CHAPTER 3.6

INTELLIGENT TRANSPORTATION SYSTEMS & TECHNOLOGY

MAP-21 requires state freight plans to include "evidence of consideration of innovative technologies and operational strategies, including intelligent transportation systems (ITS), which improve the safety and efficiency of freight movement."[113]

FIGURE 70. INTELLIGENT TRANSPORTATION SYSTEMS DEFINED

Intelligent Transportation Systems (ITS) - a collection of traditional transportation infrastructure (roads, vehicles, signs), communications, and computer technologies that are used to improve the operation of roadway, rail, air, and maritime systems. ITS technologies refer to electronic sensing technologies that continuously monitor the system's operations, computer systems that process system performance data, electronic devices that can deliver critical information to travelers, and communication networks that carry data flows between the field processing points. ITS emphasizes system operations in an efficient and safe manner through integrated management of various components of the transportation system and its services.[2]

INTELLIGENT TRANSPORTATION SYSTEMS AND FREIGHT PLANS

The freight industry has embraced ITS as a way to reduce costs, increase competitiveness, and mitigate impacts to communities and the environment. ITS technologies allow California's freight infrastructure to increase its efficiency and capacity by enabling the value and volume of freight and freight movement to increase while reducing demands on the system. ITS technologies are versatile in that they can be applied to the vast transportation infrastructure of highways, streets, bridges, tunnels, railways, seaports, and airports, as well as associated vehicles, including cars, buses, trucks, trains, aircraft, and maritime vessels. ITS can also be applied to mobile freight handling equipment, such as cranes, forklifts, and conveyor belts. Even the shipping containers used to transport goods can have ITS applications.

Both public agencies and the private sector have recognized the need for a coordinated, strategic approach to ITS deployment and have established direct links between ITS planning and other transportation and strategic planning efforts. Ideally, the outcomes of ITS planning are activities (including freight projects) incorporated and programmed into statewide, regional, and local transportation plans and freight plans. It is expected that ITS and technology projects will be specifically identified and funded within every freight funding program and that nearly all freight projects will have an ITS or advanced technology component.

ITS TRAINING AND LABOR AGREEMENTS

Critical to the utilization of ITS and advanced technologies is the need for workforce training and labor agreements that address ITS. The labor force must be able to operate and maintain the new technologies, and labor agreements must be updated to reflect the changes. In 2002, the Pacific Maritime Association (PMA) negotiated a landmark labor agreement with the International Longshore and Warehouse Union (ILWU), which allowed for significant investments in the technology necessary to expedite port gate transactions, and planned future investments and improvements. Building on that framework, the parties agreed in 2008 to enable automation at port terminals. Automation of components of the freight transport system will dramatically increase by 2040 and is expected to help achieve significant improvements in safety, reliability, impact reductions, transport speed, freight volumes and efficiency. As a result, these improvements will also generate substantial changes in the workforce. Notably, the size of the workforce has increased significantly since 2002, as technology has enabled greater cargo volumes at West Coast ports. Looking ahead, innovation is expected to be an important driver of volume growth and workforce opportunity.

FREIGHT ITS ELEMENTS

The most common freight ITS elements implemented for freight transportation operations are categorized into several systems. They include:

1. Traffic control and monitoring systems
2. Weigh-In-Motion (WIM) systems
3. Delivery-space booking systems
4. Vehicle and container location and condition monitoring systems
5. Route-planning systems
6. Driving behavior monitoring and controlling systems
7. Crash prevention systems
8. Freight location monitoring systems
9. Freight status monitoring systems
10. Rail management and operations
11. Rail crossing safety systems

Each of these freight ITS elements, described below, is summarized from The International Journal of Logistics Systems and Management (IJLSM).[114]

1. **Traffic control and monitoring systems** – These systems control and manage traffic flow by providing information to traffic authorities and logistics service providers regarding collisions, congestion, traffic flow speed, and vehicles. Technologies such as "smart" traffic lights, plate recognition cameras, and speed cameras are included. Such systems can send updates about vehicle arrival time and delays, improving the efficiency of truck, port, terminal, and warehouse operations. The environmental performance of the transportation operations is increased by decreasing transport time and vehicle idling.
2. **Weigh-in-Motion (WIM) systems** – These systems ensure that vehicles are not overloaded beyond maximum allowable weights. They are used to determine the weight of the vehicles as they move past sensors. Removing overweight vehicles from roadways increases safety and decreases damage to pavement and structures. WIM systems also improve highway system performance by eliminating or reducing truck stop times at static weight-controlling stations. WIM systems can help reduce the risk of accidents by identifying overweight vehicles and flagging them for enforcement action. Broad application of WIM monitoring can provide a wealth of traffic operations data across a wide area or along an extended corridor.

3. **Delivery space-booking systems** – These systems are used to reserve truck parking spaces for a specific vehicle at a specific time and to reserve a time to load or unload the freight. They contribute to efficiency performance by maximizing truck parking in dense urban areas where parking spaces are limited. They also allow truck drivers to find safe parking zones and avoid unsafe zones. Their application potentially reduces the total number of vehicle trips during a specific time period and maximizes utilization of available parking, potentially reducing or delaying the need to construct additional truck parking.
4. **Vehicle and container location and condition monitoring systems** – These systems provide real-time information about the position of vehicles via satellite. Information can accessed by via the web. Sensors on the vehicle can also provide real-time information about the condition of the cargo shipment, container door-lock status, and adherence to the planned route. US Customs service providers can estimate vehicle arrival times and prepare documentation prior to arrival, thus decreasing truck waiting times. Port gate operators can send estimated arrival upates to trucks in the case of cargo ship delays.
5. **Route planning systems** – These systems help with route selection based on real-time roadway and traffic conditions, enabling a driver to reroute and avoid traffic congestion. This can reduce delay for shipments and lower truck emissions.
6. **Driver behavior-monitoring and control systems –** These systems track the speed and acceleration of the vehicle and provide feedback for improving driver performance. Such feedback can lead to reduced crashes and improved fuel economy. The systems can also assist in maintaining a driver's attention to the roadway by providing real-time feedback that would inform them of signs of inattention, such as lane drift.
7. **Crash prevention systems** – These systems use sensors and information feedback to decrease the probability of accidents. Sensors installed on trucks have the capability of sending signals to the driver when the truck is getting too close to an object or is approaching too fast. Sensors and communication equipment installed on vehicles and roadway infrastructure enable vehicle-to-vehicle and vehicle-to-infrastructure communication as well as activating automated vehicle slowing or braking systems.
8. **Freight location monitoring systems** – These systems use Radio Frequency Identification (RFID) tags to allow freight tracking without the need for direct contact or optical scanning. RFID readers can be installed in vehicles, on warehouse doors, and at facility gates. Freight movement is automatically recorded, saving staff time and improving data recording accuracy. The system can read a large number of tags at the same time, improving operating efficiencies.

9. **Freight status monitoring systems** – These systems employ sensors to measure the physical attributes of the goods, such as temperature, humidity, impact-force level, light level, and vibration level. This can improve transportation outcomes by ensuring better quality products upon delivery. These systems are particularly useful for tracking dangerous, fragile, and perishable goods such as chemicals, explosives, medicines, and fresh food. A combination of sensors with automatic identification technologies, such as RFID, provides opportunities to improve the control and monitoring of goods throughout the entire supply chain.
10. **Railroad management and operations** –The benefits from ITS train applications include protection controls for both interstate and state networks, improved network capacity, operational flexibility, service availability, travel times, safety, system reliability, and security. Control and dispatch centers are able to schedule more trains on the same area of track and will also be able to 'fleet trains' heading in the same direction by spacing them more closely while still providing safe stopping distances. Developments in this area highlight the need for interoperability with road-based ITS technology, particularly at railway crossings.
11. **Rail crossing safety systems** - These systems expand the use of ITS to improve rail crossing safety, including low-cost solutions that augment more traditional treatments for crossings, such as signs, flashing lights, and boom gates. The use of short-range communications between oncoming trains and vehicles or roadside installations to warn motor vehicle drivers will likely require integration with other auto and truck-based ITS technologies.

Active ITS Initiatives and Research Projects

PrePass

PrePass is a nationally implemented system that verifies truck weight and credentials while trucks travel at highway speeds, allowing pre-credentialed, safe carriers to bypass inspection stations.[115] PrePass enables qualified trucking firms to electronically comply with state-established weight, safety, and credential requirements while passing detectors at highway speeds. By avoiding weigh-station stops and idling in queues, motor carriers reduce fuel consumption and its associated pollutants and benefit from reduced delivery times. Launched in California in 1995, PrePass is now operational at more than 280 sites in 30 states. By 2012, nearly 456,000 trucks in the US had voluntarily enrolled in PrePass and served approximately 400 million truck trips at PrePass-equipped weigh stations annually (Prepass.com). By reducing congestion in and around weigh facilities and tolling centers, PrePass improves highway safety and reduces vehicle emissions. PrePass enables enforcement personnel to concentrate on those trucks most likely to be noncompliant.

ADVANCED TRANSPORTATION MANAGEMENT INFORMATION SYSTEM (ATMIS)

The Ports of Los Angeles and Long Beach have deployed the ATMIS to monitor truck traffic within the Ports using vehicle detection devices and closed-circuit television cameras.[116] A traffic management center operated jointly by the Ports provides traveler information, including real-time traffic conditions and incidents on changeable message signs in the vicinity of the Port area.

PIERPASS

The PierPASS program at the Ports of Los Angeles and Long Beach was established to manage and improve truck movements, address congestion, and improve air quality by reducing the number of idling trucks and driver wait time.[117] PierPASS has an "Off-Peak" program that charges a traffic mitigation fee of $50 per twenty-foot-equivalent unit (TEU) container for peak-hour pickups or deliveries. The fees are used to fund additional work shifts neeed to provide service during extended hours. It is estimated that during 2007 and most of 2008 – prior to the economic downturn – off-peak work shifts handled an average of 68,000 truck trips in a typical week, or about 40 percent of all container moves at the two ports on days with both peak and off-peak shifts. Over the past eight years, PierPass Off-Peak gates have grown to handle approximately 55 percent of all container traffic at the ports, accommodating more than 23 million truck transactions, and greatly easing congestion on city streets and nearby freeways during daytime hours.

GATEWAY CITIES TECHNOLOGY PLAN FOR GOODS MOVEMENT

The Gateway Cities Technology Plan for Goods Movement program represents the most significant fusion of ITS and freight operations technologies attempted to date in North America. Through the integration of traditional freeway, arterial, and traveler information technologies with intermodal freight, port, and truck technologies, this project is studying the potential of providing an end-to-end information support system that can improve the efficiency of goods movement in Southern California. This plan is being developed by the Gateway Cities Council of Governments and the Los Angeles County Metropolitan Transportation Authority, with close involvement from the Ports of Long Beach and Los Angeles, Caltrans, the Southern California Council of Governments, and other key stakeholders.[118]

The Gateway Cities Technology Plan for Goods Movement project is composed of five strategies:

1. Data collection,
2. Transportation operations and management,
3. Emerging goods movement technology applications,

4. I-710 corridor advanced technologies applications, and
5. Commercial vehicle operations planning.

For more information on the Gateway Cities ITS applications and to access their Technology Plan for Goods Movement, please visit http://www.gatewaycog.org/what-we-do/advancing-technology/.

FREIGHT ADVANCED TRAVELER INFORMATION SYSTEM (FRATIS)

The US DOT, in conjunction with the Port of Los Angeles, a marine terminal, and a drayage trucking company, is currently testing an advanced intermodal logistics information technology system designed to improve drayage and container handling. This system, termed the Freight Advanced Traveler Information System (FRATIS), is a demonstration project funded by the US Department of Transportation (DOT). The FRATIS project seeks to improve the efficiency of freight operations by using several levels of real-time information to guide adaptive and effective decision making. The FRATIS project is focused on: 1) improving communications and sharing intermodal logistics information between the truck drayage industry and port terminals so that terminals are less congested during peak hours; and 2) improving traveler information available to intermodal truck drayage fleets so that they can more effectively plan around traffic and port congestion. Together, these two areas of focus can result in significant improvements in intermodal efficiency, including reductions in truck trips, reductions in travel times, and improved terminal gate and processing efficiency. These benefits, in turn, will directly result in the public sector benefits of improved air quality, reduced traffic congestion, and increased fuel savings. Technologies that are being utilized during the demonstration test include advanced traveler information, port terminal truck-queue-time measurement, automated ETA messaging to the terminals one day in advance of truck arrivals, direct messaging of trucks by terminals, and employment of an algorithm that will optimize truck deliveries and movements based on several key constraints (e.g., time of day, PierPASS restrictions, terminal queue status, etc.). The primary user interfaces for these technologies are a web application for drayage truck dispatchers, a mobile application for drayage truck drivers, and messaging and alerts functionality for terminal operators. This demonstration project is currently in operational testing that began in December 2013. US DOT will be expanding the FRATIS project to two more container terminals in the Ports of Los Angeles and Long Beach and eight more trucking companies in 2014. The Ports of Los Angeles and Long Beach want to expand this program to all container terminals in the Ports and as many tucking companies as possible. The FRATIS project consists of the following two information technology (IT) applications:

- **Freight Specific Dynamic Travel Planning and Performance**. This IT application bundles all of the traveler information, dynamic routing, and performance monitoring elements that users need. This application will leverage existing data in the public domain, as well

as emerging private sector applications, to provide benefits to both sectors. Other data includes real-time freeway and key arterial speeds and volumes; incident information; road closure information; route restrictions; bridge heights; truck parking availability; cell phone and Bluetooth movement and speed data; weather data; and real-time speed data from fleet management systems.

- **Drayage Optimization.** This IT application combines container load matching and freight information exchange systems to fully optimize drayage operations. The result of the optimization minimizes unproductive bobtail (this refers to a cab or tractor with no trailer or load) moves, spreading out truck arrivals at intermodal terminals throughout the day. Optimizing a freight carrier's itinerary requires a wide range of entities to participate in sharing their data (including rail carriers, metropolitan planning organizations, traffic management centers, customers, and the freight carriers themselves) in a manner that assesses all of the variables and produces an optimized itinerary. This requires development of a complex set of algorithms that leverage data from multiple sources.

I-710 Automated Truck Research

This project will implement a staged progression of commercial vehicle technologies in order to transition from current research-based, automated, commercial vehicle demonstration efforts to staged operational testing of a flow efficiency system of trucks along the planned I-710 truck lanes. The project will build upon the unique operational environment and potential partnerships of the Gateway Cities region to promote and enhance truck automated commercial vehicle research by bringing together the applications of automated commercial vehicle and automation technologies on one of the most heavily congested truck corridors in the country. The project will examine and test the specific design and operational concerns that impact the future development of the I-710 and its approaches.[119]

State Route (SR) 11 - Otay Mesa East (OME) Port of Entry (POE) ITS Technology

San Diego Association of Governments (SANDAG) and Caltrans, along with local, state, and federal agencies in the United States and Mexico, are executing an aggressive plan to self-finance a new border crossing in the San Diego and Baja California region. Annually, approximately $54 billion worth of goods move across the region's borders, and at each individual vehicle crossing, wait times regularly exceed two hours per vehicle. To sustain vibrant and effective commercial cross-border activities, a new port of entry and a connecting state highway are being created. The SR 11 and OME POE project will improve the efficient movement of people and goods between the United States and Mexico. A state-of-the-art POE and commercial vehicle enforcement facility accessed via a toll road will provide shorter and more predictable crossing times. This POE and four-lane state highway will connect the United

States-Mexico border to key regional, state, and international highways, including SR 125, SR 905, and the Tijuana-Tecate and Tijuana-Ensenada free and toll roads.[120]

FIGURE 71. SR-11 AND OTAY MESA EAST PORT OF ENTRY ITS PRE-DEPLOYMENT STRATEGY

Source SANDAG[121]

The ITS Pre-Deployment Strategies for the border crossing will address innovative operating concepts and technologies that could be deployed to ensure a secure, state-of-the-art border crossing. A major focus of the ITS deployment strategy is to help identify better time and travel experiences for passenger and commercial customers, thereby encouraging them to use the tolled border crossing by offering shorter and more predictable wait times. Compared with the current crossing, shorter wait times will also reduce emissions by preventing extended idling of vehicles waiting to cross the border. Upon construction, ITS technology deployed for the project will collect and provide real-time information on border-crossing options, toll rates, and wait times on both sides of the border for the entire San Diego-Baja California region.

SANDAG and Caltrans are pursuing multiple objectives with the new border crossing, including building additional physical capacity at the border, maximizing the efficiency of the new facility with state-of-the-art ITS technologies and innovative operating concepts, and financing the facility development predominantly as a self-help project. The data collection will work seamlessly with an advanced traveler information system to provide accurate and useful data to the customer. It is envisioned that ITS will enable six high-level systems functions along the region's border, including:

1. Data collection and analysis
2. Toll revenue collection
3. Traveler information display
4. Traffic management and monitoring
5. Vehicle safety inspections support
6. Customs and Border Protection (CBP) and Aduanas (Mexican Customs) Operational Assistance.

Smart Truck Parking on California's I-5 Corridor

The Smart Truck Parking project is a collaborative implementation and research effort among Caltrans; the University of California, Berkeley; ParkingCarma; and other partners and is sponsored by the Federal Highway Administration. It is designed to demonstrate the application of real-time parking availability information at truck stops. The premise is that truckers are given access to timely, accurate parking information so they will make better travel decisions. Currently, truckers must search for parking after a full day of driving and often do not have adequate or timely information on where they can park. The lack of information about real-time parking availability may lead to illegal parking, which poses an environmental and safety hazard to both truckers and the public. In some cases, truckers must choose between searching for safe legal parking and impinging on hours of service rules. Truck drivers will be able to check on a website or use a mobile device for real-time parking availability at selected truck stops that are participating in this project to obtain information regarding:

- Real-Time Parking Availability Information
- Truck Stop Attribute Information
- Parking Reservations

The project is currently testing or operating several sensor technologies at truck stops on I-5 in California's Central Valley. Stakeholder outreach efforts are also underway to recruit early adopters and facilitate expanded deployment.[122]

INTERSTATE 80 (I-80) WINTER OPERATIONS MULTISTATE COALITION

Interstate 80 (I-80) is an east/west transcontinental route that traverses the entire nation, from San Francisco, California, to Teaneck, New Jersey. The Coalition began as a multistate partnership between California, Nevada, Utah, and Wyoming, extending from San Francisco to Cheyenne, Wyoming. It has expanded to include Nebraska. The Coalition is developing the I-80 Corridor System Management Plan (I-80 CSMP) that seeks to identify current and future mobility and operational solutions to transportation deficiencies and to enhance livability throughout the corridor. The effort includes a Freight and Logistics working group that seeks to investigate all issues relevant to the topic of freight mobility and the I-80 corridor. The Corridor Coalition, through the I-80 CSMP, is working collaboratively with the I-80 Winter Operations Coalition to coordinate operations on the I-80 corridor in the Western US. The coordination includes the use of emerging technologies and integrated corridor management approaches to enhance communications between Traffic Management Centers and Traffic Operation Centers, and improve capabilities to deploy real-time weather information for freight transportation operators.

The I-80 Corridor Coalition was awarded funding under the Multistate Corridor Operations and Management (MCOM) program to help execute an operations platform to allow multiple states access to real-time and operational winter travel information, distribute multistate road impact information to truckers, and enhance corridor coalition partnering and activities. The Coalition is leveraging current technology investments within the corridor and synergize with other multistate efforts, such as the I-15 Mobility Alliance (I-80 MCOM application).[123]

FIGURE 72. I-80 WINTER OPERATIONS MULTISTATE COALITION PARTNERS

ource: I-80 Winter Operations Multistate Coalition

CONCLUSION

The implementation of ITS and new technologies, such as those described in this chapter, will play a significant role in helping California pursue the CFMP freight vision and meet the six goals identified in Chapter 1-1 of the CFMP. While meeting these goals, the implementation of ITS and new technologies will also concurrently address State air quality, greenhouse gas, and energy goals. California's population and traffic congestion will continue to grow. Expanding costly infrastructure to meet freight demands is not a standalone solution; the freight system must derive more productivity and capacity from existing facilities and expand only where necessary. The freight industry and public agencies acknowledge the value of using ITS technologies to increase the efficiency and capacity of California's freight infrastructure to meet the rising demands on the transportation system. The public and private sectors must continue to work together to incorporate ITS into freight projects that are identified in state, regional and local plans.