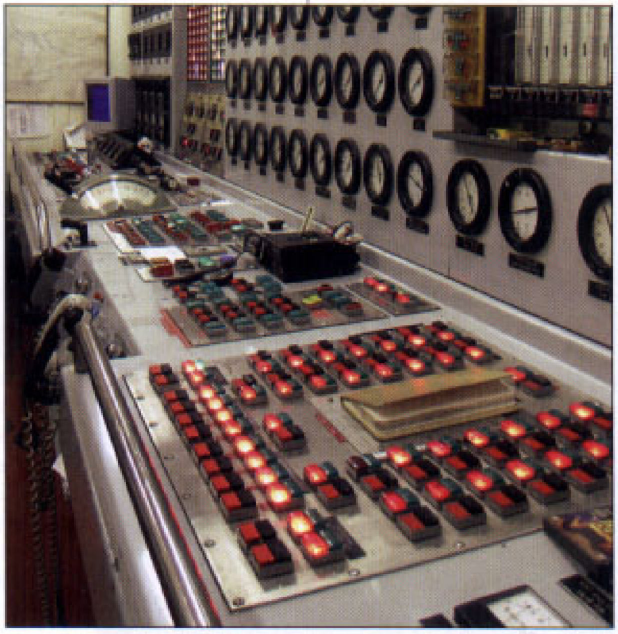
Ship modernization

Technology has changed the sailing experience

Growing through technology has always been one of the hallmarks of the maritime industry. With the advent of the 50th Anniversary of the St. Lawrence Seaway, let's examine some of the modern applications of design, propulsion, cargo handling and navigational technology and how today's Great Lakes vessels operate in comparison with past practices and knowledge.

From a design perspective, one simple change that came in the early 1960s was the installation of bow thrusters onto vessels. When you think of technology, this isn't particularly cutting edge, but an adaptation of existing technology. The bow thruster was an extremely effective addition by increasing vessel maneuverability and decreasing dependence upon harbor tugs. Subsequently, the use of bow thrusters, and stern thrusters later on, has become standard on Lakes vessel design from the 1970s onward.

Steel alters ship construction. Changes in the chemistry of steel following World War II led to the use of stronger, stress resistant high tensile steel. The lightweight steel, known in the industry as T1 steel, was used extensively in deck, frame and hull components, allowing for a reduction in the thickness of steel plating that converted to less deadweight tonnage. From a purely economic perspective the benefit was simple, a lighter ship can carry more cargo, move faster and consume less fuel.



The modern engine room features an integrated console that controls the main propulsion engines, ballasting controls and engine function readouts.

New American bulk carriers and Canadian registered Seaway class vessels built over the next quarter century soon featured deck housings placed aft, wide, cavernous cargo holds, blunt, rounded bows and rectangular sterns. The Canadian ships, designed to take full advantage of the system's locks, reached a maximum length of 730 feet. The Americans constructed more than a dozen supersized ships exceeding 1,000 feet in length, plus a variety of smaller ships that fit into the many rivers, small harbors and docks reliant upon Great Lakes shipping.

The 1,000-footers, in addition to their overall length, along with the new class of river boats, known colloquially as "sternwinders," all featured a technology that was more germaine to the Great Lakes than anywhere else—self-unloading systems. Self-unloading technology existed in the early 1900s, but the introduction in 1972 of the loop-belt unloading system, designed by Stephens-Adamson, revolutionized self-unloading technology on the Great Lakes. Almost overnight existing straight-decked vessels were retrofitted with new loop-belt systems and deck booms.

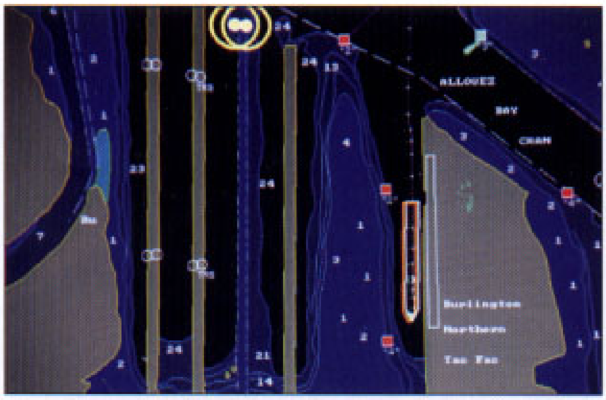
The loop-belt unloading system, utilizing a continuous internal belt, was fast and took up less physical space in the vessel, allowing for more cargo space. Up to the development of the loop-belt system, existing self-unloaders used a combination of incline conveyors and bucket elevator systems to unload their cargoes. The inclines and buckets were known to clog at belt transfer points if run too fast, producing cargo spillage that had to be manually shoveled back onto the belts. These systems, while an improvement over shore side equipment, were rendered nearly obsolete by the advent of the loop system.

The greatest impact of the self-unloading system on the Great Lakes mariner was the reduction in port time. Cargoes that previously took a day to several days to unload could now be discharged in a matter of hours. With the loop-belt, the combination of increased carrying capacity and decreased unloading time provided owners with a significant cost savings and effectively put an end to the era of extended shore time for sailors.

New forms of power. When the Seaway opened, the vast majority of the American and Canadian fleet vessels were steam powered; typically by hand-fired, triple-expansion reciprocating engines. Worldwide, the decade of the 1960s marked the beginning of a concerted shift away from steam, principally the reciprocating engines, toward the advancement of diesel technology. Spurred on by tightened federal air pollution regulations, Great Lakes fleet operators were under governmental and civic pressure to reduce stack emissions from coal-fired boilers. Thus, the shift from coal-fired boilers to the use of fuel oil was concurrent with the rise of diesel as a means of propulsion. At the time, fuel oil was cheap and the cost savings were increased with the automation of boiler controls. The reduction in the manning of the engine room brought about by the conversion to oil eliminated three firemen. While these jobs were held by non-licensed personnel, they still represented a significant savings in labor to vessel operators.

Diesel technology also caused changes in the pilothouse. For the first time, captains and mates had instantaneous control of the ship's engines, via levered throttle controls at the front window and at auxiliary stations on bridge wings. Linking the bridge and engine controls to the visual acuity of the ship's master eliminated any possible chance for an error or delay in communication resulting from the use of the traditional radio telegraph, or chadburn.

Seeing with radar. The first wave of technology to hit the pilothouse, the use of radar, actually came in the 1940s, yet into the early 1970s training in its use was still limited. For many years only the vessel master was allowed to use the ship's radar, a policy that could delay the flow of information at critical moments in the pilothouse. Today, all ship's officers are well



Top: Electronic charting systems, such as ECPINS, give detailed and accurate positioning of the vessel, its naviagtion track and its surroundings. This screen shows an ore carrier at a loading dock in Superior, Wisconsin.

Bottom: Computer powered engine monitoring, combined with bridge control stations, bring the concept of the un-manned engine room closer to reality. Here, the control center for the new diesel engine on the Ojibway electronically captures and stores engine performance data.

trained in the use of radar for vessel navigation and, while the systems are much more sophisticated than they were three decades ago, the use of radar still is not nearly as reliable in the midst of certain environmental conditions.

In 1982, Loran-C, a positioning system calculating input from electronic pulses received from land-based transmitters, was in use on most ships. Loran-C systems were more sophisticated versions of the aging radio-direction finders used for many years to triangulate a position. The Loran system was a big step in the direction of vessel positioning, but it would be a few more years before technology could provide greater accuracy.

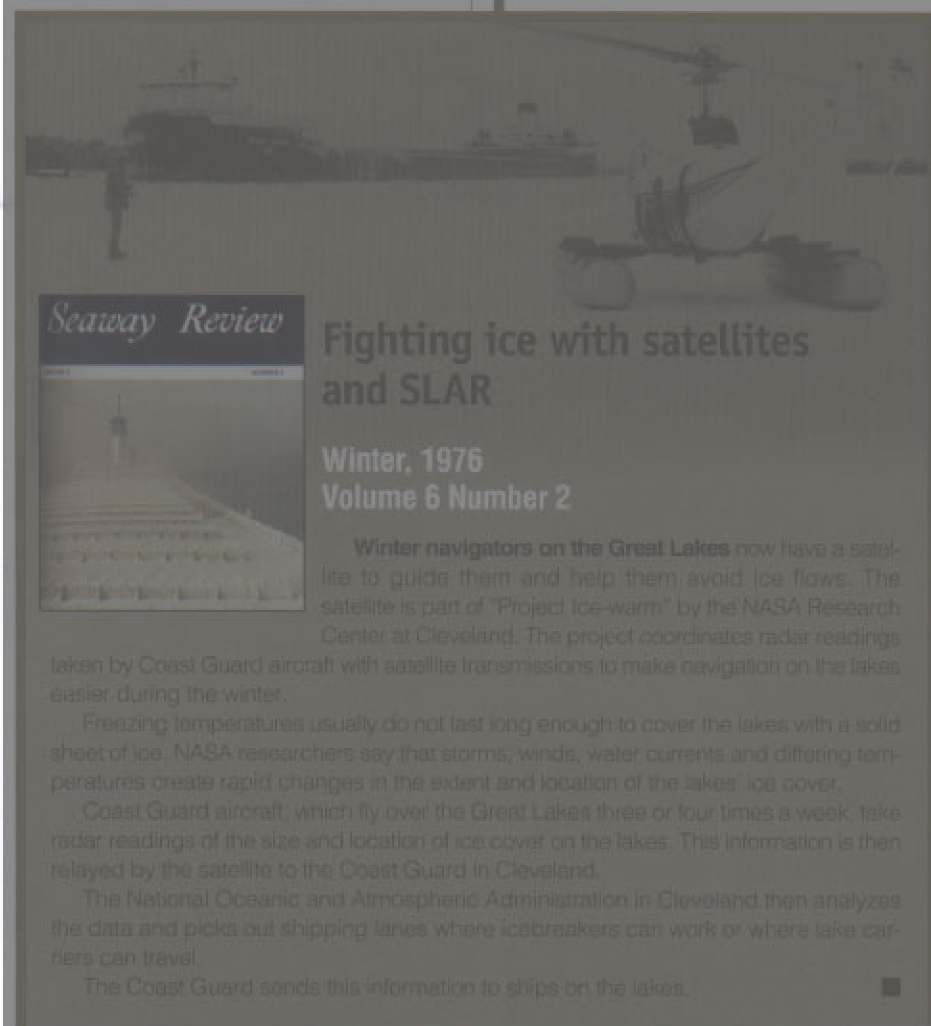
The second wave of electronic navigation assistance came in the early 1990s with the introduction of the Maptec system. Maptec utilized military technology to access a selected number of satellites to determine a ship's position. It proved to be accurate over a large area, but not accurate enough in short-range positioning or "unfamiliar" areas, such as docks and harbors. Within five years Maptec was replaced with the first generation of the electronic navigation system known as ECDIS (Electronic Chart Display and Information System), the forerunner of today's ECPINS.

ECPINS, developed by Offshore Systems, Ltd., was initially developed in 1979 for the offshore oil industry. Two generations later, in 1993, Canada Steamship Lines became the first commercial carrier on the Great Lakes to equip its vessels with the ECPINS (Electronic Chart Precise Integrated Navigation System). The system, incorporating DGPS (Differential Global Positioning System) receivers, interfaced with the Loran-C, radar and other electronic bridge systems with electronic charting to provide accurate course tracking and location information.

The use of electronic navigational posi-

"A central theme running interminably through the history of the two countries has been a deep preoccupation with the problems of linking the coastal populations to the distant resources of the interior, of leaping the great continental expanses of prairie and mountain so as to weave a kind of imperial unity into the continental economy. The American Civil War, the long Canadian task of Confederation, the elaborate regulation of common carriage in both countries—all involve this preoccupation. This is the historical and geographical context from which the opportunities and the problems of the St. Lawrence Seaway derive their deepest meaning."

Marvin J. Barloon
Professor of Economics
Western Reserve University
March 6, 1964



Seaway Review

Fighting ice with satellites and SLAR

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Winter navigators on the Great Lakes now have a satellite to guide them and help them avoid ice flows. The satellite is part of "Project Ice-warn" by the NASA Research Center at Cleveland. The project coordinates radar readings taken by Coast Guard aircraft with satellite transmissions to make navigation on the lakes easier during the winter.

Freezing temperatures usually do not last long enough to cover the lakes with a solid sheet of ice. NASA researchers say that storms, winds, water currents and differing temperatures create rapid changes in the extent and location of the lakes' ice cover.

Coast Guard aircraft, which fly over the Great Lakes three or four times a week, take radar readings of the size and location of ice cover on the lakes. This information is then relayed by the satellite to the Coast Guard in Cleveland.

The National Oceanic and Atmospheric Administration in Cleveland then analyzes the data and picks out shipping lanes where icebreakers can work or where lake carriers can travel.

The Coast Guard sends this information to ships on the lakes. ■

tioning and charting is now the standard for commercial vessels on the Great Lakes. Utilizing an array of satellites, the systems can pinpoint a vessel's position accurately to within several feet, in addition to providing a detailed stream of informational data such as the ship's speed and bearing. It is still standard practice to use paper charts to plot and track courses while at sea.

Satellite services. The use of satellites has in fact changed the entire flow of information on ships. Communication via the Internet, or the phone with the office, dock operators, vessel agents, repair facilities or tug services—whatever is needed, is now enabled through satellite service. Once at sea, a vessel is no longer out of touch with the world at large. Sailing by the stars and dead reckoning has now entered the age of sailing by satellite and digital display.

Changes in technology are only a small part of the changes in the pilothouse. The ship's master not only has the responsibility of navigating his vessel but he is also the defacto manager of the ship's information and communication resources. Bridge resource management is now a large part of the daily operational duties of the master and his bridge team. This paradigm shift has come largely in the past decade with the rapid advancement in electronics in shipboard command.

Environmental enhancements. As shipping enters the 21st Century, the industry is becoming more regulated, particularly in the area of the environmental emissions. On a national level, new EPA air pollution requirements regarding the discharge of diesel exhaust will mandate the use of cleaner burning fuels and the redesign of piston heads, the use of low emission power packs, cylinder liners and oil control rings to reduce stack emissions.

Changes in fuel are also in the offing. Vessels fueling in Minnesota have been required to use bio-diesel fuel for several years. Proponents of biodiesel blends point to increased lubricity for the engines, reduced emissions and less consumption of petroleum. To date, blends using approximately 20 percent biodiesel have shown no adverse effects on ship engines.

The discharging of ballast and waste water has been a much discussed issue that is finally gaining traction in the industry. Experimentation of various systems to control the transfer of non-native invasive species into the waters of the Great Lakes has led to the development of backflushing filters that separate solids and large organisms in combination with the use of UV radiation to kill living organisms before water is pumped out of the ballast tanks. Similarly, wastewater from ships, black water (toilets), grey water (showers, kitchens) and bilge water (engine room) also has to be treated before being removed from vessels. Self-contained sewage treatment systems have been on ships for years, but are also gaining in sophistication as technology advances. While the water is more than clean enough to pump out, convincing the crew that it is alright to drink has yet to be a convincing argument.

With all of the changes that have taken place, which has had the biggest impact? For owners and operators, larger, more efficient ships, operated with fewer crew has had a significant impact on the bottom line. For the average sailor, the electronic revolution has put an end to isolation. The changes that have taken place across the Lakes have led to Great Lakes mariners having all of the luxuries of home at their disposal—except, of course, the home.

Patrick Lapinski ■

The new "front window" bridge control console with ECPINS monitor, joystick throttle and thruster controls put all of the engine controls in the hands of the pilot.