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Feature**

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logistics

supply chains

Supply Chain Management: More Than Integrated Logistics

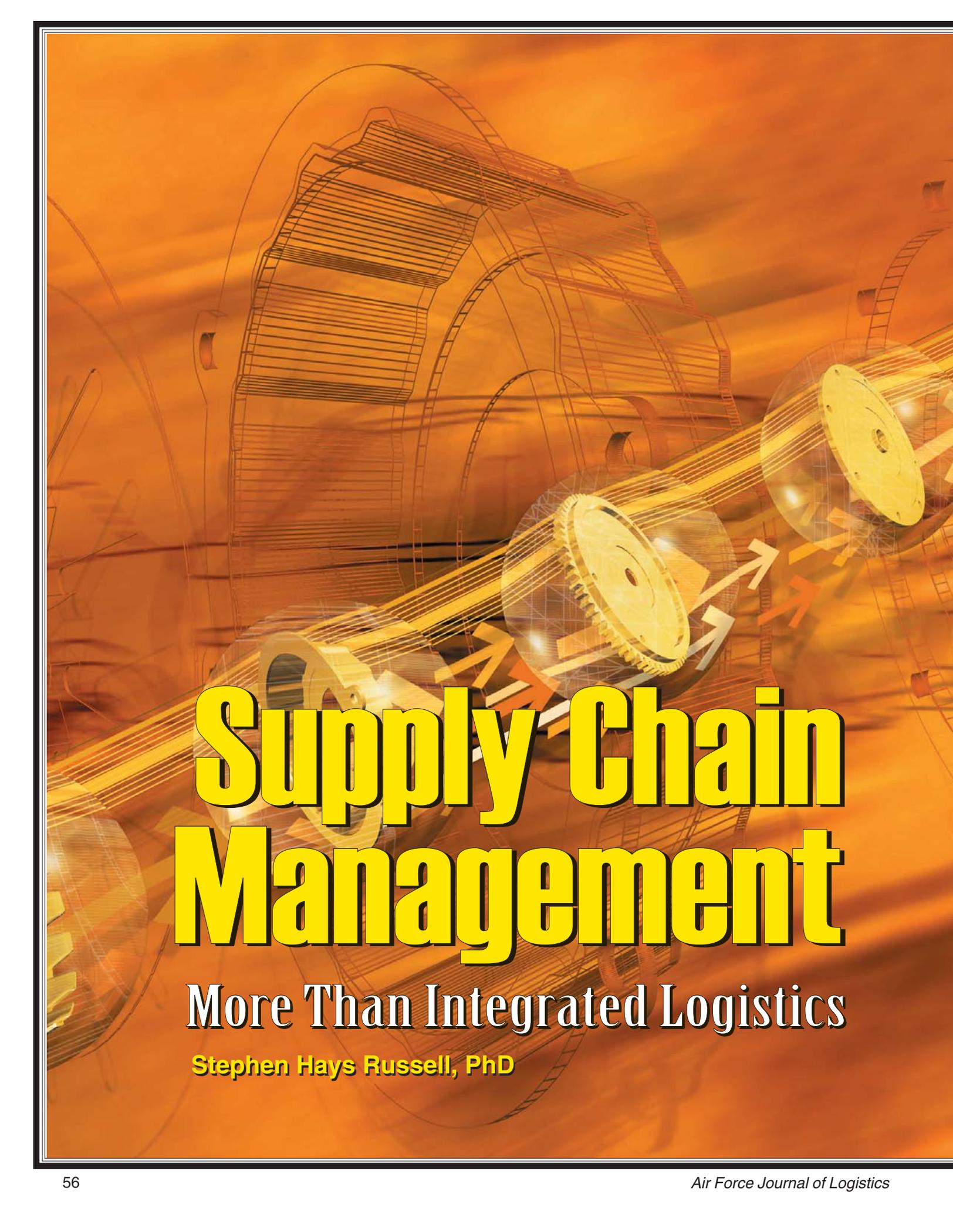
This edition's featured article was written by Dr Stephen Hays Russell. Over the years, Dr Russell has been a frequent contributor to the Journal. He is an accomplished logistician and is on the faculty of the John B. Goddard School of Business and Economics, Weber State University. In "Supply Chain Management: More Than Integrated Logistics," Dr Russell examines the historical evolution of management thought to its newest frontier—supply chain management, reviews the emerging practices that define supply chain management in both commercial and military applications, and demonstrates that supply chain management is more than integrated logistics.

He concludes with three major points.

Integrated logistics in a commercial context is coordinating logistics activities. In a military context, integrated logistics is designing reliability, maintainability, and supportability into weapon systems, focusing on customer requirements, and coordinating supply support, training, technical data, and all other integrated logistics support elements.

Supply chain thinking is a major breakthrough in thought about the interconnectivity of information technology, logistics processes, and customer support.

Supply chain management is not a passing stage in the evolution of management practice. It is a major revolution.



Supply Chain Management

More Than Integrated Logistics

Stephen Hays Russell, PhD



Introduction

Logistics as a management discipline originated in the military and later branched into the commercial sector as business logistics. Now, the hottest topic in the commercial sector is supply chain management. With the Department of Defense (DoD) jumping on this latest revolution in management thought, questions arise as to what exactly is supply chain management.

This article examines the historical evolution of management thought to its newest frontier—supply chain management, reviews the emerging practices that define supply chain management in both commercial and military applications, and demonstrates that supply chain management is more than integrated logistics.



The Development of Formal Management Thought

The evolution of management thought began in a formal way with Frederick Taylor's *Principles of Scientific Management* published in 1911. Taylor focused on issues of worker productivity. In the ensuing decades, research in management practices was directed toward efficiencies in manufacturing and services (collectively referred to as operations). Beginning in the 1950s, work by Harry M. Markowitz and others spawned a thought revolution on capital markets and financial management. During the 1960s, new approaches in marketing emerged as the areas of consumer behavior and the analysis of distribution systems became the focus of much business-related research. During the decade

of the 1970s, a trend which began in the 1960s—the migration of military logistics practices to the private sector—accelerated as corporations recognized the need to improve their distribution functions and American universities began to offer degree programs in logistics management.

New attitudes and approaches toward personnel management emerged in the 1980s as organizations recognized the importance of human resource considerations in productivity enhancement and in long-range strategic planning. The term *human resource management* was introduced. The 1980s also saw a major emphasis on quality management as US business faced increased competition from Japan.

The 1990s was a decade in which logistics management truly came of age in management thought and in private sector business practices. As the emphasis on quality matured and high quality became the standard, firms began to differentiate themselves in terms of their logistics performance. Specifically, the focus of research and practice in logistics was in terms of employing the new information technologies of the 1990s to develop capabilities and protocols for efficient and responsive material flows to meet the ever-increasing demands of customers.

The evolution of management as a discipline during the twentieth century generated a body of literature and a set of practices which today define the science of management as effective, efficient planning and control of operations, finance, marketing, quality, human resources, and logistics (see Figure 1).¹

By the year 2000, this collective maturing of management thought set the stage for a new frontier of emphasis, seeking increased customer service levels, market share, and profits by focusing on organizational interconnectivity in terms of a *supply chain*.

Years	Events
1911	Management emerges as a formal discipline of study and practice
1920s – 1950s	Writings on operations , worker productivity, and output metrics
1950s	Modern era of finance is launched
1960s	Modern thought in marketing principles and practices formulated
1970s	Accelerating trend by business to adopt principles of military logistics to distribution systems
1980s	Contemporary approaches to human resource management emerge Quality revolution
1990s	Explosive growth in logistics research and logistics emphasis in organizations
2000s	Supply chain management revolution

Figure 1. Evolution of Management Thought

Article Highlights

The term supply chain management was coined in 1982 by Keith Oliver, a management consultant at Booz Allen Hamilton. Oliver used the term to develop a vision for tearing down functional silos that separated production, marketing, and distribution. The concept was enlarged by J.B. Houlihan in 1985 when he expounded upon efficiencies and mutual benefits associated with information sharing and decision coordinating up and down a supply chain.

This article examines the historical evolution of supply chain management, reviews the emerging practices that define supply chain management in both commercial and military applications, and demonstrates that supply chain management is more than integrated logistics.

A supply chain is the sequentially-connected organizations and activities involved in creating and making a product available. A supply chain can also be viewed as a value chain inasmuch as suppliers, manufacturers, transporters, and all other components of a supply chain add value. It may also be viewed as a demand chain.

In the late 1990s, an entire culture focusing on the supply chain emerged.

According to Dr Russell, some view supply chain management as a sophisticated new name for integrated logistics. However, supply chain management is more than integrated logistics because supply chain management involves far more than logistics. Supply chains ride on the back of information systems, they include manufacturing operations, they interface with marketing and finance, and they involve such concepts as strategic sourcing, business process connectivity, risk sharing, and supplier involvement in new product development. Managing a supply chain involves activities that are outside the purview of logistics.

The Supply Chain Management Revolution

A supply chain is the sequentially-connected organizations and activities (from Mother Earth to the ultimate customer) involved in creating and making a product available. A supply chain can also be viewed as a *value chain* inasmuch as suppliers, manufacturers, transporters, and all other components of a supply chain add value. Conversely, if one looks in the reverse direction at the same activities, a supply chain can be viewed as a *demand chain*.

The term *supply chain management* was coined in 1982 by Keith Oliver, a management consultant at Booz Allen Hamilton.² Oliver used the term to develop a vision for tearing down functional silos that separated production, marketing, and distribution. The concept was enlarged by J. B. Houlihan in a 1985 article that expounded upon efficiencies and mutual benefits associated with information sharing and decision coordinating up and down a *supply chain*.³

In the late 1990s an entire culture focusing on the supply chain emerged. Universities introduced supply chain management majors or supply chain management concentrations in masters of business administration programs (Arizona State University, Syracuse University, and the University of Wisconsin, for example). Wal-Mart honed supply chain management concepts by building worldwide communication and relationship networks with suppliers to improve reliable material flows with lower inventories. Indeed, Wal-Mart is viewed by many as the premier practitioner of supply chain management with its demonstrated ability to get a network of worldwide suppliers, warehouses, and retail stores to behave almost “as a single firm with near real-time information...”^{4,5}

By the year 2000, the trend for major organizations to establish high-level executive positions with supply chain titles was in full swing.⁶

In 2005, the Council of Logistics Management changed its name to the Council of Supply Chain Management Professionals (CSCMP).

The pervasiveness of the supply chain management revolution is skillfully described by Thomas L. Friedman in his 2005 best-selling book *The World is Flat*. He considers supply chain management and its enabling information technology revolution as being behind fundamental changes in the world economy.⁷

Defining Supply Chain Management

The supply chain management concept seeks utopian performance in commerce: all activities up and down a supply chain orchestrated and coordinated (as though a single entity) to synchronize supply and demand at all levels, the sharing of information and technologies to increase innovation and to shorten product development cycles, reduction in order cycle time, replacing stocks with flows, effectively and efficiently responding to customer demands, reduced costs, and increased customer satisfaction.

Some view supply chain management as a sophisticated new name for integrated logistics. However, supply chain management is more than integrated logistics because supply chain management involves far more than logistics.⁸ Supply chains ride on the back of information systems, they include manufacturing

Article Highlights

operations, they interface with marketing and finance, and they involve such concepts as strategic sourcing, business process connectivity, risk sharing, and supplier involvement in new product development. Managing a supply chain involves activities that are outside the purview of logistics.

Figure 2 illustrates the conceptual transition from classical logistics to supply chain management, and the component parts of supply chain management. Classical logistics is concerned with the acquisition, storage, and distribution of material to get the right product to the right customer, at the right time, at the right place, in the right condition, in the right quantity, at the right cost (the *Seven R's of Logistics*).

Modern logistics, along with modern manufacturing, has moved beyond classical activities by incorporating lean practices. Here the focus is on more than just time and place utility. Lean logistics and lean manufacturing emphasize flows rather than stocks. Stockpiles of material are viewed as generally wasteful and as hiding underlying problems such as excessive production runs, poor demand forecasting, faulty inventory data, and erroneous distribution decisions. A just-in-case attitude is replaced with a just-in-time or other lean approach as systemic process problems are eliminated. In short, inventory is replaced with information in the form of real-time demand (point of sale data, for example), more accurate forecasts, and visibility on inventory location.

As illustrated in Figure 2, lean logistics and lean manufacturing become two of the five components of supply chain management. Contrary to a popular view that supply chain management is just super-charged logistics, the cornerstone of supply chain management is not logistics. Alliances with key partners, and information technology that allows supply chain partners to share accurate information on a timely basis are the building blocks of efficient and responsive supply chain operations.⁹ Upon this foundation, the introduction of lean manufacturing and lean logistics processes, together with the integration of key business processes up and down the supply chain create supply chain management.

Alliances are collaborative relationships with key partners built upon trust. In alliances, upstream partners are more than sources. They are resources to the focal firm for problem solving, and for innovation (new technologies for example). With alliances, partners are viewed as extensions of the focal firm and decisions are made in the context of mutual gain. Such collaboration is the underpinning of supplier relationship management (upstream) and customer relationship management (downstream).

Information technology is the glue that holds the supply chain together. The functional areas within the firm operate from a common, shared database. Alliance partners share data. The accuracy, the speed, the relevance, the availability, and the accessibility of information are critical for successful supply chain performance.

Supply Chain Information Systems

Information systems supporting supply chain operations are of four categories:

- **Enterprise resource planning (ERP) software.** ERP software processes all transactions in every functional area and provides real-time access to an enterprise-wide data base. ERP replaces the legacy information systems which through the years have been cobbled together by operations, finance, marketing,

Russell concludes with three key points:

- Integrated logistics in a commercial context is coordinating logistics activities with other functional areas of the firm and with customers and suppliers. In a military context, integrated logistics is designing reliability, maintainability, and supportability into weapon systems, focusing on customer requirements, and coordinating supply support, training, technical data, and all other integrated logistics support elements.
- Supply chain management is more than integrated logistics. Supply chain thinking represents a major breakthrough in thought about the interconnectivity of information technology, logistics processes, and customer support. Supply chain management is alliances with supply chain partners, lean processes, and end-to-end integration of key business processes. The enabling technology is information.
- Supply chain management is more than a passing stage in the continuing evolution of management practice. It is a major revolution which is already delivering end-to-end visibility, cost reductions, and new levels of performance metrics in meeting customer requirements.

Article Acronyms

ACS – Agile Combat Support
AFLC – Air Force Logistics Command
AFSC – Air Force Systems Command
DoD – Department of Defense
EDI – Electronic Data Interchange
eLog21 – Expeditionary Logistics for the 21st Century
EPC – Electronic Product Code
ERP – Enterprise Resource Planning
ILS – Integrated Logistics Support
IWSM – Integrated Weapons Systems Management
LSA – Logistics Support Analysis
NCW – Network-Centric Warfare
OFT – Office of Force Transformation
OSD – Office of the Secretary of Defense
RFID – Radio Frequency Identification
S&RL – Sense and Respond Logistics
SCA – Supply Chain Analytics

engineering, procurement, and so forth. Legacy systems are capability inhibited, difficult to connect to other functional areas, and cannot support supply chain dynamics.

- **Electronic data interchange (EDI) or Internet connectivity.** EDI and the Internet facilitate an interconnected business environment that allows partners to share decision-relevant information up and down the supply chain.
- **Electronic product code (EPC) technologies.** EPC technologies include bar codes, optical scanners, and radio frequency identification (RFID) technologies. EPC allows for item, case, pallet, and vehicle tagging for a *track and trace* capability in a supply chain.
- **Supply chain analytics (SCA).** SCA is any software designed to assess and improve supply chain performance. SCA can do such things as evaluate capacity, materials, and customer demand imbalances; or identify which carriers and distribution centers are most responsive.

Integrating Business Processes

The final component of supply chain management is that which makes a supply chain operational—integration of key business processes among the players up and down a supply chain.

Product Development

The objective of the product development process is bringing state-of-the-art products that meet customer wants and needs to market faster than the competition. This happens with internal integration of functions, and upstream and downstream involvement of supply chain partners.

In a supply chain management environment, engineering, manufacturing, procurement, logistics, marketing, and suppliers (and sometimes customers) work synergistically in cross-functional teams during product development.

Suppliers, viewed as resources, are involved early in the design stage of a new product. Suppliers (including supplier's suppliers) contribute information on new materials, new technologies, design engineering, process engineering, value analysis, supportability issues, and cost management. Early supplier involvement means shortened product development cycles and faster time to market of superior products.

Downstream, customers are often brought into the process through collaboration to understand their performance and design requirements, as well as their demand patterns.

Demand Management

Modern supply chains are customer-driven pull systems. The focal firm's supply capabilities must be synchronized with known and forecasted demand patterns of downstream customers. The buy-make-move functions at all levels of a supply chain are driven by real-time demand data or by meaningful, current, adaptable forecasts that reduce uncertainty and promote responsive material flows throughout the supply chain. Such a process allows for higher levels of customer service with reduced inventories.

Manufacturing Scheduling and Management

Coordination of manufacturing scheduling and management throughout a supply chain occurs with sharing of business plans and real-time inventory and demand information, and with an integrated business process of collaborative planning and forecasting. The supply chain concept requires movement away

from the old, industrial economy mindset of *make to stock* to the information-age economy which means production at all levels reflects demand and supply synchronization.

Order Fulfillment

Real-time visibility on inventory quantity and location, collaborative processes, and shared data foster flexible and responsive management of customer orders across global supply chains. Supply chain capabilities allow for seamless, continuous replenishment systems that meet or exceed customer expectations.

Product Support

The supreme goal of supply chain management—effective, efficient customer service with superior products and service—requires a network of activities for responsive, after-sale product support. This includes high service levels for spare and repair parts, technical data, maintenance and calibration services, warranties, and returns.

In sum, by formula we can define Supply Chain Management as:

Alliances + Information Technology + Lean Manufacturing + Lean Logistics + Integration of Key Business Processes

Figure 3 contrasts characteristics of classical logistics with pure supply chain management. To be sure, these are comparisons of extremes. Classical logistics does not represent information-age or modern, lean practices. Pure supply chain management is an ideal based upon levels of trust, risk, and information purity that are not descriptive of all situations and environments. Nonetheless, this comparison highlights the evolving characteristics of a management revolution called supply chain management.

Evolution from Logistics to Supply Chain Management

Figure 4 graphically portrays the evolution of logistics thought and practice.

Although logistics activities parallel the conduct of war and have existed for thousands of years, the term appears to have received its first official definition in 1905.¹⁰

Logistical activities on a massive scale occurred during World War II as huge stockpiles of materiel were pushed into theaters. The industrial-age *iron mountain* approach was the sure way to provide strategic support to military forces.

During the 1950s, two factors forced a consideration of *efficiency* in addition to effectiveness in providing logistical support to armed forces. First, the two Hoover Commissions (Commissions on the Organization of the Executive Branch of the Government) and congressional inquiries into military supply management during the Korean War identified waste and inefficiencies in military procurement and logistics. These findings spawned efficiency initiatives by the Department of Defense (DoD) that included creation of the first, single DoD-wide logistics executive (Assistant Secretary of Defense for Supply and Logistics); separate management approaches for *repairables* (now called *reparables*) and *consumables*; introduction of the item manager concept; and efforts toward standardization for items common to the three Services.¹¹

Second, major challenges associated with America's first supersonic bomber, the B-58, manifested the need to consider maintainability in design of weapon systems. Not only did engineering complexities of the B-58 make it difficult to fly, flying-hour costs were huge, and maintenance intricacies required inordinate training and skill levels and highly specialized equipment. In 1965 early retirement was ordered for this aircraft. The B-58 demonstrated the need for configuration management; reliability and maintainability engineering, and life-cycle cost management to be included in the field of logistics.¹²

During the 1960s, an engineering perspective was added to the management aspect of logistics. Logistics became a quantitative science. The principles underlying logistics support analysis and integrated logistics support emerged.

The systems approach to logistics matured in the 1970s and 1980s. The art and science of logistics was treated as a set of interrelated activities. In 1970, logistics engineers and provisioning specialists from Air Force Logistics Command (AFLC) were, for the first time, collocated with a system program office in Air Force Systems Command (AFSC).¹³ In 1976 AFLC created the Acquisition Logistics Division to work closely with AFSC to promote maintainability and support of weapons systems and ancillary equipment.¹⁴ This era saw a major push on design for maintainability, supportability, and life-cycle cost management.

In 1992, AFLC and AFSC were merged into Air Force Materiel Command. This merger strengthened the systems view of logistics by marrying the research, science, engineering, and acquisition strategy expertise of AFSC with the logistics engineering and management expertise within

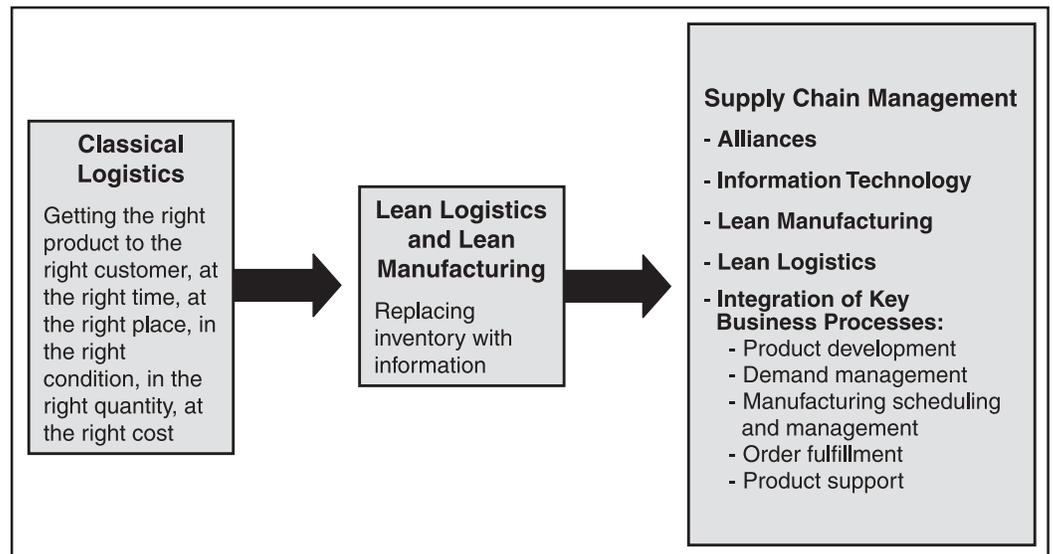


Figure 2. Conceptual Transition from Classical Logistics to Supply Chain Management

	Classical Logistics	Pure Supply Chain Management
Starting point	Requirements determination	Business process renovation
Organization	Functional silos	Integrated supply chain
Strategy	Predetermined plans of action	Adaptive capabilities for flexible response
Span of vision	First tier sources and customers	End-to-end system
Management focus	Logistics optimization	Extended enterprise optimization
Performance standards	Provider-developed	Customer-dictated
Partner selection	Quote and competition	Proposal and negotiation
Partner connectivity	Short-term contracts	Long-term contracts and strategic alliances
Contractual environment	Legalistic	Institutional trust
Relationships	Transactional; arms length	Long term, collaborative
Relationship objective	Opportunistic advantage	Mutually satisfactory outcome with emphasis on continuity of the relationship
Procurement objective	Contract compliance at minimum cost	Best value (innovation, quality, service, and price)
Supplier base	Huge	Circumscribed to select or world-class suppliers
View toward supplier	Source	Resource
Material verification	Material Inspections	Certified suppliers
Business environment	Adversarial	Mutual gain
Transportation approach	Service objective at minimum cost	Consistent, reliable, responsive service
Inventory approach	Push system; just-in-case	Pull system; replace inventory with information
Material flows	Scheduled	Self-synchronizing
Information	Industry standards, performance audits, status and exception reports	Enterprise resource planning system, electronic product codes, Internet connectivity, and supply chain analytics
Cost and service	A trade-off	Reengineer processes to increase service levels and reduce costs
Cost focus	Acquisition cost	Total cost of ownership
Support asset focus	Stocks	Flows
Risk	Low	Higher

Figure 3. Comparative Characteristics of Classical Logistics and Supply Chain Management

AFLC. The Agile Combat Support (ACS) doctrine became the targeted core competency for Air Force logistics. Program managers were given a *cradle-to-grave* responsibility for their acquisition programs as part of the integrated weapons systems management (IWSM) philosophy.¹⁵

On the commercial side of logistics, the marketing profession began to look at principles of military logistics as a way to improve distribution in the private sector in the mid-1960s. By the 1980s and 1990s, business logistics (defined as a customer-driven order fulfillment process with nine dimensions, as portrayed in Figure 4) became an important area for corporate strategy.

The 1990s also saw the blossoming of the information age, which offered the facilitating technologies for the supply chain management revolution of the 21st century.

Supply Chain Management in the US Military

The private sector borrowed best-practice concepts in military logistics beginning in the 1960s. The defense establishment is now implementing commercial best practices by pursuing the concepts, practices, and technologies of supply chain management.

Although DoD created a supply chain executive position in 1998 (Deputy Under Secretary of Defense for Supply Chain Integration), a supply chain management campaign by the Office of the Secretary of Defense (OSD) was not launched until 2003.¹⁶

The impetus for this campaign was Secretary of Defense Donald H. Rumsfeld's 2001 initiative to transform US military capabilities and the establishment of the Office of Force Transformation (OFT).¹⁷ Arthur K. Cebrowski, OFT's first director, developed the guiding philosophy of the transformation which he called network-centric warfare (NCW). NCW is best viewed as a theory of war in the information age. Information sharing

among networks of intelligence, operations, and logistics communities facilitates speed of command, flexible and situational response, and sustainability.¹⁸

As part of the NCW model, OFT unveiled the Sense and Respond Logistics (S&RL) initiative in 2003.¹⁹ S&RL is a philosophical umbrella for military supply chain management. It is a strategy for developing supply chains with players, information systems, capabilities, and protocols to respond rapidly to changing combat support requirements in the field. The *sense* aspect of S&RL is a real-time information system for gathering demand signals from the field. *Respond* is capabilities for flexible and speedy action within end-to-end supply chains. In short, S&RL is about the use of networks and sensors to create an agile supply chain with total asset visibility and real-time support capability. In an S&RL world, logistics mass is replaced with logistics speed.²⁰

Responsibility for the S&RL project has been given to the Office of the Undersecretary of Defense for Acquisition, Technology and Logistics. Their mandate is to pursue the underlying technologies and to work with the individual military departments to identify and develop their potentials for S&RL.²¹

In the interim, OSD has directed the implementation of modern supply chain practices for all DoD components. The DoD Supply Chain Material Management Regulation (DoD 4140.1-R dated 23 May 2003) mandates a supply chain framework and guiding principles for: effective and efficient end-to-end material support, meeting customer expectations while minimizing inventories, promulgating supply chain best practices in material management, and establishing the customer as the foundation driving all material management decisionmaking. This regulation requires all DoD components to measure total supply chain performance.²²

The supply chain transformation within the US Air Force was formally launched in 2003 with the Expeditionary Logistics for the 21st Century (eLog21) campaign. The goal of eLog21 is, by philosophy, to offer efficient, Agile Combat Support; by vision, an enterprise view of logistics; and in practicality, to use supply chain concepts and technology to improve weapons availability by 20 percent and to reduce support costs at the same time.²³

The eLog21 program contains all the elements of modern supply chain management. Fulfillment processes are being reengineered to increase customer service and to reduce costs. Revised and integrated business practices for sustainment mirror private sector best practices. RFID is being extensively employed for asset tracking.

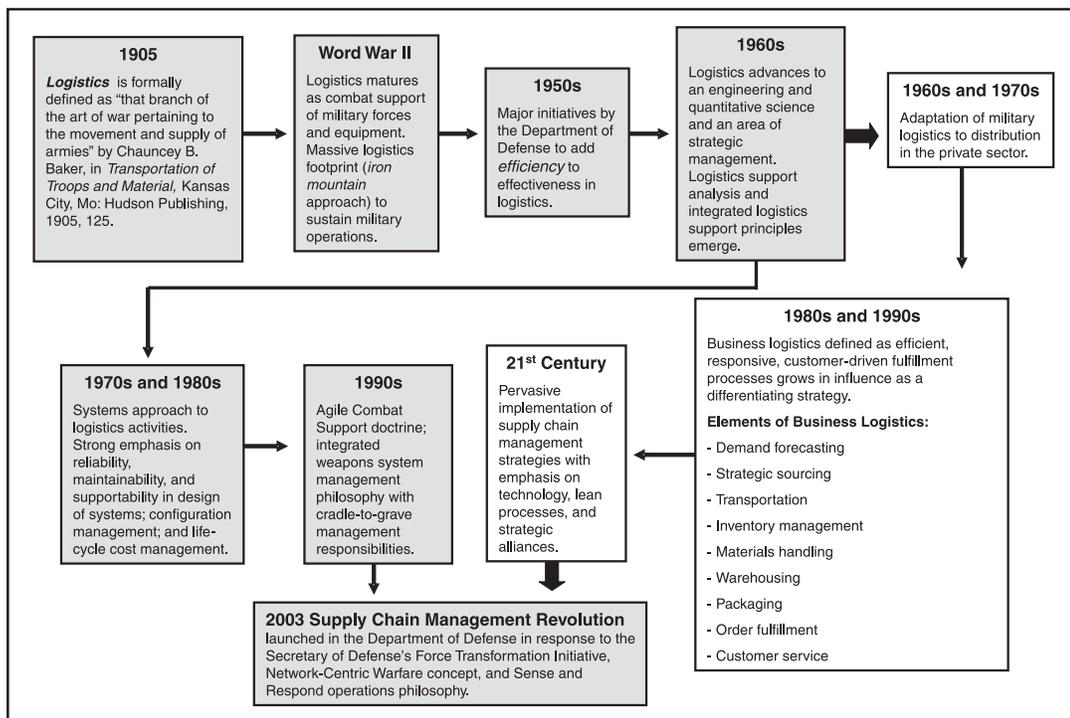


Figure 4. Evolution of Logistics Thought and Practice

And major investment in supporting information technology, the Expeditionary Combat Support System (which is the Air Force version of enterprise resource planning technology used in the private sector) is programmed.

Summary

Integrated logistics in a commercial context is coordinating logistics activities with other functional areas of the firm and with customers and suppliers. In a military context, integrated logistics is designing reliability, maintainability, and supportability into weapon systems, focusing on customer requirements, and coordinating supply support, training, technical data, and all other integrated logistics support elements.

Supply chain management is more than integrated logistics. Supply chain thinking represents a major breakthrough in thought about the interconnectivity of information technology, logistics processes, and customer support. Supply chain management is alliances with supply chain partners, lean processes, and end-to-end integration of key business processes. The enabling technology is information.

Supply chain management is more than a passing stage in the continuing evolution of management practice. It is a major revolution which is already delivering end-to-end visibility, cost reductions, and new levels of performance metrics in meeting customer requirements.

Notes

1. "Historical Background of Organizational Behavior," [Online] Available: <http://web.cba.neu.edu/~ewertheim/introd/history.htm>, accessed 2 Apr 2007). Another element in the evolution of management thought is that of human motivation and the relationship between work environment and productivity. This field of inquiry (called organizational behavior) originated with the famous Hawthorne Studies on worker productivity in the 1920s and advanced with such notable contributions as Maslow's Hierarchy of Needs (1950s) and Douglas McGregor's human relations approach to management called Theory X and Theory Y (1960s).
2. Keith Oliver, "When Will Supply Chain Management Grow Up?" *Strategy + Business*, Fall 2003, Issue 32, [Online] Available: www.strategy-business.com/press/16635507/03304, accessed 23 Apr 2007.
3. J.B. Houlihan, "International Supply Chain Management," *International Journal of Physical Distribution and Materials Management*, Vol 15, No 1, 1985, 51-56.
4. Scott Webster, *Principles and Tools for Supply Chain Management*, Boston: McGraw-Hill-Irwin, 2008, 7.
5. Thomas L Friedman, *The World is Flat: A Brief History of the Twenty-First Century*, New York: Farrar, Straus and Giroux, 2006, 151. Friedman characterizes Wal-Mart's efficient global supply chains as "The Wal-Mart symphony in multiple movements—with no finale."
6. Early examples include Kraft Foods, The Home Depot, Fairchild Semiconductor, Logitech, Delta Airlines, Whirlpool Corporation, Tyco International, and General Motors.
7. Thomas L Friedman.
8. Nonetheless, the intellectual home for the supply chain management revolution has been in logistics. Logisticians lead this movement. The logistics managers at Wal-Mart, for example, spearheaded the move to supply chain management in that organization. The leading-edge thinkers in the supply chain revolution (Douglas M. Lambert of Ohio State University, James R. Stock of the University of South Florida, and John T. Mentzer of the University of Tennessee, for example) are logisticians by background.
9. This thought appears to have been advanced first by Douglas M. Lambert of Ohio State University and director of the Global Supply Chain Forum. See Douglas M. Lambert, *Supply Chain Management: Processes, Partnerships, and Performance*, 2^d Edition, Sarasota, Florida: SCM Institute, 2006.
10. Chauncey B. Baker, *Transportation of Troops and Material*, Kansas City: Hudson Publishing, 1905, 125. For an expanded discussion on the origin of the term *logistics* and for various definitions, see Stephen Hays Russell, "The Growing World of Logistics," *Air Force Journal of Logistics*, XXIV, No 4, 15-19.
11. See "History of the Defense Logistics Agency," [Online] Available: www.dla.mil/history, accessed 18 Feb 2007.
12. For an example, see "B-58 Hustler," [Online] Available: www.globalsecurity.org/wmd/systems/b-58-fc.htm, accessed 18 Feb 2007.
13. In 1970, the B-1 System Program Office (SPO), as part of an initiative dubbed *Innovations*, colocated SPO personnel (engineers and program control people) at contractor sites (North American Rockwell in Los Angeles and General Electric Aircraft Engine Group in Evendale, Ohio). The SPO also had AFLC collocate personnel in these satellite SPOs.
14. *The Logistics of War: A Historical Perspective*, Maxwell AFB, Gunter Annex: Air Force Logistics Management Agency, 2000, 360.
15. Although intended for acquisition programs, the IWSM philosophy was expanded to product and materiel managers. The objective was to create a seamless process for spares by integrating the acquisition and sustainment processes.
16. In April 2003, OSD charged the Services with a series of supply chain transformation objectives including reengineering logistics processes, total asset visibility, and time-definite delivery. The individual Services, however, were pursuing supply chain concepts prior to that date. The Air Force Purchasing and Supply Chain Management (PSCM) project was initiated in February 2001 and progressed to its current design in April 2004. The Expeditionary Logistics for the 21st Century (eLog21) program, of which PSCM is a component and the Air Force approach to supply chain transformation, began in February 2003. For a comprehensive overview of the eLog21 program see, *Expeditionary Logistics for the 21st Century Campaign Plan*, [Online] Available: www.af.mil/shared/media/document/AFD-060831-041.pdf, accessed 30 Mar 2007.
17. See "Office of Force Transformation Homepage" [[Online] Available: www.oft.osd.mil, accessed 18 Feb 2007.
18. D. S. Alberts, J.T. Garstka, and F.P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, 2^d ed (Revised), Washington, DC: CCRP Publications, August 1999, [Online] Available: www.dodccrp.org/files/alberts_ncw.pdf, accessed 18 Feb 2007.
19. Sense and respond as a business philosophy was developed by Stephan H. Haeckel of the IBM Advanced Business Institute in 1993. See S.H. Haeckel and A.J. Slywotsky, *The Adaptive Enterprise: Creating and Leading Sense and Respond Organizations*, Harvard Business School Press, 1999; and "Operational Sense and Response Logistics: Co-evolution of an Adaptive Enterprise Capability," Office of Force Transformation, November 2004, [Online] Available: www.oft.osd.mil/Initiative/srl/S&RL_Concept_Short.doc, accessed 12 Mar 2007.
20. For an excellent treatment of the Sense and Respond model see Karen Butner, et. al., *Reshaping Supply Chain Management: Vision and Reality*, Boston: Pearson Custom Publishing for IBM Global Business Services, 2007.
21. An insightful discussion on the progress and the challenge of organizational change in moving DoD components to S&RL is found in Heather B. Hayes', "Sense and Respond in Fits and Starts," *Defense Systems*, Sept/Oct 2006, [Online] Available: www.defensesystems.com/issues/1_5/features/474-1.html, accessed 11 Apr 2007.
22. Office of the Deputy Under Secretary of Defense for Logistics and Materiel Readiness, *DoD 4140.1-R DoD Supply Chain Materiel Management Regulation*, 23 May 2003, [Online] Available: www.ditc.mil/whs/directives/corres/pdf/414001r.pdf, accessed 2 Jan 2007.
23. "eLog21 Fact Sheet," [Online] Available: <https://acc.dau.mil/CommunityBrowser.aspx?id=32774>, accessed 2 Mar 2007; "eLog21 Purchasing and Supply Chain Management," *Air Force Journal of Logistics*, 23 May 2003, [Online] Available: www.accessmylibrary.com/coms2/summary_0286-1448758_ITM, accessed 2 Mar 2007.

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