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Intelligent transport systems in Latin American sea port logistics

This issue of the *FAL bulletin* analyses the role of intelligent transport systems (ITS) in sea port logistics in Latin America.
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Introduction

Sustained growth of international traffic is putting enormous pressure on port terminals to speed up operations, keep charges competitive, and offer value-added services. These trends demand more and better investment in port infrastructure and their links inland, along with technological innovation to boost the productivity of existing infrastructure.

Intelligent transport systems (ITS) are primarily associated with freight, vehicle and infrastructure operations, where they are well known and a wide range of research and applications exist. Their use in ports, particularly to facilitate co-modal transport, is less familiar, despite the fact that their ongoing, coordinated use can improve productivity and security, and make logistics more efficient, competitive and sustainable.

This newsletter reviews the main concepts and presents some applications in Latin America, which have reinforced the sea port as an intermodal node.

I. Sea ports and intermodal nodes

By definition, a sea port is an intermodal node linking international with domestic transport. In Latin America and the Caribbean, this involves connecting high-technology maritime transport with ground transport that tends to be fragmented, relying on obsolete equipment and tariffs that allow mere subsistence, insufficient for investing in better services and technology. This mismatch poses an enormous challenge to sector

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officials, since port competitiveness increasingly depends on links to the hinterland and logistical services on offer. Aside from resolving infrastructure issues, then, the port-ground transport connection requires improvement, which should start with building suitable cooperation among participants at each link of the logistics chain, then establish shared goals, and a clear analysis of challenges and problems, to define where new technologies can contribute the most.

In their efforts to boost country competitiveness, public and private actors tend to focus on infrastructure, boosting productivity, reducing port charges, and improving customs and trade-friendly systems, without analysing intrinsic transport problems —where many logistics-related cost overruns occur. In this sense, for ITS to make freight traceable and port services and infrastructure in Latin America and the Caribbean more productive and competitive, institutional barriers and public-private coordination should be organized appropriately within each sector.

II. ITS for more sustainable, competitive ports

As a result of profound shifts in both the global economy and merchandise production and distribution, today international logistics require synchronizing multiple actors and real-time feedback to better coordinate production and value-added services. Given prevailing conditions in Latin America and the Caribbean, it is hard to make infrastructure grow apace with demand, so getting the most out of existing facilities is essential.

Today's clients demand lower costs, but also faster, more reliable and complete services, including full traceability of goods (not only port-to-port, but door-to-door), online inventory management, distribution, billing and customs procedures, among others. In this context, using ITS and other information and communications technologies (ICTs) forges an increasingly extensive, complex logistics chain, improving competitiveness and optimizing infrastructure, as discussed in the following sections.

ITS systems combine and coordinate different data processing, transmission and control technologies to boost transport efficiency, security and sustainability. They capture, process and transmit information regarding freight, traffic and vehicle operating variables, and thereby improve human resource and equipment management. Freight traceability, for example, makes possible value-added services and complex just-in-time logistics, cutting down on excess travel and wait-times on highways and at terminal access points, and improving energy efficiency and security, while trimming transport emissions to reduce both operating costs and negative externalities (social and environmental).

The region's systematic and planned integration of ITS should apply the same technological platform throughout the logistics chain, including railways and highways, to optimize transport operations and offer ongoing responses to changing market requirements.

III. The main ITS systems serving ports

A range of ITS equipment exists for handling freight. Table 1 provides basic categories, revealing that different systems can use the same technology and support diverse applications.

Table 1
ITS systems used in ports

Need	Medium	Objective	Its technology
freight traceability / security	Freight	Security	Electronic seals, tampering
		Freight quality	Temperature, humidity, vibration sensors
		Dangerous freight	Electronic Identification
			Fleet management systems
	Transport mode	Mechanical condition monitoring	Sensors: fuel level, tyre status, speed, mechanical alerts.
	Infrastructure	Monitoring traffic conditions	Traffic management systems
		Weather conditions	Weather stations monitoring rain, fog, precipitation, atmospheric pressure, etc.
	Driver	Identification	Automated identification systems
		Route conditions	Traveller information systems
		Driving times	Fleet management systems
	Equipment (cranes, trailers, other)	Depending on type of freight	Automated identification systems

Table 1 (concluded)

Need	Medium	Objective	Its technology
Infrastructure efficiency	Tolls	Free-flow	Electronic payment
	Weigh station	Non-stop	Non-stop weighing
	Port terminal access	Shorter stops	Automated identification systems
	Border crossings, customs procedures	Shorter stops	Automated identification systems
		Less paperwork	One-stop counter
			Electronic bill of lading
	Terminal logistics management	Efficient use of space and resources	Terminal operating systems
			Automated identification systems
		Reduced operating costs	Automated machine guidance
	Inspection	Selective	Automated identification systems
		Freight verification	Image processing systems
	Planning	Reliable information	Fleet management systems
	Operations	Real-time information	Terminal
			Electronic data transmission
			Port community systems
	Trade	Electronic	Electronic data transmission
			Port community systems

Source: Prepared by the authors.

IV. ITS applications in Latin American ports

The next section reviews a set of ITS applications used in Latin American ports. This is not a complete list but rather provides examples from experience in the region. Similarly, while applications such as container scanning and security monitoring systems reflect significant progress, their use is widespread throughout most of the region, so these are not discussed in detail here.

1. Port ITS and productivity

Terminal management systems focus on optimizing maritime freight processes, loading and unloading of ships, and logistics planning, including operations and localization, human resources, equipment and warehousing.

Systems integrating international trade, public agencies and transporters are referred to as port community systems (PCS). For each transport mode using the port, these optimize entry and exit traffic, identifying and establishing working priorities for equipment, personnel and localization, and thereby optimizing infrastructure and available space, to trim operating costs.

Most of these systems are expanding to include the whole logistics chain, adding electronic data interchange (EDI) to share standardized information more easily, reduce processing and inspection times in terminals, improve data accuracy, improve storage yard and vehicle efficiency, and reduce paperwork.

These ITS applications include:

- Optimization of traffic programming for all transport modes;
- Identifying and setting priorities for work orders;
- Planning and optimizing storage, personnel movements, terminal equipment and infrastructure use, inventory and inspection;
- Transport reserve and dispatch systems, to assign freight time and location;
- Providing freight trucks with intelligent access and automated guidance into reserve areas;
- Automated electronic readers to locate and register positioning in storage yards;
- Computer-assisted assignment policies for parking lots.

There are many examples of implementation throughout the region, using proprietary (associated with a single supplier) and open-source systems. These use information technologies to distribute the port's available space more effectively, thereby optimising operations. The port of Valparaiso (Chile), for example, has designed a management model that grants a concession to a single, private technology operator, who develops, administers

and operates a single platform to coordinate information exchange among all public and private bodies involved in imports and exports through the port, speeding up paperwork, and saving time and money. This system also supports a selective freight operation model in real port time, which has pushed terminal productivity much higher than the traditional first in first out (FIFO) approach.

2. Traceability throughout the logistics chain

Latin America has invested significantly in technologies to improve tracking (real-time location) and traceability (being able to follow the whole route taken by a specific item in non-real time, sometimes referred to as 'flow memory') throughout the logistics chain, which is fundamental to ensuring transport competitiveness and sustainability. This is a welcome trend, reflecting significant progress, but many firms have done so only to control theft, rather than as a general tool to improve fleet management and add services. For a growing number of economic actors, including retail and production sectors with higher purchasing power, when choosing a transport firm, security and on-time delivery are more important than price or delivery speed. To meet these requirements and thus gain access to more valuable contracts and better working conditions, companies should be well structured and trained in real-time fleet management. This makes traceability and other ITS essential, as they offer the following social and environmental benefits:

1. **They make it possible to provide integrated logistics services**, by providing the technological support necessary for complex just-in-time systems, which require reliable, up-to-date information for stock management and the entire transport chain. This favours co-modal transport, reducing costs and making multimodal logistics platforms feasible.

2. **They help cut carbon emissions and other transport-generated pollution**: making transport management responsive to prevailing demand and traffic conditions can cut delivery travel time and fuel use, reducing pollution, congestion and energy consumption. These are all particularly important to businesses increasingly concerned about their carbon footprint, offering suppliers a competitive edge.

3. **They reduce company operating costs**: primarily through reduced fuel consumption and thus greater energy efficiency. Savings just from monitoring assigned routes are estimated at about 4%. Reducing time lost during loading/unloading and empty-return trips can enhance these benefits. When combined with other ITS solutions, fleet management can also improve and make more evident driving hours, offer real-time information, and be useful in the event of accident or breakdowns en route, which also involve social benefits.

Many Latin American ports have implemented traceability solutions based on radio frequency identification (RFID). This involves an electronic tag, which sends radio signals to an interrogating antenna. Tags may provide identification only, using a unique code, or read/write data. At the Argentine port, Ingeniero White, in Buenos Aires province, for example, Cargill's has a cereal export terminal, storage silos and a malt factory. The recent rise in cereal production saw a significant jump in the number of trucks backing up around the port. This led to creation of a truck reception and quality control area (ACC), 10 km from the port. In this case, the port used UHF RFID systems which are readable at four to six metres from tags on trucks and trailers passing antennae at up to 20 km/hr. Two antenna-equipped recording positions and reading portals provided online information to Cargill's unloading software for use of RFID data in production and certification of grain quality, and peak times in ACC-destination (port or silo area) trips. Today, RFID monitoring is being expanded to cover the Bahía Blanca port and unloading wagons from other operating centres.

In Colombia, the national association of highway freight transportation, Asecarga (Asociación nacional de empresas transportadoras de carga por carretera), the transporters' federation Colfecar (Federación Colombiana de Transportadores de Carga por Carretera) and the Colombian infrastructure association (Cámara Colombiana de infrastructura) are considering an RFID-based transport visibility approach (*Iniciativa para la Visibilidad del Transporte Mediante RFID*), to identify freight and passenger vehicles using an RFID tag, so they can monitor key en-route locations, such as tolls, checkpoints, border crossings, duty-free zones, ports, etc. While this project will not replace satellite navigation systems, it will reveal the location of vehicles as they approach portals and permit traceability throughout the logistics chain, available online to owners and those working in ports, duty-free zones and logistical platforms. This will make processes more efficient and improve vehicle flow management at these locations.

Some ports, including Valparaiso (Chile) and Montevideo (Uruguay), have also used vehicle technologies such as electronic tolls. In Chile, the Televías system used for electronic tolls also traces freight throughout the logistics support area (*Zona de Extensión de Apoyo Logístico, ZEAL*) and travelling towards Valparaiso within an 11-km perimeter. The system will use four tag-reading portals to handle freight flows and security. Similarly, Montevideo uses tags to monitor cargo vehicles, although the system only monitors access to the port.

Key benefits, then, go beyond the port, for levels of traceability that improve ground freight transport efficiency, reduce wait times and increase truck productivity, by boosting capacity using the same equipment and personnel. This can also provide significant savings in fuel and emissions through greater energy efficiency.

3. Automated guidance systems

Automated guidance systems run vehicles using remote control. They involve the vehicle, the navigation and route selection system, and automated controls (including a system that monitors movement, inventory and vehicle status, an obstacle detection system and suitable interfaces with other terminal operations systems). These systems move and stack containers, using an onboard computer connected by wireless to the control centre in order to manage vehicle routes in the terminal, thereby keeping operations involving many containers constant and flexible, at lower costs.

V. Port ITS and security

Since 9/11, port security regulations have steadily tightened, as authorities try to balance security and international trade requirements. Signed by the President of the United States in 2006, the "safe port act" (Security and Accountability for Every Port Act), for example, establishes minimum security requirements for all

X-ray inspection systems produce clear images of containers, including the shape and density of contents. Radioactive systems use gamma rays and neutrons to detect nuclear material. These involve radiation portal monitors (RPM), which are large, plaque-like sensors that detect explosives, chemicals and nuclear materials. The high-sensitivity RPM, which can scan vehicles moving at up to 8 km/h, provides quicker, more effective inspections than the x-rays used today, finding 100% of radioactive material at a lower radiation dose to operators.

2. Container Security Seals

The main ISO certification requirement is for strong, long-lasting seals which can withstand an accidental break or damage (from weather or chemicals during handling), be easily and quickly removed with the right tools, and leave visible signs if there is tampering. They must include a highly legible identification mark and unique number, with any tampering (physical or chemical) producing the irreversible destruction of the seal. The electronics industry has provided many products, among them:

- Electronic seals: placed on container loading doors, where a cable is linked to fixed points on the door and a unique code is generated upon sealing. If the door opens, the code changes, thus generating evidence of tampering;
- High-security seals: made of resistant materials such as metal or steel wire cable, these both slow tampering and leave evidence of any unauthorized attempt at opening the container. These seals involve laser-generated consecutive numbering;
- Remote-control seal: this equipment adds a GPS receiver and GSM (Global System for Mobile Communications) transmitter, which send a locational message to the control centre in the event of tampering;