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CARGO HANDLING COOPERATIVE PROGRAM

A PUBLIC-PRIVATE PARTNERSHIP FOSTERING RESEARCH AND TECHNOLOGY DEVELOPMENT AMONG U.S.-FLAG OCEAN CARRIERS

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Public-private partnerships are emerging as a smart way to address major transportation problems in the United States. The Intermodal Surface Transportation Efficiency Act of 1991 supported the concept of such collaborative arrangements, the value of which is expected to be recognized in the reauthorized act.

A key attraction of public-private partnerships is the sharing or leveraging of financial and other resources. Many partnerships encourage member organizations to exchange information, share ideas, and develop cutting-edge technologies that improve transportation productivity and performance. One such partnership is the Cargo Handling Cooperative Program (CHCP), an organization supported by the Maritime Administration (MARAD) of the U.S. Department of Transportation and by U.S.-flag ocean carriers.

MISSION AND OBJECTIVES

The Cargo Handling Cooperative Program is a public-private partnership designed to foster research and technology development by U.S.-flag ocean carriers. Members pursue innovative developments in cargo handling to increase the productivity and cost-effectiveness of terminal operations. The organization has completed several successful research and development initiatives and is internationally recognized as a leader in improving cargo-handling productivity.

The mission of the program is threefold:

- To improve the state-of-the-art in intermodal marine-terminal operations by leveraging and complementing the capabilities of its member organizations;
- To provide the in-kind resources of its member companies to support other organizations' high-priority research and application projects; and
- To become the focal point for all significant information (technical, managerial, and regulatory) and operational data related to intermodal marine-terminal operations.

Program goals are to accelerate the adoption and use of available advanced technology; support the introduction of innovative technology in new systems, facilities, and equipment consistent with commercial requirements and national defense needs; train personnel in applications of new technology; improve productivity analysis and measurement techniques; and work with shippers and carriers in other transportation areas to increase awareness of the benefits of improved cargo-handling systems and equipment.

Research initiatives are established on an annual basis to focus attention on identified priorities and make more efficient use of resources. Because hundreds of millions of dollars are spent annually on cargo handling, even minor productivity improvements, such as increasing crane lifts by one or two per hour, can result in multimillion-dollar annual savings to the industry.

SCOPE OF THE PROGRAM

The Cargo Handling Cooperative Program calls for cargo-handling improvements through cooperative industry and government research and development. Activities are broadly divided into two technical areas: application-projects research and productivity initiatives.

Application-Projects Research

Application-projects research gives program members a preliminary evaluation of new technologies that could be successfully applied to marine cargo handling. This research, which emphasizes the identification of areas for improvement, may consist of industrial-engineering time studies, process flow-charting, or human-factor analyses. In addition, technology-transfer efforts may be initiated to identify new applications of existing technology and to explore and influence product develop-

ment and intermodal transportation advances by examining emerging technologies.

A broad range of applications have been undertaken through the program. These applications include the identification and prototyping of new technologies for improved container-chassis mating under the crane and proof-of-concept tests of automatic license-plate-reading technology for the identification of shipping containers. Other applications projects have involved work on hand-held computers, electronic seals, tire maintenance and repair, overweight containers, and container-stowage planning.

Productivity Initiatives

Productivity initiatives involve tests of technology, prototyping of new applications, training, studies, and extended data collection and analysis. The single requirement of these initiatives, which are undertaken in operational and technical areas, is that they improve the quality and productivity of cargo-handling operations. Key initiative areas have included automated equipment control, operations automation, and industrial-engineering analyses.

Through its automated-equipment-control initiatives, the Cargo Handling Cooperative Program has investigated many cutting-edge technologies for use in intermodal applications. Automatic equipment identification and position-location system technologies have been assessed. In addition, improved methods of handling specialty products have been analyzed, and the efficiencies achieved through implementation of bar-code tracking systems have been studied.

Operations-automation initiatives have included the development of personal computer-based decision-support models for marine-terminal construction, planning, and operations simulation. The program has focused on the evaluation and implementation of applications of advanced source-data automation, such as hand-held and vehicle-mounted computer systems for the remote entry and querying of terminal operations data; microcircuit "smart card" systems for high-density data transfer and sensor-based data automation; and radio-linked, voice-recognition systems.

The Cargo Handling Cooperative Program is administered by an executive committee made up of representatives from its member organizations: the Maritime Administration (the federal sponsor); American President Lines, Ltd.; Crowley American Transport, Inc.; and Matson Navigation Company. The committee meets twice each year to make major decisions for carrying out the program's research and development agenda. It also determines the program's technical direction, assesses its financial performance, evaluates technology demonstrations, approves an annual budget, selects technical teams, and establishes and refines operational policies.

Finally, the program's industrial-engineering analyses identify the material and design requirements that provide the foundation for program-sponsored productivity improvements. These efforts include detailed studies of terminal, yard, crane, and gate operations; industry-training evaluations; and equipment comparisons.

Project Highlights

Several research and development initiatives of the Cargo Handling Cooperative Program are briefly described below.

Automatic Equipment Identification

Radio-frequency transponder systems have been identified as potential alternatives to bar-code and other earlier generations of systems for inventory

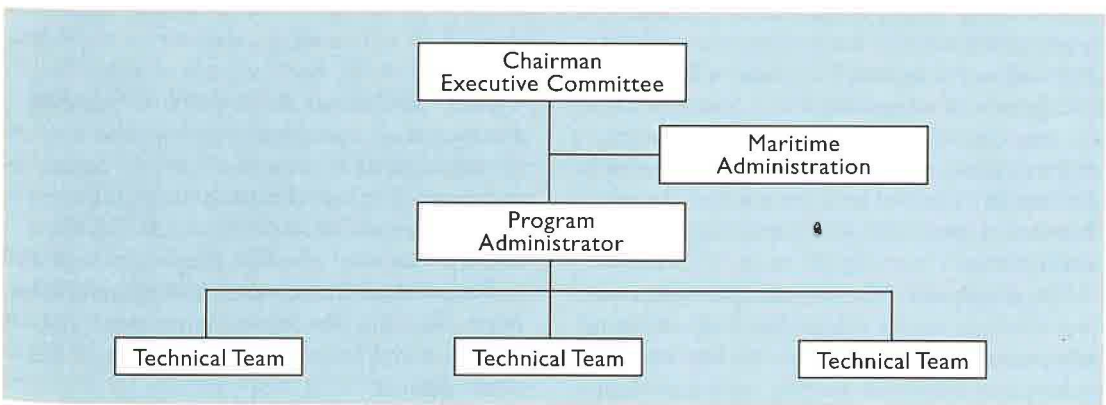


FIGURE 1 Organizational structure of the Cargo Handling Cooperative Program.

control or automatic equipment identification. Transponder tags encoded with critical identification information can be attached to intermodal containers and other equipment to be scanned by interrogating units or "readers."

The Cargo Handling Cooperative Program has played a key role in two standards-development efforts for automatic equipment identification. As the leader of one effort, the program organized representatives from all areas of the U.S. transportation industry and government. Drawing on input from maritime, trucking, rail, and aviation industries, as well as the U.S. Department of Defense, port authorities, federal and state highway departments, and vendor organizations, program members formulated standard requirements and alternatives for automatic equipment identification. In the second effort, CHCP collaborated with the technical committees and working groups of the American National Standard Institute and the International Standards Organization on the establishment of the international standard for automatic identification of freight containers (ISO 10374). Recognition of the international standard for automatic equipment identification, and commercial acceptance and implementation of this technology in member terminals, represents the ultimate success of one of the most ambitious initiatives of the program.

Equipment-Location System

In 1993 the Cargo Handling Cooperative Program began a project to test if differential global positioning system (DGPS) technology could be used to accurately locate shipping containers under real terminal-operating conditions. Because two program members—Matson Navigation Company and American President Lines, Ltd.—were using automatic-equipment-identification tags on many of their containers and chassis, the project sought to build on related productivity gains by designing an equipment-location system (ELS) to automatically identify tagged containers and chassis and relate each to its slot location within a terminal. The system was developed for use in the wheeled storage area of a terminal, where companies have the least control over actual equipment placement and would therefore realize the greatest immediate benefit. The Oakland terminal of American President Lines, Ltd., was the development and testing site.

The centerpiece of the equipment-location system is a mobile inventory vehicle featuring automatic-equipment-identification tag readers, a DGPS receiver, an ultrasonic ranging device, a wireless local-area-network communications system, and an onboard computer. The mobile inventory vehicle drives through the wheeled areas of a terminal, conducts the inventory, collects the identification and location data, processes these data, and transmits them to a base station. The base station then displays the information in a graphical map-like view of the yard.

Tests revealed that despite the changing position of satellites used by the equipment-location system, the time of day of an inventory makes no difference in the system's accuracy—nor does the location of the mobile inventory vehicle. The ELS can accurately identify and locate containers and chassis within +\- one slot of their true positions 99.4 percent and 100 percent of the time, respectively. This performance meets the criteria for proof of concept.

Hand-Held Computers

Since 1990 several initiatives have been undertaken to examine the potential benefits of using hand-held computers—personal computers that store handwritten information as digital computer information—to terminal operations. The most recent and most successful of these initiatives was the development of a seal-checker system for data collection that uses commercially available hand-held computer technology and radio-frequency communications to replace manual data collection. The system, which was created in the context of marine container-handling operations, allowed shipside equipment-transaction data collected during vessel loading and discharge operations to be recorded and transmitted to mainframe data bases in real time.

Specifically, the data-collection clerk recorded the transaction data on hand-held, pen-based computers at each of two shore gantry cranes performing cargo-handling operations alongside a ship. The data were then transmitted via spread-spectrum, radio-frequency modems to a personal computer serving as the system controller. This computer was installed in the stevedoring office and connected with the company mainframe through a 3270 terminal connection.

Video Container Recognition System

A major focus of program members is the accurate identification of containers. Currently, containers are identified either manually or through the application of automatic equipment identification—that is, the use of radio-frequency tags and readers. The latter method is efficient and reliable, but because not all containers are tagged, the use of slower and less accurate manual methods is often required.

In January 1996 CHCP began experimenting with a method of container recognition that

allows tracking of both tagged and nontagged containers. The test project at the Crowley American Transport, Inc., terminal in Jacksonville, Florida, uses video cameras and automated character recognition technologies. The high-definition cameras read the number located on the side and back of a container and the chassis number. The images are then collected and passed on to a verification workstation that uses character-recognition algorithms to identify the numbers. The movement of the container within the terminal can then be easily tracked. The project currently is focusing on refining the capture and recognition methods to be used for container identification.

Container Security Projects

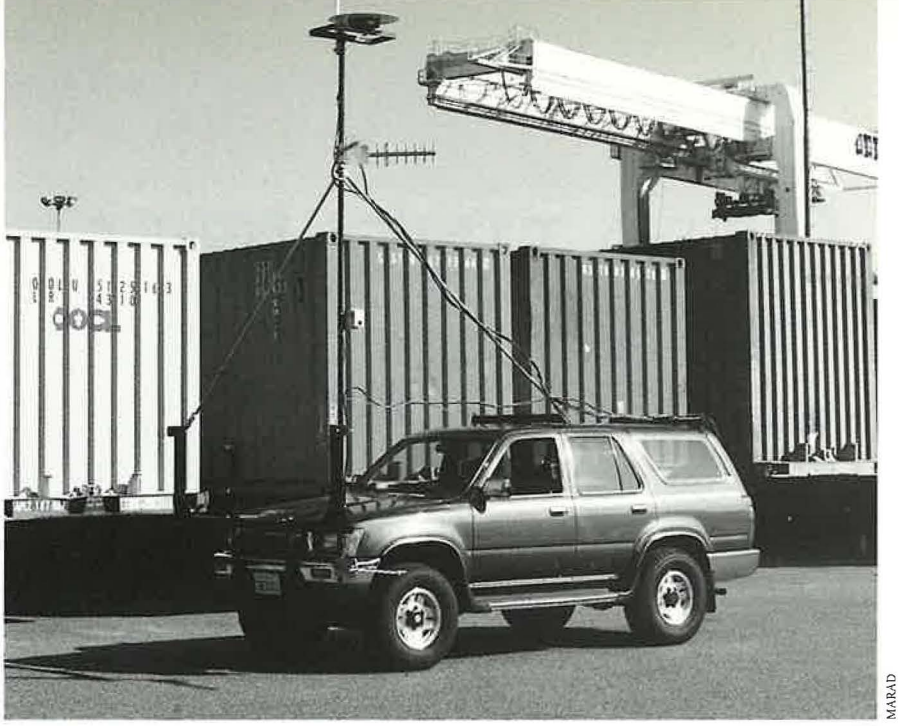
The security of containers and their contents is a major concern for the shipping industry. Current industry seals can be cut, container contents removed or unwanted contents placed inside, and the seal reapplied. Methods of securing containers thus must become either more difficult to circumvent or more capable of indicating tampering.

Although preventing all container tampering is virtually impossible, the Cargo Handling Cooperative Program has focused on the development of an electronic container seal to serve as a deterrent. The idea behind the seal is to make tampering more evident and to improve the accuracy of seal reading and recording, thereby speeding the processing of containers at terminal gates and under the crane.

The program began its electronic-seal project in 1990 with an evaluation of technologies that could be used to improve container security and automate seal reading and recording. This evaluation eventually focused on noncontact radio-frequency technology and led to the idea of threading a security loop from a radio-frequency tag through the latch of a cargo container's door. When the loop was broken, the tag would automatically record the date and time of the event and issue an audible signal. Thus a container breach could be detected even before the tag was read at the terminal.

Savi Technology was selected to develop the electronic seal, and the project progressed through a successful bench demonstration of the prototype "SealTag." This demonstration proved in a laboratory environment that the noncontact radio-frequency technology met established operational requirements for electronic seals. But the radio-frequency communications required for the seal proved incompatible with existing radio-frequency communications for the Amtech automatic-equipment-identification systems installed at the terminals of several program members. Because the problem could not be efficiently solved, the project was canceled.

The Department of Defense has tested and is considering widespread use of the SealTag to identify containers and their contents. The Savi tag system has been used to track hazardous materials and munitions traveling between Europe and the United States, as well as equipment and material shipped to Somalia and Haiti. Other variations on the product are being tested for use by the United Parcel Service and the Alberta, Canada, Department of Transportation.



MARAD

Using automatic equipment identification, differential global-positioning system technology, and on-board computer devices, the mobile inventory vehicle, developed through the Cargo Handling Cooperative Program, collects and transmits data to locate containers and chassis with nearly 100 percent accuracy.

Future Direction

During its 13-year existence, the Cargo Handling Cooperative Program has served as a test bed and forum for collaborative research and development. The development and application of advanced technologies, such as automatic equipment identification, has helped improve cargo-handling operations. Program members remain committed to finding solutions to intermodal terminal productivity, security, and safety problems.

The program is in the process of formulating a 5-year agreement that will contain provisions to expand substantially its membership. The agreement will allow membership to be extended to representatives of U.S.-owned or -based ocean carriers, railroads, port authorities, and terminal operators and stevedores, as well as to government entities responsible for ocean and marine containers. To make the program more attractive, the membership fee under the new agreement will be reduced to cover basic operating expenses. Members will fund all major, approved research and development projects at the time of inception and will focus mainly on technology sharing at the program's semiannual meetings.