, states, "What we need is vision, leadership, commitment, and stakeholder engagement on the part of the war fighters, logisticians, developers, and industry."[6]

## Notes

[1] Henry E. Eccles, RAdm, USN, *Military Concepts and Philosophy* (New Brunswick, N.J.: Rutgers State University, 1965), 67–82.

[2] Ibid., . 67–82.

[3] Douglas Menarchik, *Powerlift—Getting to Desert Storm: Strategic Transportation and Strategy in the New World Order*, (Westport, Conn.: Praeger 1993), xiv.

[4] B. S. Blanchard, *Logistics Engineering and Management*, 3d ed., (Englewood Cliffs, N.J.:  1986), 3.  Prentice-Hall, Inc.

[5] James A. Huston, *The Sinews of War:  Army Logistics*, *1775-1953,* Army Historical Series (Washington, D.C.:  Office of the Chief of Military History, Department of the Army, 1966), 663.

[6] P. G. Kaminski,  "The Revolution in Defense Logistics," prepared remarks to the 12th National Logistics Symposium and Exhibition, Alexandria, Va., October 1995.

# Chapter 2

## Changing Environments

By the mid-1990s, changes in the environment in which military logistics operates are already blooming. By 2025, the fruits of these changes will transform the current logistics system into one barely recognizable as a peculiarly military system.

The environment has been especially affected by three significant changes. First, the end of the cold war has impacted the structure of a military force which had for a generation been prepared for a global struggle against a powerful adversary, including the possibility of widespread nuclear war. Second, commercial business practices have undergone major modifications as companies have focused on quality, productivity, and international competitiveness. Finally, as a subset of business, logistics processes have benefited from greater attention paid to customer service, leaner organizations, and strategic alliances. All three changing areas will influence military logistics in 2025.

### Military Changes

With the disappearance of the Soviet Union as the United States' (US) central adversary, scenarios for future wars will likely focus on ethnically and nationalistically based regional conflicts rather than global conflicts, with the possibility of simultaneous regional conflicts. Thus the US must plan for quicker, more intense, and conceivably more lethal wars. The US may find that higher proportions of logistics needs are related to various humanitarian missions, interspersed with brief but intense sessions of supporting battlefield needs.

The US will develop dynamic response logistics support, capable of both rapidly tailoring logistics support packages to particular circumstances and responding with standardized kits for shorter, higher tempo operations. As recent US military operations have shown, there will be more work with and support from allies. However, the US must be prepared to muster a force independent of that provided by allies, either from collateral assistance by way of direct support (troops and material) or through indirect support (basing rights).

The growth of the joint responsibilities for many logistics functions—the roles of the Defense Logistics Agency in supply and distribution, the Defense Contract Administration service in contract administration, and the Defense Finance and Accounting Service for billings and payments—demonstrates an inexorable trend toward a unified and consolidated military logistics system. Only a systems approach to all military logistics operations will achieve organizational harmony and interfunctional integration to work seamlessly across the Department of Defense (DOD).

Because logistics support systems will no longer be service-, or even country-specific, all US military systems will be supported by a joint logistics system that will also be designed for compatibility with those systems operated by allies. Interoperability and interchangeability will be essential not only for major system components, but also for many of the databases and information systems used to manage materiels.

## Business Changes

The environment in which US businesses operate has changed dramatically in the last decade. A tendency toward government deregulation (especially in the transportation and communications areas), relaxed enforcement of antitrust laws, giant strides in telecommunications capabilities, widespread availability of computers, and an increasingly competitive environment have all had a significant impact on the conduct of private enterprise. Quality techniques such as "value added" have led to a reexamination of business practices and a reengineering of processes. These efforts have led to leaner and more productive organizations.

The defense industrial base in the private sector has not been spared the effects of these trends, and downsizing in defense industries has meant the loss of thousands of jobs since the late 1980s. When coupled with a result of the changed military environment, a dwindling number of weapon systems are being procured, creating a question of the viability of the US private sector manufacturing base as private defense production becomes a riskier business. Thus, principal contractors are rapidly becoming a conglomeration of airframe and electronics firms. This diminishing number of principal vendors of systems and subsystems will affect numerous subcontractors in the US industrial base, as the make-or-buy decisions of the prime contractors will lead to far fewer suppliers in the nation for subsystems, components, and spare parts.

Although the demise of many manufacturers has helped solve the problem of overcapacity in the industry, it is unlikely that weapon systems production will rise to the levels required to keep even the few remaining factories operating at efficient levels. Attempts to use foreign military sales to offset US purchases will only slightly compensate for the decline in US military procurements. Consequently, there will be greater competition for any work that may help keep the private industrial base alive. To avoid an inefficient private defense sector, there will be pressures on the organic depots, which themselves are already operating at lower levels of productivity, to release work for privatization and outsourcing. The DOD routinely reports to Congress that outsourcing to the commercial sector typically lowers costs by 20 percent.[1] This 20 percent savings would free over $3 billion per year for higher priority defense needs, such as those advocated in this paper for logistics in 2025.[2]

## Logistics Changes

New ways of doing business in logistics in the private sector have already had a significant effect on military logistics and will continue to do so in the coming years. In a study of firms rated excellent for their logistics practices, P. M. Byrne and W. J. Markham observed that logistics excellence is a management imperative for the future.[3] The benefits of logistics excellence, according to Byrne and Markham, are improved quality and service levels, faster cycle times, greater efficiency and productivity, and improved customer-company relations.[4] Practically speaking, this concept has meant developing win-win relationships with suppliers, carriers, and customers.

Logistical excellence in the future military logistics context will involve these recurring themes from the above discussion: outsourcing, strategic alliances, flexibility, focus on customer service, and state-of-the-art information technology. Adopting such a scheme means that the US must extend the concept of an integrated logistics system beyond the traditional barriers of the military logistics system to include vendors, manufacturers, and the ultimate users. Many authors have commented on the need to form strategic logistics alliances or coalitions.[5]

Military logistics uses a wide variety of unique systems, data, equipment, and materiel to support its customers. Examples include inventory management and reporting systems, military standard requisitioning and issuing procedure (MILSTRIP) formatted requisitions, specialized equipment such as forklifts and pallets tailored to specific aircraft, and the need for a variety of spare parts. These systems pose many problems even during peacetime operations. The unique systems result in redundant information systems in multiple sectors, additional time and handling of materiel, duplicate bar coding and item identification, loss of in-transit visibility, and difficulty in identifying equivalent parts or items due to the conversion from national stock numbers to manufacturers' part numbers. The system in use in 2025 must be fully integrated and streamlined with the commercial sector. This system will allow the air and space forces to obtain information directly on the status of inventory items at the commercial supplier.

The application of dual-use technologies will become increasingly critical to future logistics support due to the costs associated with specialized parts. Some unique military logistics technologies have proven costly and difficult to field, and pose significant problems when interfacing with other military services or the civilian sector. The military has also grown increasingly reliant on business logistics for the movement of materiel, and logistics processes must be able to "plug and play" with the civilian distribution systems to ensure visibility and reduce cycle time and cost.

The use of third-party suppliers of logistics that has become commonplace in the private sector in the 1990s will continue to be an attractive alternative in 2025. This concept means turning to private enterprise to provide the logistics services that have traditionally been an organic part of the military. This movement toward privatization will affect all military services, and as a common logistics structure will be sought to support the reduced DOD organizational structure. Cost-based and performance-based measures will be used as a basis for privatizing specific logistics functions. The increasing reliance on private carriers for moving military materiel, the use of commercial items, and the privatization of the depots are the harbingers of future logistics operations.

## Notes

[1] Office of Management and Budget, *Enhancing Government Productivity Through Competition: A New Way of Doing Business* (Washington, D.C.: U.S. Government Printing Office, August 1988); also Center for Naval Analyses, *Issues Concerning Public and Private Provision of Depot Maintenance*, Council of Resource Management 94–65 (Washington, D.C.: U.S. Government Printing Office, April 1994).

[2] Department of Defense, *Directions for Defense: Report of the Commission on Roles and Missions of the Armed Forces* (Washington, D.C.: U.S. Government Printing Office, 24 May 1995), 3–3.

[3] P. M. Byrne and W. J. Markham, *Improving Quality and Productivity in the Logistics Process: Achieving Customer Satisfaction Breakthroughs*, (Oak Brook, Ill.: Council of Logistics Management, 1991).

[4] Ibid.

[5] D. J. Bowersox, "The Strategic Benefits of Logistics Alliances," *Harvard Business Review* no. 4 (July-August, 1990),: 36–45; also Michael Porter, *Competitive Advantage: Creating and Sustaining Superior Performance* (New York,: The Free Press, 1985); also K. Ohmae, "The Global Logic of Strategic Alliances," *Harvard Business Review* 67, no. 2 (1989), 143–154.

# Chapter 3

## Changing Technologies

Technology advances will drive some of the greatest single changes to logistics in 2025. Technologies, especially in communication and data transmission, will change the face of logistics and make possible new organizational structures. New technologies will include many that are already in use in the civilian sector, such as FedEx's ability to monitor the delivery progress at the item level.[1] The changes in this area will be so great as to result in a qualitative difference in the way logistics is applied.

Integrating operations across distribution channels requires flexibility to switch rapidly from one mode of transportation to another based on availability of transportation and the need for assets. Inventory will be containerized and kept in motion rather than stored in a fixed warehouse. Battlefield support of the future will depend upon both military and commercial transportation built upon a network of standard shipping containers utilizing automatic identification technologies and radio frequency identification (RFI), coordinated through electronic commerce and global communications capability.

A. Braithwaite and M. Christopher discuss the need for global logistics and supply chain-management strategies, and summarize the central elements of each. They list several factors as critically important to the development of global supply chains, including extended supply lead times and uncertain transit times, multiple freight modes, and opportunities to ship intermediate components for local assembly. The greatest challenge, in their view, is to determine what information is needed for a global supply chain strategy and to use it effectively for planning. According to Braithwaite and Christopher, "the management of global logistics is in reality the management of information flows."[2]

## Information Technology and Systems

Perhaps the largest change in technology affecting logistics in 2025 will involve information technology, bringing major improvements in the management of logistics operations. Integration of information systems across the DOD will allow integration of logistics functions and processes across services. The changes in information technology will enhance the ability to monitor the location and condition of materiel at whatever level of granularity required for the given items and the situation. Information technology changes will also permit decreased inventory through increased ability to requisition materiel quickly as needed, while reducing the number of people to support this vital function. Standardized, built-in marking of acquired items will be tied to information technology to support quick identification and routing of items as satellite monitoring of location becomes routine. Consolidated information systems will allow real-time monitoring and routing of items.

Full visibility of the logistics pipeline, or complete supply chain visibility, will be coupled with more sophisticated capabilities of monitoring logistics needs. This change will result in direct delivery of needed supplies from stateside suppliers directly to the point of use.[3] The massive buildup of supplies, with a mix of known and unknown container cargoes and needed as well as unneeded items, as seen in Operation Desert Storm, will be a condition of the past. Better information will result in tailored delivery of the right supplies, at the right location, at the right time, and in the right condition. This concept will be facilitated through the use of flexible manufacturing systems (FMS) driven by computer-aided design and computer-aided manufacturing (CAD/CAM). Warehouses full of excess, obsolete assets have no place in the logistics system of the future. This outdated concept of "just-in-case" inventory control will no longer be feasible in constrained budgetary climates. Instead, items will be produced on demand from information stored in databases especially designed to support FMS machine tooling and set-ups, and free-form manufacturing.[4]

Innovative applications of the new information technologies in the areas of logistics management will impact logistics support in 2025 at all levels of the logistics process from how logisticians are internally organized (micro) to how they interface with other organizations (macro). At a macro level the continuing confluence and merging of computers and communications is changing how organizations are economically organized. Modern information technology reduces transaction costs and hence makes it more economical to use market forces rather than internal and organic processes to acquire and deliver logistics support.

Information technology is also giving rise to new organizational structures referred to as virtual corporations or networked organizations. Commerce through the Internet is exploding as the Internet is commercialized and new economic structures (such as electronic virtual money) are developed to facilitate such transactions. Electronic markets are forming to facilitate the distribution of spare parts in the airline and automobile industries. Through these developments, a more direct contact between the units in the field (customer) and the ultimate supplier will be realized.

At the micro level, information technology is revolutionizing how logistics support is delivered in the field. Revolutionary technologies, and their equally revolutionary application, such as virtual reality (VR), genetic algorithms, fuzzy logic, neural networks, and artificial intelligence robotics, will dramatically change how and where logistics support is provided. Not only will VR be used to develop and test logistics maintenance procedures and to train technicians, but when combined with adaptive programs in the form of artificial intelligence, maintenance will be remotely provided with minimal direct human involvement. These technologies combined with robotics will make space logistics truly feasible.

Robots will be placed in space controlled by software that can learn and adapt as it gains experience. This capability combined with VR can easily lead to remote maintenance of satellites. This concept is a further adaptation and refinement of a similar idea highlighted in *SPACECAST 2020*.[5] Adaptive robots can, on their own, learn to diagnose and perform most maintenance functions, and this intelligence can also be used as a buffer (along with VR) for time lags in communications between satellite orbits and the earth's surface. VR would allow maintenance troops on the surface to "follow" robotics maintenance actions instead of waiting for direct signals from space to confirm what actions are taking place. VR would also reduce bandwidth needed; the only required signal would indicate actions taken by the robot. Hence, there would be no need to send visual images, because VR will provide visual realization. Reduced signal requirements would in turn mean quicker updates and reduced time lags due to processing.

Through revolutionary advances in information technology, more "smart" parts will be developed in the future. Recent work in the area of miniaturization has highlighted the feasibility of installing smart chips onto components.[6] Smart chips built into a part will track operating hours and current condition, as illustrated in figure 3-1. Not only will these smart parts diagnose themselves, but they will order their own replacement parts if the damage cannot be repaired. These "self-reporting" parts will have the capability to determine when they are operating in a degraded mode and send a signal directly to the commercial manufacturer who will build or ship the replacement part on demand. This system will bypass the traditional aircrew debriefing, maintenance troubleshooting, and supply reordering scenarios currently in practice. The feasibility of self-reporting parts is currently being addressed and has been identified in several recent books, one by Bill Gates, and another by Nicholas Negroponte, in which smart parts are described as active labels.[7]

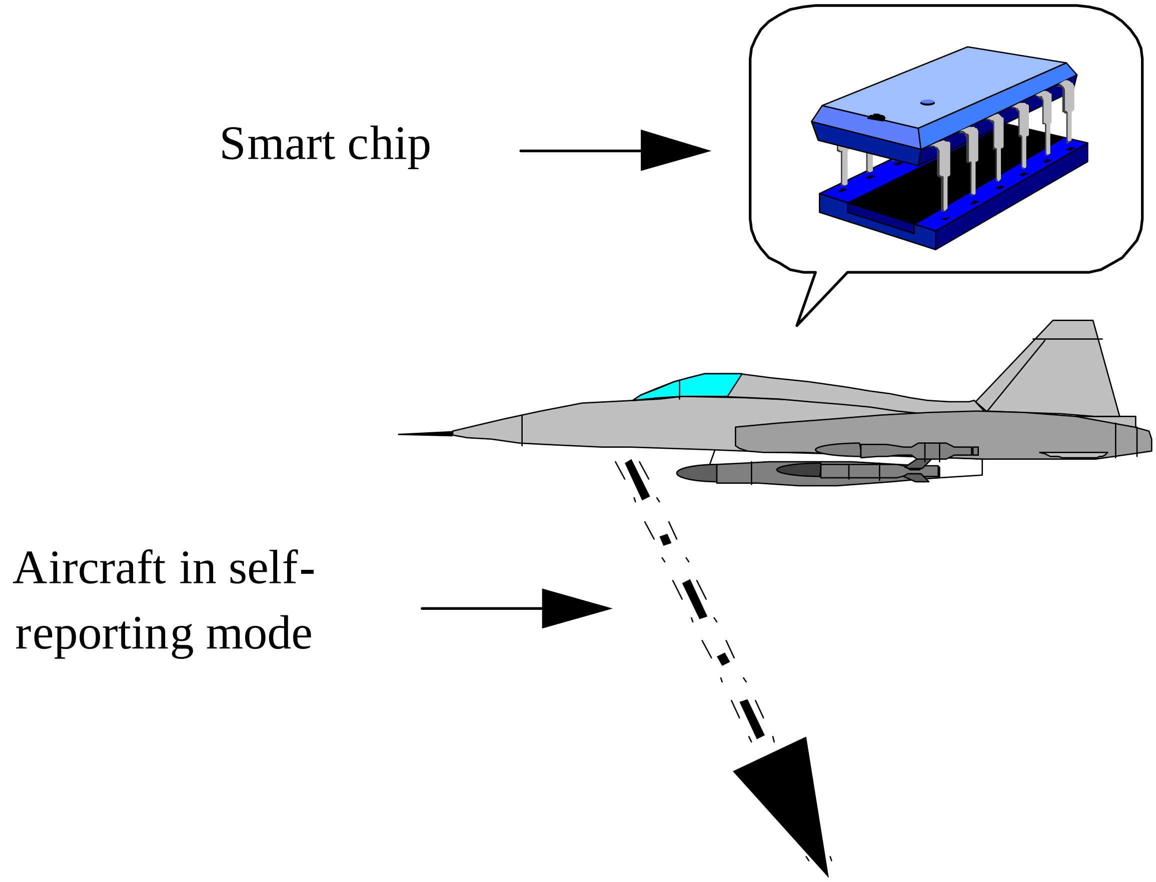


**Figure 3-1. Self-Reporting Parts via Smart Chips**

*New World Vistas* also includes a discussion of "self-monitoring and self-healing materials to permit in-flight battle damage repair."[8] While remote diagnoses and sensing of maintenance problems will be possible, neural nets and parallel processing will allow systems to reconfigure themselves around defective areas, becoming "self-repairing" parts, as illustrated in figure 3-2. The self-repairing part has the ability to detect degradation in performance and repair itself by eliminating the failed component from use or rerouting its circuits around the defective area. This concept will operate as a standby redundancy system, whereby the spare components or circuits are operated only when required to keep the part functioning. The maintenance strategy used will be that of nonmaintained redundancy. As such, the repair is only commenced when the part completely fails. It will be more cost-effective to build this self-repair capability into the parts, even with its redundant circuitry, rather than removing, repairing, and replacing parts in a cyclic pattern over the useful life of the part.

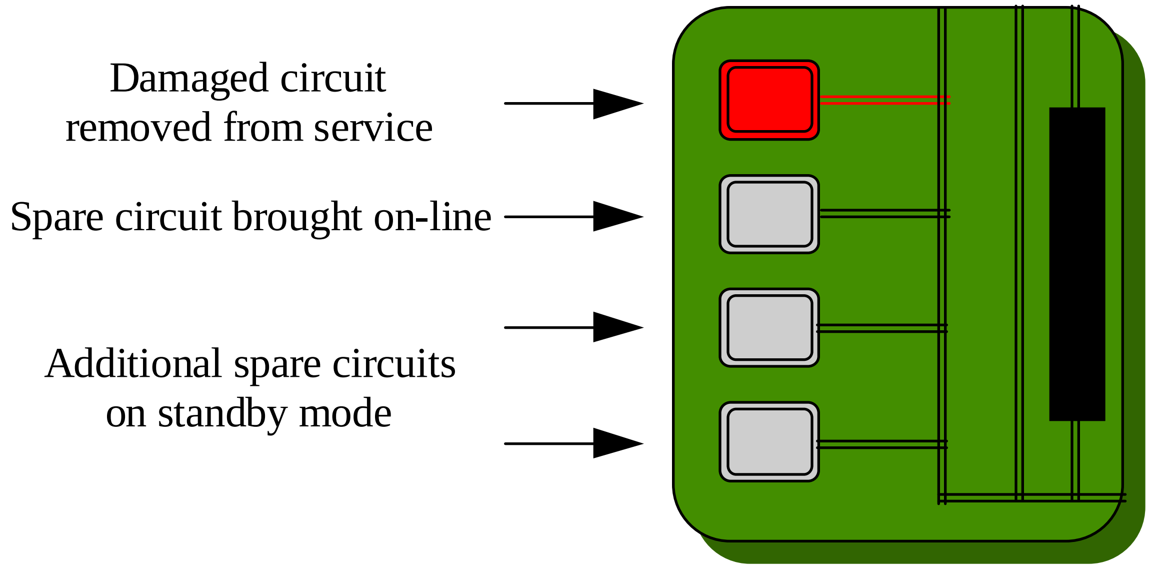


**Figure 3-2. Self-Repairing Parts via Rerouting Around Damaged Area of Circuit Card**

**Packaging and Battlefield Delivery**

Packaging material will continue to be a critical concern to future logisticians. Packaging includes several functions such as protection, ease of handling, information about the packaged product, stowability, temporary storage, and protection against tampering. Future logisticians will rely on packaging which performs these basic functions, yet does not generate disposal problems either in a peacetime or wartime environment. Elimination of the packaging provides a significant cost reduction and the elimination of an environmental concern. Future packaging will become more multifunctional with one or more desirable features. Future packaging may become:

- a fuel when combined with a catalyst;
- edible when combined with a catalyst;
- biodegradable when exposed to water after adding a catalyst;
- multipurpose (for example, internal "foam" or cushion could be remolded to accommodate different components or items—used during retrograde movements); and
- part of the component itself (the package and component form a modular unit which is installed in the weapon system).

Figure 3-3 illustrates two revolutionary options for increasing the usefulness of packaging as highlighted above. By combining the packaging with a catalyst, which could be obtained in the particular theater of operations, a fuel or food is produced.

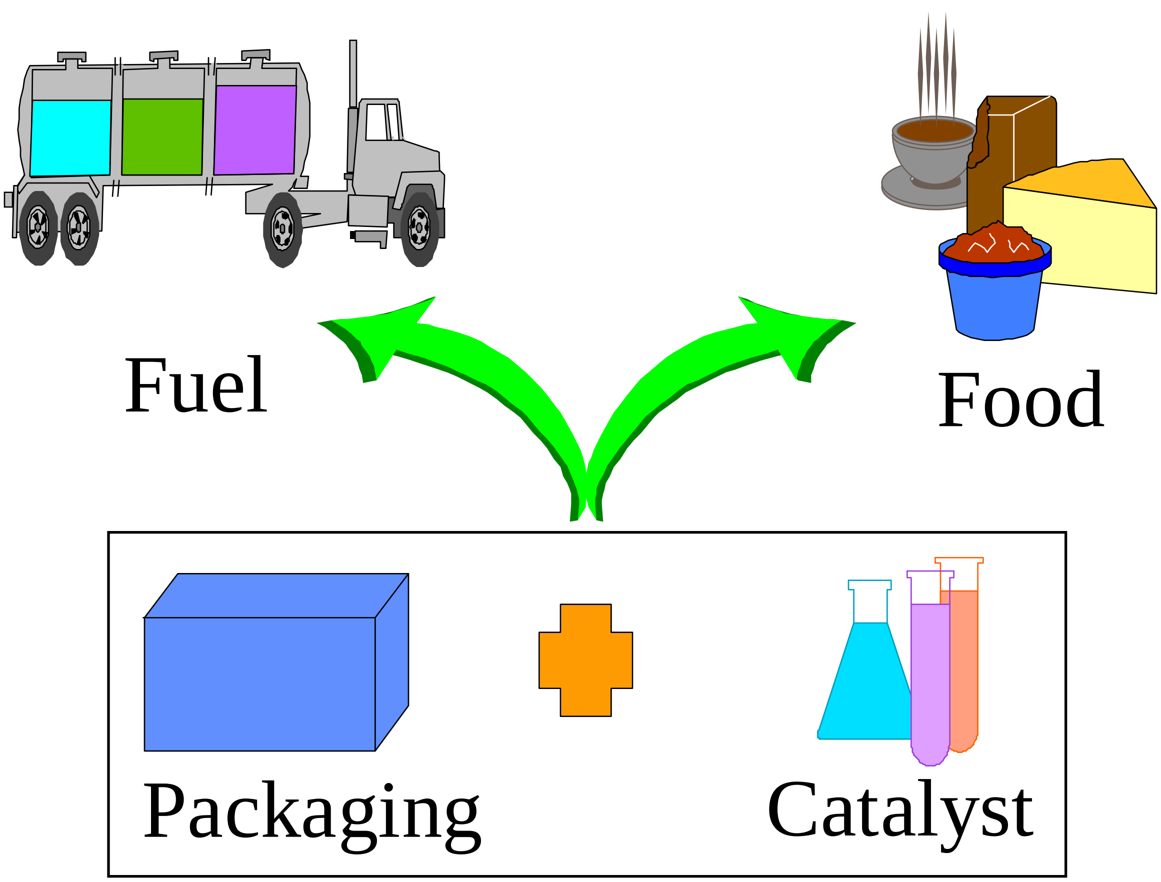


**Figure 3-3. Combining Packaging with a Catalyst to Produce Fuel or Food**

The heavy reliance on the commercial sector and external drivers for reducing cost will impact the DOD's capability to deliver materiel to engaged units. Forces mobilizing for deployment and units already deployed will move the majority of their materiel by strategic sea lift or by the Civil Reserve Air Fleet (CRAF). These mobility components rely heavily on the use of containerized freight to exploit handling efficiencies and to maximize space utilization. A new Battlefield Delivery System (BDS) will deliver containerized cargo directly to employed forces. The BDS will permit the seamless flow of containerized materiel from point of embarkation, movement by domestic surface carriers (rail or motor carrier), port loading, strategic sea lift, port off-loading, and forward movement by surface or air. Containerization provides several benefits already enjoyed by the commercial sector, including:

- reduced handling of packaged goods;
- greatly reduced pilferage and damage;
- standardized equipment available worldwide;
- movement by motor carrier, sea lift, airlift, and rail;
- ease of tracking;
- shipment of almost any good including refrigerated;
- protection from external elements;
- elimination of interior packaging; and
- portable warehousing.

The ability to move containerized materiel provides additional benefits to the military. Containerized freight would:

- be modified to serve as temporary facilities (An entire air base could arrive containerized, fitted with doors, windows, and vents. Once unloaded, containers would become offices, quarters, shelters, and clinics);
- be stored on prepositioned ships until required; and
- be fitted to include materiel, fuel, food, vehicles, water, or any other items within cubic constraints.

One problem faced by the military is rapid movement of materiel away from the destination port. Arriving containers must move by surface or be unpacked for airlift delivery. Unpacking the containers and loading the airlift adds time, equipment, personnel, and tracking requirements to the pipeline. The BDS will eliminate these requirements by allowing the container to move directly from the commercial supplier to the point of use.

The BDS will operate within the employed theater and will be composed of an air and ground element. The air portion of the BDS will consist of an airlifter in which a standard shipping container, as defined by the International Standards Organization (ISO), would become an integral structure of the fuselage. Figure 3-4 illustrates the concept of the container aircraft. The aircraft consists of three main sections: the cockpit, the wingbox, and the empennage. In its simplest form (short version), the aircraft is capable of flight by joining the cockpit, wingbox, and empennage directly together. With standard shipping containers installed between the cockpit and wingbox, and the wingbox and the empennage, the aircraft would be configured to carry cargo (stretch version). Advanced flight dynamics, mainly in software control for the stability of the aircraft, would control the aircraft's flight characteristics in both the short and stretch versions.

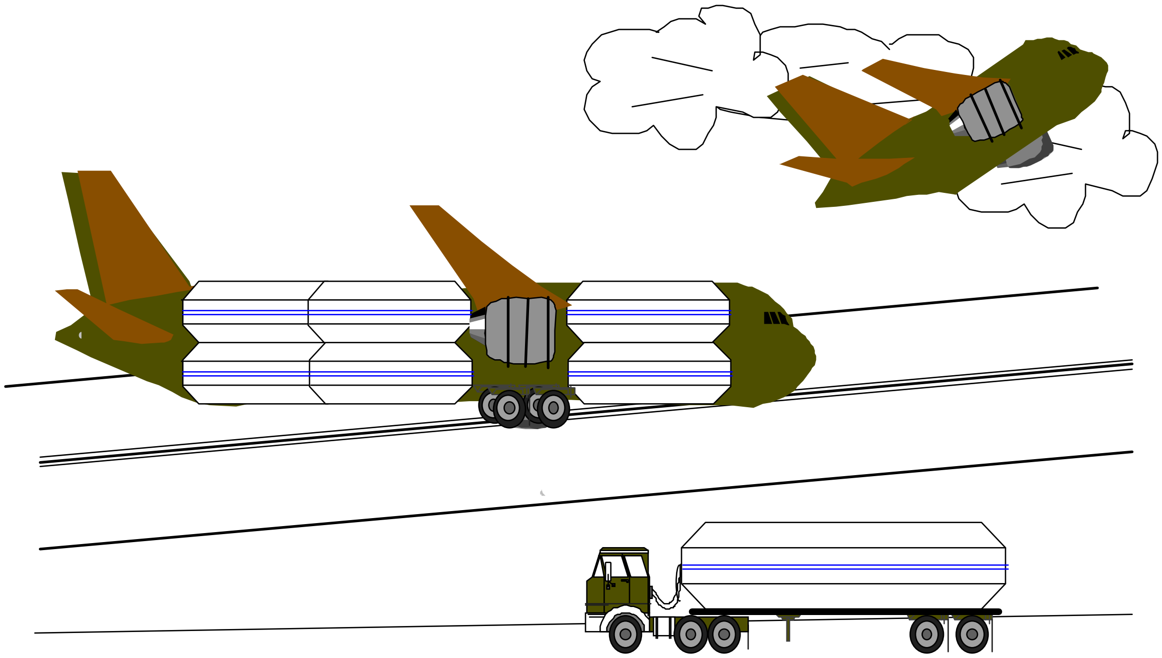

**Figure 3-4. Battlefield Delivery System Highlighting the Container Aircraft Concept**

This BDS concept can be jointly applied to the agile base concept, as illustrated in figure 3-5. The first wave of container aircraft to arrive in a theater of operations would be "disassembled." The cockpit would form a command and control facility, the aircraft engines would generate the base's power, the wings would provide fuel storage, and the containers themselves would provide shelter for troops, supplies, and equipment. The containers would integrate with the structure 2025 concept being proposed as a portable base shelter. This concept will provide a mobile base to redeploy as the combat situation dictates.

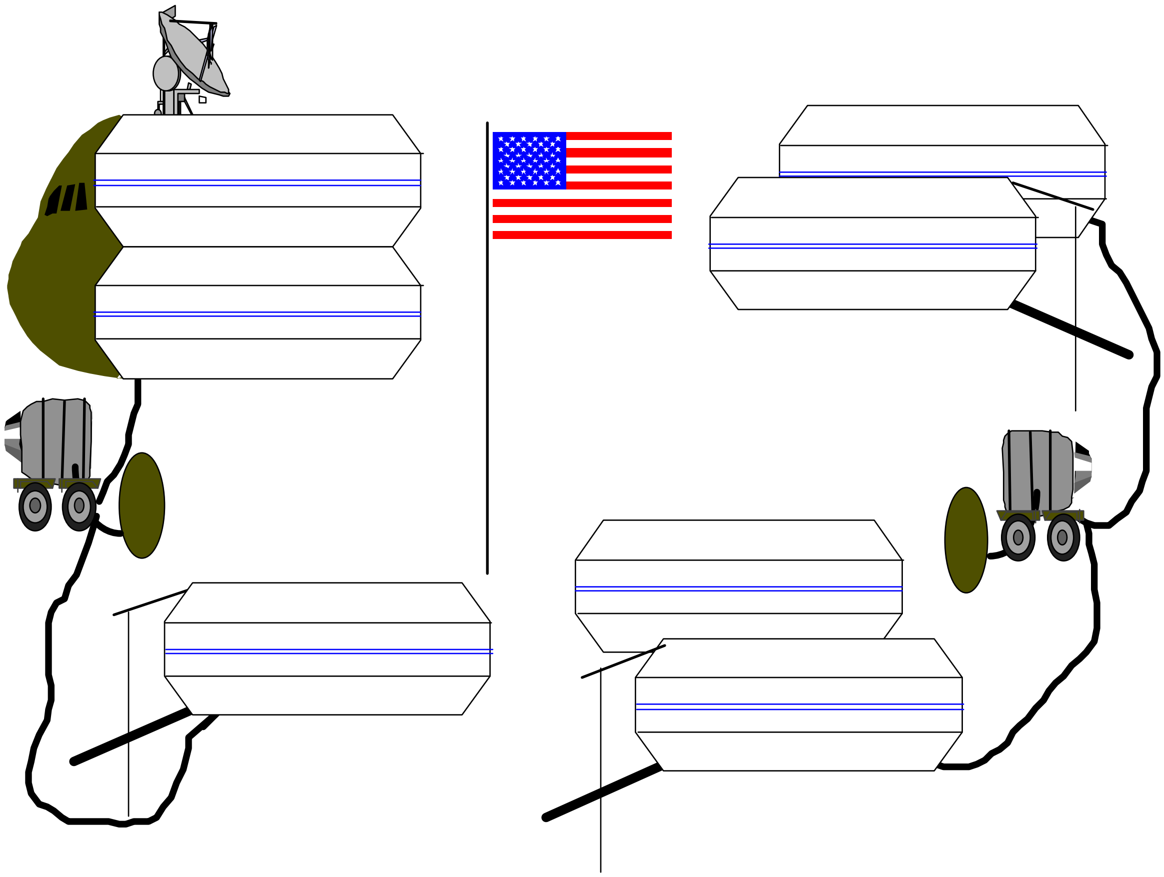

**Figure 3-5. Container Aircraft Applied to the Agile Base Concept**

The ground portion of the BDS consists of trucks, trailers, and forklifts capable of handling the containers and moving them to staging areas and then to forward deployed units. Development of a truck-trailer with the ability to lift the container without additional material handling equipment will further streamline the process. This concept is defined as demountable loads, in which a vehicle can off-load and pick up its own cargo body bed instead of just its cargo, allowing for rapid vehicle turn-around times. A smaller version of this proposed truck-trailer is currently in use by most western armies.[9]

The BDS will allow the DOD to use commercial carriers for strategic sea lift as well as domestic transportation. The standardized containerized concept allows a seamless movement from source of supply to the battlefield with minimal handling, reduced time, and increased visibility. The BDS provides the same capability whether supporting employed combat forces or providing humanitarian assistance to remote locations. The BDS enables all military services to use any combination of the four pillars of strategic mobility—strategic airlift, strategic sea lift, domestic surface movement, and prepositioning—to move containerized materiel.

## Integrating Operations

As D. J. Bowersox et al. noted, “The main strength of logistics results from treating system components on an integrated basis. . . . A systems orientation stands in direct contrast to the traditional approach of treating the activities of logistical management on a separate or diffused basis.”[10] The cost of supporting complex systems in the future coupled with a constrained resource environment means that logistics systems must be integrated. Stand-alone, service-specific logistics systems will be too costly.

Total Asset Visibility (TAV) is a current initiative being developed by the US Army designed to link all components of the DOD logistics system into a coherent whole using a comprehensive information management and communications system. The goal of TAV is to provide real-time information regarding the quantity, location, and condition of DOD assets anywhere and at any time.[11] The commercial concept of TAV is total supply chain visibility. The difficulties and costs of linking the various information systems operated by the separate military services prevent the goals of TAV from being achieved in the near future; however, the need for logistical excellence and continued rapid advances in information technology in the future will eventually overcome these parochial barriers. TAV will allow the customer to obtain real-time knowledge of the status of any requisition in the logistics system. TAV will serve as a high-tech "hot line" between the customer and the source of supply.

Knowing the status of any requisition in the system and having confidence in the accuracy of that status will eliminate the need for duplicate requisitions and a large buffer stock. In most cases, the requisition will not be initiated by a human worker but will be generated automatically as previously described as self-reporting parts. Instead of maintaining databases on inventory, information systems will conduct a worldwide poll to find status, location, and quantity on an as-needed basis from the battlefield to the commercial supplier. The request for a replacement part will be transmitted to the system node responsible for providing that part, either from inventory or from on-demand manufactures. It is likely that these supply nodes will be vendor-operated and mobile. In all instances, successful logistics support will be the product of advanced information technology, strategic alliances between the government and suppliers, and the flexibility to meet customer needs.

## Notes

[1] Fedex, http://www.fedex.com/pr/NetShip3_13_96.html, 11 April 1996.

[2] A. Braithwaite, and M. Christopher, "Managing the Global Pipeline," *The International Journal of Logistics Management* 2, no. 2 (1991): 55–62.

[3] USAF Scientific Advisory Board, *New World Vistas: Air and Space Power for the 21st Century*, summary volume (Washington, D.C.: USAF Scientific Advisory Board, 15 December 1995), 31.

[4] *New World Vistas*, (unpublished draft, the materials volume), 69.

[5] *SPACECAST 2020*, vol. 1 (Maxwell AFB, Ala.: Air University, June 1994), K-15.

[6] Nicholas Negroponte, *Being Digital*, (New York: Vintage Books, 1995), 146, 210.

[7] Ibid., 209; also Bill Gates, *The Road Ahead*, (New York: Viking, 1995), 9.

[8] *New World Vistas*, (unpublished draft, the materials volume), 69.

[9] P. D. Foxton, *Powering War: Modern Land Force Logistics* (London: Brassey's, 1994), 58.

[10] D. J. Bowersox, "The Strategic Benefits of Logistics Alliances," *Harvard Business Review* 68, no. 4 (July-August 1990): 36–45.

[11] Deputy Under Secretary of Defense (Logistics), *Total Asset Visibility Conference Program Brochure* (Washington, D.C.: American Defense Preparedness Association, 9 March 1994).

# Chapter 4

## Changing Processes

In the next 30 years, the processes that are used by logisticians will dramatically change. These changes will be driven by environmental and technological changes, as previously described, but will also result from the implementation of revolutionary new logistics techniques. This section highlights some of the changing processes that will impact logistics in 2025. B. K. Ellram and M. C. Cooper identified the principal question of supply chain management as where in the supply chain to hold inventory. This decision is based on timely, accurate flow of information. "Clearly, exchanging information for inventory is central to the supply chain management concept."[1]

A logistics support system superior to that fielded by the opponent can provide the difference between success and failure. Superior customer service in the military context means the logistics system in place supports requirements determination and forecasting processes that deliver exactly the items required, exactly where and when required. This concept is called dynamic response logistics. The commander of 2025 will provide the what, when, and where information to a logistics system which will rapidly respond to such a request. The future logistics structure will be dominated by a "pull" process rather than the predominate "push" process in use today. However, a combination of the two processes will be employed. Baseline materiel (for common mission requirements) will be pushed while specialized material (for tailored mission requirements) will be pulled.

## Materiel Requirements

The materiel acquisition system will change dramatically to meet the needs in the next 30 years. To the extent possible, materiel will be procured on demand with direct delivery to the user by the vendor. Outside contractors will be an integral part of the DOD purchasing system and will have direct access to both consumable and reparables demand information. Visibility into projected requirements provided to vendors through long-term contractual relationships will allow vendors to manufacture and distribute components based on projected requirements, current demand history, and repair capability. Furthermore, commercial carriers will project freight movements based on the manufacturer's projected production date and DOD need dates.

Coordination will entail improved methods of contracting, especially in the use of systems contracting or blanket-order agreements. The trend will be toward fewer suppliers with longer contract periods, rather than contracting on a single-order basis. The contracting function of the future will be expedited, requiring much less daily oversight after the establishment of the initial system between the commercial supplier and the DOD. In connection with increasing the reliance on local purchase, bases will procure with blanket contracts negotiated at a wholesale level, thus avoiding a contracting burden at the local level.

With on-line buying a reality, the contracting officer will receive quotes and place orders rapidly. Where centrally negotiated blanket-order agreements for large numbers of items are arranged, it will be possible for the ultimate user to order directly from the vendor without the intervention of a contracting officer every time an item is ordered. Currently, orders using MILSTRIP are routed to a source of supply which is normally a military inventory control point; in 2025, orders will be routed directly to a private vendor. Building speed into the logistics system refers to the necessity to translate customer requirements into the completed system or spare parts as swiftly as possible. As product life cycles continue to shrink, the need to combine concurrent engineering with advanced information technology becomes more important. New systems will be built using as much commercial-off-the-shelf and nondevelopmental item equipment as possible.

Further extension of this interface between the commercial supplier and the military will dramatically reduce the need for the current supply structure. Ultimately, there will be no clear distinction between wholesale and retail supply operations, and a fusion of the two systems will occur. Through the process of commercial suppliers using rapid delivery methods to send parts on demand from direct interface with demand information and self-reporting parts information, there will be a decreased number of line items held in inventory. Hence, the holding of inventory at depots will be minimized, dramatically decreasing holding costs. Decreasing inventory will also result in a reduction of the storage and transportation infrastructure at the base level. The days of oversized warehouses, strictly for storing inventory, are quickly passing, and it is likely that the consolidation of warehouses already underway in the mid-1990s will continue.

New information systems will be needed to cope with these changes. Asset visibility of materiel held in stock will remain important even as these stocks disappear, while in-transit visibility requirements will continue to increase. Communication systems will be integrated with those of private carriers and with suppliers to provide the visibility of items required. War plans based on major regional conflicts will result in commercial cargo carriers carrying the bulk of cargo to a hub just outside the conflict zone, with DOD aircraft responsible for hub-to-battle zone movements. The future of transportation, with a greater reliance on vendor-to-user shipments of materiel, will decrease the need to arrange secondary transportation. Hence, the control of secondary transportation will be greatly eliminated. However, this same phenomenon will result in greater tracking difficulties, expanding requirements for in-transit visibility.

## Asset Maintenance

The landscape of asset maintenance will dramatically change in the next 30 years. Over the past several decades, the lead time for new weapon systems has become increasingly protracted, due to the increasing complexity of modern weapon systems and the complexities of acquisition procedures. Therefore, weapon systems are likely to change less than supporting technologies and the ways in which those weapon systems are used.

The number of uninhabited aerial weapon system platforms will continue to increase. This feature alone will decrease the number of environmental systems required for aircrew safety. The use of modular components and the extensive use of software-controlled avionics will require maintenance practices that repair software malfunctions. The future maintainer will repair weapon systems using maintenance computers talking to the weapon system computers, rather than using the traditional hardware wrench-turning methods in use today. Improved reliability of a smaller number of weapon systems means that fewer repairs will be necessary. Advances in weapon systems and on-board equipment will undoubtedly continue to become more reliable, thus consuming fewer logistics resources.

Improved maintainability, which has resulted from attention to acquisition logistics, will result in a smaller maintenance burden. Sophisticated test equipment required for modern maintenance will be more mobile. The Multifunction Aerospace Support System (MASS) is one design currently undergoing evaluation. MASS is envisioned to replicate the functions of nine types of current flight-line support equipment resulting in a substantial reduction in the deployment footprint.[2] By outsourcing repairs to the commercial sector, the base maintenance function will attempt to reduce overhead costs. Therefore, weapon systems will be designed with two-level repair in mind, and remove-and-replace will be the preeminent technique of local repairs. With the advent of self-repairing parts, and self-reporting parts, component maintenance will be radically redefined. Due to the decreasing failure rate of parts, repairs and remanufacturing of failed parts will occur at commercial firms.

The future of depot-level maintenance will be affected by the dwindling number of weapon systems being procured. Decreasing numbers of weapon systems will mean decreasing numbers of systems and subsystems. Required maintenance tasks will affect the viability of the private sector manufacturing base. To keep the remaining contractors alive, repair work will be consigned to private industry at the expense of organic depots. The DOD will be unable to afford the infrastructure of trained personnel, specialized equipment, publications, and data for the relatively small number of repairs that will be accomplished. Increased use of private firms for logistics support will decrease the number of DOD personnel associated with logistics. The DOD annually reports to Congress that at least 250,000 civilian employees are performing commercial-type activities that could be performed by competitively selected private companies.[3]

Self-repairing parts and the evolution of increased reliability will change the nature of the component repair process. No longer will large quantities of parts migrate back to the depot for repair. Instead, the commercial sector will process those parts that fail and require repair or remanufacturing. In wartime, replacement parts will be repaired or manufactured in the theater of operations for a variety of deployed weapon systems through the Mobile Asset Repair Station (MARS). MARS, as illustrated in figure 4-1, is a concept whereby parts can be repaired or manufactured using a mobile facility which can be land-based or water-based in or near the theater of operations, but out of harm's way. The facility features a set of fully-integrated flexible manufacturing systems and robotics systems that are linked to the commercial manufacturers. These manufacturers supply the specifications to the FMS which then produces the part or component. Many of the required materials necessary for MARS to manufacture the components will be obtained from local countries.

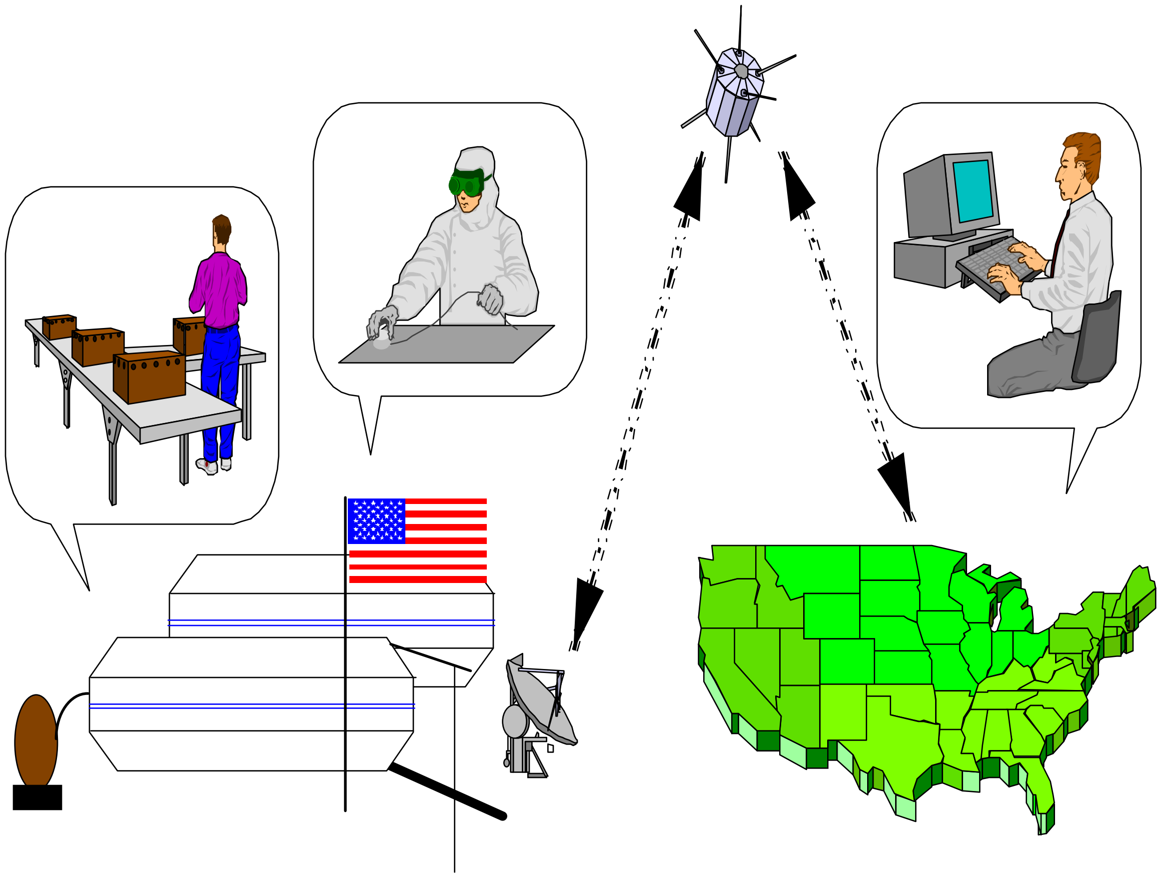

**Figure 4-1. Mobile Asset Repair Station (MARS) Concept**

MARS will reduce current repair and manufacture turn-around times by days for a number of avionics and mechanical components from a variety of weapon systems. Although the actual logistics tail has not been reduced in length, what flows through the tail has changed. Instead of transporting failed and serviceable avionics and components (atoms), information will be transmitted (bits and bytes).[4] A drawback to "Desert Express," which transported critical reparable parts daily from the US to the Gulf, was that it required a significant allocation of scarce airlift, with two dedicated aircraft and several spare aircraft stationed along the route at various US and European bases.[5]

## Financial Management

Financial management systems within the DOD will certainly change in the next 30 years. Future financial management systems will possess three capabilities:

- assignment of direct and indirect costs to specific logistics activities,
- translation of management action into the effect on total costs, and
- integration of logistics financial information with other logistics and financial management systems.

Future cost management systems will require the capability to assign direct and indirect costs to specific logistics functions and subsequently to the product, customer, or weapon system receiving logistic support. Many financial systems already possess the capability to assign direct costs to the activities being performed; however, direct costs will represent a significantly lower proportion of total costs as logistics incorporates more and more technology-based processes.

As direct costs shrink in their relative importance and magnitude, indirect resources will continue to grow in total dollars and management focus. Manufacturing firms have already encountered this phenomenon. Direct labor represented about 85 percent of total costs when traditional cost management systems were designed in the 1920s. However, automation and technology applications have replaced direct labor with many indirect cost functions. Direct costs in many firms today represent only 16 percent of total costs, but the traditional cost systems continue to use direct labor as the principal means for assigning indirect costs.[6]

Currently, using direct costs as an allocation tool creates these challenges for DOD logistics managers:

- Since unit-based allocation suggests costs vary with volume, managers cannot accurately determine how changes in customer service affect total costs.
- There is no reward for reducing indirect cost categories—benefits are diffused across all products.
- Although costs appear to be reduced by eliminating direct labor, they really are not because proportionately the majority of total costs are attributed to indirect costs.
- While overhead costs appear fixed and not affected by management action, in fact, they can be affected through the application of appropriate management practices.
- Rewards, which should be based on cost center performance, become dependent on total product, customer, and channel profitability.

The assignment of indirect costs to logistics activities will require a means for tracing indirect labor and other logistics resources to the activities performed. The tracing of resources provides the total cost of performing individual activities or, by summing activity costs, the costs of different processes. Future cost management systems will be capable of tracing indirect labor hours, depreciation, training, supervision, data processing, information system costs, and other indirect cost categories to logistics activities.

The resulting activity information will provide significant advantages over conventional cost management systems. Activity-based cost information can:

- more accurately determine how changes in logistics service requirements will affect total costs,
- provide ability to trace indirect resources to logistics activities and the cost of their outputs,
- focus on high-cost activities or processes,
- translate logistics performance into cost measures or weapon system availability,
- provide greater visibility over logistics costs—better trade-offs within DOD, and
- simulate changes and impact on logistics costs.

Cost information at the activity level will enable logistics managers to determine the cost per output of each logistics activity as well as the costs of supporting specific weapon systems. The ability to accurately determine activity costs provides the cost information necessary for making smart trade-offs within an integrated logistics system.

Logistics and financial management systems will require significant integration to better support management decision making. Current systems frequently send conflicting signals to DOD managers. These systems use different data to report inventory balances and financial status, do not interface well with one another, and use a large number of interfaces with numerous support systems with inaccurate or "dirty" data. The reports are focused on the expenditure of funds or tracking labor hours rather than on activity costs or management performance. Future systems will use a single database, capable of accepting updates from many users. A single, integrated database will eliminate many of the discrepancies between systems and data inaccuracies. Design of the database and management systems will be developed with supporting management decision making, and not financial reporting, as its principal objective.

**Notes**

[1] B. K. Ellram and M. C. Cooper, "Supply Chain Management, Partnerships, and the Shipper-Third Party Relationship," *The International Journal of Logistics Management* 1, no. 2 (1990): 1–10.

[2] E. Boyle, T. Matthew and Lt Col D. Smoot, "Rethinking Support Equipment," *Air Force Journal of Logistics*, Fall 1995, 28–31.

[3] Department of Defense, *Report on the Performance of DoD Commercial Activities* (Washington, D.C.: U.S. Government Printing Office, 30 January 1995), 5.

[4] Nicholas Negroponte, *Being Digital* (New York: Vintage Books, 1995), 13.

[5] Douglas Menarchik, *Powerlift—Getting to Desert Storm: Strategic Transportation and Strategy in the New World Order*, (Westport, Conn.: Praeger 1993), 145–146.

[6] Jeffrey G. Miller and Thomas E. Vollman, "The Hidden Factory," *Harvard Business Review*, September-October 1985, 142–150.

# Chapter 5

# Conclusion

Logistics in 2025 will operate in a vastly different landscape than exists now. Changes affecting logistics will occur in environments, technologies, and processes leading toward the development of dynamic response logistics. Environments will change in the military, business, and logistics sectors. Technologies will change in information technology and systems, packaging and battlefield delivery, and integrating operations. Processes will change in materiel requirements, asset maintenance, and financial management.

These changes will attest to the fact that the dynamic relationships among logistics elements, illustrated in figure 5-1, will reshape the future structures of logistics. These dynamic relationships will be formed through a combination of synergy and balancing activities among logistics elements. Logisticians recognize that numerous trade-offs will occur between logistics processes. Rapid transportation allows for frequent inventory replenishment, thereby lowering inventory levels and reducing the need for fewer and smaller warehouses. Precise delivery of information will reduce the uncertainty associated with inventory and lead to the reduction of safety stocks.

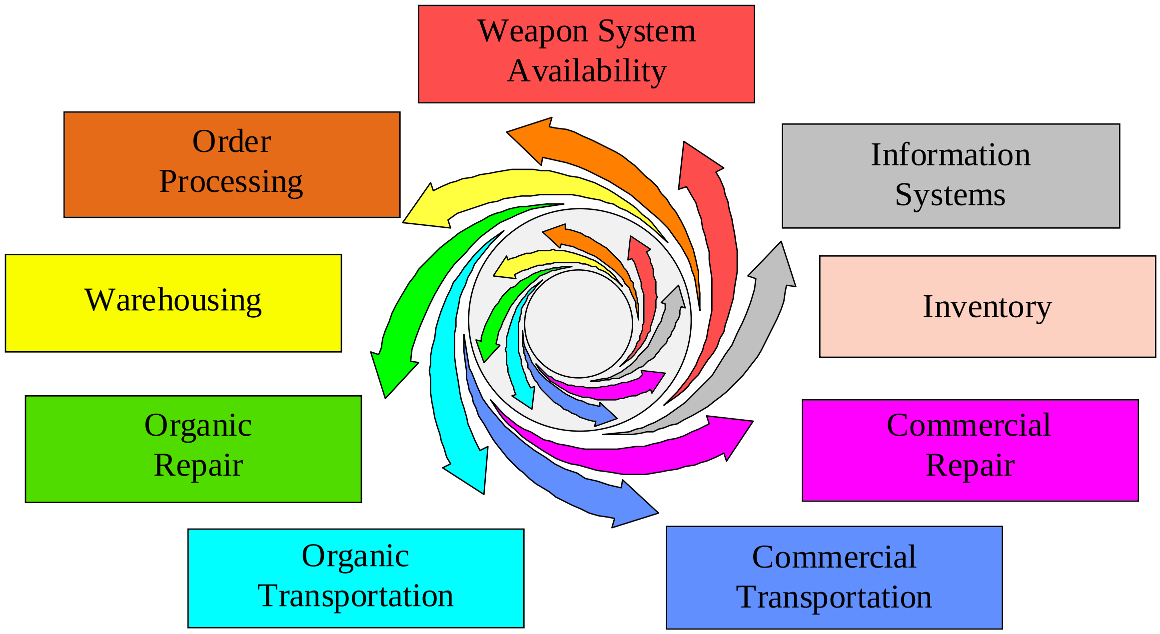


**Figure 5-1. Logistics Dynamic Relationships**

Table 1 lists the evolutionary and revolutionary concepts developed in this study. Logistics operations of the future will operate under an integrated logistics system, or "supply chain management," which will govern logistics decisions and operations. Logisticians of the future will become aware of the entire "bench-to-battle" sequence of interactions which will deliver the needed item rapidly and efficiently. Logistics decisions in one area will be made with a recognition of their impact in other areas as well. Increasingly, an awareness of the cost of logistics trade-offs will impact logistics decision making, especially in the notion of trading inventory for information: information is cheap, while inventory is expensive. Future cost management systems capable of accurately assigning costs to logistics activities will permit effective cost trade-offs and reduce total logistics costs while enabling logisticians to target high-cost activities or support processes for reengineering action or privatization.

**Table 1**

**Evolutionary and Revolutionary Concepts**

| Evolutionary | Revolutionary |
|---|---|
| • Rapid response logistics | • Self-repairing & -reporting parts |
| • Privatization & outsourcing | • Multifunctional packaging |
| • Stronger military & commercial alliances | • Container aircraft |
| • Complete supply chain visibility | • Wholesale & retail fusion |
| • Activity-based cost information | • Mobile Asset Repair Station (MARS) |

The revolutionary concepts developed in this study are within US technological capability of the next 30 years. The use of self-repairing and self-reporting parts will greatly reduce both the proverbial logistics "footprint" and decrease the logistics "tail." Multiuse packaging, in which packaging combined with a catalyst produces either a fuel or food product, will reduce the additional shipments of those items into the theater of operations. The BDS with a standard shipping container will provide for a seamless transportation system from the commercial vendor to the theater of operations. The container aircraft will increase the flexibility of the BDS concept and integrate into the agile base concept. The fusion of the wholesale and retail logistics structures will provide for a streamlined flow of goods and equipment and complete supply chain visibility. Logistics will move from a just-in-case system to dynamic response logistics.

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