The Elmer A. Sperry Award
1991

for advancing the art of transportation

The Elmer A. Sperry Medal

The Elmer A. Sperry Award

The Elmer A. Sperry Award shall be given in recognition of a distinguished engineering contribution which, through application, proved in actual service, has advanced the art of transportation whether by land, sea or air.

In the words of Edmondo Quattrocchi, the sculptor of the Elmer A. Sperry Medal:

"This Sperry medal symbolizes the struggle of man's mind against the forces of nature. The horse represents the primitive state of uncontrolled power. This, as suggested by the clouds and celestial fragments, is essentially the same in all the elements. The Gyroscope, superimposed on these, represents the bringing of this power under control for man's purposes."

Presentation of

The Elmer A. Sperry Award for 1991

to

Malcom P. McLean

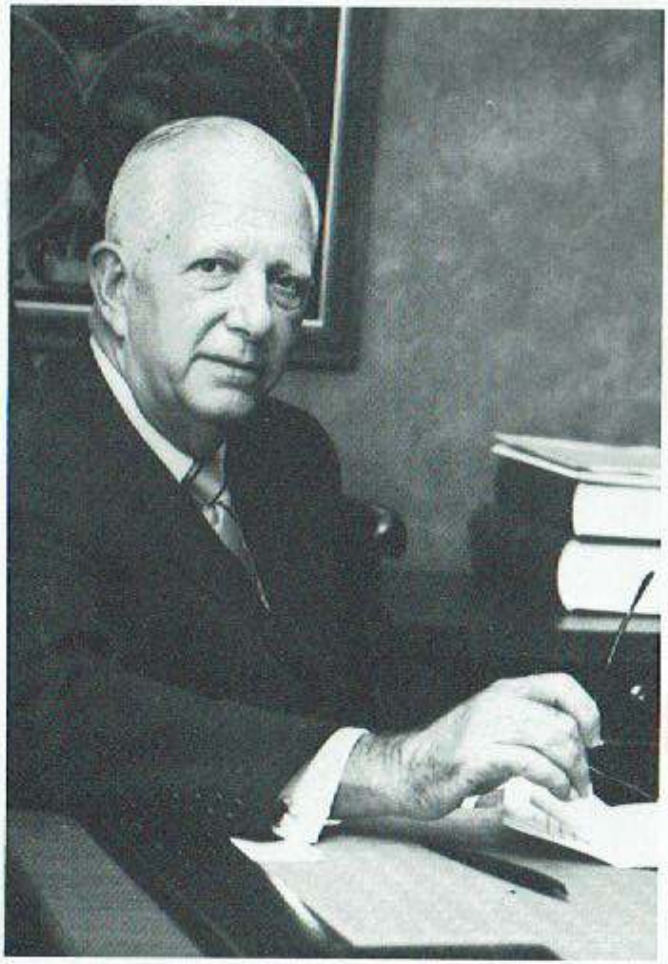
by

The Board of Award under the sponsorship of the:

American Society of Mechanical Engineers
Institute of Electrical and Electronics Engineers
Society of Automotive Engineers
Society of Naval Architects and Marine Engineers
American Institute of Aeronautics and Astronautics
American Society of Civil Engineers

At the 1991 SAE International Congress & Exposition
Tuesday, February 26, 1991
Detroit, Michigan

AWARD CITATION



MALCOM PURCELL MCLEAN

for his pioneering work in revolutionizing
cargo transportation through the introduction
of intermodal containerization

BIOGRAPHY OF AWARDEE

MALCOM PURCELL MCLEAN

Malcom Purcell McLean was born on November 14, 1913 in Maxton, North Carolina, one of seven children. He grew up and attended school in North Carolina. As a teenager, he began his trucking career by hauling empty tobacco barrels in an old trailer.

In the middle of the Depression, 1934, he started the McLean Trucking Company in Red Springs, North Carolina, with a single used truck. Over the next two decades, he built McLean Trucking into the second largest trucking company in the United States.

While running McLean Trucking, he developed the concept of carrying trucks on ships. His early plans centered around the carriage of cargo along the East and Gulf Coasts of the United States. On February 16, 1954, Malcom McLean revealed his concept to carry van-type, demountable bodies from semi-trailers on board ship in a coordinated system of sea and land transportation.

The U.S. had regulations prohibiting the ownership of competing modes of transport. In 1955, Malcom McLean sold his highly successful trucking company in order to carry out his bold plan to introduce ships dedicated to carrying containers.

In 1955, Malcom McLean purchased Pan-Atlantic Steamship Company and, four months later, Waterman Steamship Company. He first introduced container shipping on four converted tankers and, in 1957, converted six Waterman C-2 type vessels into full containerships.

He changed the name of Pan-Atlantic to Sea-Land Service, Inc. in 1959, as the company expanded its operations domestically and internationally.

In 1978, Malcom McLean resigned his directorship in RJR. The following year, he purchased United States Lines Company, the largest and one of the oldest U.S. flag shipping lines. He embarked upon an expansion plan that included the construction of twelve of the largest containerships in the world. U.S. Lines became a victim of depressed shipping rates, world economic recession, and an intense rate war in the Pacific, and the company was dissolved in 1987.

During Malcom McLean's three decades of leadership, containerization grew into an approximately $100 billion capital-intensive, worldwide industry, having major impact on highway, rail, air and, particularly, sea transportation.

Malcom McLean's many accomplishments include the introduction of fully cellular containerships; the large scale transportation of refrigerated containerized cargoes on land and sea; the development of purpose-built intermodal containerships; the development of a fleet of 33-knot containerships (the fastest cargo ships ever built); the construction of a fleet of Jumbo Econships (at the time the largest containerships ever built); the development of a vast array of mechanical devices used for the handling of intermodal equipment; early pioneering efforts in double-stacked rail transport, and a variety of other accomplishments in the intermodal container transportation field.

Malcom McLean's nearly single-handed efforts in Viet Nam in the late 1960s broke a logistical log jam with his introduction of containerships and containerization in a military environment.

During the period 1955 to 1991, Malcom McLean has also been active in many other fields, including heavy investments in real estate (Diamond Head Corporation); life insurance (Loyal American Life Insurance Company); corporate farming, and other fields.

In 1973 he bought the 400,000 acre First Colony Farm, a vertically integrated agricultural operation. Early on he recognized that the United States has energy resources in peat that exceed the combined resources in gas, oil, hydroelectricity and thermal power. First Colony Farm has at least 200,000 tons of surface peat and, therefore, he pioneered in the United States in the introduction of mechanical equipment for the harvesting of peat and he experimented heavily in applications of this fuel to solve the country's energy problems.

In the late 1960s and early 1970s, he experimented in mass production and transport of modular housing. He extrapolated his experience in material handling to the development of a machine to transfer patients from hospital beds to stretchers.

Malcom McLean has been the recipient of many awards for his accomplishments and his contribution to transportation. Malcom McLean won the trucking "Distinguished Service" Award for his leadership in progressive truck fleet modernization and establishment of safety programs, presented at the Automotive Transport Vehicle Show in New York in 1952.

In 1959, the "American Legion Merchant Marine Achievement" Award was presented by President Eisenhower to Malcom McLean's firm for its development of ships to carry containers.

In 1970, Malcom P. McLean was presented the "Seley Transportation" Award by the Transportation Association of America, and the "Man of the Year" Award by the World Trade Club of New York, the "Connie" Award by the Containerization Institute in 1974, and the "Admiral of the Ocean Seas" (AOTOS) award in 1984. In 1990, he was presented the first "Intermodal Pioneer and Visionary" Award at the International Intermodal Expo 90 Conference.

Fortune Magazine has selected Malcom McLean as one of the ten outstanding innovators of this century. He has been described as "one of the few men who changed the world"[1]. He is universally recognized as the "Father of Containerization."

[1] Forbes, 23 March 1987

IMPACT OF CONTAINERIZATION

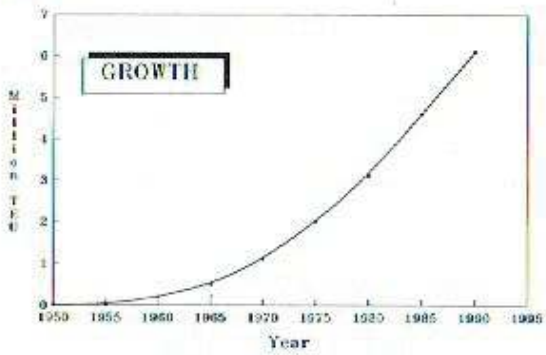
The one innovation in the 20th century that has had the most profound impact on the transportation of cargo is CONTAINERIZATION. It has revolutionized the methods for handling goods, the vehicles that carry them, and the terminals where they are consolidated, stored, transferred and distributed. Containerization has touched virtually every mode of transport and particularly highway, rail, marine and air. It has changed the way shippers package their products. It has had a major effect on preventing the damage and pilferage of cargoes in transit. It has improved the transport of perishable cargoes. Containerization has caused radical changes in such traditional industries as insurance, forwarding, brokerage, storage and warehousing, local delivery services, documentation, etc. Containerization has changed trading patterns and opened new markets to goods that would otherwise have been transported.

Containerization has stimulated the development and manufacture of a great variety of containers, chassis and handling equipment. It has changed the design of ports and terminals.

Containerization has brought efficiency to the use of labor and capital, with the result that cargo freight rates, in many cases, in real dollars, have fallen rather than risen in terms of real dollars. The manufacturers and the consumers of the cargo have benefitted. It has been responsible for the opening of new markets for many cargoes. A large number of new container-related industries have brought economic advantages to their workers.

The military has found numerous ways to integrate containerization into its missions, particularly in the area of logistics and supply. It has found new uses for containerization in operations through the use of portable hospitals, communications centers, machine shops, housing units, etc.

Containerization has spread worldwide and is at work in every country in the world. Containerization has had a very far reaching effect, is universal in its application, and affects the everyday life of everyone.



World Container Population

HISTORY OF CONTAINERIZATION

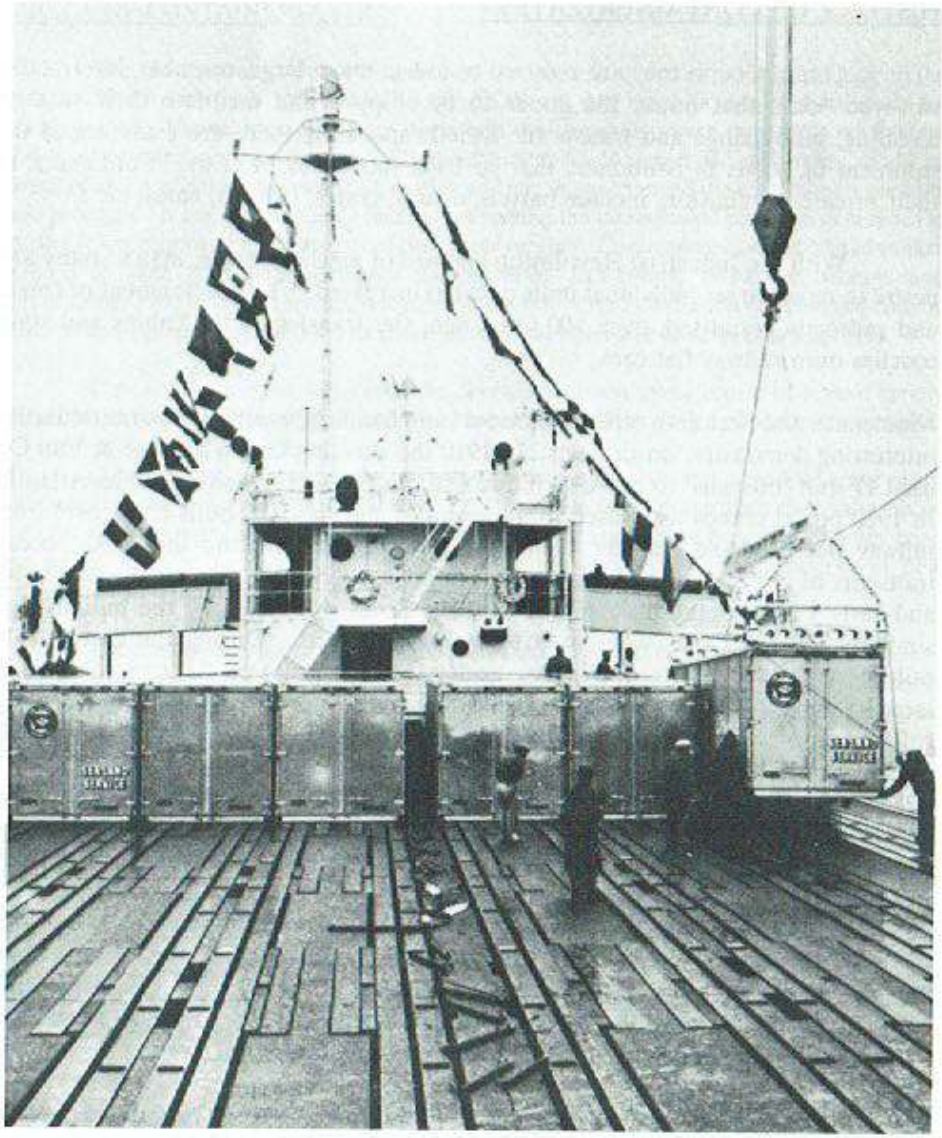
Containers, as they are referred to today, mean large, reusable, intermodal, van-type boxes that house the goods to be shipped and facilitate their storage, handling, interchange and transport. Strictly speaking, there are examples of the shipment of goods in containers that go back thousands of years. Containers, in their broadest definition, include barrels, drums, crates, cartons, bales, etc.

With the Industrial Revolution and age of mechanization, man's ability and desire to move larger individual units of cargo increased. The development of cranes and railroads permitted, over 100 years ago, the transfer of the cabins and stage coaches onto railway flat cars.

Nineteenth and twentieth century transport and handling equipment permitted some interesting demonstration projects. In 1910 the Bowling Green Storage & Van Co. used 17 foot "lift-vans" to move furniture and other goods inland and trans-Atlantic. In 1920 portal cranes were used to move crates and specially-built containers from railway flat cars and transfer them to road vehicles. During the 1930s, ocean transport of rail boxcars by Seatrain Lines proved successful. During the late 1940s and early 1950s, metal, pilfer-proof CONEX boxes were used by the military and similarly DRAVO vans were used by civilian interests. During the early 1950s, railroads began to transport highway trailers (with wheels) on flat cars (TOFC) in large numbers. TMT and other companies began transporting trailers in ocean-going roll-on/roll-off (Ro-Ro) services to the Caribbean and elsewhere. These were all precursors of the Age of Containerization.

In 1955, Malcom McLean bought Pan-Atlantic Steamship Co. and Waterman Lines, traditional domestic coastwise and international steamship companies, respectively. Pan-Atlantic had World War II-built T-2 tankers. These vessels were equipped with spar decks, which had been used to transport military aircraft during the war. It was McLean's plan to carry demountable van bodies on the ships between Texas and Newark, New Jersey. He had Brown Trailer Company build several hundred 33-foot long containers for this purpose. At that time, 33 feet was the longest permissible length for a semi-trailer on all U.S. highways.

On April 26, 1956, the tanker IDEAL X, sailed from Newark to with 58 containers. The ALEMA, the MAXTON, and COLINGA HILLS entered service shortly thereafter. Within the first eight months, the IDEAL X and her three sisters transported over 67,000 tons of cargo in containers. This service proved to be successful, but it was apparent that full containerships with greater capacity would



The historic first loading of the T-2
tanker, IDEAL X, in Port Newark
on April 26, 1956

be even more successful. Therefore, McLean quickly converted six Waterman general cargo ships of the C2-S-E1 Class to full containerships by adding sponsons to the ships' sides, cells (for stacking the containers in the ship), and steel pontoon covers for enclosing the holds. The GATEWAY CITY and her five sisters each had a capacity of 226 35-foot containers. This work was done at the Mobile Ship Repair Co. in Alabama. The Skagit Corp. of Sedro-Woolley, Washington, built 12 portal-type shipboard gantry cranes for the six ships. These diesel-driven cranes moved longitudinally on the ships. Transverse moving trolleys moved out over the sides of the ships to pick or place containers onto chassis on the dock.

McLean had the Fruehauf Corp. build 2,000 aluminum 35-foot containers. Skeletal, goose-neck, tandem axle chassis were built by various manufacturers.

In 1959 Pan-Atlantic was renamed Sea-Land Service, Inc. and the Sea-Land coastwise business had expanded to several ports in the U.S. Gulf and East Coast. Sea-Land converted a fleet of T-2 and T-3 tankers into full container ships.

To support this operation, Sea-Land built thousands of 35-foot containers and chassis, mostly of the dry-container type. However, it was clear from the beginning that refrigerated cargoes, both frozen and chilled, could be easily transported within the system. Therefore, McLean had the Thermo King Corp. build dual powered (electric - for shipboard, and propane - for highway) reefer units for mounting on insulated containers. Other specialized equipment developed in those early years included open-top containers ("rag tops") for top-loading of heavy cargoes, tank containers, meat-railers (for hanging meat), garment containers (for hanging garments), half-high containers (for dense products), etc.

While these developments were taking place on the East Coast, Matson Navigation Co., in San Francisco, was developing a similar system for the transport of 24-foot containers between California and Hawaii in converted C-3 type ships. Matson sailed her first ship, HAWAIIAN MERCHANT, with 20 containers on deck in 1957. In 1958 Matson converted six additional ships to carry 75 containers on deck. On May 9, 1960, Matson's first fully cellular containership, the HAWAIIAN CITIZEN, entered service. Matson made unique contributions to the technology, particularly with the development of the shore gantry container crane, which were built, almost exclusively by the Pacific Coast Engineering Co. (PACECO) of Alameda, California. PACECO also pioneered in the development of on shore gantry cranes.

T-2 tanker, IDEAL X, 1956

S.S. ELIZABETHPORT, "Queen of the Containerships," 1961

The 1970s showed further expansion and penetration of the container concept onto all continents. Both in the United States and abroad, container technology matured. Sophisticated control systems, computerized documentation, controlled atmosphere of perishable cargoes, highly specialized terminal facilities, double-stacked rail equipment, the air transportation of containers, containerized mail, and other developments emerged.

Through the 1980s, containerization continued to grow with the developing nations also participating in the technology and the benefits. The more developed maritime nations focused on larger and faster ships and larger and more sophisticated terminals. The concepts of land bridges, both in the United States and in Europe-Asia, were stimulated by improved rail-container transport.

McLean, who sold his interests in Sea-Land in the late '60s, acquired United States Lines in the late '70s and in the early '80s began a program of building 12 Jumbo Econships, each with a capacity of 4400 TEUs. After considerable skepticism on the part of many of his competitors, they soon followed suit, building Panamax and post-Panamax containerships. The first post-Panamax containerships were a fleet of five C-10 vessels of the President Kennedy Class built in West Germany by American President Lines. Evergreen, Nedlloyd and others have likewise followed suit with the construction of post-Panamax ships.

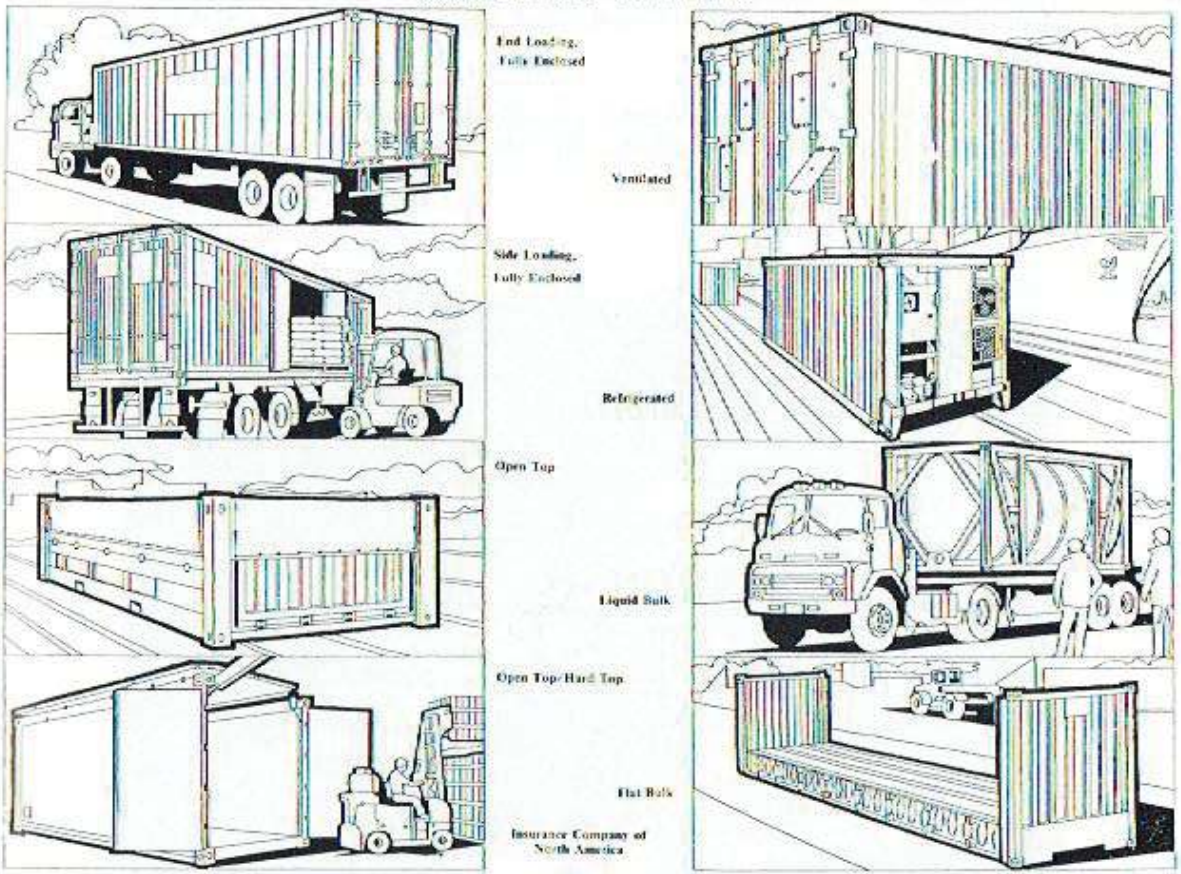
In the early '50s, the maximum size containers were keyed to the U.S. highway regulations. By 1960, the highway regulations in the United States permitted 40-foot containers on the nation's highways and, consequently, stimulated by U.S. military interests, the American Standards Association promoted the concept of 10, 20, 30, 40-foot containers. These containers were 8' wide and 8'-0" or 8'-6" high. The International Standards Association followed the U.S. lead and adopted these sizes as a world's standard. These sizes, particularly the 20- and 40-foot container sizes, remain the sizes of choice for most operators from the '60s, '70s and '80s. However, land and rail transport, especially in Europe, permit a 2.5 meter (approximately 8'-6") wide road vehicle. The new U.S. highway regulations also permit vehicles of this width. Changes in height limits make 9' and 9' 6" high cube containers also viable. Increasingly longer lengths also make 45-foot, 48-foot and 53-foot long containers in the U.S., and similar metric lengths abroad, of interest to many.

Developing countries, who are full participants in the container revolution, have made major investments in this capital-intensive technology. Because of the greater difficulty in acquiring capital, they have proven reluctant to changing standards. This, therefore, forms one of the more controversial issues in improving container technology during the 1990s.

The S.S. SEA-LAND MCLEAN and her seven sister ships in the SL-7 Class are the fastest cargo ships ever built. Designed to operate at 33 knots, the SEA-LAND MCLEAN averaged 35 knots from Bishop's Rock to New York. (These vessels have been converted to fast naval auxiliaries.)

MV SEA LAND PATRIOT, one of the first diesel driven 2500 TEU containerships.

TYPICAL CONTAINERS



There are many challenges facing operators and designers of land, rail, air and sea container equipment in the coming decade, and the innovators will find fruitful ground in container technology to improve transportation.

SHIPS

The world shipboard slot capacity is about 3,000,000 TEU in 4,650 ships. Half of all shipboard container capacity is to be found in fully cellular vessels (on a TEU basis). In 1989, there were approximately 1,515,000 slots in approximately 1,250 ships. The other types include Ro-ro, Ro-ro/container, conversions, semi-container, break-bulk, bulk-container and barge carrier. The maximum size of containerships continue to grow.

Sea-Land's Jumbo Econships are now exceeded in size by post-Panamax ships constructed in recent years by American President Lines, Nedlloyd, Evergreen, and others.

One of McLean's Jumbo Econships, The M.V. AMERICAN NEW YORK,
on her maiden voyage, transiting the Panama Canal.
This vessel and her 11 sisters were, in 1984, the world's
largest containerships, with a capacity of 4456 TEU.
(These vessels are now Sea-Land's Atlantic Class)

CONTAINER TERMINALS

Specially constructed marine container terminal facilities are equipped with wharves, cranes, container marshalling and parking yards, power sources for reefer containers, consolidation sheds for less-than-container lot sizes, maintenance garages, rail transfer stations, and gate-receiving facilities.

Worldwide marine terminal facilities saw a 65,843,815 TEU throughput in 1987. Hong Kong had a 3,457,182 TEU throughput that year and is expecting to triple this figure by 2000. Inland truck, rail and barge transfer terminal support intermodal containerization with similar throughputs. The ECT Delta terminal in Rotterdam represents one of the most technically advanced, and highly automated, facilities in the world.

Port Authority terminals in Elizabeth, New Jersey, with Sea-Land's Terminal in foreground, and Maher, Universal, and Maersk Terminals in background. The world's fastest cargo ship, the SEA-LAND MCLEAN, is in the lower right foreground.

CONTAINER HANDLING EQUIPMENT

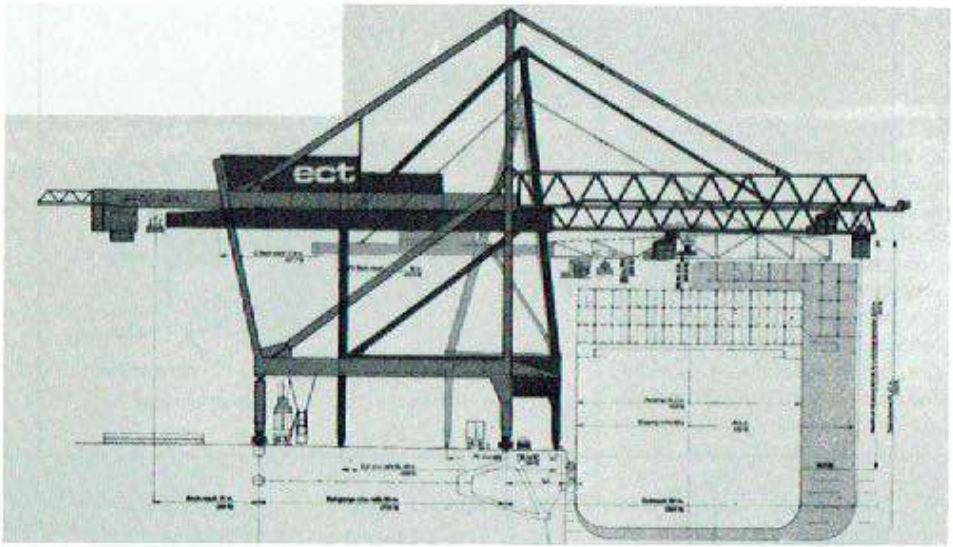
The loading and discharge of containers from ships is accomplished with a variety of types of shipboard and shore cranes. However, the predominant type is the large, rail-mounted, hinged boom gantry crane, of which there are approximately 1,500 worldwide.

Containers are moved in the terminal, principally by straddle cranes and heavy-capacity fork lift trucks. In 1990, there were over 1,200 yard gantries worldwide and over 1,800 large straddle carriers.

Tractors, chassis, spreaders, and other equipment also form essential components in the handling of containers.

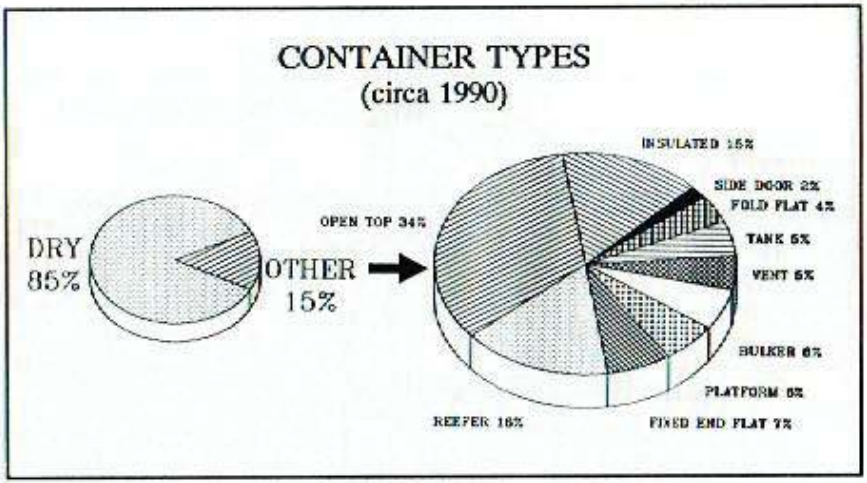
Straddle carriers moving containers on the wharf in a grounded-box terminal

Ship gantry crane loading a containership in a chassis terminal



Shore gantry container cranes showing the earlier Panamax-type design to handle containerships up to 106-ft. beam and the latest gantries at ECT's terminal in Rotterdam designed to handle post-Panamax ships (130-ft. beam)

The world container population in 1990 stands at approximately 6,000,000 TEU. While the dry van predominates, at least ten other types exist in sizeable numbers (see below). There are many other types of specialty containers, including car-tainers, livestock containers, meat railers, half-height, open-sided, etc. Approximately three-quarters of all containers are steel, on a TEU basis. The remainder are aluminum (15%) and GRP/plywood (10%). Fifty-eight percent of the containers are 20-foot, forty percent are 40-foot, and the remainder are other sizes.



Dry Cargo	Open Top - Fabric	Insulated
Ventilated	Open Top - Hard	Refrigerated
Heated	Dehumidified	Anti Sweat
Liquid Tank	Dry Bulk	Flat Rack
Garment	Meat Railer	Folding
Canvas Side	Car Carrier	Cattle Tainer
Half Height	Dry Cargo High Cube	Power Box
Port-a-camp	Barracks Container	Special Purpose
Cryogenic	Pressure Tank	Clear Sided Flat
Heated Tank	Open Half Height	Platform
Side Access Container	Post Flat Rack	Tilting Container

RAILROADS

Early intermodal rail transport consisted exclusively of "piggy back" trailer-on-flat-car (TOFC). Container-on-flat-car (COFC) service on U.S. and overseas railroads emerged in the early 1960s. McLean experimented with double-stacked rail cars. However, APL put the large scale application of double-stacked rail cars in service in the U.S. European rail operators are involved in non-standard swop bodies as well as the extensive transport of conventional containers.

Sea-Land's early double-stacked container operation

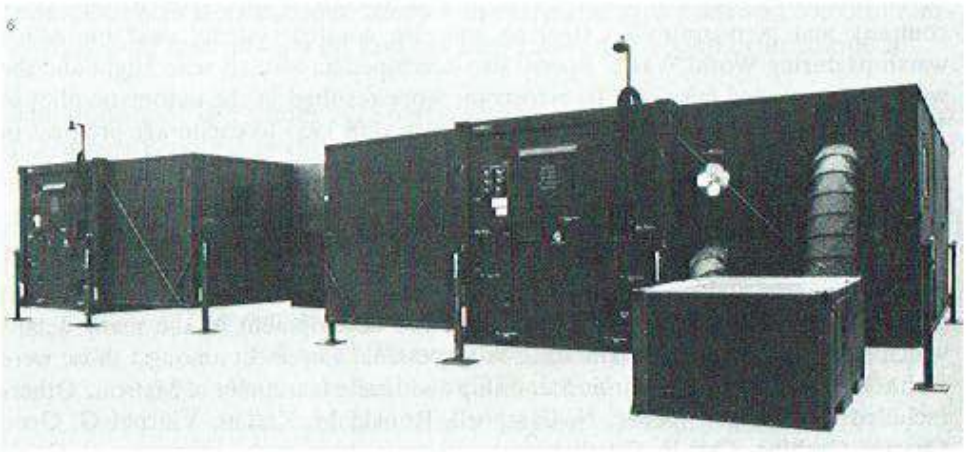
AIR TRANSPORT

Air cargo is a development of the post World War II era. By the late 1950s, the advent of commercial jet aircraft had further stimulated air freight, which, up to this time, was mostly 2. The emergence of the jumbo and wide body jets made the use of cargo containers inevitable. While these containers were mostly of the "igloo" type, SAE sponsored a standards effort for an aircraft-friendly van type intermodal container. A number of these lightweight 8'x 8' units were built in the late '60s and early '70s for use on 747s, L-1011s and DC-10s. Most of the container development in the air cargo industry has been limited to the smaller shaped units.

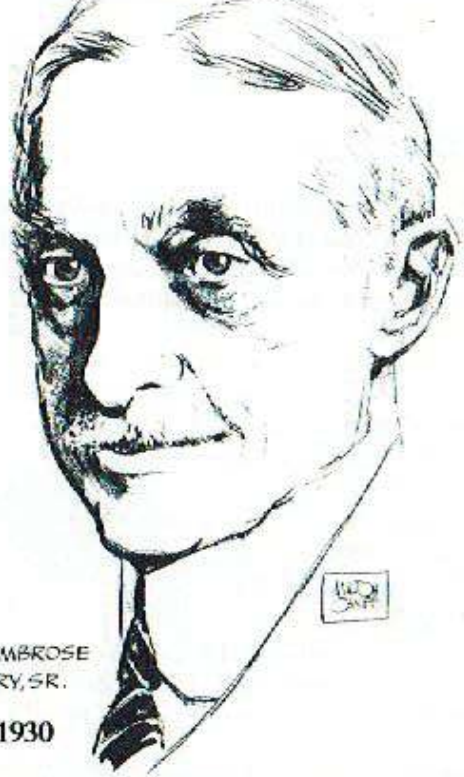
MILITARY APPLICATIONS

The U.S. military containerization is growing and can be expected to expand even further with reductions in overseas troop levels. The U.S. military depends very heavily on the availability of commercial containers. In addition, the various branches have their own dedicated equipment, estimated in 1990, at the following levels:

U.S. Army	
Dry vans, Milvans, Reefers, and Surgeon-general side access containers	12,000
U.S. Air Force	
Side-access dry vans	2,000
U.S. Marine Corps	
Open tops, Half-heights, Rigid shelters, EMI shelters, Knockdown shelters, and Pre-positioned containers of various types	15,000
U.S. Navy	
Reefers, Tricons, Dry vans, and Tactical shelters	9,000



U.S. Military Containers



Elmer A. Sperry, 1860-1930

After attending Cornell University in 1879-80, Sperry invented an improved electric generator and arc light and opened an electric company in Chicago. He invented electric mining equipment, locomotives, streetcars and an electric automobile. He developed gyroscopic stabilizers for ships and aircraft, a successful marine gyro-compass and gyro-controlled steering and fire control systems used on Allied warships during World War I. Sperry also developed an aircraft searchlight and the world's first guided missile. His gyroscopic work resulted in the automatic pilot in 1930. The Elmer A. Sperry Award was established in 1955 to encourage progress in transportation engineering.

Other Contributors

Many engineers and operating personnel in the various modes of transport and equipment manufacturing were involved in the development of the many details which made intermodal containerization successful. Foremost amongst those were Keith Tantlinger of Pan-Atlantic Steamship and Leslie Harlander of Matson. Others included Cecil Egger, Robert N. Campbell, Ronald M. Katims, Vincent G. Grey, Charles Cushing, Carl R. Gottlieb and many others in such companies as Grace Lines, Alaska Steamship, Fruehauf, Thermo King, George Sharp Co., J. J. Henry Company and Seatrain Lines.

The Founding of
The Elmer A. Sperry Award

To commemorate the life and achievements of Elmer Ambrose Sperry, whose genius and perseverance contributed so much to so many types of transportation, the Elmer A. Sperry Award was established by his daughter, Helen (Mrs. Robert Brooke Lea), and his son, Elmer A. Sperry, Jr., in January 1955, the year marking the 25th anniversary of their father's death. An additional endowment to support the award was received in 1978 upon the death of Mrs. Lea. Additional gifts from interested individuals and corporations also contribute to the work of the Board.

Elmer Sperry's inventions and his activities in many fields of engineering have benefitted tremendously all forms of transportation. Land transportation has profited by his pioneer work with the storage battery, his development of one of the first electric automobiles (on which he introduced 4-wheel brakes and self-centering steering), his electric trolley car of improved design (features of its drive and electric braking system are still in use), and his rail flaw detector (which has added an important factor of safety to modern railroading). Sea transportation has been measurably advanced by his gyrocompass (which has freed man from the uncertainties of the magnetic compass) and by such navigational aids as the course recorder and automatic steering for ships. Air transportation is indebted to him for the airplane gyro-pilot and the other air-navigational instruments he and his son, Lawrence, together developed.

The donors of the Elmer A. Sperry Award have stated that its purpose is to encourage progress in the engineering of transportation. Initially, the donors specified that the Award recipient should be chosen by a Board of Award representing the four engineering societies in which Elmer A. Sperry was most active:

The American Society of Mechanical Engineers
(of which he was the 48th President);
American Institute of Electrical Engineers
(of which he was a founder member);
Society of Automotive Engineers; and
Society of Naval Architects and Marine Engineers.

In 1960, the participating societies were augmented by the addition of the Institute of Aerospace Sciences. In 1962, upon merging with the Institute of Radio Engineers, the American Institute of Electrical Engineers became known as the Institute of Electrical and Electronics Engineers; and in 1963, the Institute of Aerospace Sciences, upon merger with the American Rocket Society, became the American Institute of Aeronautics and Astronautics. In 1990, the American Society of Civil Engineers became the sixth society to become a member of the Elmer A. Sperry Board of Award.

Important discoveries and engineering advances are often the work of a group, and the donors have further specified that the Elmer A. Sperry Award honor the distinguished contributions of groups as well as individuals.

Since they are confident that future contributions will pave the way for changes in the art of transportation equal at least to those already achieved, the donors have requested that the Board from time to time review past awards. This will enable the Board in the future to be cognizant of new areas of achievement and to invite participation, if it seems desirable, of additional engineering groups representative of new aspects or modes of transportation.

The Sperry Secretariat

The donors have placed the Elmer A. Sperry Award fund in the custodianship of The American Society of Mechanical Engineers. This organization is empowered to administer the fund and has generously agreed to assist in handling the Award procedures. The fund has been placed in an interest bearing account, and earnings are used to partially cover the expenses of the Board. The principal account is augmented from time to time by donations from interested individuals and organizations.

The Elmer A. Sperry Board of Award Secretariat is administered by the American Society of Mechanical Engineers, which has generously donated the time of its staff to assist the Board in its work. The Secretary is appointed by the ASME from among its senior staff personnel.

The Elmer A. Sperry Board of Award welcomes suggestions from the transportation industry and the engineering profession for candidates for consideration for this Award.

PREVIOUS ELMER A. SPERRY AWARDS

1955 To *William Francis Gibbs* and his Associates for development of the S.S. United States.

1956 To *Donald W. Douglas* and his Associates for the DC series of air transport planes.

1957 to *Harold L. Hamilton, Richard M. Dilworth* and *Eugene W. Kettering* and Citation to their Associates for the diesel-electric locomotive.

1958 to *Ferdinand Porsche* (in memoriam) and *Heinz Nordhoff* and Citation to their Associates for development of the Volkswagen automobile.

1959 to *Sir Geoffrey De Havilland, Major Frank B. Halford* (in memoriam) and *Charles C. Walker* and Citation to their Associates for the first jet-powered aircraft and engines.

1960 to *Frederick Darcy Braddon* and Citation to the Engineering Department of the Sikorsky Aircraft Division, *Sperry Gyroscope Company*, for the three-axis gyroscopic navigational reference.

1961 to *Robert Gilmore Letourneau* and Citation to the Research and Development Division, *Firestone Tire and Rubber Company*, for high speed, large capacity, earth moving equipment and giant size tires.

1962 to *Lloyd J. Hibbard* for application of the ignition rectifier to railroad motive power.

1963 to *Earl A. Thompson* and Citation to his Associates for design and development of the first notably successful automatic automobile transmission.

1964 to *Igor Sikorsky* and *Michael E. Gluhareef* and Citation to the Engineering Department of the Sikorsky Aircraft Division, *United Aircraft Corporation*, for the invention and development of the high-lift helicopter leading to the Skycrane.

1965 to *Maynard L. Pennell, Richard L. Rouzie, John E. Steiner, William H. Cook* and *Richard L. Loesch, Jr.* and Citation to the Commercial Airplane Division, *The Boeing Company*, for the concept, design, development, production and practical application of the family of jet transports exemplified by the 707, 720 and 727.

1966 to *Hideo Shima, Matsutaro Fuji* and *Shigenari Oishi* and Citation to the *Japanese National Railways* for the design, development and construction of the New Tokaido Line with its many important advances in railroad transportation.

1967 to *Edward R. Dye* (in memoriam), *Hugh DeHaven*, and *Robert A. Wolf* and Citation to the research engineers of *Cornell Aeronautical Laboratory* and the staff of the Crash Injury Research projects of the *Cornell University Medical College*.

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1969 to *Douglas C. MacMillan, M. Nielsen* and *Edward L. Teale, Jr.* and Citations to Wilbert C. Gumprich and the organizations of *George G. Sharp, Inc., Babcock and Wilcox Company,* and the *New York Shipbuilding Corporation* for the design and construction of the N.S. Savannah, the first nuclear ship with reactor, to be operated for commercial purposes.

1970 to *Charles Stark Draper* and Citations to the personnel of the *MIT Instrumentation Laboratories, Delco Electronics Division, General Motors Corporation,* and Aero Products Division, *Litton Systems,* for the successful application of inertial guidance systems to commercial air navigation.

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1977 to *Clifford L. Eastburg* and *Harley J. Urbach* and Citations to the Railroad Engineering Department of *The Timken Company* for the development, subsequent improvement, manufacture and application of tapered roller bearings for railroad and industrial uses.

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1979 to *Leslie J. Clark* for his contributions to the conceptualization and initial development of the sea transport of liquefied natural gas.

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1982 to *Jörg Brenneisen, Ehrhard Futterlieb, Joachim Körber, Edmund Müller, G. Rainer Nill, Manfred Schulz, Herbert Stemmler* and *Werner Teich* for their contributions to the development and application of solid state adjustable frequency induction motor transmission to diesel and electric motor locomotives in heavy freight and passenger service.

1983 to *Sir George Edwards, OM, CBE, FRS; General Henri Ziegler, CBE, CVO, LM, CG; Sir Stanley Hooker, CBE, FRS* (in memoriam); *Sir Archibald Russell, CBE, FRS*; and *M. André Turcat, Ld'H, CG*; commemorating their outstanding international contributions to the successful introduction and subsequent safe service of commercial supersonic aircraft exemplified by the Concorde.

1984 to *Frederick Aronowitz, Joseph E. Kilpatrick, Warren M. Macek* and *Theodore J. Podgorski* for the conception of the principles and development of a ring laser gyroscopic system incorporated in a new series of commercial jet liners and other vehicles.

1985 to *Richard K. Quinn, Carlton E. Tripp*, and *George H. Pfuhl* for the inclusion of numerous innovative design concepts and an unusual method of construction of the first 1,000-foot self-unloading Great Lakes vessel, the *M/V Stewart J. Cort*, which revolutionized the economics of Great Lakes transportation.

1986 to *George W. Jeffs, Dr. William R. Lucas, Dr. George E. Mueller, George F. Page, Robert F. Thompson* and *John F. Yardley* for significant personal and technical contributions to the concept and achievement of a reusable Space Transportation System.

1987 to *Harry R. Wetenkamp* for his contributions toward the development and application of curved plate railroad wheel designs.

1988 to *J. A. Pierce* for his pioneering work and technical achievements that led to the establishment of the OMEGA Navigation System, the world's first ground-based global navigation system.

1989 to *Harold E. Frohlich, Charles B. Momsen, Jr.* and *Allyn C. Vine* for the invention, development and deployment of the deep diving submarine, *Alvin*.

1990 to *Claud M. Davis, Richard B. Hanrahan, John F. Keeley*, and *James H. Mollenauer* for the conception, design, development and delivery of the FAA enroute air traffic control system.

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